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North Atlantic Marine Mammal Commission

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MEETINGS & OFFICE BEARERS 2000

Members of the Commission		**Councillors**
Faroe Islands	(F)	Mr Kaj P. Mortensen
Greenland	(G)	Mr Einar Lemche
Iceland	(I)	Ms Kristín Haraldsdóttir
Norway	(N)	Ms Rannveig Bøthun

Council

Chairmen – 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/10 – Tenth Meeting of the Council, 26 – 28 September 2000, Sandefjord

Management Committee

Chairmen – 1993-94 Mr Kjartan Høydal (F) interim
1994-98 Mr Einar Lemche (G)
1998… Mr Kaj P. Mortensen (F)
Ninth Meeting of the Management Committee, 26 September 2000, Sandefjord

Management Committee Working Group on Inspection and Observation
Chairman Dr Egil Ole Øen (N)

Committee on Hunting Methods
Chairmen - 1994-98 Ms Amalie Jessen (G)
1998… Mr Jústines Olsen (F)

Management Committee Working Group on By-catch
Chairmen – 1998-99 Mr Gislí A. Víkingsson (I)
1999… Dr Arne Bjørge (N)

Scientific Committee

Chairmen – 1995-97 Prof. Tore Haug (N)
1997-2000 Dr Mads Peter Heide-Jørgensen (G)
2000 ... Mr Gísli A. Vikingsson
Eighth Meeting of the Scientific Committee, 13 - 16 June 2000, Akraberg, Faroe Islands

Scientific Committee Working Group on Management Procedures
Chairman Dr Nils Øien (N)

Scientific Committee Working Group on Abundance Estimates
Chairman Dr Nils Øien (N)

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

Chairmen – 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

Chairman	Prof. Øystein Wiig (N)

Scientific Committee Working Group on the North Atlantic Fin Whales

Chairman	Mr Gislí A. Víkingsson (I)

Finance and Administration Committee

Chairmen **-** *1998* **-** *2000*	Mr Øyvind Rasmussen (N)
2000 …	Mr Einar Lemche (G)

The NAMMCO Fund

Chair **-** *1998 -2000*	Ms Ulla S. Wang (F)
2000 …	Ms Kate Sanderson (F)

Secretariat

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

SECTION 1 - COUNCIL

1.1
REPORT OF THE TENTH MEETING OF THE COUNCIL

Sandefjord, Norway 25 – 28 September 2000

The NAMMCO Council held its 10th Meeting at the Rica Park Hotel in Sandefjord, Norway 26 – 28 September 2000. 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, including the recently formed Eastern Caribbean Cetacean Commission (ECCO). The List of Participants is contained in Appendix 1.

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

1. OPENING PROCEDURES

1.1 Welcome Address

The Chairman in her opening remarks expressed satisfaction that the Host Agreement between NAMMCO and the Norwegian Government would be signed at this Tenth meeting of the NAMMCO Council. She then introduced the Norwegian Ambassador Odd Gunnar Skagestad who gave an address of welcome to the Tenth Meeting of the Council on behalf of the Norwegian government. He noted that it was appropriate for the NAMMCO Council to hold its meeting in Sandefjord with its strong traditions in whaling. The full text of the address is contained in Appendix 4.

1.2 Invited Presentation: Dr Ray Gambell

The Chairman introduced Dr Ray Gambell, the newly retired Secretary to the International Whaling Commission (IWC).

In his presentation Dr Gambell described some of his experiences in his 37-year involvement in the IWC, and discussed issues that had represented critical turning points for the Commission, including the implementation of the moratorium on commercial whaling and the Revised Management Procedure. At the end of his presentation Dr Gambell graciously entertained a few questions from the audience. The full text of Dr Gambell's keynote address is contained in Appendix 4.

1.3 Opening Statements

The heads of the delegations of the Faroe Islands, Greenland and Iceland made opening statements to the meeting. In addition, the observer from the Government of Japan made an opening statement. These statements are contained in Appendix 4.

1.4 Admission of Observers

On behalf of the Council, the Chairman welcomed the observers from governments, intergovernmental and non-governmental organisations. In particular she welcomed to the Council for the first time the observer from the Eastern Caribbean Cetacean Commission.

The Secretary, Dr Grete Hovelsrud-Broda, informed the Council that the following had sent their regrets in not being able to attend the meeting: The Convention on International Trade in Endangered Species (CITES), the Convention on the Conservation of Migratory Species of the Wild (UNEP/CMS), the Food and Agriculture Organisation (FAO), International Council for the Exploration of the Sea (ICES), the North-East Atlantic Fisheries Commission (NEAFC), the European Bureau for Conservation and Development (EBCD), the World Conservation Union (IUCN), the International Working Group for Indigenous Affairs (IWGIA), the Nunavut Tungavik Incorporated, the Nunavut Wildlife Management Board, and the World Council of Whalers.

1.5 Adoption of Agenda

The Agenda as contained in Appendix 2, was adopted.

1.6 Meeting Arrangements

The Secretary outlined the practical and social arrangements for the meeting. Of particular importance in this regard was the signing ceremony of the Host Agreement between NAMMCO and Norway to be held on September 26 at the Sandefjord Whaling Museum, followed by a tour of the museum and a reception.

A list of documents presented to the meeting is contained in Appendix 3.

2. FINANCE AND ADMINISTRATION

2.1 Report from the Secretariat

The Secretary referred to document NAMMCO/10/13 and reviewed the activities of the Secretariat during the past year. In addition to the Working Groups under the Scientific Committee, the Secretariat staff had participated in a number of international meetings, seminars and workshops both through presentations and in the capacity of observers (see also Item 9). The Council noted that the Scientific Secretary had participated in a workshop on distance sampling, which had already proven useful for the preparations of working papers for the Scientific Committee Working Group on Abundance Estimates.

The Secretary informed the Council that the Secretariat had participated in a number of arrangements relevant to marine mammal issues that had been held in Tromsø. The Secretary had been instrumental in organising a round-table discussion on sealing in Norway in connection with a local arrangement in Tromsø, *Utseilerdagan*, which marks the departure of the sealing vessels every year in March. NAMMCO had also been represented with an information booth at the *Fiskeridagan*, a local arrangement promoting various aspects of fisheries in Norway and which drew a large number of spectators.

The Secretary informed the Council that she had participated in a conference on the management of marine mammals held in Oslo in January 2000, hosted by the Norwegian Fishermen's Association. The Secretary had also made a presentation on NAMMCO to the annual course for whaling inspectors in Norway.

The Council noted the recent changes in the Secretariat staff, with the Administrative Assistant, Tine Richardsen, being replaced by Charlotte Winsnes. Richardsen had worked for NAMMCO since 1997 and would leave Tromsø for a job in Oslo (see Item 11). The Council welcomed the new staff member to NAMMCO.

2.2 Report of the Finance and Administration Committee

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

The Finance and Administration Committee held a meeting on 30 August 2000 in Copenhagen. The tasks of the Committee were to review audited accounts for 1999, to develop a draft budget for 2001 and a forecast budget for 2002 (see under item 2.3), to finalise the Rules of Procedure for the Council (see under item 2.4) and to consider other financial and administrative matters related to the activities of the Council. The report of the Committee was available to the meeting as document NAMMCO/10/4.

2.2.1 Information

The Council noted the Finance and Administration Committee decision to terminate the regular circulation of the news clippings Selected Cuts. It also noted that the Secretariat would look into a news clipping service that would select relevant items and provide the electronic links to articles of interest. The system of links to relevant newspaper articles and other items would be sent to an expanded list of recipients including those who received Selected Cuts.

The Council noted the Finance and Administration Committee suggestion that the Secretariat reorganise the links on the NAMMCO website with the assistance of the members of the Committee.

2.2.2 Host Agreement

The Council noted that the implementation of the Host Agreement would also have financial implications, which would be discussed in detail at the next Finance and Administration Committee meeting.

2.2.3 Other Matters

The Chairman thanked the Finance and Administration Committee for their report (see also under items 2.3, 2.4 & 2.5).

2.3 Commission Budget 2001 and Forecast Budget 2002

2.3.1 Accounts 1999

The Council noted that the Finance and Administration Committee in a telephone meeting in March 2000 had reviewed the final accounts of the Commission for 1999. The Council formally approved the accounts (see Appendix 5).

2.3.2 Commission Budget 2001

The Council **adopted** the budget for 2001, as contained in NAMMCO/10/4 Annex 1.

The Council noted that the budget contained the estimated financial changes resulting from the implementation of the Host Agreement. The Council also noted that there are no guidelines for the Secretariat on how to operate the budget, and that it is desirable for the Secretariat to have flexibility in this regard while also carefully monitoring the budget items. The Council noted the need for guidelines for Staff Travel. It further noted that sale of publications would be included as a separate item under Income. The Council instructed the Secretariat to prepare a breakdown of the budget items related to the Scientific Committee for the review of the Finance and Administration Committee.

2.3.3 Forecast Budget 2002

The Council **adopted** on a preliminary basis the forecast budget for 2002, as contained in NAMMCO/10/4 – Annex 1. In so doing, it was noted that the budget for 2002 was the same as for 2001 with the exception of the budget item for Meetings, which had been increased in 2001 to accommodate the Weapons and Ammunition Workshop. The Council noted that the membership contributions remained the same for 2002 in anticipation of the financial implications of the Host Agreement.

2.4 Rules of Procedure

At the last Council meeting (Akureyri, Iceland 1999) the Council adopted the revised draft of the Rules of Procedure for the Council with a note to the Finance and Administration Committee to finalise outstanding items (Annual Report 1999: 11). The Chairman presented a draft in which the outstanding items had been dealt with. He noted that the main issues remaining from last year were the admittance of observers to Council meetings, and the release of documents, and that the Finance and Administration Committee recommended that the Council adopted this draft. The Council **endorsed** the Rules of Procedure as contained in Appendix 6 in this volume.

The Council **agreed** to ask the Scientific Committee to develop its Rules of Procedure in conformity with those of the Council. The Council must approve the Scientific Committee Rules of Procedure.

The Faroe Islands noted that the Rules of Procedure for the Council is an important development for NAMMCO, in particular in relation to the question of observers.

Norway drew attention to the fact there is a need for further discussion on how to include the press at Council meetings.

2.5 Other Business

2.5.1 Staff Rules

The Council noted that with the completion of the Host Agreement between NAMMCO and the government of Norway, the Secretariat would finalise the development of the Staff Rules for the Secretariat to be discussed at the next meeting.

2.5.2 Observation Scheme

The Council noted that the Finance and Administration Committee is the appropriate forum for discussing future administrative aspects of the NAMMCO International Observation Scheme.

3. SCIENTIFIC COMMITTEE

3.1 Report of the Scientific Committee

Mads Peter Heide-Jørgensen, outgoing chairman of the Scientific Committee, presented the Report of the 8th Meeting, which was held in Akraberg, Faroe Islands from 13 to 16 June 2000. The full report is included in Section 3 of this volume. Heide-Jørgensen noted that the past year had been very busy for the Scientific Committee, with Working Groups addressing requests forwarded to it by the Council related to the economic aspects of marine mammal - fisheries interactions and the status of North Atlantic harbour porpoise, Faroese fin whales, and beluga and narwhal off West Greenland.

National Progress Reports for 1999 from the Faroe Islands, Iceland and Norway were submitted to the Scientific Committee, while the Report for 1998 from Greenland was not available at the meeting. All National Progress Reports are included in Section 4 of this volume.

3.1.1 Economic Aspects of Marine Mammal-Fishery Interactions

At its 8th meeting in Oslo in September 1998 the Council requested that the Scientific Committee should investigate the following economic aspects of marine mammal-fisheries interactions:

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 input for the models;

iii) to discuss specific cases where the present 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?

At the 7th Meeting of the Scientific Committee in April 1999, the Committee decided to reactivate the Working Group on the Economic Aspects of Marine Mammal - Fisheries Interactions to deal with this request. It was agreed to separate the request into two sections. At the first Working Group meeting items i) and ii) were to be considered, while treatment of item iii) was to await the conclusions on the first two. The Working Group comprised of Scientific Committee members and invited experts from Canada, Iceland, Norway and the United States, met in Copenhagen 16-17 February 2000 under the chairmanship of Aqqalu Rosing-Asvid.

The Scientific Committee found that significant uncertainties remain in the calculation of consumption by marine mammals, and that this uncertainty was the most important factor hindering the development of models linking consumption with fishery economics. It is necessary to explicitly describe the uncertainty inherent in consumption estimates, but this is not possible in most cases with the data currently available. The quality of the data necessary to estimate consumption is generally highest for minke whales and harp seals in the Barents and Norwegian Seas, pilot whales around the Faroes and for harp, hooded and grey seals off south-eastern Canada. Consumption by marine mammals approaches or exceeds fisheries landings in some areas. While this does indicate that there is at least a potential for interaction between marine mammal predation and fisheries, the magnitude of marine mammal predation must be put into the context of total natural mortality for the target species. 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, and preliminary investigations in this area have already been conducted.

The Scientific Committee therefore recommended that the next logical step in addressing the request from the NAMMCO Council should be for NAMMCO to lead or assist in the development of a multi-species-economic model for a candidate area. The most suitable candidate areas were identified as the Barents/Norwegian Seas, and the area around Iceland. However, the Scientific Committee reiterated that the estimation and model uncertainties are such that definitive answers to part iii. of the request from the Council, to quantify the economic aspects of marine mammal-fisheries interactions in candidate areas cannot be expected in the near term.

The Council **emphasised** the importance of the request and noted that no other organisation was willing or able to address such questions for the North Atlantic. The Council expressed its concern that the Scientific Committee had concluded that answers to part iii could not be expected in the near term, and queried the Scientific Committee Chairman about the aspects of the difficulties with such a study. The Council **agreed** that the Scientific Committee, despite the difficult task, should keep pushing forward in the areas where knowledge is available. The Council further **agreed** that NAMMCO should inform relevant sister organisations about NAMMCO's work on this topic.

3.1.2 North Atlantic Harbour Porpoise

In 1997, the Council recommended that the Scientific Committee should carry out a comprehensive assessment of the harbour porpoise throughout its North Atlantic range. 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 International Symposium on Harbour Porpoises in the North Atlantic was held on board the Norwegian Coastal Steamer *MS Nordlys enroute* from Bergen to Tromsø, September 10-14, 1999. It was attended by 31 delegates from 12 countries and included 22 presentations. The Symposium agenda was structured around four theme sessions, each led and chaired by an invited keynote speaker: 1) Distribution and stock identity; 2) Biological parameters; 3) Ecology and pollutants; 4) Abundance, removals and sustainability of removals. The keynote speaker for each session also provided an overview of the theme and a synthesis of the results of the discussions.

The Scientific Committee utilised the report of the Symposium to develop its own assessment advice. Although 13 stocks of harbour porpoises have been identified in the North Atlantic, it is apparent that further research is required to further resolve and discriminate stocks. While biological parameters are available for some areas, they are required on a population specific basis. In particular, unbiased and precise estimates of survival/mortality are needed. Harbour porpoises are inhabitants of coastal waters and their habitat includes some of the most polluted waters of the North Atlantic. They also have a small body size, and therefore a relatively high metabolic rate and they feed at high trophic levels, making them very susceptible to some pollutants. 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. These related to stock delineation, stock-specific biological parameters, estimates of abundance and removals and the integration of research efforts (Section 3.1, p. 135).

Heide-Jørgensen noted that the approach of holding a symposium to deal with matters that did not pertain directly to management had proven valuable in this instance. However he recommended that future symposiums should, if possible, be held in cooperation with other organisations to broaden the base of participation.

3.1.3 West Greenland Beluga

In 1999, the Scientific Committee noted that index surveys conducted in the West Greenland beluga wintering area since 1982 indicated a decline of more than 60% in abundance, and that the aggregation was likely declining due to overexploitation. In response, the NAMMCO Council asked the Scientific Committee to provide advice on the level of sustainable utilisation of West Greenland beluga in different areas and under different management objectives. To address this request for advice the Scientific Committee decided to arrange for another meeting of the Working Group on the Population Status of Beluga and Narwhal in the North Atlantic. The Working Group, including members of the Scientific Committee as well as invited experts from Norway, the United States and Mexico met in Oslo from 15-17 June 2000 under the chairmanship of Professor Øystein Wiig. Heide-Jørgensen noted that it had not been possible to secure the participation of Canadian experts in the Working Group, as they had been refused permission to attend by the Canadian authorities. In this regard he urged the Council to come to a cooperative agreement with the Canada/Greenland Joint Commission on Conservation and Management of Narwhal and Beluga.

The Scientific Committee concluded that while there is some evidence that more than one stock of beluga may winter in West Greenland, there is insufficient information at present to warrant stock division. Evidence of a stock decline emerges from a series of aerial surveys flown over the over-wintering area between 1981 and 1999. Over this period, the index count from the surveys has decreased by about 60%. The estimated stock size in 1998-1999 was 7,941 (95% CI 4,264-14,789).

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. While a change in beluga distribution might also explain the observed reduction in abundance, there is no evidence to support this. It is apparent that harvest must be reduced to about 100 animals per year to have any significant chance of stopping the decline in the stock within the next 10 years. The benefits of a delayed or graduated reduction in harvest must therefore be weighed against the increased risk of continued stock decline. The Scientific Committee also recommended that future harvest quotas should be allocated to hunting areas in proportion to past harvests, that seasonal closures be implemented to allow beluga to recolonise areas they may previously have occupied, and that cow-calf pairs should be protected to reduce the number of adult females harvested. In addition, the Scientific Committee developed a comprehensive set of research recommendations for West Greenland beluga (Section 3.1, p. 143).

The Council expressed its deep concern over the depleted status of the beluga off West Greenland, noting the finding of the Scientific Committee that severe reductions in catch are required to halt the decline of this stock. It was accepted that the Canada/Greenland Joint Commission on Conservation and Management of Narwhal and Beluga (JCNB) had competence to provide management advice for this stock, which is shared by Canada and Greenland. The Council therefore **directed** the Secretary to convey this concern to the JCNB, and to maintain a close liaison with the JCNB on this and other issues of mutual concern.

3.1.4 West Greenland Narwhal

In 1999 the Council asked the Scientific Committee to identify the information that is required to provide advice on the level of sustainable utilisation of West Greenland narwhal in different areas and under different management objectives. The Working Group on the Population Status of Beluga and Narwhal in the North Atlantic (see 4.1.3) was tasked with providing advice to the Scientific Committee on this matter.

Satellite tracking and genetic studies indicate that, in general, narwhal occupy discrete local areas during the summer, and there may be relatively little exchange between these areas. During the winter, they are more dispersed. Although the total numbers of narwhal occupying Baffin Bay and East Greenland waters may be quite large, small local aggregations may still be subject to overexploitation. This was noted as a particular concern for the Ummannaq area, where large harvests occur in some years, and to a lesser extent in Qaanaaq, Melville Bay and Upernavik. The Disko Bay area appears to be a wintering area where two or more stocks may mix.

Developing recommendations on the sustainable harvest of narwhal in Greenland will require significant additional research and cannot be done at present. However, this may become a priority, particularly in West Greenland where hunting effort may switch to narwhal because of the decline in the beluga stock. The Scientific Committee developed research priorities for narwhal related to catch statistics, stock delineation and stock abundance (see Section 3.1, p. 144), and recommended that they should continue to monitor the development of the research that is needed to complete the assessment of West Greenland narwhal.

3.1.5 Faroese Fin Whales

In 1999 the Council asked the Scientific Committee to continue its assessment of fin whale stocks in the North Atlantic, focussing in the near term on the status of fin whales in Faroese Exclusive Economic Zone (EEZ) waters. The Scientific Committee was directed to focus particularly on the following issues:

– Assess the long-term effects of annual removals of 5, 10 and 20 fin whales in Faroese EEZ waters;
– Information gaps that may need to be filled in order to complete a full assessment in this area."

To deal with this request, the NAMMCO Scientific Committee re-established its Working Group on North Atlantic Fin Whales. The Working Group, which included members of the Scientific Committee as well as invited experts from Denmark, South Africa and the United Kingdom, met from 12-13 May in Tórshavn, Faroe Islands.

The Scientific Committee noted that there was little information with which to delineate stock areas for fin whales in the North Atlantic, and therefore conducted assessments on arbitrarily defined stock areas of various sizes. Assessments were based on historical harvest data and abundance data from the North Atlantic Sightings Surveys (NASS). The results of these assessments indicated that fin whales in the area have likely been substantially depleted by past harvests, but there was great uncertainty in the results, depending primarily on the choice of stock area and Maximum Sustainable Yield Rate. Estimates of sustainable yield ranged from 5 to 257, depending on the scenario considered.

Further it was noted that the historical catch data archived by the Faorese Museum of Natural History and by the IWC are not in agreement and that the differences are unsystematic. The Faroes are currently working on generating a complete catch data set.

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 (see Section 3.1, p. 147).

The Faroe Islands noted that some of the recommended research, including collection of biopsy samples for genetic work and deployment of satellite-linked tags, had already been initiated, and that further information should therefore be available within a reasonable time frame.

3.1.6 White-Beaked, White-Sided and Bottlenose Dolphins

In 1998 the Council recommended that the Scientific Committee should undertake an assessment of distribution, stock identity, abundance and ecological interactions of white-beaked and white-sided dolphins in the North Atlantic area. The Scientific Committee responded in 1999 by concluding that there was insufficient information on stock structure, abundance and feeding ecology to carry out a meaningful assessment of these species at that time. In 1999, the Council asked the Scientific Committee to analyse results from NASS-95 and other sightings surveys as a basis for establishing abundance estimates for the stocks, and to co-ordinate the efforts of member countries to conduct research to fill the noted information gaps. The Council also asked the Scientific Committee to include bottlenose dolphins in the assessment.

To address this request, Scientific Committee members were asked to provide information on ongoing national research programs for these species, and to assess the feasibility of increasing research efforts in this area.

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 during the surveys. 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 will be published soon. By-catch of white-sided and white-beaked dolphins in Iceland, and directed catch of white-sided, white-beaked and bottlenose dolphins in the Faroes offer the best opportunities for sample collection and research. The Scientific Committee therefore made the following recommendations:

- that the analysis and publication of Icelandic studies on white-sided and white-beaked dolphins be completed as soon as possible;
- 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;
- that sample collection in other areas continue on an opportunistic basis.

The Faroe Islands noted that, in response to this advice, they had already initiated a sampling program for these species. However, it was considered likely that it would take some years to collect sufficient data for a meaningful assessment, so the item should be kept open on the agenda of the Scientific Committee.

3.1.7 North Atlantic Sightings Surveys

At its 1999 meeting, the NAMMCO Council noted that abundance estimates from NASS-95 have not been completed for some species. The Council 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.

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 only the estimate for minke whales in the Norwegian area had 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.

In 1999 the NAMMCO Council recommended that the Scientific Committee continue its efforts to co-ordinate future sighting surveys in the North Atlantic. Priority species should be minke whales and fin whales, and the Council recommended that the survey design be optimised for these species and for those areas where abundance estimates are most urgently required. Co-ordinated sightings surveys are planned for 2001, and the Scientific Committee agreed to play a central role in the planning of these surveys.

3.1.8 Proposal for a NAMMCO Science Fund

At the 9th meeting of the NAMMCO Council in 1999, the Chairman of the Scientific Committee proposed that the Scientific Committee be given the option of conducting its own research with funding provided by the Council. This would facilitate closer cooperation 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.

The Council asked the Scientific Committee to develop a full proposal for a scientific research program within the Scientific Committee, and to bring it to the Council for consideration at the 2000 meeting. Heide-Jørgensen presented the proposal to the Council.

The purpose of the proposed "NAMMCO Science Fund" would be to enable the NAMMCO Scientific Committee to conduct research projects that would assist in the deliberations of the Scientific Committee. Supported projects could either be directly relevant to specific requests, or of importance for the development of techniques, methods, models or background information pertinent to the work of the Scientific Committee. The Scientific Committee would administer the Science Fund, and would be responsible for proposal approval, funding and project monitoring. The Council would approve funding for the Science Fund as an addition to the Scientific Committee budget. It was proposed that the initial funding level for 2001 would be NOK 1,000,000.

In response to this proposal, the Council noted that while the proposed Science Fund was interesting and had potential, more time and discussion would be needed to reach a decision on the matter. The Council **agreed** to keep the matter under consideration and revisit it at the next meeting.

3.1.9 Publications

Heide-Jørgensen noted with satisfaction that the second volume of NAMMCO Scientific Publications, *Minke whales, harp and hooded seals: Major predators in the North Atlantic ecosystem*, had just been published and was being distributed by the Secretariat. The following additional volumes of NAMMCO Scientific Publications are planned:

i. Sealworm Infections
ii. Harbour Porpoises in the North Atlantic
iii. Population Status of Narwhal and Beluga in the North Atlantic.

3.1.10 Concluding remarks

The Chairman of the Council thanked the Chairman of the Scientific Committee for his comprehensive report. Noting that Mads Peter Heide-Jørgensen was stepping down as chairman of the Scientific Committee, the Chairman of the Council expressed the appreciation of the Council for his dedicated service to NAMMCO, and welcomed Gísli Víkingsson (Iceland) as new Chairman of the Scientific Committee.

Matters regarding scientific requests and advice from the Scientific Committee were forwarded to the Management Committee for further consideration (see under 4.2 below, and the Report of the Management Committee, which is contained in Section 2 of this volume).

3.2 Other business

3.2.1 Revised Rules of Procedure for the Scientific Committee

The Council at their second meeting in 1993 accepted the Rules of Procedure for the NAMMCO Scientific Committee. 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. Heide-Jørgensen presented a draft revision of the Rules. In response, the Council referred the matter to the Finance and Administration Committee (see item 2.4 of this section).

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, which was held in Sandefjord on 27 September. A preliminary report was distributed as NAMMCO 10/8-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. It further noted that the Report from

Greenland had been delayed, but would be forthcoming shortly.

The reports on marine mammal research in member countries submitted to the Management Committee are contained in Section 4 of this volume.

4.1.2 Proposals for Conservation and Management

<u>*Status of Past Proposals*</u>

Harp and Hooded Seals

<u>Northwest Atlantic</u>

The Council noted that Greenland and Canada have held bilateral discussions on management of this stock, and that advice from NAMMCO had been considered.

<u>White/Barents Seas</u>

The Council noted Norway's comment that the Russian Federation manages this stock, including the traditional allocation of catch quotas to Norway. It also noted Norway's question to the observer from the Russian Federation whether there are any plans to incorporate NAMMCO's management advice (see Section 2.1, page 74) on this species into future catch efforts, or whether further advice from NAMMCO would be desirable. The Council noted that there are currently no firm plans to that effect in the Russian Federation.

Northern Bottlenose Whales

The Council noted that while Faroese law presently protects the bottlenose whale, small numbers (3 animals in 2000) are actively utilised locally for their meat and their oil. The Council further noted that the Faroe Islands had informed the Management Committee that measures would be taken to ensure that legislation is consistent with this traditional, opportunistic catch.

Long-finned Pilot Whales

The Council noted that the Faroe Islands had deployed four satellite tags on pilot whales in 2000, providing valuable information on movements and distribution of these whales.

Minke Whales – Central North Atlantic

The Council noted that the Scientific Committee's assessment of the Central North Atlantic minke whale stock had taken into account the uncertainties regarding stock delineation and abundance estimates that had come to light in the NASS 95 survey, and in recent genetic research. The Council reiterated the satisfaction of the Management Committee that the Scientific Committee Working Group on Abundance Estimates would be considering these matters at their meeting in the autumn of 2000.

<u>*Status of Past Requests*</u>

The Council took note of the document NAMMCO/10/MC/4, which was an update summary of requests for advice by the NAMMCO Council to the Scientific Committee, and responses by the Scientific Committee since 1992.

4.2 Recommendations for Requests for Advice

Economic Aspects of Marine-Mammal –Fisheries Interactions

New Request for Advice

The Council **agreed** to the Management Committee recommendation that the Scientific Committee continue the assessment of the economic aspects of fishery – marine mammal interactions narrowing the focus to minke whales and harp seals in the areas of Barents Sea and Iceland.

Harbour Porpoise

Recommendations for Scientific Research

The Council **agreed** to the endorsement by the Management Committee of the research recommendations conveyed on pages 135-136 of the Report of the Scientific Committee.

Beluga - West Greenland

Proposal for Conservation and Management

The Council **agreed** with the acceptance by the Management Committee that with respect to this stock of beluga the Canada/Greenland Joint Commission on Conservation and Management (JCNB) would provide management advice. The Council also **agreed** with the Management Committee recommendation that closer links should be developed between NAMMCO and JCNB. The Council noted that Greenland would again discuss this issue with the hunters. The Council expressed its deep concern over the depleted status of the beluga off West Greenland, noting the findings of the Scientific Committee that severe reductions in the catch are required to halt the decline of this stock.

New Request for Advice

The Council **agreed** with the Management Committee's recommendation that the Scientific Committee continues its assessment of the West Greenland beluga. The Council noted that a joint meeting of the Scientific Working Group of JCNB and the NAMMCO Scientific Committee Working Group on the Population Status of Narwhal and Beluga was anticipated to be held in the spring of 2001.

Recommendations for Scientific Research

The Council **agreed** to the Management Committee endorsement of the research recommendations suggested by the Scientific Committee (see Section 3.1, pages 143-144).

Narwhal – West Greenland

Proposal for Conservation and Management

The Council noted the acceptance by the Management Committee that the JCNB would provide management advice for this stock, which is shared by Canada and Greenland. The Council **agreed** to the Management Committee's recommendation that closer links are developed with the JCNB on this and other relevant issues.

New Request for Advice

The Council **agreed** to the Management Committee's recommendation that the

Scientific Committee completes an assessment of narwhal in West Greenland, with a special emphasis on evaluating the extent of movements of narwhal between Canada and Greenland.

Recommendations for Scientific Research
The Council **agreed** to the Management Committee's endorsement of the Scientific Committee research recommendations (see Section 3.1, page 144) and further **agreed** to urge member governments to act on these recommendations, and also to inform non-member governments about these recommendations.

Fin Whales – Faroese Exclusive Economic Zone
New Request for Advice
The Council **agreed** to the Management Committee's recommendation that the Scientific Committee continue its assessment as new data becomes available, in particular in relation to stock delineation.

Recommendations for Scientific Research
The Council **agreed** with the Management Committee's endorsement of the Scientific Committee research recommendations (see Section 3.1, page 147), and further **agreed** to urge member governments to act on these recommendations, and also to inform non-member governments about these recommendations.

White-beaked, White-sided and Bottlenose Dolphins
New Request for Advice
The Council **agreed** to the Management Committee recommendation that the Scientific Committee monitors the developments in the areas of stock identity, distribution, abundance and biology, and continues its assessments as new data become available.

Recommendations for Scientific Research
The Council **agreed** with the Management Committee's endorsement of the Scientific Committee research recommendations (see Section 3.1, page 150), and also **agreed** to urge member and non-member governments to act on these recommendations.

North Atlantic Sightings Survey
The Council noted that the Scientific Committee Working Group on Abundance Estimates would meet in autumn 2000 to plan the 2001 surveys. The Council further noted that the Management Committee urged the member countries to co-operate to the fullest extent possible in co-ordinating their survey efforts.

4.2.1 Report of the Working Group on By-catch
The Council noted the Management Committee endorsement and encouragement of the member countries to establish mandatory logbook-data-collection-systems as an initial step to identify areas and fisheries that would be the focus of further efforts. The Council further noted that the Management Committee supported the Working Group's recommendation to initiate a system of by-catch reporting to NAMMCO through the National Progress Reports, and that the Secretariat was directed to modify

the format of the Reports accordingly. The Council also noted that the Management Committee directed the Working Group to meet again prior to the next Annual Meeting of NAMMCO (see Section 2.1, page 78).

4.3 International Observation Scheme

The Council noted the Management Committee review of the implementation of the International Observation Scheme for 2000 under the Joint NAMMCO Control Scheme for the Hunting of Marine Mammals, and for the planned observation activities for 2001 (see Section 2.1, page 78).

The Council noted the Management Committee's emphasis on continued dissemination of information of the Scheme in NAMMCO member countries and that this would assist the observers in continuing to carry out their activities in a satisfactory manner. The Council further noted that the Management Committee repeated the recommendation from the previous year, urging NAMMCO member countries to provide the Secretariat with names of contacts for the observers.

4.3.1 Report of the Working Group on Inspection and Observation

In reference to the Report of the Management Committee Working Group on Inspection and Observation, the Council **agreed** to the Management Committee's endorsement of the recommendations contained in the Report. The Report is contained in Section 2.3.

The Council further noted the Management Committee decision to reconstitute the members of the Working Group as an *ad hoc* committee to monitor the Scheme with a focus on observed apparent infringements and subsequent actions by relevant authorities (see Section 2.1, page 78).

4.4 Other Business

4.4.1 Proposal for a Conference on Users Knowledge and Scientific Knowledge in Management Decision-Making

With reference to the proposal for a conference with the working title Users Knowledge and Scientific Knowledge in Management Decision Making, the Council **agreed** to the Management Committee's decision to task the Secretary with developing this proposal further together with an Advisory Group (see Section 2.1, page 79).

The Council noted that the Management Committee tasked the Advisory Group to consider whether and how the previous proposal for incorporating users knowledge into the Scientific Committee's deliberations could be incorporated into the Conference (see NAMMCO Annual Report 1999 page 88).

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 on 29 August 2000. The report is contained in Section 1.2.

5.1.1 Update on Hunting Methods in Member Countries

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 August meeting (Section 1.2, page 59).

The Chairman of the Committee on Hunting Methods presented the updated lists of regulations and references on hunting methods in member countries. These lists were developed by the Committee and appended to the Committee Report (see Section 1.2, Appendices 1 and 2).

5.1.2 Recommendations

The Chairman of the Committee on Hunting Methods presented the status of each country's follow-up to the recommendations resulting from the NAMMCO Workshop of Hunting Methods (Nuuk, 9-11 February 1999) The NAMMCO Council at its 9th Annual Meeting (Akureyri Iceland 1999) adopted these recommendations (see NAMMCO Annual Report 1999 Section 1.3, item 7 page 71).

5.1.3 Weapons and Ammunitions Workshop

The Council **agreed** to the recommendation of the Committee on Hunting Methods to hold a Workshop on Weapons and Ammunition.

The Council **agreed** that the goals of the Workshop would be to increase the understanding of weapon types, ammunition and ballistics for hunters, administrators and other personnel, and to develop a minimum set of requirements pertaining to weapons and ammunition types with regard to the different species.

The Council noted that this would be secured through addressing topics such as:
- An introduction to different killing methods pertaining to marine mammals
- Weapon types and ammunition in combination with terminal ballistics
- The impact of weapon types and ammunition on different marine mammals species
- Safety for the hunters with respect to weapons use.

The target groups for the Workshop would be hunters and relevant government officials and including the members of the Hunting Method Committee.

Finally, the Council also noted that extra funds had been included for meeting costs in the 2001 budget to allow for the costs of organising the Workshop.

The Chairman thanked the Committee for their report.

6. THE NAMMCO FUND

6.1 Report of the NAMMCO Fund

The Chairman of the Board of the NAMMCO Fund, Kate Sanderson (Faroe Islands), presented the report to of the NAMMCO Fund to the Council. The Board met in

Copenhagen 31 August 2000 to review this year's applications for funding from the NAMMCO Fund. The report was contained in document NAMMCO/10/11.

The Council noted that the total available funds of NOK 255,000 had been allocated to fund projects for 2000. It also noted that the quality of the applications for each year determine whether all the funds are allocated.

6.1.1 Applications

The Council noted that the Secretariat had received nine applications for funding for 2000, and that the Board of the NAMMCO Fund decided to fund three of these.

The successful applications were:

Exhibition on marine mammals – An exhibit in *Polaria*, an arctic centre in Tromsø, Norway, which will present the polar areas and the Barents Sea Region to the public – particularly children and youth, both international and national. The highly visible exhibit will focus on marine mammals and fish interactions and the ecosystem.

Kids-www. – An educational website by the High North Alliance, targeting children and youth. The focus of the website will be sustainable use of marine mammals, set in the larger context of environmental issues. Information on the website would be distributed to educational institutions as a source of information for teachers.

Faxi the whale – A website about whales in the North Atlantic, designed by Sjávarborgin Efh., in Iceland, will provide information on whaling and rural communities that traditionally rely on harvesting whales. Folk tales will be utilised in presenting the material, thus combining the modern technology of multimedia presentations with traditional story telling.

6.1.2 Other business

The Council noted that the Secretariat would have the mandate to technically evaluate the applications. It was further noted that the date for applicant notification had been extended until 15 September, while the application deadline of 1 June had been kept. The Council **endorsed** the Board's recommendation that NOK 200,000 should be included in the budget for 2001.

The Chairman thanked the Board of the NAMMCO Fund for their report.

7. ENVIRONMENTAL QUESTIONS

The Scientific Secretary to NAMMCO, Daniel Pike, presented a document prepared by the Secretariat titled "Assessment of Organisations Addressing Contaminant Issues Relevant to the Management of Marine Mammals." The document was presented to the meeting as NAMMCO/10/9. The issue of marine contaminants has been on the NAMMCO agenda since its beginning, and is also mentioned in the NAMMCO Agreement. The paper was prepared as a response to a request at the Ninth meeting of the NAMMCO Council in Iceland in 1999, where the Secretariat was instructed to prepare a review of organisations addressing marine environmental questions and the types and scope of these issues. A particular focus of the review was to distinguish between the organisations that are relevant to the management of marine mammals versus those that are relevant to the management of marine pollution.

The review focussed on inter-governmental organisations (IGOs) and international non-governmental organisations, while national government organisations and non-governmental organisations were also considered.

It was generally found that IGOs were seen to be potentially the most relevant to NAMMCO. These IGOs fell into two main categories: regulatory organisations (e.g. OSPAR, UNEP and WHO) and scientific organisations (e.g. IOC, ICES, IWC Scientific Committee and EEA). In addition the Arctic Council was considered to be relevant in this context. The review suggested that it would be useful for NAMMCO to establish cooperative links with both types of organisations.

The review included a suggestion for how NAMMCO could move forward in addressing member countries' concerns about contaminants in the marine environment. These included establishing observer arrangements between NAMMCO and relevant IGOs, communicate concerns about contaminants in marine mammals, co-ordinate scientific activities with other relevant organisations and request scientific advice from other relevant scientific organisations that may have more expertise than NAMMCO's Scientific Committee. The review provided an overview over the environmental organisations that are active in the area of marine contamination.

The observer from the IWC drew the attention of the Council to the adoption by IWC of a consensus resolution on POPs and heavy metals.

The Council thanked the Secretariat for producing the document and noted that this was a useful working paper for information on the work of various organisations concerned with contaminants.

The Council noted the links previously established between NAMMCO and other organisations such ICES, with respect to the issue of contaminants in the marine environment. The Council further noted that the Arctic Council Working Groups of PAME and AMAP work on contaminant issues of relevance to NAMMCO, and represented a potential forum for joint discussions on the topic.

The Council **agreed** with the suggestion from the Faroe Islands to continue the effort to establish a formal contact with OSPAR, and with the suggestion to focus on the relevant IGOs that, in particular, are concerned with the scientific or regulatory aspects of contaminants. The Council further tasked the Secretariat with approaching other organisations to convey NAMMCO's concern about pollution in the marine environment.

The Council expressed an interest in exchange of ideas and information on this topic between the member countries. It was noted that decisions for how to proceed further and what role NAMMCO would play on the international arena would be a topic for future discussions within the Council.

The Council **concluded** that this topic would be kept on the agenda of NAMMCO, and that this would be a live document to be updated regularly.

8. TRADE AND MARKETING INFORMATION

The Secretary to NAMMCO, Grete Hovelsrud-Broda, presented a document prepared by the Secretariat titled "Trade and Markets: Marine Mammal Products" which was available to the meeting as document NAMMCO/10/10.

At its 9th Annual Meeting the Council instructed the Secretariat to prepare a discussion paper which would address:
1) The possibilities for enhancing trade and marketing in marine mammal products among NAMMCO member countries;
2) the economic opportunities for coastal people in member states afforded by an increased utilisation of marine mammal products, and;
3) options for increasing the marketing and utilisation of marine mammals in NAMMCO member countries.

These are broad areas of inquiry and the discussion paper could only attempt to indicate the range of issues that had been taken into consideration. Under item 1) three areas of inquiry were identified: existing trade relations, trade barriers and international standards and the existing markets for marine mammal products. A number of issues were addressed under item 2) including the question of whether increased utilisation would be possible within the current quota systems, and the current production of marine mammal products in each member country. Under item 3), the discussion paper examined existing marketing strategies and options for new products. The discussion paper concluded that there are two predominant areas of concern: 1) the question of whether trade between NAMMCO member countries is possible with respect to international trade issues and market potential for products, and 2) products and product development.

The Council thanked the Secretariat for producing a thorough and useful document, and **noted** that although NAMMCO is a resource management body, issues related to trade in marine mammal products are relevant to NAMMCO member countries. The Council supported Norway's point that competence for decision making on international trade issues was the responsibility of other bodies. The Council **agreed** that a clear distinction must be made between the function of different organisations. The Council further **agreed** that this would serve as an information document for NAMMCO and not as an advisory document. It was also **agreed** that this item should be kept on the agenda at future meetings, and that NAMMCO could be a potential forum for further discussion.

9. EXTERNAL RELATIONS

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

IWC International Whaling Commission

The Council noted that the Secretary had represented NAMMCO as observer at the 52nd annual meeting of the IWC that was held in Australia in June-July 2000. She attended both the IWC Scientific Committee meeting and that of the Commission.

In following previous practice NAMMCO submitted an opening statement to the IWC, providing updated information on the recent activities of the organisations. The statement was available to the Council meeting as document NAMMCO/10/13-4.

Arctic Council – Senior Arctic Officials Meetings

The Secretary informed the Council that she had attended two Sustainable Development Working Group (SDWG) meetings and two Senior Arctic Officials (SAO) Meetings of the Arctic Council, held in the United States. The press release from the Arctic Council SAO meeting in Fairbanks, Alaska 26 – 28 April 2000 was made available to the meeting as document NAMMCO/10/13-6. The Secretary also attended a workshop on Marine Living Resources in Bodø, Norway, organised by Norway in relation to the deliberations of the Arctic Council SDWG. The Chairman's Summary from this workshop was available to the meeting as document NAMMCO/10/13-1.

Pending the anticipated attainment of observer status to the Arctic Council, the Council **agreed** that NAMMCO should pay close attention to the activities of the Arctic Council and its Working Group. The Council further **agreed** that relevant Arctic Council documents would be carefully reviewed by NAMMCO. In addition, the Council **agreed** that NAMMCO should develop specific ideas for active collaboration with the Arctic Council in areas of mutual interest, both in relation to environmental protection and sustainable development and to ensure that *inter alia* work is not duplicated.

The Faroe Islands circulated the draft framework document for the Sustainable Development Working Group under the Arctic Council, which was expected to be formally adopted at the forthcoming Arctic Council ministerial meeting in Barrow, Alaska in October. The document was made available to the meeting as NAMMCO/10/13-9.

CITES – Convention on International Trade in Endangered Species of Wild Fauna and Flora

The Secretary reported on her attendance as NAMMCO observer at the 11th Conference of the Parties (COP 11) to CITES, which was held in Nairobi, Kenya in April 2000.

The Council noted that NAMMCO had, upon request from the CITES Secretariat, provided comments on the proposal from Norway to transfer the Northeast Atlantic and Central North Atlantic stocks of minke whales from Appendix I to Appendix II. In addition, the Council was informed that the Secretary made an intervention at the COP 11 meeting concerning the Norwegian down-listing proposal. The text of the intervention was available to the meeting as document NAMMCO/10/13-2.

The Secretary informed the Council that NAMMCO had not been invited to participate in the upcoming meeting where the CITES criteria for classification of species were to be discussed. The Council **agreed** that the Secretary should request that NAMMCO is included in hearings of CITES. The Council **agreed** that NAMMCO would discuss and clarify its views on relevant issues addressed by CITES.

IWMC – International Wildlife Management Consortium
The Council noted that the Secretary had attended the 2nd Symposium on Sustainable Use: In Search of Innovative Conservation Initiatives, held in Chengdu, China 22 – 26 November 1999. The abstract of her paper presented to the Symposium: "Conservation of Marine Mammals in the North Atlantic", was available to the meeting as document NAMMCO/10/13-8.

ICC – Inuit Circumpolar Conference
The Council noted that a paper prepared by the Scientific Secretary had been presented by the Council Chairman, Amalie Jessen at the ICC Roundtable Discussion on the Removal of Trade Barriers held in Washington DC, USA 20 November 1999. An abstract of the paper entitled "Overview of the sustainability and management of sealing in the North Atlantic" was available to the meeting as document NAMMCO/10/13-7.

NEAFC Northeast Atlantic Fisheries Commission
Einar Lemche (Greenland) reported from the 1999 Annual Meeting of NEAFC in London 22 – 25 November. The Commission had reviewed reports from the International Council for the Exploration of the Seas (ICES) concerning the status of fish stocks in the Northeast Atlantic. In particular for the oceanic redfish, blue whiting, Norwegian spring spawning herring and deep-water stocks. The Commission had agreed on regulatory measures for one more straddling stock, for the mackerel stock. The Commission introduced a satellite vessel monitoring system from 1 January 2000.

ICES – International Council for the Exploration of the Sea
The NAMMCO Secretariat was invited to comment on the ICES document: *Towards the 21st Century: A Strategic Plan for ICES* that was to be presented at the ICES Open Forum 26 September 2000, Brugge, Belgium. The comments will be included in the revised Strategic Plan. The NAMMCO review of the ICES document was available to the meeting as NAMMCO/10/13-3.

NAFO – Northwest Atlantic Fisheries Organisation
Kolbeinn Árnason (Iceland) reported from the 22nd Annual Meeting of NAFO held in Boston, USA 18-22 September 2000.

Mr Árnason reported that the Joint Scientific Council/Fisheries Commission Working Group on the Precautionary Approach evaluated and discussed a precautionary approach to cod and yellow-fin tuna in two areas in terms of harvest strategies, conservation and enforcement measures, and research and monitoring. The Fisheries Commission adopted scientific advice on levels of harvest for all stocks, and agreed to a number of conservation and enforcement measures. These included a new fishing strategy for avoiding excessive incidental catch, and a modification of the Program for Observers and Satellite Tracking which would include vessel-monitoring systems. Mr Árnason further reported that the General Council deliberated on several issues regarding external and internal NAFO policy, including Dispute Settlement Procedures and an agreement to continue appropriate actions against non-Contracting Party fishing in NAFO regulated areas.

NASCO North Atlantic Salmon Commission
The Council **agreed** that NAMMCO would seek observer status at the next NASCO meeting and that the Faroe Islands would represent NAMMCO provided the response was positive.

Canada/Greenland Joint Commission on Conservation and Management of Narwhal and Beluga
In order to seek a constructive approach to co-operation and to clarify the role of NAMMCO and JCNB with respect to scientific advice and management advice on narwhal and beluga, a JCNB meeting primarily considering these matters was held 18-19 July in Nuuk, Greenland (see Section 3.1, page 124). A compromise was worked out that Greenland and Canada should consider that management advice would only be given by the JCNB, while both NAMMCO and the JCNB's Scientific Working Group could provide scientific advice. The Council also **agreed** to initiate a more active exchange with the JCNB including the exchange of observers at meetings.

The Secretary also informed the Council that the Scientific Secretary had attended meetings of the Society of Marine Mammology and the European Cetacean Society.

10. INFORMATION

The Secretary informed the Council of work and plans regarding information on NAMMCO that is aimed at the general public.

The NAMMCO website, www.nammco.no, continues to be developed and expanded, and the Council noted that the Secretariat is increasingly responsible for maintaining and expanding the website.

The Secretary introduced the new NAMMCO information brochure to the Council. She explained that, for financial reasons, the brochure had been produced instead of the posters discussed at the last Council meeting.

The Faroe Islands congratulated the Secretariat on the brochure and suggested that the member countries receive a supply for distribution.

The Faroe Islands also informed the Council about a new website being developed on whales and whaling in the Faroe Islands.

The Council noted that Volume 2 in the Scientific Committee Publications Series, *Minke Whales, Harp and Hooded Seals: Major Predators in the North Atlantic Ecosystem*, edited by Gísli A. Vikingsson and Finn Kapel, had been published. The Council noted that Volume 1 in the Series, *Ringed Seals in the North Atlantic* continued to be well received and has been mentioned in a number of peer-reviewed journals. The Secretary drew in particular their attention to a review of the book published in the journal *Arctic.* The review was made available to the meeting as document NAMMCO/10/13-5.

The Faroe Islands informed the Council that the Faroese Government was organising, in collaboration with the Nordic Council of Ministers, a conference on the protection of the sea and sustainable use of marine living resources in the North Atlantic to be held in Tórshavn in June 2001.

The Council **agreed** to instruct the Secretariat to promote the new Scientific Committee volume and the Scientific Committee findings on marine mammal - fisheries interaction to relevant organisations such as NEAFC, NASCO and NAFO. The Council **agreed** that this is a method of indicating to such organisations that this is an important issue in fisheries and management and that NAMMCO is addressing this.

11. ANY OTHER BUSINESS

ECCO - the Eastern Caribbean Cetacean Commission

The observer from ECCO informed the Council that the ministers of the five member countries, St Kitts and Nevis, Dominica, St. Lucia, St. Vincent and the Grenadines and Grenada had signed a statement of intent to develop an agreement focussing on co-operation and management in marine mammal management. The plan is to hold a workshop to formally establish the organisation. He noted that ECCO so far has experienced financial difficulties in running the organisation. Mr Walters further explained that ECCO is sceptical to IWC attempts to manage small whales. The members of ECCO are also members of the IWC and utilise whales. ECCO is recognising the issue of marine mammal – fishery interactions, and is hoping to co-operate with the FAO (Food and Agriculture Organisations) in this regard.

Mr Walters appealed to the NAMMCO member countries to help establishing the organisation. He concluded his statement by inviting NAMMCO to become observers to ECCO.

The Council stated their appreciation for the statement and expressed encouragement at seeing ECCO develop further. Greenland suggested that the Council discuss how NAMMCO could be of assistance to the realisation of ECCO.

Circulation of Documents
The Council requested the Secretariat to circulate all documents to be considered at the Council meeting at the latest 1 month prior to the meeting.

12. CLOSING ARRANGEMENTS

12.1 Next meeting
The next Council meeting, to be hosted by Greenland, would be held in Ilulissat 4 – 8 February 2002. Greenland noted that Council meetings must be held at least three months after the Scientific Committee meetings, in order for Greenland to translate, circulate and receive comments on the Scientific Committee Report from the hunters and the hunting organisations. The next Scientific Committee meeting will be held in October 2001.

In conclusion the Chairman, Amalie Jessen, expressed her thanks to the delegates, the Chairs, and to the rapporteurs for their efforts. In addition she thanked Norway for hosting the meeting. On the occasion that the Administrative Assistant, Tine Richardsen, was leaving NAMMCO the Chairman and the Secretary presented her with gifts and thanked her for her dedicated service to NAMMCO and wished her the best of luck in her new endeavours.

Norway took the opportunity to thank all the participants, in particular the Chairman and the Secretary for their efforts. He reflected on the meeting as having been rewarding and noted that the results from the meeting were useful steps forward.

12.2 Adoption of press release
A press release summarising the main decisions and recommendations of the 2000 Annual Council Meeting as contained in Appendix 7 was adopted.

Appendix 1

LIST OF PARTICIPANTS

DELEGATES

Faroe Islands
Dr Dorete Bloch
Mr Gutti Guttesen
Mr Regin Jespersen
Mr Kaj P. Mortensen (C)
Mr Jústines Olsen
Ms Kate Sanderson
Mr Heðin Weihe

Greenland
Mr Siverth Amondsen
Ms Amalie Jessen (Chair)
Mr Einar Lemche (C)
Mr Kim Mathiasen
Ms Mogens Møller Walsted
Mr Isak Vahl

Iceland
Mr Kolbeinn Árnason
Ms Kristín Haraldsdóttir (C)
Mr Eidur Gudnason
Mr Konráð Eggertsson
Mr Kristján Loftsson
Mr Gísli A. Víkingsson

Norway
Mr Bjørn Hugo Bendiksen
Dr Arne Bjørge
Ms Rannveig Bøthun
Ms Stine Hammer
Mr Arnfinn Karlsen
Mr Elling Lorentsen
Mr Odd Gunnar Skagestad (C)
Mr Tor Are Vaskinn
Dr Lars Walløe
Ms Hild Ynnesdal
Dr Egil Ole Øen

Scientific Committee
Dr Mads Peter Heide-Jørgensen

OBSERVERS

Governments

Canada
Ms Édith Dussault

Denmark
Mr Henrik Fischer

Japan
Dr Dan Goodman
Mr Makoto Ito

Russian Federation
Mr Rudolf Borodin
Mr Mikhail Botvinko
Ms Olga Podkorutova
Mr Alexander Zelentsov

Intergovernmental organisations

Eastern Caribbean Cetacean Commission (ECCO)
Mr Horace Walters

International Whaling Commission (IWC)
Mr Henrik Fischer

Non-governmental organisations

Africa Resources Trust
Dr Jon Hutton

High North Alliance (HNA)
Mr Rune Frøvik
Mr Jan Odin Olavsen
Mr Geir Wulff-Nilsen

International Wildlife Management Consortium (IWMC)
Mr Jaques Berney

Researcher
Mr Steinar Andresen

Sustainable Use Parliamentarian Union (SUPU)
Mr Steinar Bastesen

Invited speaker
Dr Ray Gambell

SECRETARIAT

Dr Grete Hovelsrud-Broda
Mr Daniel Pike
Ms Tine Richardsen
Ms Charlotte Winsnes

C = Councillor

Appendix 2

AGENDA

1. Opening procedures
    - 1.1 Welcome address: Ambassador Odd Gunnar Skagestad
    - 1.2 Invited presentation: Dr Ray Gambell
    - 1.3 Opening statements
    - 1.4 Admission of observers
    - 1.5 Adoption of agenda
    - 1.6 Meeting arrangements
2. Finance and Administration
    - 2.1 Report from the Secretariat
    - 2.2 Report of the Finance and Administration Committee
    - 2.3 Commission Budget 2001 & Forecast Budget 2002
    - 2.4 Rules of Procedure
    - 2.5 Other business
3. Scientific Committee
    - 3.1 Report of the Scientific Committee
    - 3.2 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. The NAMMCO Fund
    - 6.1 Report of the NAMMCO Fund
    - 6.2 Other business
7. Environmental questions
8. Trade and marketing information
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 3

LIST OF DOCUMENTS

NAMMCO/10/1	List of Participants
NAMMCO/10/2	Agenda
NAMMCO/10/3	List of Documents
NAMMCO/10/4	Report of the Finance and Administration Committee
NAMMCO/10/4 – Annex 1	Draft Budget 2001 and Forecast Budget 2002
NAMMCO/10/4 – Annex 2	Draft Rules of Procedure for the Council
NAMMCO/10/5	Report of the Scientific Committee, 16-19 May 2000
NAMMCO/10/6	Rules of Procedures for the Scientific Committee
NAMMCO/10/7	Proposal for a Science Fund
NAMMCO/10/8	Report of the Management Committee , 27 September 2000
NAMMCO/10/9	Environmental Questions
NAMMCO/10/10	Trade and Marketing paper
NAMMCO/10/11	Report of the NAMMCO Fund
NAMMCO/10/12	Report of the Committee on Hunting Methods
NAMMCO/10/13	Information
NAMMCO/10/14	Proposal for a Conference
NAMMCO/10/15	Pamphlet for the NAMMCO Scientific Publications
NAMMCO/10/16	New NAMMCO Brochure

Appendix 4

ADDRESS AND OPENING STATEMENTS TO THE COUNCIL BY MEMBER DELEGATIONS AND OBSERVER GOVERNMENTS

NORWAY - ADDRESS OF WELCOME

Ambassador Odd Gunnar Skagestad, Norwegian Ministry of Foreign Affairs

Madam Chairman, Delegates, Observers and Guests, Dear Friends.

On behalf of the Norwegian Government, I have the honour and pleasure to welcome you to Norway to this tenth meeting of the Council of NAMMCO. I believe it is no accident, but rather most appropriate that we meet here in Sandefjord, a city noted above all for its strong traditions in the history of the whaling industry. And on a personal note, I find it particularly pleasant to be back in the NAMMCO business after a long period of absence, stretching almost back to the 9 April 1992, when at the Nuuk meeting some of us, including certain individuals who are present here today, spent the whole night negotiating the final text of the NAMMCO Agreement.

Norway continues to attach great importance to the work of NAMMCO and the cooperation between the North Atlantic countries. In a narrow, but nevertheless important, sense, our aim is to defend the culture and interests of the coastal people in our part of the world. In the broader sense, NAMMCO also forms part – on the regional level - of the comprehensive regime structure of international cooperation on environment conservation and resource management that started with the 1946 International Convention for the Regulation of Whaling. Since the 1970’s, this regime structure has grown to include such basic and broad-scale agreements as the 1973 CITES agreement, the 1982 UN Law of the Sea Convention, the Agenda 21 of the 1992 UNCED Conference and the 1992 Convention on Biological Diversity – all of which firmly established and entrenched the twin principles of conservation and sustainable use of nature’s resources. These two objectives are actually two aspects of the same issue: Without sustainable use, conservation for its own sake makes little sense.

Although these principles are otherwise universally accepted, powerful forces have long claimed an arbitrary exception with regard to marine mammals, and whales in particular. NAMMCO cannot aspire to a global role on this issue, but it certainly can – and should – be a voice of sanity and reason and uphold, in the regional context, the main principles which are embodied in the broad international agreements and instruments which I just mentioned.

It has been noted – time and again – that NAMMCO is a *young* organization. Indeed, it still is, but during its eight years of existence NAMMCO has matured into a well-established and highly respected creature, well on its way to developing into a serious management organization. Notably, and as was pointed out in our Opening Statement to last year’s Council meeting, NAMMCO has embarked upon work that other management organizations are incapable of because of lack of political will to stick to the principle of sustainable harvesting of the natural resources of the sea.

The foundation for the success of NAMMCO is the work of its Scientific Committee. We congratulate the Scientific Committee on the consistently high standards of its work, and look forward to see the results of its current and future tasks, as assigned by the Council. At the same time, we would also like to encourage a stronger international participation and involvement with the Scientific Committee by persons from other than the member countries, so as to broaden the base of its work and further enhance its quality and reputation.

The question of a Host Agreement between Norway and NAMMCO has been discussed for a long time. I am pleased to be able to announce that this matter has now been finalised and that the Agreement is ready to be signed at the present meeting. If all goes as planned, this task will be performed by our Minister of Fisheries, Mr. Otto Gregussen, who will be with us at this evening's reception.

I am furthermore truly pleased to note that this year's Council meeting will include a presentation by a most distinguished guest, Dr. Ray Gambell OBE. Dr. Gambell has recently left the International Whaling Commission (IWC) after 24 years' tenure as the IWC's Secretary, - an assignment which he performed with the highest standards of professionalism, impartiality and integrity. Ray, I wish you a very warm welcome to Norway!

We would also like to welcome the observers to the NAMMCO meeting. We appreciate the support you give us. We believe that it is in our mutual interest to further the development of NAMMCO's cooperation with interested states and relevant organizations – whether they are IGO's, NGO's or scientific bodies.

Madam Chairman, distinguished Participants: We hope you will enjoy your stay in Norway, and that the surroundings here in Sandefjord will be optimally conducive to the constructive handling of the serious and important work that lies ahead of us. We look forward to fruitful discussions and decisions in the Council, hopefully continuing to build NAMMCO as an organization that, true to the principle of sustainable use, takes care of the needs of the coastal communities of the North Atlantic.

THE FAROE ISLANDS - OPENING STATEMENT

Madam Chair, delegates, observers, distinguished guests, ladies and gentlemen

The Faroe Islands are very pleased to be attending this tenth meeting of the Council of NAMMCO. It is a great pleasure to be here in Sandefjord at the 10^{th} Annual Meeting of NAMMCO. My delegation would like to thank our Norwegian colleagues for hosting this meeting. It is always a pleasure to be here in Norway and many links have been made between the people of Faroe Islands and the people of Norway.

In particular we are pleased that the Host Agreement between NAMMCO and Norway has now been finalised and that we will witness its signing here this week in the historic whaling town of Sandefjord. This is an excellent way to mark the tenth meeting of the Council, and we would like to express our appreciation to the Government of Norway for their cooperation in negotiating the Agreement, which has both political and practical significance for the status of the Commission as an intergovernmental body..

Being an anniversary of sorts for NAMMCO, we would like to recall the comments we made in our opening statement last year in Akureyri. There we proposed that it was time for some serious stocktaking, not only of the specific activities generated so far in our scientific and management cooperation, but also in terms of the overall objectives and priorities of the organisation. The Faroese delegation would very much like to see some general discussion among delegations here in Sandefjord, whether formally or informally, on the future role of the Commission in relation to the future plans and objectives of individual member countries.

Our concern is to keep the organisation on track as a body for cooperation on management, conservation and research on marine mammals. To do this, we must ensure that the advice we request from the scientists is based on realistic priorities and concerns in terms of conservation and management. We must also be willing to act on the advice we receive, knowing as we do that there will always be degrees of uncertainty involved.

To keep our cooperation through NAMMCO dynamic and meaningful, it is important to stress, both for ourselves and for others, that management and conservation of marine mammals also means taking account of a wide range of other factors – from the review and improvement of hunting methods, to international transparency in national regulations for hunting activities, to a more effective incorporation of economic, social and cultural factors into our resource management decisions. Not all forms of marine mammal hunting require complicated quota calculations – our own pilot whale hunt is a good example of this. We hope that our cooperation through NAMMCO will continue to recognise that it is possible to reach agreement on management measures which are appropriate for the type of utilisation in question.

We welcome therefore a discussion of trade-related issues as a basis for enhancing our mutual understanding of the economic and cultural contexts in our respective whaling and sealing communities.

We also welcome the Secretariat's overview of international organisations working to address contaminants in marine mammals and the marine environment. We recall the NAMMCO Conference in Shetland in 1995 which focussed on these issues, and we see a role for NAMMCO in drawing greater international attention to the need to focus on the management of pollution – rather than the utilisation of marine mammals - when it comes to contaminants in the marine environment. This work should be carried out in the appropriate international fora, and the focus needs to be strengthened on the global responsibility for securing the nutritional and economic value of the food we get from the top of the marine food chain here in the North Atlantic.

These and other issues on our agenda promise to make this tenth meeting of the Council an important one for shaping the future direction of our cooperation, and we look forward to making our contribution to this process.

GREENLAND - OPENING STATEMENT

Mrs Chairman, Ambassador, delegates and observers

The Greenlandic delegation is very pleased to participate in this 10th meeting of the Council here in Sandefjord.

Greenland would like to extend our appreciation of the meeting facilities and the hospitality we are enjoying.

During the past few years the Scientific Committee has provided advice for all stocks where delegations have requested such advice - including advice which is definitely not to the users' liking. Maybe we now need a break for implementation back home of all this advice. During the break we should discuss our mechanisms for requesting and delivering advice, while keeping the focus on what we want to be NAMMCO's role. At the same time we should embark upon the other important issues before us.

Greenland supports the further development of the dialogue between scientists and users in the common quest for bridging their knowledge of the marine mammal species and habitats. The outcome of this valuable cooperation constitutes a prerequisite for politicians to pass the legislation necessary and for managers to implement the needed measures to make full use of these natural resources on a sustainable basis. In order to assist this endeavour Greenland supports the idea of having a conference on this issue.

Greenland looks forward to the member countries' approval of a new set of Council Rules of Procedures guiding Council activities. Although other NAMMCO bodies may have their own specific Rules of Procedures it is important that these procedures are not contrary to the Council Procedures.

Greenland supports the Committee on Hunting Methods' idea of arranging a workshop on Ballistics with the participation of hunters, managers and other directly involved persons.

Finally, Greenland welcomes the signing of the Host Agreement between the Government of Norway and NAMMCO. This has been a unique experience for Norway as well as NAMMCO.

ICELAND - OPENING STATEMENT

Mr. Chairman, delegates, observers, ladies and gentlemen.

It is with great pleasure that the Icelandic delegation attends the 10th meeting of the Council. We would like to take the opportunity to thank the Norwegian Government for inviting us here to Sandefjord, which is certainly an appropriate meeting place.

We are confident that, as past meetings, this meeting will be fruitful and constructive, furthering and strengthening the important co-operation for the conservation, rational utilisation and study of marine mammals in the North Atlantic.

An important step will be taken at this meeting when a Host Agreement between NAMMCO and Norway will be signed. Iceland is particularly pleased that a satisfactory agreement has been reached. It will confirm NAMMCO's status as an international organisation in Norway.

The importance of NAMMCO lies not least in the fact that it is a regional umbrella organisation that covers all the different marine mammal populations in the North Atlantic. It builds upon co-operation between countries with shared values and common concerns for conservation and rational management of marine mammals as other living resources of the sea, regarding the ecosystem as a whole.

In the past years NAMMCO has made valuable contributions to the conservation and rational management of marine mammals, not least through the work of the Scientific Committee.

Iceland stresses the need for continuos monitoring of the status of North Atlantic marine mammal stocks. The role of NAMMCO in co-ordinating joint sighting surveys and analysing the results is very important is this respect.

An important work is carried out by NAMMCO on the role of marine mammals in the ecosystem, including a study on the economic aspects of marine mammal-fisheries interactions. For future work further scientific research is needed. This includes both collection of basic data on the consumption and food selection by marine mammals and economic information. Iceland stresses the importance of this work. As a matter of fact all initiatives that further the understanding of the role of marine mammals in the ecosystem are of great value.

SCIENCE, MANAGEMENT AND POLITICS

Ray Gambell
Former Secretary, International Whaling Commission

Introduction

Whaling is for many people around the world a symbol of our use and management of all the world's natural renewable resources. Because of past over-exploitation, concerns about the hunting and killing methods employed, and whether animals with such large brains should even be regarded as a source of food and other products, there have been considerable pressures to bring an end to all whaling, or at least the commercial variety. But these attitudes are largely culturally-based so that here in Sandefjord, and more widely in Norway and the other Arctic nations, there is a greater appreciation of the important contribution that whales and whaling have made to the lives of the communities involved in the past and a hope that this might continue or be resumed.

I was especially struck by part of the report by one of the Non-Governmental Organisation observers who attended the most recent Annual Meeting of the IWC held in Adelaide, Australia. This was her first experience of the IWC in action and she wrote:
"It was shocking to me to personally watch (sic) as international governmental representatives actually worked on detailed legal language that will be used to manage commercial whaling when, not if, it resumes. I was surprised to learn that the moratorium was established with the purpose of stopping whaling until such time as there is an accepted management scheme in place to conduct commercial whaling. A number of NGOs hoped or believed the moratorium would spell the end of commercial whaling." (Heather Rockwell, CSI Observer, W*hales Alive* IX.3).

Now this is undoubtedly a widely held view, not just by NGOs but by some government as well. Yet the preamble to the International Convention for the Regulation of Whaling signed in 1946, and which established the IWC, clearly states that the Contracting Governments:
"recognising the interest of the nations of the world in safeguarding for future generations the great natural resource represented by the whale stocks"
decide to
"provide for the proper conservation of whale stocks and thus make possible the orderly development of the whaling industry."

The moratorium

So how did the IWC get into this position, where some members, as well as people outside the organisation, believe that commercial whaling should no longer be permitted?

There is no doubt that the whale stocks have been successively depleted for centuries, and this process was scarcely halted by the various intergovernmental Agreements developed during the 1930s. The 1946 Convention tried to build on these earlier texts, but the lack of adequate scientific knowledge and advice meant that the demands of the industry for the largest catches possible could not be resisted with any great justification.

However the obviously declining catches particularly in the Antarctic, the major whaling ground, led to a call at the United Nations Conference on the Human Environment held in Stockholm in 1972 for a ten-year moratorium on commercial whaling, a strengthening of the IWC, and an increase in research. As a result, the IWC established a permanent Secretariat, and attempted to promote increased research on whales. But because the IWC Scientific Committee had just persuaded the Commission to accept the principle of management of individual stocks rather than by combinations in the old Blue Whale Unit system, the idea of a blanket moratorium was resisted. Instead, a New Management Procedure was introduced using the concept of Maximum Sustainable Yield as the target for all stocks. The NMP attempted to use the available scientific knowledge on whale biology and numbers to calculate sustainable catch limits, and also gave total protection to the most depleted stocks.

It soon became clear that the NMP was flawed as a procedure for determining unequivocally safe catch limits. Never-the-less, increasingly restrictive catch limits were introduced, and during the late 1970s there were successive attempts to establish an end to all commercial whaling. These included a ban on the use of factory ships and an end to sperm whaling. But the three-quarters majority necessary to amend the Schedule to the Convention to pass the moratorium could not be reached. However, the Seychelles led the IWC in 1979 to declare the Indian Ocean a whale sanctuary. Closing off parts of the world's oceans to commercial whaling was seen as an effective method of both limiting the scale of whaling and preventing any large-scale resumption, so the Southern Ocean was also declared a sanctuary in 1984.

The moratorium itself, as the setting of zero catch limits for commercial whaling on all stocks is popularly known, was finally adopted at the 1982 Annual Meeting of the IWC. By 25 votes in favour, to 7 against, and with 5 abstentions, commercial whaling was to end with effect from the 1985/86 pelagic and the 1986 coastal seasons. This three-quarters majority had been hard to achieve, but there had been a concerted effort by groups opposed to whaling to encourage governments to join the IWC with this policy. It is interesting to see the way in which many new or re-joined members came into the Commission, and how they voted. From 1976 to 1982, 24 governments adhered to the Convention and so became member of the IWC. Of these, 18 voted for the introduction of zero catch limits, 2 were opposed and 4 abstained.
Coupled with the ban on whaling, the Commission agreed
"that the provision would be kept under review and by 1990 at the latest the Commission will undertake a comprehensive assessment of the effects of this decision on whale stocks and consider modification of this provision and the establishment of other catch limits."

It was not entirely clear what these phrases meant, but the Scientific Committee set about carrying out detailed assessments of the most important whale stocks, and also developed five separate management procedures which required the minimum of data input. These procedures were rigorously tested through computer simulations, and one was selected as the Revised Management Procedure (RMP) to replace the discredited NMP.

Current whaling

Through the provisions of the Convention and legal objections there are at present three kinds of whaling being conducted in the world in association with the IWC (but not all under its control).

Norway is whaling within its coastal waters under objections it legally lodged to the classification of the minke whale stock as Protected under the NMP, and to the zero catch limits.

Japan is conducting legal research whaling in the Antarctic and the North Pacific under a specific provision of the Convention.

The IWC actually regulates only aboriginal subsistence whaling.

The chief interest at this time is whether or not the IWC will move forward to keep its commitment to consider setting other catch limits than zero. The Scientific Committee has provided a robust and conservative management procedure in the RMP, which the Commission has accepted as the means for calculating catch limits for baleen whales. But the Commission has been slow to adopt the other aspects of regulation, monitoring and control which it believes are necessary to have in place before any resumption of commercial whaling can be considered. These constitute the so-called Revised Management Scheme (RMS) which has been debated and revised over a number of years with little progress in developing an agreed formulation. However, at the last IWC Annual Meeting in Adelaide, there did seem to be some real signs of progress, with texts circulated and the prospect of further negotiations.

It has been suggested that those governments (including Australia, New Zealand, UK and USA) that are opposed to any resumption of commercial whaling were putting a series of obstacles in the way of achieving any progress in these discussions. Certainly this tactic produced delay in moving forward, and thereby satisfied such an aim. One possible cause for a change in attitude now amongst the more moderate governments is the realisation that the major whaling activities being conducted by IWC member nations are actually outside IWC control.

A way forward

There are now at last signs of progress in the IWC of developing the texts for Schedule amendments that will lay the legal framework for establishing inspection and observation schemes which are deemed by the members to be the necessary pre-cursors for a resumption of commercial whaling under IWC control. There will continue to be opposition from those governments that are committed to opposing such a move. The augments which will be advanced will include the fact that whale watching is a significant economic industry in areas where whales come close inshore and near tourist centres. However, Norway has both whaling and whale watching industries co-existing, so the one activity does not necessarily exclude the other. In addition, it can be noted that the USA has promoted the resumption of aboriginal whaling by the Makah Indian tribe on the gray whales which are such an important whale watching feature of the North American Pacific coast.

There appear to be three possible outcomes from the current impasse within the IWC.
- Decide on a permanent end to all commercial whaling.
- Allow carefully regulated and monitored commercial whaling under IWC control.
- Limit any future commercial whaling to that already in existence.

The first would not be strictly in conformity with the 1946 Convention, while the second could permit a wider activity than some governments would favour. Ireland has attempted to broker a compromise along the lines of the third option by putting forward a package of measures. This would declare all the world's oceans as a sanctuary for whale, but allow continuation of the operations currently being conducted in coastal waters, and with a ban on international trade in whale products. There are elements here both acceptable and contrary to the wishes of all parties.

Noting the way in which the votes necessary to adopt the moratorium on commercial whaling in 1982 were recruited, with NGOs providing briefing materials, advisors and even Commissioners in some cases, it might be worth reflecting on the comment by the Commissioner for New Zealand at a recent IWC meeting:
"There is only one procedure available to those who disagree with a Schedule amendment and that is to move a further Schedule amendment and seek the required three-quarters majority effectively to overturn the earlier decision." (Verbatim Record, 50th Annual Meeting, 1998).

It is clear that unless the IWC does take action soon to bring current whaling under its authority, it will lose all credibility as the internationally recognised global forum for the conservation of the whale stocks and the regulation of whaling industry. This is its mandate, which applies to all waters where its members conduct whaling. Adoption of appropriate Schedule amendments will help to negate all the differences of interpretation and opinion over the legality of previous decisions by the Commission.
In the end, the whale will continue to be the symbol of our ability to manage the natural world, whether wisely or well. I hope it is the latter.

Appendix 5

AUDITED ACCOUNTS FOR 1999

1. PROFIT AND LOSS ACCOUNT (NOK)

	1999	***1998***
Income		
Contributions	2,830,000	*2,730,000*
Interest received (netto)	69,000	*84,000*
Total Income	2,899,000	*2,914,000*
Expenditure		
Secretariat costs	2,745,000	*2,653,000*
Meetings	110,000	*54,000*
Scientific Committee	399,000	*38,000*
Projects, NAMMCO Fund	50,000	*0*
Conference Sealing the Future	-	*-26,500*
Total operating expenses	3,304,000	*2,718,500*
Operating result	**405,000**	***195,500***

2. BALANCE SHEET 31 DECEMBER 1999

Current assets		
Bank deposits (restricted 114,084)	951,786	*1,557,805*
Outstanding claims	0	*11,600*
Total assets	951,786	*1,569,405*
Current liabilities		
Employees tax deduction & tax	79,986	*33,806*
Creditors	137,255	*11,210*
Other	23,229	*409,200*
Total current liabilities	240,470	*454,216*
Restricted equity		
Relocation fund	200,000	*200,000*
NAMMCO Fund	254,663	*104,663*
Total restricted equity	454,663	*304,663*
Distributable equity (General reserve)	256,653	*610,526*
Total equity	711,316	*1,115,189*
Total liabilities and equity	951,786	*1,569,405*

Appendix 6

RULES OF PROCEDURE FOR THE COUNCIL

I Representation

1. Each Contracting Party shall appoint a Councillor as its main representative.

II Decisions

2. The Chairman may decide that unanimity is reached if he deems so. If no objection is made, the decision is thereby taken. A Contracting Party may call for a vote. Votes shall then be taken by show of hands or by roll call in the English alphabetical order. When a Contracting Party so requests the vote shall be conducted by secret ballot.

3. Each Contracting Party shall have one vote.

4. Decisions of the Council shall be taken by the unanimous vote of those Contracting Parties present.

5. Between meetings, decisions may be taken by correspondence.

III Chairman and Vice-Chairman

6. The Council shall elect from among its members a Chairman and a Vice-Chairman, each of whom shall serve for a term of two years and shall be eligible for re-election provided that they do not serve for more than four years in succession in each office. The Chairman and Vice Chairman shall not represent the same Contracting Party.

7. The Chairman and Vice-Chairman shall take office at the conclusion of the annual meeting at which they are elected.

8. The powers and duties of the Chairman shall be:
   a) to declare the opening and closing of each meeting;
   b) to preside at meetings;
   c) to call for and announce the decisions and the results of votes;
   d) to determine a schedule of meetings for annual or special meetings of the Council;
   e) to call for extraordinary meetings of the Scientific Committee after consultation with the Council;
   f) to arrange for the appointment of the members of subsidiary bodies as required;
   g) to approve a draft report of the proceedings of each meeting prior to its transmission to Contracting Parties for final adoption;
   h) generally, to make such decisions and give such directions to the General Secretary as will ensure, especially in the interval between meetings, that the business of the Organisation is carried out efficiently and in accordance with

its decisions.

9. Any Contracting Party may request that a ruling by the Chairman is put to a vote. The Chairman's ruling stands unless a majority of the Parties present and voting cast a negative vote.

10. Whenever the Chairman is unable to act, the Vice-Chairman shall exercise the powers and duties prescribed for the Chairman.

11. If the office of the Chairman is vacated, the Vice-Chairman shall become Chairman for the balance of the term.

12. The Chairman, or Vice-Chairman when acting as Chairman, shall not act as head of delegation and another member of his or her delegation shall exercise this function.

IV Preparation for meetings

13. Each Contracting Party shall notify the Secretary as far as possible in advance of any meeting of the names of its representatives, alternates, experts and advisers who will attend.

14. A provisional agenda for each annual or special meeting of the Council shall be prepared by the Secretary, in consultation with Chairman, and be dispatched by the Secretary to all Contracting Parties, their representatives, and invited observers, not less than 60 days before the date fixed for the opening of the meeting.

15. Any member of the Council may propose supplementary items by informing the Secretary thereof no later than 30 days before the meeting.

16. The Secretary shall prepare the draft agenda for the meeting, including the supplementary items, and transmit it to all Contracting Parties, their representatives, and invited observers, no later than 15 days before the meeting along with explanatory memoranda.

17. The Secretary shall make all necessary arrangements for meetings of the Council.

18. No order of business shall be the subject of a decision unless the subject matter has been included in the draft agenda.

19. The Council shall adopt the final agenda of the meeting at the opening session of its meeting.

V Observers

20. The Council may, in accordance with Article 8, invite non-contracting governments and inter-governmental and inter-parliamentary organisations, global and regional, to participate as observers to meetings of the Council.

21. Non Governmental Organisations may apply for observer status at the meetings of the Council.

a) Applications for observer status from NGO's shall be sent to the Secretariat no later than 90 days before the next Council meeting. Applicants for observer status shall provide information on the role, functions and operations of their organisation and other information necessary for the Council to assess the application. The decision will be made no later than 30 days prior to the meeting.

The Council will decide on such status in accordance with article 8 of the Agreement[1] and the following procedures:

b) Once an NGO is admitted as observer to the Council, their status shall continue for such time as no objection from any Contracting Party is raised on the matter.

c) Any Contracting Party may request information referred to under a) at any time from an observer.

22. Observers may make statements and submit relevant documents to the meetings at the discretion of the Chairman.

23. The Council can decide to establish fees for the attendance of observers at its meetings.

VI Management Committees

24. The Council shall establish appropriate Management Committees and co-ordinate their activities.

25. The Council shall establish guidelines and objectives and approve the Rules of Procedure for the work of the Management Committees.

VII Other committees and subsidiary bodies

26. The Council may decide to establish other committees and subsidiary bodies to deal with specific areas of its work.

27. Committees and subsidiary bodies may determine their own Rules of Procedure, which shall be approved by the Council.

28. In the absence of specific Rules of Procedure approved by the Council for its committees and subsidiary bodies, the rules set out in sections I – IV, X and XI of the Rules of Procedure for the Council shall apply, *mutatis mutandis*, as appropriate.

[1] Article 8 of the NAMMCO Agreement: "The Council may agree to admit observers to meetings of the Commission when such admission is consistent with the objective set out in Article 2."

29. Attendance of observers shall only be permitted at meetings of committees and subsidiary bodies of the Council when decided by the committee/subsidiary body and approved by the Council, in conformity with Article 5.

VIII Commission finances

30. The Council shall approve audited accounts and endorse the Commission budget for the following year at its annual meeting, and approve a forecast budget for the subsequent year.

31. The financial affairs of the Commission shall be audited annually by external auditors appointed by the Council.

IX Secretariat

32. The Secretary shall:

a) have full power and authority over the Secretariat subject to the general supervision of the Council;

b) make all arrangements necessary for meetings of the Council, Scientific Committee and Management Committees and their respective subsidiary bodies;

c) prepare and transmit provisional and draft agendas in accordance with Rules set out in Section IV;

d) receive the credentials of observers according to § 21 and report thereon to the Council as required;

e) perform such other functions as are set out in these Rules and as may otherwise be determined by the Council.

X Language

33. English shall be the official and working language of the Council and its committees and subsidiary bodies. Any other language may be used, on condition that those doing so provide interpreters if necessary. All official reports, publications and communications of the Council and its committees and subsidiary bodies shall be in English.

XI Reports and Documents

34. A report of the meeting of the Council shall be distributed as soon as possible to the Contracting Parties by the Secretary after finalisation in accordance with procedures outlined in § 8 g). Reports of the Council shall clearly reflect all decisions taken by the Council and all discussions of substance on issues dealt with by the Council at its meeting.

35. Reports of meetings of all committees and subsidiary bodies shall be provided to Contracting Parties by the Secretary as soon as possible after their final adoption by the committee/subsidiary body. Reports will not be released to the public until they have been dealt with by the Council.

36. The Commission shall publish annually, following the annual meeting of the Council, a report of the Commission's activities. This report shall *inter alia* include reports of the meeting of the Council, Management Committees, Scientific Committee, and of other committees and subsidiary bodies, as well as National Progress Reports submitted by Contracting Parties.

Appendix 7

FINAL PRESS RELEASE

The North Atlantic Marine Mammal Commission (NAMMCO) held its Annual Meeting in Sandefjord, Norway from 25-28 September 2000. The meeting was attended by delegations from the member countries, Norway, Iceland, Greenland and the Faroe Islands, 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. The meeting began with an opening presentation by Dr Ray Gambell, OBE, recently retired Secretary of the International Whaling Commission, on the science, politics and management of whaling in the 20th century and beyond.

NAMMCO Signs Host Agreement with the Government of Norway
The Host Agreement between NAMMCO and the Government of Norway was signed on 26 September 2000, in Sandefjord, Norway, in connection with NAMMCO Annual Meeting. The Host Agreement was signed by the Minister of Fisheries Otto Gregussen, and Amalie Jessen, Chairman of the NAMMCO Council. The Host Agreement regulates the types of status, privileges, and immunity that NAMMCO officials, representatives and the Secretariat will have in relation to Norwegian authorities, and represents a permanent regulation of the relationship between Norway and the Commission. The Agreement will ensure that NAMMCO's officials and representatives have an independent status with regard to Norwegian authorities. This Host Agreement is the first of its kind that has been formalised between the Norwegian Government and an international organisation located in Norway, and is based on similar agreements in other countries.

West Greenland Beluga
The Scientific Committee completed its assessment of the status of the beluga off West Greenland, and reported to the Council that the stock was severely depleted. The Council expressed its deep concern over the depleted status of the beluga off West Greenland, noting the finding of the Scientific Committee that severe reductions in catch are required to halt the decline of this stock. It was accepted that the Canada/Greenland Joint Commission on Conservation and Management of Narwhal and Beluga (JCNB) had competence to provide management advice for this stock, which is shared by Canada and Greenland. It was therefore recommended that closer links be developed with the JCNB for this and other issues of mutual concern.

The Scientific Committee will continue its assessment by addressing short-term research questions related to the impact of ice entrapments on natural mortality, refinement of past aerial survey estimates and stock structure. The Scientific Committee will also establish a mechanism for the collection of anecdotal data on beluga distribution and abundance in Baffin Bay and Davis Strait, from surveys conducted for other reasons and from local knowledge.

Economic Aspects of Marine Mammal - Fisheries Interactions

The Council stressed the importance of continued work on the economic aspects of marine mammal - fisheries interactions. The Scientific Committee advised the Council that the next logical step in the investigation of the economic aspects of marine mammal - fisheries interactions would be to develop multi-species economic models for candidate species and areas. The most suitable candidates were identified as the Barents/Norwegian Seas and the area around Iceland. The Council recommended that the Scientific Committee proceed with this activity and provide updated information for the next meeting.

The Council also noted that important research on the ecological role of marine mammals is being carried out in other areas such as in the Western North Pacific by Japan, and expressed its support for this activity.

West Greenland Narwhal

The Scientific Committee provided research recommendations for West Greenland narwhal to answer questions about catch statistics, stock identity and abundance. The Council requested that the Scientific Committee evaluate the migration patterns of narwhal in Baffin Bay and Davis Strait.

Fin Whales and Dolphins

The Scientific Committee was not able to complete full assessments of Faroese fin whales and white-beaked, white-sided and bottlenose dolphins because of a lack of information on stock identity, distribution, abundance and biological parameters. The Council requested that the Scientific Committee monitors developments for these species and completes the assessments when new information becomes available.

Collection of Data on Marine Mammal By-catch

Based on the conclusions of the Working Group on By-catch, the Management Committee endorsed and encouraged the efforts of member countries to establish mandatory logbook data collection systems as an initial step to identify areas and fisheries where further effort should be focused. It was decided to initiate a system of by-catch reporting from member countries to NAMMCO through the annual National Progress Reports, starting with data on numbers and species of marine mammal by-catch in fisheries.

North Atlantic Sightings Surveys 2001

Joint cetacean sightings surveys will be carried out again in 2001, co-ordinated through the Scientific Committee of NAMMCO, with fin whales and minke whales as priority species.

International Observation of Whaling and Sealing

Observations under NAMMCO International Observation Scheme were conducted on sealing and whaling activities in Norway and of pilot whaling in the Faroes. The observations were carried out by international observers appointed by NAMMCO. No infringements or violations were reported.

Hunting Methods

The Council accepted the recommendation of the Committee on Hunting Methods to convene a workshop on weapons and ammunition to involve hunters, munitions experts, government officials. The goal of the Workshop will be to increase the understanding of weapon types, ammunition and ballistics and to develop a set of requirements pertaining to weapons and ammunition types with regard to the different species.

Conference on Users Knowledge and Scientific Knowledge in Management Decision Making

The Council decided to develop plans for a conference in 2002 to address how users' knowledge can be combined with scientific knowledge to provide a better information base for management decisions. The conference will include resource users, scientists and resource managers. The Council appointed an advisory group to plan the conference, to take place in 2002.

Cooperation on Marine Mammals in the Eastern Caribbean

The Council welcomed the information of the imminent establishment of the Eastern Caribbean Cetacean Commission (ECCO) and expressed its willingness to assist the organisation in its development.

1.2
REPORT OF THE COMMITTEE ON HUNTING METHODS

Copenhagen, Denmark, 29 August 2000

The Committee met at the Home Office of the Faroe Islands in Copenhagen on 29August 2000. Attending the meeting were Jústines Olsen, Chairman, (Faroe Islands), Mogens Møller Walsted (Greenland), Kristjan Loftsson (Iceland), Egil Ole Øen, and Kirsti Larsen, (Norway), Grete Hovelsrud-Broda, Tine Richardsen and Charlotte Winsnes from the Secretariat.

1 & 2 OPENING PROCEDURES

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.

Two additional documents were presented:
- Report of the Committee's meeting on 6 September 1999
- Recommendations from the NAMMCO Workshop on Hunting Methods held February 9 – 11, 1999

3. UPDATE ON HUNTING METHODS IN MEMBER COUNTRIES

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

Faroe Islands

Olsen (Faroe Islands) reported that there had been one new regulation in 2000 dealing with whaling. One new area where whaling can take place has been added. The seabed in the bay has been cleared in order to make it suitable for a drive hunt. The whale bay has been preliminary approved.

Øen (Norway) inquired about recent experiences with the new knife. Olsen explained that it is being developed as a new killing technique, intended to severe the blood supply to the brain and the spinal chord in one single incision and it seems to be very efficient, but it requires precision. The users must therefore be trained before using it. The plan is to give a demonstration to the hunters and then to develop an instruction manual. Because this knife requires a high level of precision it is important to proceed slowly in order to avoid faulty use.

Greenland

Large Cetaceans

Møller Walsted (Greenland) informed the Committee that the Greenland Home Rule Government has implemented a new legislation on hunting. However, the new hunting legislation passed in 1999 will not have a different impact on marine mammals compared to the legislation of 1997 it replaces. The Greenlandic Government has in principle decided that the rifle hunt of large whales will be further reduced in the future. In the long-term, guidelines are being developed that will provide compensation for the hunters who change from rifle to harpoon. The KNAPK (the hunting and fishers association) does not consider this a positive development. One concern is that hunters from small villages do not have alternative hunting methods. The government is planning a mini seminar with the hunters, where hunting techniques and equipment will be discussed.

Small Cetaceans

There are currently no changes in the regulations for small cetaceans. Efforts are being made to reduce the catches of beluga. In the short-term, beluga hunting will be limited to hunters with “erhvervsjagtbevis”. While in the long-term restrictions will be enforced on this category as well. This will be discussed in the recently formed Hunting Council (Fangstrådet). This Council gives advice to the Greenlandic Government and consists of members from KNAPK, KANUKOKA (National Association of Municipalities), TPAK (sports hunters and fisher association) a representative from the Department of Industry and one from the Department of Health and Environment of the Home Rule Government. Apart from these permanent members to the Hunting Council, a number of representatives from other involved authorities and interested parties participate in the meetings. This latter group is not entitled to vote. The Hunting Council functions in relation to a wide range of issues pertaining to large mammals. The terms of reference for the Council would be circulated to the Committee members.

Møller Walsted further explained that there had been an increase in pilot whale sightings and that hunting regulations pertaining to these whales are being considered.

Iceland

Iceland had nothing to report since whaling is presently not taking place in this country.

Norway

Whaling

The minke whale hunt in Norway has been extended to the end of August, and the analysis of the results has not yet started. So far 487 whales had been taken.

This year all whaling vessels have been equipped with the new penthrite grenade, “Hvalgranat-99” and there have been no reports of any equipment malfunctioning. Last year (1999) five vessels were equipped with a prototype of this grenade. There was a positive marked difference between boats using the prototype of the new grenade and those using the “old” type as the new penthrite grenade showed an efficiency of instantaneous kills of 72% while the “old” only reached 58%. Preliminary analysis from the 2000 hunting season shows that the rate of instantaneous killed animals might be even higher this season. A few boats have reported more than 90% instantaneous kills using the new grenade and it therefore seems evident that further improvements in killing efficiency will depend on the hunters’ competence and the quality of the rest of the hunting equipment used.

Øen (Norway) reported on an accident where a 50-mm Kongsberg harpoon cannon had fired accidentally during the process of loading. This incident was the second accidental firing with this type of harpoon guns over the last years. The canon will be carefully examined by weapons experts and when the expert report is completed, a meeting will be held between the weapons experts, the hunters' organisations and the producers of the canons to discuss how to prevent such accidents in the future. Recognising that it must be the hunters who have the full responsibility for the functioning of their equipment, it is important to also recognise that the Kongsberg canon has a complicated construction and most are very old. Some regulations should therefore be formalised with respect to the handling of the weapons.

Sealing

Meat has always played a secondary role with respect to the seal hunt in Norway. New efforts aim to alter this with developing methods of processing seal on board. And work to develop new regulations pertaining to the processing of meat and the hygiene on board has started.

4. RECOMMENDATIONS

The Chairman asked the member countries to present the status of each country's follow-up to the recommendations resulting from the NAMMCO Workshop on Hunting Methods (Nuuk, 9 –11 February 1999) and adopted by the Council in the 9th NAMMCO Annual Meeting (Akureyri, 1999).

There were two recommendations pertaining to the Faroe Islands.

1. The first pertained to the new blunt hook. In the long-finned pilot whale drive hunt, the new blunt hook for securing the animals is increasingly being used. A proposal regarding the production of 500 such hooks is being presented to the politicians for consideration this fall. One issue is the funding of the production of such equipment.

2. The other recommendation pertained to the killing of stranded northern bottlenose whales. Olsen (Faroe Islands) explained that adequate rifles and ammunition have been ordered and are expected to arrive in the Faroes shortly. The Faroe Islands has no tradition in rifle hunting. The rifles will therefore be tested on the heads of already dead long-finned pilot whales.

Øen (Norway) commented that a description of the shooting process and an autopsy of the carcass would be useful for others in order to understand how the ammunition and rifle function on such animals. He pointed out that no precise anatomical description of the northern bottlenose whale exists today. When the next stranded animal is killed it is therefore important that an autopsy is performed and external features like eyes, blowhole etc. is recorded as co-ordinates for future killing.

There were a number of recommendations pertaining to hunting of small cetaceans in Greenland. Møller Walsted (Greenland) reported that an update would be forthcoming. He was new to the job and had not yet been able to investigate the follow-up on the recommendations.

Recommendation 4. Baleen whale hunting
a) Øen (Norway) informed that the new whale harpoon, adjustable for each individual harpoon canon is being commercially produced and its use is increasing.

b) Regarding Greenland's use of rifles in minke whale hunting Møller Walsted (Greenland) explained that a seminar is planned focusing on the rifle hunt. There are however conflicting interests regarding this type of hunting in Greenland.

One of the arguments is economic, because the grenades are very expensive in Greenland and priced at a much higher level than in Norway. In an effort to assist the planned transition from rifle hunting to the use of harpoon canons, the Hunting Method Committee considered whether the harpoon grenades could be sold at the same price in Greenland as in Norway. (See also item 4c in the Workshop Recommendations).

In conclusion the Chairman pointed out that the follow-up of the recommendations from the workshop would be an item on the agenda for the next committee meeting.

5. FUTURE WORK

Weapons and Ammunition Workshop
With reference to the discussion at the last Committee meeting the members of committee agreed to organise a workshop focussing on the following.

Draft Program
Goal of Workshop
The goal would be to increase the understanding of weapon types, ammunition and ballistics for hunters, administrators and other personnel, and to develop a set of minimum requirements pertaining to weapons and ammunition types with regard to the different species.

Target Groups
The target groups of the workshop would be hunters, government officials and the Hunting Method Committee members.

Topics for the Workshop
1) An introduction of different killing-methods that in general pertain to whales and seals
2) Weapon types and ammunition in combination with terminal ballistics
3) The impact of weapon types and ammunition on different marine mammal species
4) Safety for the hunters with respect to weapon use.

Results from Workshop
In order to obtain the goals of the workshop it is imperative to secure the broadest

possible involvement from the hunters. One possibility would be to initiate a process prior to the workshop where hunters and their organisations engage in an internal process addressing the issues.

Following the workshop there should also be a process whereby hunters in general benefit from the findings of the workshop. One method of disseminating the result would be through a report translated into the relevant languages in the NAMMCO member countries.

Practical Arrangements
Attendance: approximately 40-60 participants
Workshop language: Nordic
Venue: Reykjavik, Iceland, September/October 2001, 2-3 days duration
Tentative budget: NOK 100,000

6. ELECTION OF CHAIR AND VICE-CHAIR

Jústines Olsen and Egil Ole Øen were re-elected as chair and vice-chair respectively.

7. ANY OTHER BUSINESS

Øen (Norway) informed the committee that the Norwegian School of Veterinary Science had received an inquiry from Mannetron, a US company, producing a 5 meters static display Killer Whale. They are looking for internal organs needed as originals to produce silicon organ replicas. Norway does not hunt killer whales and such organs are not available in Norway. The inquiry was therefore distributed to the Committee members in case other member countries could provide the company with such organs.

8. ADOPTION OF REPORT

The final report of the meeting was adopted by correspondence.

Appendix 1

CURRENT LAWS & REGULATIONS FOR MARINE MAMMAL HUNTING IN NAMMCO MEMBER COUNTRIES

(Last updated 6 September 2000)

Faroe Islands

Løgtingslóg	nr 57 frá 5. juni 1984 um hvalaveiði
	nr 54 frá 20. mai 1996 um broyting í løgtingslóg um hvalaveiði
Kunngerð	nr 19 frá 1. mars 1996 um undantak fyri friðing av hvali
	nr 126 frá 23. juni 1997 um friðing av hvali
	nr 46 frá 8. april 1998 um grind
	nr 107 frá 21. november 1989 um góðkenning av hvalvágum, sum broytt við kunngerð nr. 64 frá 11. mai 1992, kunngerð nr 127 frá 27. august 1992, kunngerð nr. 141 frá 23. juni 1993 og kunngerð nr 34 frá 24. mars 1994.
	nr 166 frá 27. august 1993 um fyribilis góðkenning av hvalvágum
	nr 118 frá 23. oktober 1996 um fyribilis góðkenning av hvalvágum
	nr 72 frá 17. mai 2000 um fyribilis góðkenning av hvalvágum

Greenland

Landstingslov	nr 12 af 29. oktober 1999 om fangst og jagt
Bekendtgørelse	nr 26 af 9. september 1993 om betalingsjagt og -fiskeri
	nr 20 af 11. maj 1994 om fangst af isbjørne i Grønland
	nr 30 af 11. oktober 1995 om fangst af hvid- og narhvaler
	nr 6 af 29. februar 1996 om ændring af bekendtgørelse
	nr 26 af 24. oktober 1997 om ekstraodinær syn og godkendelse af harpunkanoner
	nr 7 af 26. februar 1998 om fredning og fangst af hvalros ved Grønland
	nr 13 af 3. april 1998 om rapportering ved fangst og anskydning af store hvaler
	nr 12 af 3. april 1998 om fangst af store hvaler
	nr 4 af 1. februar 2000 om erhvervsjagtbeviser
	nr 5 af 1. februar 2000 om fritidsjagtbeviser

Fangstregistreringsskema (1993)

Landsrådsvedtægt af 31. august 1959, stadfestet den 12. februar 1960 om fredning af spraglet sæl

Iceland

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

Lov av 16. juni 1939 om fangst av hval
Lov av 3. juni 1983 nr 40 om saltvannsfiske mv.

Melding fra Fiskeridirektøren:

J-45-89, 14.3.89.	Forskrift om kontroll av utøvelse av selfangst
J-52-2000, 6.3.2000	Forskrift om regulering av fangst av sel i vesterisen og østisen i 1999.
J-34-98, 27.2.98.	Forskrift om endring av forskrift av 20.2 1991 om utøvelse av selfangst i Vesterisen og Østisen.
J-20-99, 19.2.99.	Forskrift om adgang til å delta i fangst av vågehval i 1999.
J-124-99, 19.2.99.	Forskrift om regulering av fangst av vågehval i 1999.
J-83-99, 3.5.99.	Forskrift om utøvelse av fangst av vågehval i 1999. Instruks for inspektører under vågehvalfangsten i 1999, 13.4.99.

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Caulfield, R. A, Qeqartarsuarmi arfanniarneq: Greenland Inuit Whaling in Qeqartarsuaq Kommune, West Greenland, IWC Document TC/43/AS 4, 1991.

GHR, Designation of Types of Rifles in Greenland, IWC Document TC/43/AS 1, 1991.

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SECTION 2 - MANAGEMENT COMMITTEE

2.1
REPORT OF THE NAMMCO MANAGEMENT COMMITTEE

Sandefjord, Norway, 27 September 2000

1. – 3. OPENING PROCEDURES

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

4. NATIONAL PROGRESS REPORTS

National Progress reports were available from the Faroes, Iceland and Norway for 1999 (see Section 4 of this volume). Greenland informed the Management Committee that their National Progress Report had been delayed but would be forthcoming shortly.

In reply to a question from the Faroes on why the minke whale quotas were not reached in 1999, Norway informed the Management Committee that the quotas had not been reached in the North Sea area because of poor weather and a probable shift in minke whale distribution. The quotas were reached in most of the other catching areas.

The Management Committee decided that the National Progress Reports should directly address the management measures and research undertaken by member countries in response to NAMMCO proposals for conservation and management, and research recommendations. The Committee directed the Secretariat to change the format of the Reports accordingly.

The Management Committee recalled the invitation issued in 1998 to Canada and the Russian Federation to provide information on catch levels and management strategies with respect to shared stocks, and noted that such information had been provided by Canada in 1998. The Management Committee agreed to recommend that this invitation be reiterated before future meetings of the Management Committee.

The Management Committee took note of the reports and thanked the member countries for this information.

5. STATUS OF PAST PROPOSALS FOR CONSERVATION AND MANAGEMENT

The Chairman drew the attention of the meeting to the updated list of proposals for conservation and management decided by NAMMCO since its establishment, as contained in Appendix 3. He invited information from the Parties on developments with regard to earlier 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 noted that no new measures had been taken since those noted in 1999. Greenland further noted that walrus had been sighted in the Nuuk area this year, and that hunters had been informed that they could not be hunted because of the restrictions resulting from this proposal.

5.2 Ringed Seal

There were no comments under this agenda item.

5.3 Harp seal

5.3.1 Northwest Atlantic

Greenland noted that this stock was shared with Canada and that the two countries have held bilateral discussions on management of this stock, during which the advice from NAMMCO had been considered.

5.3.2 White/Barents Sea

Norway noted that the Russian Federation manages this stock, including a traditional allocation of catch quotas to Norway. Referring to the NAMMCO advice (Appendix 4) that "...future quota levels approaching the replacement yield are advised", Norway raised the question of whether there are plans from the Russian side with regard to future catch efforts that would reflect this management advice, or whether more specific management advice from NAMMCO would be desirable. The observer for the Russian Federation indicated that they had no firm plans at present as to future quota levels in the area.

5.4 Hooded seal

5.4.1 Northwest Atlantic

Greenland noted that this stock was shared with Canada and that the two countries have held bilateral discussions on management of stock, during which the advice from NAMMCO was considered.

5.5 Northern bottlenose whales

In 1995 the Management Committee concluded that the traditional 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 stock. The Faroe Islands noted that while Faroese law presently protects the bottlenose whale, small numbers of bottlenose whales occurring in bays in the Faroe Islands are actively utilised locally for their meat and oil. Three animals had been taken in this way in 2000. The Faroe Islands informed the Management Committee that measures would be taken to ensure that legislation is consistent with this traditional, opportunistic catch.

5.6 Long-finned pilot whales

The Faroe Islands informed the Committee that satellite tags had been deployed on 4 pilot whales this year, and that valuable information on movements and distribution had been obtained from this project.

5.7 Minke whales - Central North Atlantic

It was noted that recent research had not indicated a genetic difference between whales taken in the West Greenland and Central stock areas. In addition, some analytical problems have come to light with the abundance estimate from the aerial survey component of the NASS 95 survey around Iceland, and this estimate should be reconsidered. It was noted, however, that the Scientific Committee’s assessment of the Central North Atlantic minke whale stock (NAMMCO Annual Report 1998) had taken into account the uncertainties regarding stock delineation and the abundance estimate. The Management Committee was pleased to note that the Scientific Committee Working Group on Abundance Estimates would be considering these matters at their meeting in fall 2000.

6. STATUS OF PAST REQUESTS TO THE SCIENTIFIC COMMITTEE

The Chairman 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).

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

Recommendations for new requests for scientific advice from the Scientific Committee are summarised in Appendix 4, in order of their relative priority as assessed by the Committee.

7.1 Economic aspects of marine mammal - fisheries interactions

7.1.1 New request for advice

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.

7.2 Harbour porpoise

7.2.1 Recommendations for scientific research

The Management Committee noted and endorsed the research recommendations conveyed on pages 135 - 136 of the Report of the Scientific Committee, and urged member and non-member governments to act on these recommendations.

7.3 Beluga - West Greenland

7.3.1 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.

7.3.2 New request for advice
The Management Committee recommended that the Scientific Committee continue its assessment of West Greenland beluga with reference to the short-term research goals identified on page 143 of the Scientific Committee Report. 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.

7.3.3 Recommendations for scientific research
The Management Committee noted and endorsed the research recommendations conveyed on pages 143 - 144 of the Scientific Committee Report, and urged member and non-member governments to act on these recommendations. The anticipated meeting mentioned under agenda item 7.3.2 should address this recommendation.

7.4 Narwhal - West Greenland
7.4.1 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.

7.4.2 New request for advice
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.

7.4.3 Recommendations for scientific research
The Management Committee noted and endorsed the research recommendations conveyed on pages 144 of the Scientific Committee Report, and urged member and non-member governments to act on these recommendations. Issues related to narwhal will also be addressed at the joint meeting noted under item 7.3.2 above.

7.5 Fin whales - Faroese Exclusive Economic Zone
7.5.1 New requests for advice
The Management Committee noted that the requested assessment 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.

7.5.2 Recommendations for scientific research

The Management Committee noted and endorsed the research recommendations conveyed on page 147 of the Scientific Committee Report, and urged member and non-member governments to act on these recommendations.

7.6 White-beaked, white-sided and bottlenose dolphins

7.6.1 New requests for advice

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.

7.6.2 Recommendations for scientific research

The Management Committee noted and endorsed the research recommendations conveyed on page 150 of the Scientific Committee Report, and urged member and non-member governments to act on these recommendations.

7.7 North Atlantic Sightings Surveys

The Management Committee noted that the Scientific Working Group on Abundance Estimates would meet in autumn 2000 to plan for the co-ordination of joint sighting surveys to be carried out in 2001. The Management Committee urged member countries to co-operate to the fullest extent possible in co-ordinating their survey efforts.

8. REPORT OF THE WORKING GROUP ON BY-CATCH

The Chairman of the Working Group on By-catch, Arne Bjørge, presented the Report of the Working Group from their meeting on 25 September 2000 (Section 2.2). Presently by-catch data is not being reliably collected in NAMMCO member countries, but all member countries are in the process of instituting data collection programs. The Working Group considered the advantages and disadvantages of various data collection methods, and concluded that while independent observer programs provide the most reliable information on by-catch, they are costly and not practical for small-scale fisheries. Logbook data collection programs are less precise with regard to obtaining specific data, but they provide broad coverage at a low cost, and allow the identification of problem areas that can be further analysed by other means. All NAMMCO countries either have or are presently planning to introduce logbook data collection programs. The Working Group provided recommendations related to the collection of by-catch data, the reporting of by-catch information to NAMMCO and the use and release of by-catch data by NAMMCO (see Appendix 4 page 114).

Iceland made a reservation with respect to the evaluation of monitoring procedures in item 5.2 of the report. In its opinion the Report was in this regard too simplistic, qualifying different monitoring measures. Iceland pointed out that mandatory reporting was generally accepted as a reliable method in monitoring fisheries. Iceland underlined the impracticality of using observers as a main monitoring method due to high costs. Finally Iceland stated that the Table on page 110 could not be used for differentiating between various methods.

The Management Committee endorsed and encouraged the efforts of member countries to establish mandatory logbook-data-collection-systems as an initial step to identify areas and fisheries that would be the focus of further efforts. Only very simple data on the numbers of each species caught need be collected as a starting point. The Committee also supported the recommendation to initiate a system of by-catch reporting to NAMMCO through the National Progress Reports, and directed the Secretariat to modify the format of the Reports accordingly. The question of establishing a database at the Secretariat, and of developing a policy on the use and release of by-catch data, was considered premature at this point in time, and was deferred until more information becomes available. The Management Committee directed the Working Group to meet again before the next Annual Meeting to review the progress in this area, and to provide guidance on the harmonisation of activities undertaken by member countries.

9. REPORT OF THE WORKING GROUP ON INSPECTION AND OBSERVATION

The Chairman of the Working Group, Egil Ole Øen presented the Report from the meeting held in November 1999 (Section 2.3). The Working Group emphasised the importance of the principle that the Secretariat should have independence in choosing the timing and location of observations, but also noted that co-operation with local authorities is important. There was a general recognition of the need for more information about the Scheme in member countries, and means of delivering this information were considered. The Working Group also dealt with matters concerning potential violations, reporting, administration and safety issues.

The Management Committee endorsed the recommendations contained in Part 8 of the Report. The Committee noted that the Working Group had completed its task of establishing the Observation Scheme, but noted the continuing need for a standing review body to monitor the implementation of the Scheme and provide recommendations for improvement. To this end the Management Committee decided to reconstitute the members of the Working Group as an *ad hoc* committee to monitor the Scheme. The *ad hoc* committee will meet prior to the next Annual Meeting, draft a proposal for its own terms of reference, and provide a report (in parallel with the Secretary's report on the Scheme) focussing on observed apparent infringements and subsequent actions by the relevant authorities.

10. IMPLEMENTATION OF THE JOINT NAMMCO CONTROL SCHEME

10.1 NAMMCO International Observation Scheme 2000

The Chairman referred to the report of the NAMMCO International Observation

Scheme under the Joint NAMMCO Control Scheme for the Hunting of Marine Mammals, prepared by the Secretariat. The Secretary presented the report to the Management Committee.

The Management Committee noted that there appears to be a greater awareness of the NAMMCO Observation Scheme this year than last year. In this regard, the Committee noted the importance of continued dissemination of information about the Scheme in NAMMCO member countries and that this would assist the observers in continuing to carry out their activities in a satisfactory manner.

The Management Committee noted the recommendation repeated from last year, that NAMMCO member countries should provide the Secretariat with names of contacts for the observers.

10.2 NAMMCO International Observation Scheme 2001

The Management Committee noted that observation activities for 2001 would be implemented for pilot whale hunting in the Faroe Islands and whaling and sealing activities in Greenland and Norway.

11. PROPOSAL FOR A CONFERENCE ON USERS KNOWLEDGE AND SCIENTIFIC KNOWLEDGE IN MANAGEMENT DECISION MAKING

The Secretary introduced a proposal for a conference with the working title Users Knowledge and Scientific Knowledge in Management Decision-Making. With reference to Item 11 of the Scientific Committee Report, the Management Committee noted that the conference would go a slightly different route by addressing the question of how both users knowledge and scientific knowledge best could be incorporated into management decisions.

The Management Committee agreed that the Secretary, together with an Advisory Group consisting of members appointed by the NAMMCO member countries, would be trusted with developing this proposal further, in relation to both the substance and to the practical arrangements.

With reference to the Management Committee Report from 1999 (Annual Report 1999 page 88), the Management Committee tasked the Advisory Group with evaluating whether and how this previous proposal for incorporating users knowledge into the Scientific Committee's deliberations could be incorporated into the Conference.

12. ADOPTION OF REPORT

A draft report of the meeting, containing all matters of substance agreed by the Management Committee, was reviewed and approved.

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 - Faroese Exclusive Economic Zone
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 By-catch
9. Report of the Working Group on Inspection and Observation
10. Implementation of the Joint NAMMCO Control Scheme
10.1 NAMMCO International Observation Scheme 2000
10.2 NAMMCO International Observation Scheme 2001
10.3 Other matters
11. Proposal for a Conference
12. Any other business
13. Adoption of report

Appendix 2

LIST OF DOCUMENTS

NAMMCO/10/MC/1	List of documents
NAMMCO/10/MC/2	Agenda
NAMMCO/10/MC/3	List of proposals for conservation and management (up to and including NAMMCO/8)
NAMMCO/10/MC/4	Summary of requests by NAMMCO Council to the Scientific Committee, and responses by the Scientific Committee
NAMMCO/10/MC/5	Report of the Management Committee Working Group on Inspection and Observation 1999
NAMMCO/10/MC/6	Report of the NAMMCO International Observation Scheme 2000
NAMMCO/10/MC/7	Report of the Management Committee Working Group on By-catch
NAMMCO/10/MC/8	Proposal for a Conference

National Progress Reports

NAMMCO/SC/8/NPR-F	Faroe Islands - Progress Report on Marine Mammal Research in 1999
NAMMCO/SC/8/NPR-G	Greenland - Progress Report on Marine Mammal Research in 1998 -99 (Not Available)
NAMMCO/SC/8/NPR-I	Iceland - Progress Report on Marine Mammal Research in 1999
NAMMCO/SC/8/NPR-N	Norway - Progress Report on Marine Mammal Research in 1999

Council documents

NAMMCO/10/5	Report of the Scientific Committee, 13-15 April 1999

5. LIST OF PAST PROPOSALS FOR CONSERVATION AND MANAGEMENT

(Up to and including NAMMCO/10 – 2000)

5.1 Atlantic walruses

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).

5.2 Ringed seals

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 - see *NAMMCO Annual Report 1996*:149 (Fig.1)).

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 Annual Report 1996*: 81).

5.3 Harp seals in the Northwest Atlantic

5.3.1 Northwest Atlantic

5.3.1.1 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 Annual Report 1996*: 81).

5.3.1.2 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 Annual Report 1998: 22).*

5.3.2 White/Barents Sea

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 Annual Report 1999*: 133).

5.3.3 Greenland Sea

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.

5.4 Hooded seals

5.4.1 Northwest Atlantic

5.4.1.1 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 Annual Report 1996*: 81-82).

5.4.1.2 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 Annual Report 1998:* 23).

5.4.2 Greenland Sea

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 Annual Report 1999:86*).

5.5 Northern bottlenose whales

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 Annual Report 1995*: 48)

The Faroe Islands informed the Management Committee that while Faroese law presently protects the bottlenose whale, small numbers of these whales occurring in bays in the Faroe Islands are actively utilised locally for their meat and oil. Measures would be taken to ensure that legislation is consistent with this traditional opportunistic catch (see Item 5.5 page 74).

5.6 Long-finned pilot whales

The Faroe Islands informed the Management Committee of their wish to continue to utilise pilot whales in an opportunistic manner as has been done for centuries. Catches of pilot whales may vary from year to year and total allowable catches are not considered appropriate for this form of hunt. In some years catches may exceed 2,000 whales, and in other years they may be much smaller, while the average annual catch between 1971-96 were about 1,400 whales.

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 Annual Report 1997*: 64-65).

5.7 Minke Whales - Central North Atlantic

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 Annual Report 1998:*75).

The Management Committee noted that recent research had not indicated a genetic difference between whales taken in the West Greenland and Central stock areas. It was further noted that some analytical problems had come to light with the abundance estimate from the aerial survey component of the NASS 95 survey around Iceland, and that this estimate should be reconsidered (see Item 5.7 page 75).

5.8 Beluga - West Greenland

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 beluga 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 Annual Report 1999: 99)*.

5.9 Narwhal - West Greenland

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 Annual Report 1999:86-87).*

5.10 North Atlantic fin whales

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 Annual Report 1999:87).*

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

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 cooperation with the hunters.

In order to solve the many practical questions in the pilot project process the Committee agreed that the proposed Assessment Committee should carefully prepare the meeting on the "Draft Minke Whale Stock Status Report", and particular work with the Secretariat with respect to the following questions:

- Define areas and type of information subject to dialogue between scientists and minke whale hunters
- Should the scientists meet minke whale hunters from all interested countries at the same time, or should there be meetings between scientists and minke whale hunters in each of the interested countries?
    - Time and venue for meetings
    - Papers to be distributed before the meetings
    - Language / interpretation
    - How to select hunters with relevant knowledge
    - Planning of questions to be asked to hunters

(NAMMCO Annual Report 1999:88).

REFERENCES

NAMMCO Annual Report 1995. North Atlantic Marine Mammal Commission, Tromsø. 186pp.

NAMMCO Annual Report 1996. North Atlantic Marine Mammal Commission, Tromsø. 227pp.

NAMMCO Annual Report 1997. North Atlantic Marine Mammal Commission, Tromsø. 260pp.

NAMMCO Annual Report 1998. North Atlantic Marine Mammal Commission, Tromsø, 181 pp.

NAMMCO Annual Report 1999. North Atlantic Marine Mammal Commission, Tromsø, 265 pp.
NAMMCO Annual Report 2000. North Atlantic Marine Mammal Commission, Tromsø, 359 pp.

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 10th 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, 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 to 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 be published in a future volume of *NAMMCO Scientific Publications.* (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 <u>recommended</u> 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:

To be addressed in 2001 and beyond.

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)

*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 Scientific Committee has not yet considered its report.

Central North Atlantic minke whales:

*Code/Meeting:*4.7/March 1997
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:*4.8/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)

Northern bottlenose whales:

*Code/Meeting:*4.9/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:*4.10/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:*4.11/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 Chairman 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:*4.12/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: 4.13/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: 4.14/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:*4.15/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: 4.16/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:

To be addressed in 2001.

Code/Meeting: 4.17/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:

Assessment will be carried out when the required information becomes available. The specific question on narwhal movements will be addressed in 2001.

Harbour porpoises:

Code/Meeting: 4.18/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: 4.19/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: 4.20/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: 4.21/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)

Ringed seals:

Code/Meeting: 4.22/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: 4.23/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: 4.24/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)

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

Code/Meeting: 4.25/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.

Code/Meeting: 4.26/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: 4.27/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: 4.28/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 4.25.

Code/Meeting: 4.29/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: 4.30/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: 4.31/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: 4.32/NAMMCO/10

Request:

The Management Committee noted that the requested assessment (4.2X) 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.

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)

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.

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

25 September 2000, 1800-1900, Sandefjord, Norway

1. INTRODUCTION AND ELECTION OF CHAIRMAN

Arne Bjørge welcomed the participants (see Appendix 1), and agreed to act as Chairman of the Working Group for the meeting.

2. ADOPTION OF AGENDA

The Draft Agenda (Appendix 2) was adopted without change. A list of documents available for the meeting is in Appendix 3.

3. APPOINTMENT OF RAPPORTEUR

Daniel Pike, Scientific Secretary of NAMMCO, was appointed as Rapporteur.

4. INFORMATION REGARDING ONGOING MONITORING AND MANAGEMENT OF MARINE MAMMAL BY-CATCHES OUTSIDE THE NAMMCO AREA

Arne Bjørge gave a general introduction to the history of and recent developments in the issue of marine mammal by-catch. The issue first came to the fore in the 1970's with regard to the high by-catch of dolphins in the Pacific tuna fishery. Increased public awareness stimulated research on the issue, which eventually led to modifications in fishing gear and changes in fishing practices that have largely eliminated by-catch in the tuna fishery without significant reduction in fishing effort or catches of target species. Recent attention to the by-catch issue has focussed on high by-catches of harbour porpoises in some fisheries, particularly in Denmark and the USA.

The parties to the Agreement on Small Cetaceans in the Baltic and North Seas (ASCOBANS) recently passed a resolution that aimed at limiting by-catch at levels of 1.7% to 2% of the population size per year. Further, this resolution recommended that member countries should work towards including marine mammal by-catch in the common fishery policy of the European Union.

Monitoring and mitigation of marine mammal by-catch has for several years been an item for discussion in the IWC Scientific Committee's sub-committee on Small Cetaceans. The focus has been on the use of acoustic alarms, "pingers" that emit sound to warn animals of the presence of fishing gear. In 2000, the IWC Scientific Committee convened a workshop to discuss other mitigation measures. Three topics were discussed: 1) modification of gear and fishing practise, 2) spatial and/or temporal fishery closures, and 3) development and use of alternative fishing gear.

Denmark has a documented by-catches of harbour porpoise in a bottom-set gillnet fishery. An annual catch of around 7,000 porpoises was estimated for a cod fishery in the Central North Sea in 1995. In 1997, Denmark initiated large-scale experiments to test the effectiveness of pingers. These experiments demonstrated conclusively that pingers were effective in reducing harbour porpoise by-catch, at least in the short term. An Action Plan for the mitigation of harbour porpoise by-catch was developed in 1998 in cooperation with scientists and fishers. As a result, the use of pingers has been made mandatory for certain fisheries in high-risk areas and periods.

The USA has also made the use of pingers mandatory for certain fisheries, in combination with temporal and areal fishery closures. However there is some evidence that harbour porpoise are becoming habituated to pingers, and their effectiveness may decrease after the initial beneficial effect.

5. REVIEW PROGRESS IN MONITORING AND MANAGEMENT OF MARINE MAMMAL BY-CATCHES WITHIN THE NAMMCO AREA

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

Iceland has analysed the effectiveness of its present system of fishery logbooks for monitoring marine mammal by-catch. It appears that the system has resulted in incomplete data and that changes are required. It is anticipated that the rules governing fishery reporting will be changed over the coming year to improve the situation. In addition, Iceland will increase the number of independent observers monitoring fisheries from vessels this year.

The Greenland Fishery Licence Authority has introduced a new reporting form for observers on fishery vessels that will make the reporting of marine mammal by-catch mandatory. The Department of Industry has also set up a Working Group to work with the issue of by-catch.

The Faroes presently have a logbook system for fishermen that should track marine mammal by-catch. However the incidence of by-catch appears to be low, and is not viewed as a major problem in the Faroes.

In Norway there is presently no system for the reliable reporting of marine mammal by-catch. However it is recognised as necessary and a system is being planned with three main objectives: 1) maximum reliability, 2) minimum of cost and extra labour for fishers, and 3) minimum of cost and additional bureaucracy for government. Several monitoring methods have been considered but a final decision has not yet been made. It is anticipated that a monitoring system will be in place in 2001. The Institute of Marine Research has also been conducting research on some aspects of marine mammal by-catch. Tag return data has been analysed to estimate the by-catch of grey and harbour seals. Observers have monitored some North Sea fisheries. Finally, the harbour porpoise has been chosen as a species for which estimates of abundance and trends in abundance are required, necessitating estimation population level effects of by-catch.

5.2 Evaluation of procedures developed and implemented by NAMMCO Member Countries

The development of by-catch data collection systems is still at a developmental stage in the NAMMCO member countries, so it is too early to evaluate the procedures being used. However, the Working Group in a general sense (see Table 1) compared the advantages and disadvantages of various mechanisms.

Independent observers on fishing vessels

Independent observers onboard operating fishing vessels is the most widely recognised method to obtain reliable statistics of by-catches. If the fishery is homogenous with regard to by-catches throughout its range, a sub-sample of the fleet can be observed and the results extrapolated to the whole fleet. However, if there is obvious variability over the area or season, the fishery may be stratified and sub-samples of each strata are observed to extrapolate over the respective strata and subsequently summarised over all strata to cover the complete fleet.

Mandatory reporting

Mandatory reporting is regarded as less reliable for obtaining by-catch statistics and likely produces underestimates of total by-catch. However, this method may provide guidance towards fisheries, areas and seasons where marine mammal by-catches are likely to be a problem. The statistics from mandatory reporting may be a sufficient basis to establish control mechanisms and to develop correction factors for the reported statistics.

Harbour surveys and control in landing harbours

This system is based on the assumption that incidentally caught marine mammals are regarded as valuable contributions to the total catch, and thus will be landed at the harbour together with the target species. By observing fishing vessels when returning to a harbour, statistics may be obtained for the fleet operating from that harbour.

Questionnaires (Interviews)

This method is regarded as less reliable than independent observes onboard fishing vessels. However, it may be developed as a supplementary method to mandatory reporting.

Automated monitoring

Monitoring fishing operations is possible by combination of video techniques and sensors. Data may be stored in sealed data loggers on board or transmitted, e.g. via satellites to a monitoring station in the respective countries. The cost of automated monitoring will mainly be related to purchasing and installing the instruments, and may be low compared to observer based monitoring. Although the technology for building automated systems exits, the purpose-built instruments for this type of monitoring are not yet developed and available. However development in this field is proceeding rapidly and appropriate technology should be available in the near future.

Table 1. Five possible methods for monitoring marine mammal by-catches are listed with their respective properties.

Monitoring methods	Method properties					
	Reliability	No additional control required	Workload for fishers	Costs	Practicality	Available methodology
Independent observers	+	+	+	-	-	+
Mandatory reporting	?	-	-	+	+	+
Harbour controls	-	-	+	-	-	+
Questionnaires (interviews)	-	-	-	+	+	+
Automated monitoring	+(?)	+(?)	+	+	(?)	-

Conclusion

Only by-catch monitoring by independent observers is regarded as a method that provides reliable results with regard to precision. However, the associated costs may be very high, dependent on the number of observers involved. This method is probably only feasible on larger vessels if observers are placed onboard for additional purposes. Mandatory reporting should not be used as a stand-alone method, but is very useful because it provides a large coverage at very low costs, and may constitute a basis for stratifying control regimes. Harbour controls may be useful in communities where marine mammal by-catches are regarded as valuable contribution to total catches. Automated monitoring is a promising method not yet available, which may be feasible primarily for larger vessels.

6. MECHANISMS FOR NAMMCO MEMBER COUNTRIES TO REPORT BY-CATCH TO NAMMCO

NAMMCO does not presently have a mechanism whereby member countries report marine mammal by-catch. The Working Group recognised that the most appropriate method will depend on the level of detail required by NAMMCO. Summarised by-catch data could be reported in National Progress Reports by member countries, as is harvest data at present. However, detailed by-catch data suitable for analytical purposes would require a rather complex database and electronic data transfer procedures.

The Scientific Committee noted in 1999 that the use of catch data in stock assessments generally required a detailed knowledge of accuracy, precision, catch composition, exact location of catch etc. which was not achievable in a single comprehensive database. The Committee recommended that detailed catch data be compiled for use in assessments on a case-by-case basis by national research institutes. The Working Group considered that the same might be true of by-catch data. Nevertheless, it was noted that summarised by-catch data should be available to the Secretariat to answer queries and to provide information.

The Working Group therefore decided to ask the Management Committee for direction on the level of detail of by-catch data that should be held at the Secretariat. This will to some extent dictate the reporting mechanism that is required.

7. MECHANISMS FOR QUALITY CONTROL OF BY-CATCH STATISTICS COMPILED AND SUBMITTED BY NAMMCO MEMBER COUNTRIES

7.1 Review of national quality-control procedures and routines

It was considered that discussion of this item was premature as by-catch data collection systems are not yet in place in NAMMCO member countries.

7.2 The role of the NAMMCO Scientific Committee in quality control of by-catch statistics

Once again it was noted that this will to some extent depend on the level of detail of by-catch data that is to be held at the Secretariat. The Chairman of the Scientific Committee, Gísli Víkingsson, felt that the Scientific Committee would likely limit itself to assessing the effects of by-catch on marine mammal stocks, and would leave the question of quality control of by-catch data to national authorities that have the best knowledge of the fisheries in question. However, the Scientific Committee has not discussed this matter.

8. NAMMCO POLICY ON THE USE AND RELEASE OF MARINE MAMMAL BY-CATCH DATA COMPILED AND SUBMITTED BY NAMMCO MEMBER COUNTRIES

It was generally agreed that, if NAMMCO is to act as a clearinghouse for high quality information on marine mammal by-catch, it must have a clear policy on its use and dissemination. As a first principle, it was considered that such data should be freely available. However, it was also noted that such information should not be released until it is fully analysed and validated.

The intersessional correspondence group developed a set of items that may be considered for inclusion in a NAMMCO policy, if the Management Committee decides that a detailed database on marine mammal by-catch should be established at the Secretariat. These items are listed in Appendix 4.

9. RECOMMENDATIONS

- The Management Committee should provide guidance on the level of detail required in a by-catch database to be held at the NAMMCO Secretariat. They may also wish to consult the Scientific Committee on this issue. However, as an initial step the Working Group recommends that the format of the National Progress Reports be modified such that summarised by-catch information is reported to NAMMCO on an annual basis.
- Following a decision on the nature of any by-catch database to be held by the Secretariat, the Management Committee should develop a policy on the use and

release of marine mammal by-catch data.

- The most promising and widely used mechanism for by-catch data collection in NAMMCO member countries is logbook reporting by fishers. This mechanism should be further strengthened, made mandatory and validated by member countries.
- The Working Group on Marine Mammal By-catch should meet in 2001 immediately before the Annual Meeting to review the progress in this area, and to provide guidance on the harmonisation of activities undertaken by member countries.

10. ADOPTION OF THE REPORT

The Working Group adopted the Report on September 26, 2000.

Appendices 1, 2 & 3

Appendix 1 - LIST OF PARTICIPANTS

Dr Arne Bjørge (Chairman)
Mr Kolbeinn Árnasson (Iceland)
Mr Elling Lorentsen (Norway)
Mr Daniel Pike (NAMMCO)
Mr Mogens Møller Walsted (Greenland)
Mr Gísli A. Víkingsson (Iceland)
Mr Heðin Weihe (Faroe Islands)
Mr Kim Mathiasen (Greenland)

Appendix 2 - AGENDA

1. Election of Chairman
2. Adoption of Agenda
3. Appointment of Rapporteur
4. Information regarding ongoing monitoring and management of marine mammal by-catches outside the NAMMCO Area
5. Review progress in monitoring and management of marine mammal by-catches within the NAMMCO Area
   - 5.1 Progress in monitoring marine mammal by-catches by NAMMCO Member Countries
   - 5.2 Evaluation of procedures developed and implemented by NAMMCO Member Countries
6. Mechanisms for NAMMCO member countries to report by-catch to NAMMCO
   - 6.1 Use of National Progress Reports
   - 6.2 Other potential Mechanisms
   - 6.3 Recommended mechanisms
7. Mechanisms for Quality Control of by-catch statistics compiled and submitted by NAMMCO Member Countries
   - 7.1 Review of national quality-control procedures and routines
   - 7.2 The role of the NAMMCO Scientific Committee in quality control of by-catch statistics
8. NAMMCO policy on the use and release of marine mammal by-catch data compiled and submitted by NAMMCO Member Countries
9. Recommendations
10. Adoption of the report

Appendix 3 - LIST OF DOCUMENTS

NAMMCO/10/MC/BC/1	List of Participants
NAMMCO/10/MC/BC/2	Draft Agenda
NAMMCO/10/MC/BC/3	Preliminary List of Documents
NAMMCO/10/MC/BC/4	Draft policy document on the use and release of marine mammal by-catch data

Appendix 4

ITEMS TO BE CONSIDERED FOR POSSIBLE INCLUSION IN A NAMMCO POLICY REGARDING INFORMATION ON MARINE MAMMAL BY-CATCH

The following items were put forward by the intersessional correspondence group on marine mammal by-catch. If NAMMCO decides that a database on marine mammal by-catch should be established at the Secretariat, these items may be considered for inclusion in a NAMMCO policy on the use and release of marine mammal by-catch data:

- All information submitted to NAMMCO should in principle be free and available to the general public.
- NAMMCO may act as a forum for development and dissemination of high quality information regarding by-catches of marine mammals in fisheries.
- To achieve the above objective, NAMMCO may compile submitted data and present processed information and informative facts regarding by-catches of marine mammals, impacts on marine mammal stocks, and any management actions taken to ensure that by-catches remain within sustainable levels.
- In cases and communities where incidentally caught marine mammals contribute to the total value of the catch, any by-catch information released by NAMMCO may include factual data on the socio-economic and nutritional value of marine mammal products.
- Previous to any release by NAMMCO, all data submitted by member nations should be subject to validation and quality control. Control may be conducted by the NAMMCO Scientific Committee, or another body defined within the established Secretariat of NAMMCO.
- By-catch per unit effort, by-catch per unit landed catch, or similar basic data that may be used for further extrapolation to asses by-catch in wider fisheries, or for assessment of total by-catches within areas, should not be released by NAMMCO until sufficient time has been allocated for the NAMMCO Scientific Committee to carry out such assessments.
- NAMMCO has the sole responsibility to ensure safety and protection of any by-catch data and statistics kept on NAMMCO electronic databases.
- NAMMCO should observe any copyrights associated with scientific publications by national institutes or scientists related to national by-catch data submitted to NAMMCO.

2.3
NAMMCO MANAGEMENT COMMITTEE AD HOC WORKING GROUP ON THE OBSERVATION SCHEME

11 November 1999, Greenland Home Rule Government, Copenhagen

The meeting was attended by Egil Ole Øen (Chairman) and Kirsti Larsen (Norway); Kristján Loftsson and Kolbeinn Árnasson (Iceland); Amalie Jessen (Greenland); Jústines Olsen and Regin Jespersen (Faroe Islands); Tine Richardsen (Secretariat) and Grete Hovelsrud-Broda (General Secretary).

1. – 3. OPENING PROCEDURES

The Chairman of the Working Group, Egil Ole Øen, convened the meeting and welcomed the participants. He opened the meeting by pointing out that this was an *ad hoc* Working Group that would cease to exist at the end of the meeting.

At its annual meeting in Akureyri, on October 6 - 7 1999, the Management Committee agreed to task an *ad hoc* Working Group with the following mandate:

”To review the implementation of the Observation Scheme to examine practical and administrative matter requiring consideration and development, and seek better co-ordination of the observation activities.”

The Chairman stressed the importance of the principle of transparency of the Observation Scheme combined with the independence of the Secretariat in implementing the Scheme. He pointed out that in principle the Secretariat must be able to operate the Scheme without intervention from the various authorities in the member countries.

The General Secretary was elected as rapporteur, in collaboration with the Secretariat. The draft agenda was adopted.

4. IMPLEMENTATION OF THE OBSERVATION SCHEME IN 1999

This heading includes Items 4.1 – 4.3 from the agenda.

Hovelsrud-Broda (Secretariat) reviewed the reports from this year’s observations (see NAMMCO/MC/9/6). Observation activities were reported to have been carried out in connection with pilot whale hunt drives in the Faroe Islands, whaling and sealing in Greenland, and whaling and sealing in Norway. These observations were carried out according to the Guidelines to Section B – the International Observation Scheme of the Joint NAMMCO Control Scheme for the hunting of Marine Mammals. Hovelsrud-Broda (Secretariat) presented the budget for the Observation Scheme to the Working Group.

The Secretariat outlined experiences in implementing the Scheme in 1999 in relation to the guidelines to section B of the Joint NAMMCO Control Scheme. A number of questions concerning the practical implementation and administrative procedures were raised and discussed. The Working Group decided to formulate a number of these concerns as recommendations (see Item 8). Other concerns were discussed and clarified during the meeting. Based on this year's experiences the Secretariat pointed out that the practical implementation requires a certain amount of flexibility for the Scheme to be efficient. The Working Group agreed that better information from the local authorities to the Secretariat, and from the Secretariat to the observers, in addition to better communication between the involved parties would ensure such flexibility. The Working Group noted that it would be beneficial if the observers could consult with the Secretariat throughout the observation activities in order to deal with unexpected events.

The Working Group suggested changing the contract between the observers and NAMMCO to accommodate the need for flexibility. The change would allow the observer to extend the period of observation under unusual circumstances. The Secretariat should be contacted to approve the observers' suggestions.

The Secretariat initiated a discussion about the reports written by the observers. After two years of implementation, the reporting, although sufficient in all cases, varies from observer to observer. The Working Group emphasised the need for the reports to be short and concise, and only contain information about area, time, violations, and information on how the observation was carried out, and in accordance with the forms issued to the observers, by the Secretariat. The Working Group agreed that additional and general comments or information should be conveyed directly to the Secretariat and be kept separate from the actual reports. The Working Group agreed that it is the responsibility of the Secretariat to instruct the observers in how to use the forms properly.

The Working Group noted the importance of the Secretariat having independence from the local authorities in each member country in implementing the Scheme. The Secretariat is responsible for choosing the best location for the observations of sealing and whaling activities. The Working Group suggested that this could best be ensured through increased flow of information about hunting statistics, location of catches and time frames from the authorities in each country to the NAMMCO Secretariat (see also Item 8, Recommendations).

5. OBSERVATION ACTIVITIES IN 2000

Hovelsrud-Broda (Secretariat) presented the planned observation activities for 2000. The Working Group agreed that each country automatically forward the planned dates for the whaling- and sealing activities to the Secretariat to the extent that this is possible. In addition, the Working Group recommended that the authorities inform the Secretariat about appropriate hunting areas, optimum periods for observation and the schedule for inspector courses. In accordance with the Management Committee Report item 9.2 (see NAMMCO/9/9) the Working Group reviewed the implementation plans for 2000 as proposed by the Secretariat. The Working Group had no further comments to the plans.

6. COMMENTS AND SUGGESTIONS FOR THE IMPLEMENTATION OF THE OBSERVATION SCHEME, BY THE MEMBER COUNTRIES

6.1 Greenland

Jessen (Greenland) reviewed the implementation of the Scheme for 1999 in Greenland and stressed the importance of communication between the Secretariat and the local authorities, in particular prior to the arrival of the observer, but also during the activities. Jessen also pointed out that it is important to identify the relevant information, from both the Secretariat and the local authorities, that is needed by the observer in order to perform the tasks he/she are given.

6.1.2 Other

Hovelsrud-Broda (Secretariat) suggested that a general letter of information about the Observation Scheme be issued to the authorities in each member country. They are in turn responsible for having these letters translated and distributed. Jessen (Greenland) noted that it is important that the information about the Scheme is issued to the local authorities by the Secretariat, and not from the central authorities in the country in question. Jessen also stressed the importance of receiving information from the Secretariat, about the time frame and location involved, well in advance off the commencement of the activities in order to prepare the necessary materials for the observer.

Jústines Olsen (Faroe Islands) informed the Working Group that in the Faroe Islands a press release describing the Scheme is issued prior to the planned observation. Jessen (Greenland) suggested that such a letter or press release should be issued twice, once as general information and once closer to when the observations are taking place.

Under this item the Working Group also discussed how the observer should handle violations, even when these are not observed directly. The Working Group agreed that all violations, real or rumoured, have to be investigated carefully before a report is filed. Jessen suggested that it would help the process of investigating violations to require the observers to date all observations made. The Working Group agreed that the Secretariat should send copies of the reports to the appropriate authorities in each NAMMCO member country.

6.2 The Faroe Islands

6.2.1 Place and time frame for Hunting Activities

This item was also covered under Item 4. The Faroe Islands reiterated that it is important for the Secretariat to have information on the most optimum time and place for hunting activities, in order to implement the Scheme the best way possible.

6.2.2 Evaluation of Observation Reports.

This item was covered under Item 4.

6.2.3 Administration
This item is in reference to the local administration of the observers. Olsen (Faroe Islands) reviewed the Scheme in the Faroe Islands. The *sysselmenn* are informed about who and when the observer is arriving in the Faroe Islands. Olsen stressed the importance of the observer having a local contact person to assist in solving the practical questions. Jessen (Greenland) explained that in Greenland it would often be necessary for the observer to hire a skiff in order to observe hunting activities. It is necessary to establish a contact person in the local municipality who can assist the observer in finding a skiff.

The Working Group recommended that the Secretariat check the insurance policy for the possibilities of placing observers on boats.

6.2.4 Other
No other matters were discussed under item 6.2.

6.3 Norway
6.3.1 Information
In order to improve the implementation of the Observation Scheme Kirsti Larsen (Norway) suggested that the Secretariat prepare an information package to be distributed by the appropriate authorities in each country to the local authorities, to the hunters, to the national inspectors and to the people being observed. The package will include information about NAMMCO, the basis for the agreement, the objectives of the observation scheme and the background and competence of the observers.

In addition, Larsen (Norway) recommended that information about NAMMCO and the Observation Scheme is provided in conjunction with the courses for the whaling crew and the whaling vessel inspectors, and at the joint courses for the sealing crew and the sealing vessel inspectors. Norway further recommended that representatives from the Secretariat and the NAMMCO observers should participate in the inspector courses. It was also recommended that the same information be given to the regional offices, Statens næringsmiddeltilsyn, veterinarians and the whale and seals processing plants.

Jessen (Greenland) suggested that the information package should also include hunting statistics and time frames.

6.3.2 Other
There were no issues under this item.

6.4 Iceland
There were no additional comments from Iceland.

6.5 Other
The Chairman suggested that the Working Group review Section B of the NAMMCO Joint Control Scheme. This was useful and led to productive discussions on many of the points in the Guidelines. Paragraphs B. 2.3 reporting of violations, and B.2.4

reports, were covered under items 6.1.2 and 4, respectively. The Working Group agreed that there were no problems associated with paragraphs B.2.5 and B.2.6. In connection with B.4.3, language competency of the observers, Jessen (Greenland) pointed out that it can be dangerous to have a person who do not speak the language, on board a vessel, in the event of an emergency.

7. RECOMMENDATIONS

The Working Group agreed to forward the following recommendations to the Management Committee:

The Working Group recommended that each member country provide the Secretariat with detailed information on hunting statistics, quotas, and time frames and places for the most optimum areas of observation.

The Working Group recommended that each member country provide the Secretariat with names of contact persons in each location, for the Secretariat and for the observers.

The Working Group recommended that general information about NAMMCO and about the Observation Scheme be given to the appropriate people and authorities in the member countries. This information should be translated to the local languages and distributed to local officials by the central authorities.

The Working Group recommended that the observation reports are short, concise and formal. They should only contain information on time frame, type of instruction prior to observation, area, violations, and the type of observation activity.

The Working Group recommended that the observers were made anonymous before the reports are published.

The Working Group recommended that comments by each member country to the respective reports must be received by the Secretariat within a month after the reports are issued.

8. ADOPTION OF REPORT

The report of the Working Group was adopted by correspondence after the meeting. The Chairman thanked the Working Group for participating and the Greenland Home Rule Government for providing the facilities and lunch.

SECTION 3 - SCIENTIFIC COMMITTEE

3.1
REPORT OF THE EIGHTH MEETING OF THE NAMMCO SCIENTIFIC COMMITTEE

Akraberg, Faroe Islands, 13 - 16 June 2000

1. CHAIRMAN'S WELCOME AND OPENING REMARKS

Chairman Mads Peter Heide-Jørgensen welcomed the members of the Scientific Committee to their 8th meeting (Appendix 1). He noted that the past year had seen the departure of one of the founding members of the Scientific Committee, Jóhann Sigurjónsson, and his replacement by Droplaug Ólafsdóttir. In addition Christian Lydersen, who could not attend the meeting, had replaced Lars Folkow.

2. ADOPTION OF AGENDA

The agenda (Appendix 2) was accepted with no changes.

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 1999 from the Faroes, Iceland, and Norway were submitted to the Committee. The National Progress Report from Greenland was not available.

4.2 Working Group Reports and Other Documents

Working Group Reports and other documents available to the meeting are listed in Appendix 3.

5. COOPERATION WITH OTHER ORGANISATIONS

5.1. International Whaling Commission

Nils Øien reported from the annual meeting of the International Whaling Commission Scientific Committee (IWC/SC) held in May 1999. The IWC/SC had considered the following issues of concern to the NAMMCO Scientific Committee:

- The Catch Limit Algorithm had been re-programmed under the auspices of the Norwegian Computing Centre, and the revised program will be re-tuned by the IWC Secretariat in time for the next meeting of the IWC/SC.
- The theoretical aspects of combining partial abundance estimates for a single stock area over several years were considered.
- A working group established with the task of seeking an operational definition of stock continued its work.

- A new abundance estimate for the Central Small Area around Jan Mayen Island for 1987 was accepted by the IWC/SC.
- The status of beluga and narwhal worldwide was reviewed. Stock structure was identified as the most important question for these species. Concerns were expressed about the decline of beluga in West Greenland and other areas.
- By-catch mitigation methods were reviewed.
- A Greenlandic research program to conduct abundance surveys for minke and fin whales were reviewed, and will be further developed for the next meeting.
- The Pollution 2000+ program, which aims to assess the effects of various pollutants on cetaceans using harbour porpoise and bottlenose dolphins as model species, was accepted.

The question of potential involvement in the latter program by the NAMMCO Scientific Committee was considered. Some scientists from NAMMCO member countries are already involved in the program, and it was generally agreed that the NAMMCO Scientific Committee could add little to the program by becoming officially involved. It was therefore decided to monitor developments in this area but not to seek direct involvement.

5.2 ICES

Tore Haug reported that the last ICES Annual Science Conference did not include programs directly of concern to NAMMCO. However, two working groups (Working Group on Marine Mammal Habitats and the Working Group on Marine Mammal Population Dynamics and Trophic Interactions) addressed questions relating to marine mammals in Baltic waters during a meeting in March 2000.

Daniel Pike noted that the ICES Working Group on Marine Mammal Population Dynamics and Trophic Interactions had provided a report from their 1998 meeting that had been utilised by the NAMMCO Scientific Committee Working Group on Marine Mammal – Fisheries Interactions in their deliberations, and that future interaction with this Working Group should be considered. Grete Hovelsrud-Broda reported that she had recently met with the new General Secretary of ICES (David deGriffith), and would soon be completing the process of establishing a Memorandum of Understanding with ICES for cooperation on scientific matters.

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

The Joint Commission has not met since 1997. The NAMMCO Scientific Committee has been tasked with providing management advice for West Greenland beluga and narwhal (see items 9.4 and 9.5). Daniel Pike noted that he had suggested a joint meeting between the NAMMCO Scientific Committee Working Group on Narwhal and Beluga and the Scientific Working Group of the Joint Commission. This proposal, however, was not accepted. The Canadian Department of Fisheries and Oceans has since denied permission to Canadian scientists to participate in the NAMMCO Working Group.

The Scientific Committee noted that this situation was not conducive to scientific cooperation and progress on this matter, and urged the Council of NAMMCO to come to a cooperative agreement with the Joint Commission.

6. INCORPORATION OF USERS KNOWLEDGE IN THE DELIBERATIONS OF THE SCIENTIFIC COMMITTEE - REPLY FROM COUNCIL

At its 8th meeting in Oslo in September 1998 the Council recommended that the Scientific Committee should 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. At its 9th meeting in Akureyri in October 1999 the Council endorsed the proposals and provided some guidance for the Assessment Committee working with the Minke Whale Stock Status Report:
”... the proposed Assessment Committee should carefully prepare for the meeting on the “Draft Minke Whale Stock Status Report”, and in particular work with the Secretariat with respect to the following questions:

- Define areas and type of information subject to dialogue between scientists and minke whale hunters
- Should the scientists meet minke whale hunters from all interested countries at the same time, or should there be meetings between scientists and minke whale hunters in each of the interested countries?
- Time and venue for meetings
- Papers to be distributed before the meetings
- Language / interpretation
- How to select hunters with relevant knowledge
- Planning of questions to be asked to hunters.

The Scientific Secretary reported that little progress had been made on this item since the Council meeting. Discussions have been initiated with hunter organisations in Norway and Greenland regarding their participation in a minke whale assessment group, but no formal planning decisions have yet been made. It is anticipated that the minke whale assessment process will be formally initiated sometime in 2000.

7. UPDATE ON STATUS OF MARINE MAMMALS IN THE NORTH ATLANTIC

At its 5th meeting in 1997, the Scientific Committee agreed that the “List of Priority Species” should be replaced by a new document, entitled ”Status of Marine Mammals in the North Atlantic”. The new document would incorporate status information on all marine mammal species in the North Atlantic. At its 7th meeting in 1999, the Scientific Committee agreed that the Secretariat should proceed with the development of this report, with priority given to the eight species (minke whale, fin whale, walrus, pilot whale, bottlenose whale, beluga, narwhal, ringed seal) for which the Scientific Committee has generated advice. It is planned that these documents will be translated as appropriate and circulated to hunters’ organisations in member countries for their comments and incorporation of hunters' knowledge (see Item 6). Once the final versions are ready, they will be published by one or several means, most likely on the NAMMCO Web Site and as a brochure.

The Scientific Secretary noted that draft stock status reports have been completed for minke whales and pilot whales. Both reports are under review by the Scientific Committee, and should be formally approved as soon as possible. Progress on these reports has been slower than anticipated because of competing priorities. However at least two more reports should be completed by year-end.

Noting the importance of these reports in addressing agenda item 6, the Scientific Committee agreed to complete their review of the two draft stock status reports before 1 July 2000. The Committee also directed the Scientific Secretary to complete reports on ringed seal and walrus as the next highest priorities.

8. ROLE OF MARINE MAMMALS IN THE MARINE ECOSYSTEM

8.1 Economic aspects of marine mammal-fishery interactions

At its 8th meeting in Oslo in September 1998 the Council requested that the Scientific Committee should investigate the following economic aspects of marine mammal-fisheries interactions:

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 input for the models;

iii) to discuss specific cases where the present 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?

At the Seventh Meeting of the Scientific Committee in April 1999, the Committee decided to reactivate the Working Group on the Economic Aspects of Marine Mammal - Fisheries Interactions to deal with this request. It was agreed to separate the request into two sections. At the first Working Group meeting items i) and ii) were to be considered, while treatment of item iii) was to await the conclusions on the first two. The Working Group met in Copenhagen 16-17 February, 2000, and their report is included as Annex 1.

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. While point estimates of abundance are available for some species in some areas at certain times of the year, data on seasonal distribution is lacking for all species and areas. Diet can be variable within and between years for some species, and more data are needed to derive predation functions to link diet composition to prey abundance. Energy consumption can be described generally through allometric relationships, but many of these species concentrate their energy consumption over relatively short periods of the year, and data describing this seasonality is lacking for most species. It is necessary to explicitly describe the uncertainty inherent in consumption estimates, but this is not possible with the data currently available. The quality of the data necessary to estimate consumption is generally highest for minke whales and harp seals in the Barents and Norwegian Seas, pilot whales around the Faroes and for harp, hooded and grey seals off south-eastern Canada.

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. Harp seals and minke whales are the most important marine mammalian consumers of fish in the Barents and Norwegian Seas. Minke whales are likely the most important consumers around Iceland, although the data on diet composition are very limited. Dolphins of genus *Lagenorhynchus* are likely of importance also, but there are too few data on abundance, distribution and diet to assess this quantitatively. The harp seal is the most important consumer in most areas of Greenland, but here data were again too sparse to derive reliable quantitative estimates. Harp seals are the most important pinniped predator off southeastern Canada, but the importance of cetaceans in this area has not been assessed.

In addition to these species that undoubtedly are important because of their large consumption, there are also species that might be in more direct conflict with fisheries, because of their consumption of valuable fish species of commercial size. The hooded seal is known to be in this category, but both narwhal and sperm whales are also known to eat commercially interesting fish. This potentially makes narwhal important consumers in Baffin Bay, and sperm whales so in the Norwegian Sea, but no data on their diets are available from these areas. Killer whales appear to be important predators on herring in Icelandic and adjacent waters and humpback, pilot and sperm whales may also be important consumers of commercial fish species.

Consumption by marine mammals was similar to fisheries landings in some areas. While this does indicate that there is at least a potential for interaction between marine mammal predation and fisheries, the magnitude of marine mammal predation must be put into the context of total natural mortality for the target species. For example, while minke whales and harp seals may be important predators on cod and capelin in some areas, cod are likely of far greater importance as predators on both fish species.

Multispecie 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, and preliminary investigations in this area have already been conducted. Furthermore, such models can be linked to fisheries economic models to assess the impact on fisheries. The Working Group concluded that, for certain selected areas and species, there were sufficient data on marine mammal consumption, stock dynamics of prey species, and the economics of the fisheries themselves, to make this a realistic proposition.

The Scientific Committee therefore recommended that the next logical step in addressing the request from the NAMMCO Council should be for NAMMCO to lead or assist in the development of a multi-species-economic model for a candidate area. A subcommittee of the Working Group could be tasked with developing the specifications for such a model. The candidate species/areas identified, in order of preference, were:

1. Consumption by minke whales and harp seals in the Barents and Norwegian Seas. Likely fishery interactions are with capelin, herring and cod. The major information gap identified is likely the lack of predation functions applicable under various conditions of prey availability.
2. Consumption by minke whales around Iceland. Likely fishery interactions are with capelin and cod. The major data gaps identified were a lack of area- and season- specific diet data for minke whales, and a lack of data on energy consumption by minke whales. However, this last could likely be addressed with data from other areas.

The Scientific Committee reiterated that the estimation and model uncertainties are such that definitive answers to part iii. of the request from the Council, to quantify the economic aspects of marine mammal-fisheries interactions in candidate areas, cannot be expected in the near term.

The Scientific Committee thanked Aqqalu Rosing-Asvid for his efforts as chairman of the Working Group, and agreed to his request to select a new chairman in the near future.

9. MARINE MAMMAL STOCKS-STATUS AND ADVICE TO THE COUNCIL

9.1 & 9.2 Harp and hooded seals

Ecological studies in the Nordic Seas

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. A research cruise to the pack-ice in the Fram Strait between approximately 82°27’ N; 33°00 E (north of Kvitøya) and the Greenland east coast was performed in the period 23 September - 12 October 1999. Biological material for studies of feeding habits, nutritional status, lipid contents, age, reproduction, genetics and pollutants were collected from both harp and hooded seals in the area

The project will continue in 2000-2002, preferably (i.e., if sufficient funding is obtained) as a joint effort for the four NAMMCO-countries Greenland, Iceland, Faroes and Norway. In 2000, a research cruise to the pack ice along parts of the east coast of Greenland, will be conducted in July/August. The objective will be to obtain data on distribution, diet and body condition from the two seal species. Simultaneously, harp and hooded seals taken by local hunters in eastern Greenland

and as by-catches in other fisheries in Iceland and the Faroes, will be sampled for the same parameters in these countries.

Aerial harp seal pup surveys in the White Sea

During the 1997 and 1998 meetings of the Joint ICES/NAFO Working Group on Harp and Hooded Seals (WGHARP), it was noticed and appreciated that Russian scientists had made substantial efforts to obtain reliable pup production estimates for the White and Barents Sea stock of harp seals. As also stated in the 1998 report, WGHARP looked forward to seeing progress in this Russian work, including experimentation with the isohaline method as well as further analyses of the 1998 photographic survey data.

In January 2000 Russian scientists decided that new aerial pup surveys would be conducted in the White Sea during the 2000-breeding season. On several occasions the WGHARP has discussed the possibilities and indisputable advantages involved in exchange of scientists between the "harp-and-hooded-seal-counting" countries during each other's fieldwork and subsequent analyses, discussions and presentations of results. This would ensure standardisation of both the field- and analytical methods involved. For this reason Russian scientists were asked if it would be possible for Norwegian and Canadian scientists to participate in the 2000 aerial surveys, field work as well as subsequent analyses. An immediate positive answer and invitation was received, and Norway participated with four persons during fieldwork in the period 6 – 17 March 2000. Unfortunately, the intended Canadian participation proved impossible this time. Further participation by foreign guest scientists in subsequent analyses and presentation of the obtained data is planned.

The Russians decided to attempt to obtain two full independent surveys of the breeding lairs: one with helicopter and one with aeroplane. The helicopter, plane and photographic equipment applied were virtually identical to what were used in the 1997 and 1998 surveys. The base for the helicopter surveys was a small village named Zimnyaja Zolititsa north of Arkhangelsk. The helicopter survey was performed, starting in the north and proceeding south and south-westwards during the period 10-12 March, usually with two flights per day. The whole breeding area was covered with parallel transects between which the distances were 7.4 km in low density areas or 3.7 km in more densely populated areas. The weather was favourable, and an apparently good coverage was obtained using this method. Representatives of the Norwegian group participated on all flights. The aeroplane was stationed in Arkhangelsk. Using information about positions of the breeding lairs obtained during the helicopter surveys, the aeroplane aerial surveys started on 13 March with a reconnaissance flight. The first photographic survey was performed on 16 March (with Norwegian participation) during which about half of the breeding lair was covered with parallel transects with a distance of 7.5 km between them. On 18 March a full coverage photographic survey was successfully performed with the aeroplane.

The obtained full coverage, using helicopter and aeroplane independently, clearly fulfils the previous recommendation given by WGHARP that the various parts conducting research in the White Sea should combine their efforts to optimise activities and ensure that surveys, sampling and assessments are completed successfully. Presumably, the 2000 fieldwork will provide two independent estimates for which comparison would be both interesting and useful. How these new estimates relates to the 1997 (helicopter survey) and 1998 (aeroplane survey) estimates will also be of great interest. For relevant comparison, it is of utmost importance that interpretation of obtained photos is standardised.

WGHARP 2000

It is the intention of Russian scientists to analyse the data and present the results at the WGHARP meeting in Copenhagen 2-6 October 2000. The terms of references for the group at this meeting will be to:

a) complete the assessment of stock size and pup production of harp seals in the White Sea / Barents Sea and of hooded seals in the Greenland Sea;
b) assess the sustainable yield at present stock sizes for the above two stocks and provide short- and medium-term catch projections for these stocks as well as for Greenland Sea harp seals;
c) identify B_{lim}, B_{msy} and other relevant biological reference points for Greenland Sea harp seal, Greenland Sea hooded seal, and the White Sea / Barents Sea harp seals. These are parameters derived from fishery biology which pertain to the minimum stock size required to maintain a viable population.
d) examine current biological reference points used for harp and hooded seals, and consider the appropriateness of these and other possible reference points (including B_{lim} and B_{msy}) for the stocks of Greenland Sea harp and hooded seals and White Sea / Barents Sea harp seals;
e) summarise new information on predation on commercially important fish stocks by marine mammals;
f) agree on objectives and presented plans for the forthcoming Workshop on Population Modelling of Pinnipeds.

Items c) and d) are set up to provide ACFM with the information required to respond to requests for advice/information from the Joint Norwegian-Russian Commission. WGHARP will report at the 2001 Annual Science Conference and to ACFM at its October/November 2000 meeting. Furthermore WGHARP will report to the NAFO Scientific Council at its meeting in May 2001.

9.3 Harbour porpoise

In 1997, the NAMMCO Council recommended that the Scientific Committee should carry out a comprehensive assessment of the harbour porpoise throughout its North Atlantic range, to include distribution and abundance, stock identity, biological parameters, ecological interaction, pollutants, removals and sustainability of removals. 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 Scientific Committee formed a steering committee, consisting of Tore Haug, Gísli Víkingsson, Lars Witting and Geneviève Desportes who, in concert with the NAMMCO Secretariat, made the International Symposium on Harbour Porpoises in the North Atlantic a reality.

The International Symposium on Harbour Porpoises in the North Atlantic was held on board the Norwegian Coastal Steamer *MS Nordlys* enroute from Bergen to Tromsø, September 10-14, 1999. It was attended by 31 delegates from 11 countries and included 22 presentations. The Symposium agenda was structured around four theme sessions, each led and chaired by an invited keynote speaker: 1) Distribution and stock identity; 2) Biological parameters; 3) Ecology and pollutants; 4) Abundance, removals and sustainability of removals. The keynote speakers also had the responsibility of summarising the discussions around their respective themes, and synthesising conclusions and recommendations. These were presented and discussed on the final day of the Symposium. The report from the symposium is presented in Annex 2.

Both the invited review papers and many of the submitted papers are offered the possibility of being published in a separate symposium volume of NAMMCO Scientific Publications.

Distribution and stock identity

In addition to the keynote review of current and published information (by Liselotte W. Andersen), this session contained two papers, dealing with satellite tracking (in Kattegat/Skagerrak) and stock identity studies (based on material from the North Sea and Barents Sea) using genetic techniques.

<u>Movements and distribution</u>

Although the general distribution of harbour porpoises in the North Atlantic has been described, little information is available on the movements of porpoises within and between areas. Information on the extent of movements made by porpoises, whether there is any temporal variation in their movements, and whether there are differential movements made by females and males, or mature and immature individuals, is essential to understand the dynamics of the different stocks. Fortunately, recent advances in satellite telemetry have been successfully applied in several regions, allowing for an initial examination of these variables.

Available data has revealed that porpoises are capable of extensive movements in the western Baltic, inner Danish waters, Kattegat and Skagerrak. Immature porpoises were observed to move from the inner Danish waters up to 800 km along the Swedish west coast to the southeast of Norway during April-July. Mother/calf pairs tagged in the same area moved back and forth along a 100 km coastline of west and north Sjælland in Denmark. Adult males were observed to be more stationary than the adult females and the immature animals, staying within an area of a few kilometres for several weeks during April-June and November-December. Only immature porpoises entered the northern Kattegat and Skagerrak. Contact was maintained with the porpoises throughout the reproductive season from late March to early December. The adult animals stayed within the inner Danish waters and the western Baltic in the period of contact, suggesting that these areas contain animals from the same breeding stock.

Preliminary results from yet unpublished experiments have revealed that three adult harbour porpoises tagged in Varangerfjord in northern Norway have exhibited extensive movements both along the Russian coast and into the Barents Sea.

Data on the movements of harbour porpoises on the east coast of America are also available from satellite tagged animals.

Stock Identity

Genetic techniques have been widely used in studies of population structure in a variety of species including cetaceans. Within the last decade, genetic techniques have provided valuable information regarding harbour porpoise population structure. Unfortunately, there has been an inconsistent application of diverse techniques, such as RFLP analysis of mtDNA, sequencing of mtDNA, isozyme electrophoresis and microsatellites, in the different areas. This means that a valid comparative analysis between nearby areas, which would contribute to a more coherent picture of the harbour porpoise sub-populations/populations, cannot be performed. Nevertheless, the population genetic studies applied in the different regions do to some extent support the existence of genetically different harbour porpoise sub-populations/populations in the North Atlantic.

Although the International Whaling Commission (IWC) has divided the North Atlantic into 13 putative sub-populations, several new studies suggest that a revision of this putative structure is required. In the Northeast Atlantic it has been suggested that the North Sea may be divided into a northern and southern region. Further, it has been suggested that the northern North Sea may have an east-west division where porpoises may be associated with the coasts of either Scotland or Norway. If females are more philopatric than males, then such a division in stocks may be maintained in spite of high probability of offshore mixing.

Some confusion about the definition of the North Sea and inner Danish Waters (IDW) exists. Previously, Skagerrak was included in both the North Sea and the Baltic Sea. More recent population genetic studies includes the Skagerrak in the North Sea and not in the inner Danish waters, and distinguish between the IDW and the North Sea. Another recent study detected significantly different haplotype frequencies between samples from the Kattegat-Skagerrak area, the Swedish Baltic Sea and the Norwegian west coast, but it was not clear whether the Kattegat-Skagerrak sample was considered to represent the North Sea or the inner Danish waters or Swedish waters. In the latter case, 2 different sub-populations within the Kattegat, Skagerrak and Belt waters was indirectly assumed, i.e. a Swedish Baltic and a inner Danish water or Swedish water sub-population.

In Icelandic, Faroese, Iberian and West African waters, no genetic population structure studies had been applied to test the proposed population structure model of harbour porpoises in these regions.

In the discussion under this item, some points were raised: 1) That there is a great need for cooperation between jurisdictions for both genetic and satellite tracking studies; 2) That there is a need for ways of combining various types of data (e.g. data from tracking, genetic and contaminants studies) to get a better picture of stock identity and boundaries; 4) That there is a need for a coherent theoretical framework for analysing stock identity and determining sustainability.

Biological parameters
There were six papers presented in this session, covering aspects of reproduction, growth and life history. The keynote paper (by Christina Lockyer) presented a review of current and published information. Further, new information was provided on parameters for harbour porpoise from Iceland, West Greenland and Denmark. A summary of the most current biological parameter data is provided in the Table 1 of Annex 2.

The following points were raised in the discussion under this item: 1) That the possibility of determining sexual maturity from biopsy samples be thoroughly investigated, as this would aid greatly in determining the structure of wild populations; 2) Satellite tracking of instrumented mother-calf pairs may give information on maximum duration of lactation - however genetic samples must be collected to confirm the mother-calf relationship.

Ecology and Pollutants
Seven papers were presented under this session, covering items such as health status, pollution, fatty acid compositions, diets, parasites and echolocation. The keynote paper (by Arne Bjørge) presented a review of current and published information on habitat use, trophic ecology and contaminants.

Harbour porpoises are inhabitants of coastal waters and their habitat includes some of the most polluted waters of the North Atlantic. Harbour porpoises have a small body size, and therefore a relatively high metabolic rate, and they feed at high trophic levels. These three factors combine synergistically to place the species in an ecological situation where it is highly exposed to environmental contaminants.

Harbour porpoises are most frequently observed in areas with water depths of less than 200 m. This is confirmed by the recent findings on the distribution and movements of animals equipped with satellite-linked tags. However, harbour porpoises have also been observed over deep oceanic waters during offshore sighting surveys.

Harbour porpoises feed at or near the seabed, and benthic fish species constitute a large proportion of their diet. Temporal and spatial changes in diet compositions have been observed. These changes possibly reflect seasonal changes in the relative abundance of prey stocks, and differences in prey communities according to local bathymetry and other environmental factors. Even though harbour porpoises forage almost exclusively on fish, a wide range of fish species are represented in the diet. Fish in general have little capacity to metabolise some important pollutants, such as organochlorines, and therefore act as an effective mechanism in the transfer of pollutants to piscivorous marine mammals such as the harbour porpoise.

Some of the classical organochlorines, such as PCB’s, are still abundant in the marine biota, and represent a continuing health hazard for top marine predators. Harbour porpoises feed at approximately the same trophic level as grey and harbour seals and white-sided dolphins. In Norwegian waters, the foraging habitats and diets of harbour porpoises and harbour seals overlap almost completely. However, mean levels of total PCB and DDT in harbour porpoises were 2-3 times those of harbour seals from the same areas, possibly reflecting a poorer capability of harbour porpoises to metabolise these compounds. Gradients in levels of organochlorines in harbour porpoises have been observed over short distances both in the Northwest and Northeast Atlantic.

Recent deployments of satellite-linked transmitters on harbour porpoises revealed large variability in individual movement patterns and habitat use. Some individuals travelled long distances in short periods of time (at the scale of hundreds of kilometres) between foraging sites. This underlines the importance of careful consideration of spatial and temporal scale in studies of harbour porpoise habitat use. Knowledge of habitat use is a prerequisite for an improved understanding of exposure to pollutants, and the pathways of compounds from the environment to the tissues and organs of the harbour porpoise.

Abundance, removals and sustainability of removals

There were four papers presented in this session, covering issues such as habitat-related management in the Northwest Atlantic, status in the Baltic, and experiments and action plans aimed to reduce by-catches in fisheries. The keynote paper (by Garry Stenson) presented a review of current and published information.

<u>Stock Identity</u>

In order for stock assessment and management to be effective, it is necessary to understand the relationship between animals that are being caught and the animals that are surveyed. This is particularly important for areas/stocks subject to high removals. The relationship between putative populations in one such area, the North Sea, Skagerrak, Kattegat, Belt and Baltic, is unclear.

A point raised in the discussion was that there is considerable uncertainty about the precise meanings of terms like “stock”, “population” and “sub-population”, especially as they are used by researchers in different fields and by resource managers. The Scientific Committee of the IWC established a Working Group on Stock Identity in 1998, to develop operational definitions of stock. NAMMCO should follow developments in this area. Collaborative, often international, work is required, particularly for stock identification and abundance estimation.

<u>Biological Parameters</u>

Unbiased estimates of reproductive parameters are required on a population specific basis. The extent of potential biases in reproductive parameters determined from catches should be therefore be examined. In particular, unbiased and precise estimates of survival/mortality are needed.

<u>Abundance estimates</u>

Estimates of abundance for harbour porpoise are rarely available, and the confusion over stock identity in many areas makes interpretation difficult. No estimates are available for Newfoundland, Greenland, Faroe Islands, Iberia, NW Africa, and Western UK areas. Partial estimates only are available for Baltic area. Estimates from

Icelandic and Norwegian surveys are more than 10 years old and refer to offshore populations only. Surveys from the North Sea, Kattegat and area, and Celtic Sea are now >5 years old.

In the discussion it was emphasised that abundance surveys be carried out as part of an overall monitoring strategy with clear objectives. The objectives of the strategy often help to determine the design of the surveys. Consistency is sometimes more valuable than precision when comparing a series of abundance surveys.

Removals
Estimates of anthropogenic removals are crucial, as this is usually the only parameter that can be affected by management. Yet such estimates are difficult to obtain and are unavailable for many areas. There are no quantifiable estimates of total removals for Gulf of St. Lawrence, Newfoundland, Norway, Iceland, the Baltic, Sweden, and NW Africa. Estimates of removals are available from Greenland. The North Sea, Kattegat and Irish Sea/Western UK areas have some observer coverage, but it is not complete for all fisheries. There are no recent removals off the Faroe Islands.

Estimates of by-catch may be affected by very rapid shifts in fishing effort or better methods of estimating incidental catches. It is important to involve fishermen to ensure that they understand the issue and participate in the monitoring programs. Without it there will be no acceptance of the estimates and/or mitigation methods. Projects currently underway (e.g. EPIC) may provide some methods of mitigating incidental catches.

Ecological Factors
We do not understand the relationship between environmental /ecological factors and the distribution of porpoises. Such knowledge would improve the efficiency of surveys, and might also lead to ways of mitigating by-catch. In addition, the impact of predators on porpoise population, and how changes in the abundance of predators (or prey) affect harbour porpoise population dynamics, is unknown.

Recommendations

- A standardisation of genetic techniques, for example in the use of nuclear markers and mtDNA, should be agreed upon, so that a world-wide comparison of the genetic relationships can be performed.
- It is recommended that the present satellite telemetry studies continue and that new telemetry studies are initiated in all areas where the stock structure is unclear. It is particularly important that a greater temporal range is covered.
- Results from other studies, such as geographic variation in morphometrics, pollutant levels, and fatty acids should be combined with the results of genetic and telemetry studies to provide a more complete picture of the population structure.
- The calculation of demographic parameters for all populations is recommended. Basic biological parameters are especially needed for the populations in the Gulf of St Lawrence, the Faroe Islands, Ireland and the

western UK, the Iberia / Bay of Biscay and the Black Sea (See Annex 2, Fig.1).

- There is a need for integration of research plans to consider harbour porpoise distribution, prey abundance and distribution, ecotoxicology and the biological effects of pollutants simultaneously. Such collaborative efforts will make more efficient use of data and samples. An example would be the use of distribution information from satellite tagging programs to understand exposure to pollutants.
- Current estimates of abundance and removals are absent or out of date for virtually all populations. Efforts must be made to monitor fishing effort, catches and abundance on a regular basis. These are especially critical in areas that are undergoing significant changes in fisheries or ecological conditions.

The Scientific Committee noted that the approach of holding a symposium to deal with matters that did not pertain directly to management had proven valuable in this instance. However it was considered beneficial that future symposiums should, if possible, be held in cooperation with other organisations to broaden the base of participation.

9.4 & 9.5 Beluga and Narwhal

In 1997 the Council requested the Scientific Committee to "examine the population status of narwhal and beluga (white whales) throughout the North Atlantic." The Scientific Committee convened a Working Group on the Population Status of Narwhal and Beluga in the North Atlantic, 1-3 March 1999 to address this request. In considering the report from that Working Group (NAMMCO 2000), the Scientific Committee noted that index surveys conducted in the West Greenland beluga wintering area since 1982 indicated a decline of more than 60% in abundance, and that the aggregation was likely declining due to overexploitation. The Scientific Committee found that there was insufficient information to assess the status of narwhal stocks in Greenland, but noted some concern about the aggregation in the Ummannaq area, which is subject to substantial catches in some years.

At the 1999 meeting of the Management Committee of NAMMCO, the Committee noted its appreciation for the comprehensive status reports on beluga and narwhal in the North Atlantic. The Management Committee furthermore 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 that is lacking in order to answer the same question proposed in respect to beluga. To answer this request for advice the Scientific Committee decided to arrange another meeting of the Working Group on the Population Status of Beluga and Narwhal in the North Atlantic. The meeting was held in Oslo during 15-17 June 2000 under the chairmanship of Professor Øystein Wiig. The report of the Working Group in contained in Annex 3.

Assessment of sustainable harvest levels of beluga in West Greenland

Stock structure

The evidence of a population structure of West Greenland beluga is equivocal. The seasonal pattern of beluga harvesting in West Greenland is illustrative of the temporal and spatial distribution of beluga in the area. Beluga are harvested in the Qaanaaq area (see Fig. 1, Annex 3) beginning in September. Subsequently they are harvested in the Upernavik district in October, Ummannaq in November, and in the Disko Bay settlements from November through April. There is winter harvesting in communities to the south of Disko bay as far as Maniitsoq and Nuuk. The Upernavik and Qaanaaq areas again harvest beluga on a smaller scale beginning in April. The pattern is suggestive of a southward migration of beluga along the West Greenlandic coast beginning in September, overwintering in Davis Strait to the south of Disko Bay, and a return migration to the north beginning in April. Particularly the fall migrations are often very predictable in timing.

Various studies of population structure involving satellite tracking of instrumented whales, genetics, comparisons of organochlorine profiles and tooth morphology have been conducted. All evidence suggests that beluga wintering in the North Water should be treated as a separate stock that apparently has no exchange with beluga wintering in West Greenland. All beluga that are subject to harvesting in West Greenland presumably summer in the Canadian High Arctic. For the wintering grounds in West Greenland a northern and a southern stock component has been tentatively identified with a proposed stock delineation around 67^{o}30’N. Genetic evidence does not confirm such a splitting, but organochlorine contaminant profiles and to some extent tooth morphology provides some support for it.

The Scientific Committee nevertheless concluded that there was insufficient information to divide the stocks at present, although there is some indication that such a division may be warranted. It was noted however that division into two stocks would result in a lower sustainable yield than that from the single stock situation, and that the Scientific Committee’s conclusion was not conservative in this regard. If more than one stock exists, the risk of overharvest of any one stock could be reduced by spreading the harvest throughout the present hunting area, rather than concentrating the harvest in any one area.

Harvest statistics

The data on catch statistics for beluga in West Greenland for 1862 through 1998 were reviewed. For the period 1862 to 1891 catches south of Sisimiut were assumed to consist exclusively of beluga whereas for the area north of Sisimiut it was assumed that 70% of the catches were beluga and the rest were narwhal. For the period prior to 1954, catches from Maniitsoq, Nuuk, Paamiut and Qaqortoq were excluded as these were taken outside the present range of beluga in West Greenland and may therefore have belonged to a different, now extirpated stock. After 1954, catch levels were evaluated on the basis of official catch statistics, trade in mattak (whale skin), sampling of jaws and reports from local people and other observers. Three options were given for correction of catches based upon auxiliary statistics on trade of mattak and observations of catches (low and medium options) and on likely levels of loss rates in different hunting operations (high option). The high option for the catch statistics included a correction of the drive fishery in the northern municipalities (Qaanaaq and Upernavik) with a loss factor of 10% and a loss factor in all other areas where open water hunting is practised of 30%.

It was also noted that catches in the Canadian High Arctic were high around the turn of the last century, and that some proportion of this catch may have consisted of West Greenlandic animals. However, there is no way to assess what this proportion was, and it was thought that these catches likely had little influence on the present status of West Greenland beluga.

Population Parameters

All sex and age classes of beluga are subject to harvesting in West Greenland. Sampling during ten years between 1985 and 1997 resulted in an overall mean age of 7.7 years in females and 6.5 years in males of the harvested population older than 1 year in all municipalities. In the samples more females than males were taken (712 vs. 596), but there was an equal proportion of both sexes among calves less than 1 year of age (44 females, n=89). The estimate of survival rate in West Greenland beluga is less than those determined for beluga populations in the White and Kara seas and in Alaska for comparable age truncations. Since the exploitation levels are much lower in these areas the low apparent survival rate from West Greenland is consistent with the other evidence of a population decline there. Data on population parameters for West Greenland beluga presented in Heide-Jørgensen and Teilmann (1994) were agreed to be the best available information.

Trends in Abundance

The coastal area between Disko Island and Nuuk in West Greenland has been identified as an important wintering area for beluga. To assess trends in relative abundance of beluga, visual aerial surveys were conducted over this area in March in seven years between 1981 and 1999 (see Fig.1, Annex 3). To collect data necessary to calculate corrections of animals missed by the observers or submerged during the surveys in 1998 and 1999, continuous video surveillance of the track line was conducted. No overall changes in distribution of beluga within the surveyed area could be detected and no beluga were seen in the southernmost area between Maniitsoq and Paamiut in surveys in 1994, 1998 and 1999. In 1999, reconnaissance south to Kap Farvel revealed no beluga south of the survey area. The relative abundance of beluga within the surveyed area has declined considerably since 1981 and the recent estimates indicate an abundance that is between a third and a quarter what it was in the early 1980s. When analysing the sightings as a line transect survey and correcting the abundance estimate for whales that were either submerged or at surface but missed by the observers, an estimate of total abundance of 7,941 (95%CI: 4,264-14,789) beluga wintering in West Greenland in 1998-1999 was derived.

It was noted that there was some beluga sightings at the western edge of the survey blocks in 1998 and 1999. Additionally, beluga are known to occur in small numbers north of Disko Island. This indicates that the surveys did not cover the complete winter distribution of beluga in the area, and therefore underestimate the number of beluga to some unknown degree. Compared to surveys conducted in the 1980s, the frequency of large groups (>10) has decreased, while the frequency of small groups has increased.

Assessment models

Three assessment models of the West Greenland beluga situation were examined - each approaching the assessment from somewhat different perspectives, with differences in input data and analytical methods.

The first assessment model, using the HITTER-FITTER technique and applied by Douglas Butterworth, requires, at a minimum, a single abundance estimate for a particular year and a catch series. A stock trajectory is computed to "hit" the abundance estimate given assumptions about Maximum Sustainable Yield Rate (MSYR) and certain biological parameters. The results indicate that the stock is severely depleted, ranging from a worst case ($MSYR^{1+}$=1%, lower 5%-ile of survey abundance estimate) of 6% to a best case ($MSYR^{1+}$=4%, estimated survey abundance) of 20% of pre-exploitation size. Projections with a constant catch of 100 to 700 whales per year indicated that, with $MSYR^{1+}$=1%, a catch of 100 animals per year will not allow the stock to recover, and catches of 400 and 700 animals cause extinction of the stock within 20 years. For $MSYR^{1+}$=4%, an annual catch of 100 does allow stock recovery, while a catch of 400 does not and a catch of 700 causes extinction within 20 years.

The second assessment model – the so-called Innes model developed by the late Stuart Innes - estimated stock sizes and yields for the North Water and West Greenland aggregations of beluga in a Bayesian inference framework. The population model incorporated changes in recruitment with respect to the stock's size relative to its carrying capacity. The analysis used the series of stock index surveys conducted off the west coast of Greenland (1981 to 1998), one population estimate of the combined North Water-West Greenland stocks from 1996, and a catch series from Canada and Greenland (1862-1998) to provide an estimate of yield and stock size for the West Greenland and North Water beluga stocks.

The stock size for the beluga wintering off West Greenland in 1997 was estimated as 5,230 (3,090 – 8,910, 95% Credibility Interval (CrI)) whales, which is nearly identical to the survey estimate from 1998-99. The model indicated that, projected to 1999, this stock can sustain a landed catch of about 100 whales (96; 21 – 271, 95% CrI) with a total removal (incl. losses and underreporting) of 160 (27-489, 95% CrI). The catches of beluga from West Greenland have been higher than the estimated 97.5% Credibility Level of the maximum net productivity since about 1968 when catches, or at least reports of catches increased by an order of magnitude. These catches have reduced the West Greenland stock size to about 10% of the estimated stock size in 1861.

The third assessment model – the so-called RISKASS model developed by Carlos Alvarez and Mads Peter Heide-Jørgensen - evaluated the dynamics of a discrete logistic population model to fit estimates of absolute and relative abundance from the aerial surveys from 1991 through 1999 and using catch data from 1954 to 1998.

Estimation of the intrinsic rate of increase and the depletion rate was conducted with maximum likelihood estimation and by Bayesian integration. To evaluate the effect of future catch limits, the change in population size after 5 and 10 years of harvest was measured. Two types of catch limits were applied: either constant annual removals or a harvest rate set as a proportion of the population size. The initial population size in 1954 was estimated at about 30,000 beluga. The intrinsic rate of increase was between 0.03 and 0.04. The population was consistently estimated to be under 30% of its size 50 years ago, and can be considered depleted. A high probability of extinction was calculated if harvesting continues at present levels, and even a constant catch level of 150 beluga per year resulted in a risk of 20% that the population will not recover. A catch set to be half the intrinsic rate of increase suggested a sustainable harvest of 130 beluga for the first five years and should be adjusted to new estimates of abundance thereafter. A gradual reduction of catches over 4 yrs and a constant harvest of 100 animals thereafter would have a high probability of allowing stock recovery within the next 50 years. However the uncertainty in the data is reflected in wide probability distributions for the abundance in the future, even if no catch is allowed after the gradual reduction.

Comparison of Assessment Models

The three assessment models were compared for the following key parameters:

Correction factors for surveys

This is defined as the combined effect on the survey counts of diving whales not visible to observers, and visible whales missed by observers. The estimated value from the Innes model included a correction for whales outside of the survey area. The values were very similar and it was concluded that this has a negligible influence on the conclusions of the assessment.

Killed-but-lost and underreporting

For the HITTER-FITTER and the RISKASS models, the estimates for deficiencies in the catch statistics were incorporated into the input catch series, whereas the Innes model estimated these correction factors. In comparison the correction factor derived from the model described in the Innes-model is somehow higher, but it also corrects for years in which no whales were reported killed.

Depletion rate

The estimates of depletion rate reported by the three models were very similar.

R_{max}

The estimates of R_{max}, defined as the maximum potential rate of increase of the stock, was almost identical for the Innes and RISKASS models, whereas the HITTER model resulted in lower values.

General Conclusions

All three assessment models reached the conclusion 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. While it is conceivable that the apparent depletion of the stock could have been caused by a shift in winter distribution out of the survey area, there is no evidence to support this hypothesis. The distribution of beluga in the core index survey area has not changed over the 18 years surveys have been conducted. The surveys have been extended to the south to Paamiut and Kap Farvel, but no additional animals have been found in this area. There are no observations from other sources or surveys to indicate that beluga are occurring in significant numbers outside the survey area at the time when the surveys are conducted. It was therefore concluded that the West Greenland stock was indeed substantially depleted, and that the most likely reason for this depletion was harvesting above sustainable levels, particularly over the past 40 years. No quantitative information on hunting effort was presented, but there is little doubt that hunting effort has increased over the period, with the increasing number of boats, improved communication and navigation technology and improved landing, storage and processing facilities (Statistisk Årbog 1997).

Recommendations for sustainable harvest levels

The RISKASS assessment model was used to provide estimates of sustainable yield for the stock. It was considered however that any of the three models could provide similar and valid results, and the choice of models was based on availability at the meeting.

Catches for 1998 and 1999 were not available and it was decided to allocate a catch of 700 to 1998, given that 487 were reported caught by September 1998 and additional catches could be expected after that, and to use the same catch figure for 1999. This was done to make the estimate of abundance current to 1999.

The average of the high and medium options for catch series gave an overall correction factor of 1.2 to correct for killed-but-lost whales and underreporting. It was considered that the killed-but-lost ratio might justify a higher correction factor, but it was also noted that a significant number of ice-entrapped whales were harvested periodically. If ice-entrapped whales are fated to die, their harvest should be considered a part of natural mortality, and these catches should be subtracted from the catch statistics. Thus the factor of 1.2 was chosen as a compromise between a higher catch option incorporating a more realistic estimate of killed-but-lost whales, and a medium option which did not include killed-but-lost whales.

The primary management objective identified was to arrest the decline of the West Greenland beluga, and that all catch options should be judged against this objective. It was also decided to present options incorporating a delayed or gradual reduction in the catch, since these were considered the most realistic alternatives from a socio-economic point of view and the most likely to be adopted.

Table 3 in Annex 3 shows the probability that the stock size in 2011 will be lower than the stock size in 2001 under the various catch options considered, and Fig. 2 in Annex 3 shows the probability distributions of stock size in 2011 under these options. To address the management objective of arresting the decline in beluga numbers, the best option is to cease harvesting immediately (Option 6). This guarantees that the stock decline will cease by 2011. The worst option is to keep harvesting at present or higher rates (Option 1), which will cause continued stock decline and may cause stock extinction by 2011.

It is apparent that harvest must be reduced to about 100 animals per year to have any significant chance of stopping the decline in the stock within the next 10 years. Options 3, 4 and 5 illustrate the cost or risk of delay of management action in terms of the probability of continued stock decline. For example, for Option 3, which allows a stepwise reduction in harvest to 100 animals over a 4 year period, the risk of continued stock decline is about twice as great as that for Option 4, which implements an immediate reduction to an annual catch of 100 whales. Option 5 shows the increased risk associated with delaying the implementation of harvest reduction compared to Option 3. The benefits of a delayed or graduated reduction in harvest must therefore be weighed against the increased risk of continued stock decline embodied in these options.

Population monitoring

In light of the uncertainties related to the allocation of the catch limits, it will be necessary to conduct frequent surveys to improve model predictions. It is suggested that surveys of the index area should be conducted every 5 years.

Allocation of harvest

The Scientific Committee, having decided to consider West Greenland beluga as one stock, decided that the most risk-averse option would be to distribute catches on three hunting areas and thereafter on municipalities in proportion to past catches. The suggested allocation is illustrated in Table 4 of Annex 3.

Seasonal closures

It is well documented that beluga occurred seasonally in large numbers in Southwest and South Greenland before 1930, and that the most simple explanation for the disappearance of these beluga is past overexploitation. To facilitate recolonisation of these areas, the following seasonal closures are recommended for West and Southwest Greenland:

Northern area (North of 72°00’N):	June through August
Central area (67°30’N to 72°00’N):	June through October
Southern area (65°00’ to 67°30’N):	May through October

For the area south of 65°00’N, it is suggested that no harvesting of beluga be allowed at any time.

It should be stressed that these seasonal and spatial closures will not halt or reverse the recent decline in beluga abundance, but are only proposed to promote the recolonisation of areas that were formerly inhabited by beluga.

Protection of cow-calf pairs

It was noted that the protection of cow-calf pairs would reduce the number of adult females harvested, which would assist in the recovery of the stock.

Recommendations for future research on beluga in West Greenland

The following studies will improve the assessment of beluga in West Greenland and should be given priority for completion within short-term:

- Investigate the impacts of ice entrapments on: (1) population (develop model to simulate effects on population) and (2) catch statistics (separate whales taken in ice entrapments from other harvest numbers and rerun models. Ice entrapment mortalities should be accounted for under R_{max} and not under harvest.)
- Examine the occurrence of ice entrapment events and the relationship to sea surface temperature (or other environmental factors). Are ice entrapments predictable?
- Examine past aerial survey data for: (1) detection probabilities of small vs. large pods and (2) estimation biases due to differing pod sizes among years. Re-examine the quality of the 1981 and 1982 aerial surveys. Are these surveys useful for trend analysis?
- Review results on the potential stock structure of beluga in west Greenland, specifically evaluate tooth morphology data and tagging data that will be available late in 2000.
- Models currently assume a 50:50 sex ratio in the harvest. Include data on sex ratio of the harvest in the models; evaluate results of the model and predicted impacts on the population of beluga and on recommended quotas.
- Conduct a formal and independent review of the model (formulation and estimation techniques) developed/used by Alvarez and Heide-Jørgensen in SC/8/BN/10 (RISKASS). This research is especially needed if the NAMMCO Scientific Committee will use this model or a variation in further analyses.
- Establish a method for formally collecting “anecdotal” data on beluga distribution and abundance in Baffin Bay and Davis Strait. These observations could be from surveys conducted for other projects or from local ecological knowledge.

Whereas the short-term priorities for studies could be completed in a year and could improve the assessment a number of other important studies were also identified that may need some longer time for their completion:

- Develop age-structured model and simulate impacts of deposition of 1 or 2 growth layer groups per year in beluga teeth.
- Abundance and trend estimate needed in 3 to 5 years. Next survey should include areas to the north of Disko Island and to the west of trend area. Continue to collect data as line transect and strip transect for comparison with previous years of data.
- Continue to use video for estimation of correction factors for surveys.
- Collect beluga dive data for West Greenland in March. Needed for estimating correction factors for abundance estimates.
- Further evaluate stock structure of west Greenland beluga. Determine

whether hiatus in aerial survey sightings (near 67^o 30') in March is constant from year to year and whether the hiatus could delineate distribution of different stocks.

- Determine availability of skin samples in March from areas north and south of the hiatus (near 67^o 30'). If sufficient number of samples exists then conduct genetic analysis for stock structure.
- Determination whether 1 or 2 growth layer groups (GLGs) are deposited annually in beluga teeth. NAMMCO should provide support for a planned workshop on beluga ageing techniques.
- Estimate R_{max} with life history data and evaluate impacts of deposition of 1 or 2 GLGs per year in beluga teeth.

Research needed to establish sustainable harvest levels for narwhal in West Greenland

Satellite tracking and genetic studies indicate that, in general, narwhal occupy discrete local areas during the summer, and there may be relatively little exchange between these areas. During the winter, they are more dispersed. Although the total numbers of narwhal occupying Baffin Bay and East Greenland waters may be quite large, small local aggregations may still be subject to overexploitation. This was noted as a particular concern for the Ummannaq area, where large harvests occur in some years, and to a lesser extent in Qaanaaq, Melville Bay and Upernavik. The Disko Bay area appears to be a wintering area where two or more stocks may mix.

Developing recommendations on the sustainable harvest of narwhal in Greenland will require significant additional research and cannot be done at present. However, this may become a priority, particularly in West Greenland where hunting effort may switch to narwhal because of the decline in the beluga stock. The following research priorities were developed for narwhal:

<u>Catch statistics</u>

1. Improve the collection of current harvest statistics, including information on loss rates. Loss rate may be significant in some areas and times, and all population removals must be considered in stock assessment.
2. Review historical harvest statistics, providing, to the extent possible, corrections for underreporting and killed-but-lost animals. Also, records of harvesting of ice-entrapped whales should be reviewed, and it should be determined if these should be included as removals or as a component of natural mortality. Modelling should be carried out to determine the possible effects of stochastic events such as ice entrapments on estimates of sustainable yield.

<u>Stock identity</u>

1. Sampling should be continued in hunting areas, and genetic analyses should be carried out to determine if there is annual variability in the genetic structure of narwhal in aggregation areas. This will help to determine if significant mixing between aggregation areas occurs.
2. Satellite tracking experiments should be conducted from all aggregation areas,

to determine if significant mixing between aggregation areas occurs, and to identify migration routes and wintering areas.

<u>*Abundance*</u>

1. Abundance surveys should be carried out in aggregation areas, particularly in the Qaanaaq, Melville Bay and Ummannaq areas. It will be necessary to repeat abundance surveys over several years as the numbers in an area can vary significantly from year to year.

Future work on beluga and narwhal

The Scientific Committee decided that it will be important to have another meeting of the Working Group on the Status of Beluga and Narwhal in the North Atlantic when the short-term research priorities for beluga are addressed and to review the development of the research that is needed to complete the assessment of narwhal. It was suggested that such a meeting is needed within a year.

9.5 Fin whales

At the 1999 meeting of the NAMMCO Council the following request to the Scientific Committee was adopted by the Management Committee:

"...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 Exclusive Economic Zone (EEZ) 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 EEZ waters;
- Information gaps that may need to be filled in order to complete a full assessment in this area."

To deal with this request, the NAMMCO Scientific Committee re-established its Working Group on North Atlantic Fin Whales, which met 12-13 May in Tórshavn. The report of the Working Group is included as Annex 4.

Stock structure and abundance

The Scientific Committee considered the stock structure of fin whales in the North Atlantic in some detail in 1999 (NAMMCO 2000) and noted that stock delineation was the most critical issue in fin whale assessment in the North Atlantic. While it was evident that the stock structure of fin whales is more complex than reflected by the present stock areas, the details of stock structure were not considered clear enough to identify boundaries between the different North Atlantic fin whale stocks. This applies especially for areas where there is little information on stock identity, as in the case of fin whales found in Faroese waters.

Fin whales are seen year-round in the Faroes, but there is a definite seasonal pattern to their distribution and abundance. The locations of historic catches and recent incidental observations of fin whales show the apparent seasonal changes in fin whale distribution in the area. At the beginning of the main catching season in May, whales were caught to the south. Subsequently catches were also taken west to the north-west.

Whales on the western side of the island were usually observed in waters over 500 m deep. In June-July, fin whales have been observed from the Faroe Islands to eastern Iceland. In July-August, catches were concentrated to the north and east of the isles. By October, most catches and observations were to the south-east of the Faroese plateau.

While these data show apparent seasonal migrations in the area, their interpretation requires amongst other thing information on whaling/observational effort. Some information on whaling effort might be obtained from an examination of log-books. Unfortunately, it is not possible from the information available to determine whether the animals observed off the Faroe Islands comprise a separate stock or are part of one or more larger stocks that migrate through Faroese waters.

There is virtually no other new information available on the stock structure of fin whales in Faroese and adjacent waters, and it remains the most critical issue in developing assessments of fin whales in this and other areas. Given the paucity of information with which to construct stock boundaries for the Faroese area, assessments were conducted on arbitrarily defined stock areas. It is important to recognise that these areas were not intended to be realistic alternative stock areas, but are merely areas defined to explore the dynamics of the fin whale population implied by different assumptions. The following stock areas were considered (See Annex 4, Fig. 1):

1. Faroese 200 nm exclusive economic zone (EEZ)
2. Medium Area comprised of Block A as defined in NASS-95 (see NAMMCO 1998).
3. Large Area, including the eastern part of the Icelandic area (blocks 5, 6 and 8), Block A and the West Norway area (block NSC) (see (NAMMCO 1998).

Abundance estimates for the Medium and Large areas were available from the NASS 87, 89 and 95 surveys, and were calculated from published sources. For the Faroese EEZ, estimates were calculated by applying density estimates of block A as defined in NASS-95. This estimate is based on the assumption of an even density of fin whales in block A. It would have been more appropriate to conduct a restratification of survey data for this specific area, however time restrictions did not allow this to be carried out.

Catch data for fin whales was kindly provided by the IWC from their catch dataset, and sensitivity analyses were conducted under different assumption about struck and lost whales.

Assessments

It was decided to base assessments on the HITTER-with-fixed-MSYR approach (see below). This requires a single abundance estimate for a particular year, which a stock trajectory is computed to “hit”. Given that three abundance estimates are available, it was agreed that the HITTER assessments would be based on an average of the three results taken to pertain to an intermediate year (1991). An inverse variance weighting approach was used, effected by weighting the logs of the abundance estimates by the squared inverses of their CV's in the weighting process.

The results indicated that the current status of the Faroese fin whale resource ranged from a worst case (Faroese EEZ, $MSYR^{1+}$=1%, lower 5%-ile of average of survey abundance estimates) estimate of depletion of 0.04 to a best case of 0.29 (Large Area, low harvest assumptions, $MSYR1^{+}$=4%, weighted average abundance). Thus under any of the scenarios considered here, the extent of depletion is substantial. The corresponding "worse-to-best" range of current replacement yield estimates is from 5 to 257.

In considering these results the Scientific Committee noted that in the worst case projections considered, combinations of extreme assumptions on MSYR (1%), stock area (Faroes EEZ) and abundance were used. Combining extremes in this manner makes for a scenario that is highly improbable. Nevertheless, even for higher MSY rates, the resource was estimated to be substantially depleted (<30%) for all cases considered.

The Scientific Committee also noted that the larger areas considered were not intended to reflect the only plausible stock hypotheses. For example, it is possible that the Faroese catch may have come from a stock that extends over a larger area that includes all or part of the East Greenland-Iceland stock area. If such was the case, the extent of depletion would not be nearly so substantial as suggested here. Unfortunately, presently available information did not allow the Scientific Committee to rule out even the least optimistic stock area scenarios.

Conclusions

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 strongly recommends that a research programme is undertaken to elucidate the stock structure of fin whales in this area. Highest priority should be given to the determination of whether the animals found in Faroese waters comprise a separate local stock. Under this scenario, the results reveal a severely depleted (11% or less of initial) stock, that even with no catches would take over 20 years, and perhaps much longer, to recover to half its initial estimated abundance.

It should be recognised that this represents a worst case scenario. Should the research programme reveal that these animals do not comprise a separate stock, then the results from the other scenarios show that the depletion level would not be so great. However, a reliable assessment would require elaboration of the relationship of fin whales found in Faroese waters to those in adjacent waters.

Recommendations for future research

1. Biopsies should be collected in Faroese and adjacent waters for studies into stock structure using a suite of genetic methods as well as analyses of pollutants, fatty acids and stable isotope profiles. Within season sampling is particularly important in attempting to determine whether fin whales found in Faroese waters comprise a separate local stock. A biopsy sampling component should be added to ongoing and planned sightings surveys in Faroese and nearby areas.
2. Recent advances in satellite tracking technology suitable for large whales will likely make this technique useful and cost effective in studies of stock delineation. Satellite telemetry may prove particularly useful to discriminate between the many plausible interpretations of seasonal fin whale distribution around the Faroes.
3. Careful examination of Faroese catch records is encouraged as these may help to discriminate between the different scenarios examined at this meeting as well as resolve the discrepancies between the catch data supplied by the IWC and that derived from Faroese archival sources.

9.6 White-beaked, white-sided and bottlenose dolphins

At its 8th meeting in Oslo in September 1998 the Council recommended that the Scientific Committee should undertake an assessment of distribution, stock identity, abundance and ecological interactions of white-beaked and white-sided dolphins in the North Atlantic area. The Scientific Committee responded in 1999 by concluding that there was insufficient information on stock structure, abundance and feeding ecology to carry out a meaningful assessment of these species at that time.

In 1999, the Council tasked the Scientific Committee with facilitating 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 sampling in other areas.

Furthermore, the Council agreed that, in connection with the updated request for advice from the Scientific Committee on white-sided and white-beaked dolphins, that bottlenose dolphins also be included in this assessment.

Members of the Scientific Committee reported on progress in research on these species from their respective member countries.

Sightings surveys

Sightings surveys have been planned and conducted for specific target species, and the target species have varied by member country. The target species influences the design of the survey, and if a survey is optimised for a certain species, it will not be as effective for others. In some instances, it may be impossible to derive reliable estimates of absolute abundance for non-target species.

The Norwegian components of the NASS surveys have been optimised for minke whales. The surveys were conducted in passing mode, so the identification of individual dolphin species was usually not possible. It will not be possible to derive estimates of absolute abundance from these data, even for the aggregated category of ”dolphins”, as the estimation of school size is not reliable for these species for surveys conducted in passing mode. However it will be possible to produce maps showing the relative abundance and distribution of aggregated dolphin species. It was considered that the results may warrant no further analysis than the distribution maps already published in NAMMCO (1998).

The target species of the Faroese component of the NASS surveys was the long-finned pilot whale. The surveys were conducted in passing mode with a random sample collected in delayed-closure mode to estimate school sizes. In most cases, dolphins were identified to species. While these data have not been analysed, it was considered important to provide distribution maps for dolphins in this area and, if feasible, to derive species-specific abundance estimates.

The Icelandic shipboard components of the NASS surveys were optimised for minke, fin and sei whales. The surveys were conducted in delayed-closure mode, but closures were not generally conducted for dolphin species. Therefore the identification of dolphins was often uncertain. Nevertheless, preliminary abundance estimates from the NASS-95 survey for white-sided, white-beaked and unknown spp. dolphins have already been published (Sigurjónsson and Víkingsson 1997).

The Scientific Committee noted that previous NASS surveys in the Faroes and Icelandic areas offered the best available opportunities to develop information on the distribution and at least relative abundance of these species. The Icelandic and Faroese members therefore agreed to provide a costed proposal to analyse these data. The Working Group on Abundance Estimates, which will meet later in year 2000 (see Item 10.2), will consider this proposal

Other research

It was noted from the outset that these species have not been of high priority for research in NAMMCO member countries. They are taken sporadically in drive hunts in the Faroe Islands, and there is some by-catch in Iceland. They are very rarely taken in Norway or Greenland, so sampling opportunities have been limited in these areas. There is very little published literature on white-beaked and white-sided dolphins, and almost nothing is known about their distribution, abundance and ecology.

In Norway, biopsies are being collected on an opportunistic basis during surveys for other species. To date, few samples have been collected, and there are no plans for analysis until sufficient numbers of samples have been collected. In Iceland, sampling has been conducted on by-caught white-sided and white-beaked dolphins over several years. It was noted that some aspects of these analyses, such as feeding and life-history studies, are nearing the publication stage. The Faroes is the only location where directed catching for white-sided, white-beaked and bottlenose dolphins is carried out, and as such could provide an excellent opportunity for sample collection.

It was noted that these species have been priority species for research in the Faroes, but that there are insufficient resources to carry out sample collection on an *ad hoc* basis.

The Scientific Committee considered that it would be difficult to co-ordinate the efforts of member countries to conduct research on these species, as the interests of member countries appeared to vary widely. Although some concerns have been expressed by the Norwegian fishing industry that small dolphins potentially compete with fisheries in some areas, the general interest in these species in Norway and Greenland is very low, and it is likely that research there would proceed very slowly. By-catch of white-sided and white-beaked dolphins in Iceland, and directed catching for white-sided, white-beaked and bottlenose dolphins in the Faroes offer better opportunities for research. The Scientific Committee therefore made the following recommendations:

1. that the analysis and publication of Icelandic studies on white-sided and white-beaked dolphins be completed as soon as possible;
2. 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;
3. that sample collection in other areas continue on an opportunistic basis.

10. NORTH ATLANTIC SIGHTINGS SURVEYS

10.1 Status of analyses and presentations of previous NASS surveys

At its 1999 meeting, the NAMMCO Council noted that abundance estimates from NASS-95 have not been completed for some species. The Council 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.

The present status of analyses and publications from NASS-95, 89 and 87 as well as West Greenlandic aerial surveys is shown in Table 1. For the most recent survey (NASS-95), only the abundance estimate for minke whales in the Norwegian survey area has been published in the primary scientific literature. Abundance estimates for some other species have been calculated and accepted by the NAMMCO Scientific Committee. For other species, no abundance estimates have been calculated or published. Abundance estimates have been published from the earlier NASS surveys for most species. Only abundance estimates for the target species (minke and fin whales) of the West Greenland aerial surveys have been published.

The Scientific Committee agreed that further analyses of the abundance of non-target species (i.e. all but minke, pilot, fin and sei whales) 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.

10.1.1 Prospects for a NAMMCO Publication of previous surveys

In 1997, the NAMMCO Scientific Committee decided to publish the major findings from the NASS-95 survey in a volume of *NAMMCO Scientific Publications* to be edited by Nils Øien and Jóhann Sigurjónsson. Nils Øien reported that the abundance estimates for minke whales in the Norwegian survey area had already been published, and it was now planned to publish the abundance estimates for harbour porpoise elsewhere.

Considering that few primary papers would be available for a volume of the *NAMMCO Scientific Publications,* the Scientific Committee now considered that there was little prospect in continuing with a co-ordinated publication of the results from NASS-95. The Committee therefore urged the relevant National Institutes to proceed with the analysis and publication of NASS-95 results through other avenues.

10.2 Co-ordination of future sighting surveys, their analyses and presentation

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. Priority species should be minke whales and fin whales, and the Council recommended 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.

The Faroes and Iceland have plans for conducting sightings surveys in 2001, with minke whales and fin whales as the major target species. These surveys were postponed from 2000 to take advantage of simultaneous surveys in adjacent areas to improve coverage. Survey design will be similar to that used in 1995, and further planning and co-ordination with other surveys is ongoing.

The Scientific Committee noted that future surveys in Norway and Greenland would be conducted according to requests set by the Scientific Committee of the IWC. However, to the extent possible, the surveys will be co-ordinated among the four NAMMCO countries. Surveys in the Norwegian area will continue with partial coverage in every year over a six-year cycle, with minke whales as the target species. The IWC Scientific Committee is developing a plan for future surveys of minke whales and fin whales in Greenland.

The Scientific Committee decided to activate the Working Group on Abundance Estimates to assist in planning and co-ordinating the surveys. In addition, the Working Group will be tasked with co-ordinating any further analysis and publication of the results from NASS-95 that is warranted. The Working Group will meet in fall 2000, and again in spring 2001 if required.

Table 1. Status of analysis and publication of results from the North Atlantic Sightings Surveys and the West Greenland aerial surveys, 1987-1995.

SURVEY	**SPECIES**	**AREA/ STOCK**	**ESTIMATE AVAILABLE ? (Yes/No Ref.)**	**COMMENTS**
NASS-95	Minke	Norwegian survey area, Northeast Atlantic stock.	Yes (Schweder *et al.* 1996, IWC 1997, NAMMCO 1998)	An estimate with CV has been accepted by the IWC Scientific Committee and by the NAMMCO Scientific Committee.
NASS-95	Minke	Icelandic and Faroese survey areas, Central Atlantic stock.	Yes (NAMMCO 1998)	The NAMMCO Scientific Committee has accepted an estimate with CV. The result has not been published in a peer-reviewed journal. Survey considered partial due to coverage and timing.
NASS-95	Fin	Norwegian survey area, North Norway stock.	Yes (NAMMCO 1998)	The NAMMCO Scientific Committee has accepted an estimate with CV. The result has not been published in a peer-reviewed journal.
NASS-95	Fin	Norwegian survey area, West Norway and British Isles stocks.	Yes (NAMMCO 1998)	As above.

SURVEY	SPECIES	AREA/ STOCK	ESTIMATE AVAILABLE ? (Yes/No Ref.)	COMMENTS
NASS-95	Fin	Icelandic and Faroese survey areas, East Greenland-Iceland stock.	Yes (NAMMCO 1998)	As above.
NASS-95	Sei	Norwegian survey area, Eastern stock.	Yes (NAMMCO 1998)	As above.
NASS-95	Sei	Icelandic survey area, Iceland-Denmark Strait stock.	Yes (NAMMCO 1998)	As above. Estimate considered partial due to coverage and timing.
NASS-95	Pilot	Northeast and central Atlantic.	Yes (NAMMCO 1998)	The NAMMCO Scientific Committee has accepted an estimate with CV. The result has not been published in a peer-reviewed journal.
NASS-95	Humpback	Northeast and central Atlantic.	No	Distribution map in NAMMCO (1998).
NASS-95	Blue	Northeast and central Atlantic.	No	As above.
NASS-95	Sperm	Northeast and central Atlantic.	No	As above.

SURVEY	SPECIES	AREA/ STOCK	ESTIMATE AVAILABLE ? (Yes/No Ref.)	COMMENTS
NASS-95	Killer	Northeast and central Atlantic.	No	As above.
NASS-95	Northern bottlenose	Northeast and central Atlantic.	No	As above.
NASS-95	Harbour porpoise	Northeast and central Atlantic.	No	As above.
NASS-95	Small delphinidae	Northeast and central Atlantic.	No	As above.
NASS-89	Minke	Norwegian survey area, Northeast Atlantic stock.	Yes (Schweder *et al.* 1997)	
NASS-89	Minke	Icelandic survey area, Central Atlantic stock.	Yes (Gunnlaugsson and Sigurjónsson 1991)	Partial for area not covered in 87.
NASS-89	Fin	Eastern Atlantic, North Norway stocks.	Yes (Christensen *et al.* 1992)	
NASS-89	Fin	Eastern Atlantic, West Norway and British Isles stocks.	Yes (Christensen *et al.* 1992)	

SURVEY	SPECIES	AREA/ STOCK	ESTIMATE AVAILABLE ? (Yes/No Ref.)	COMMENTS
NASS-89	Fin	Icelandic and Faroese survey area, EGI stock.	Yes (Buckland *et al*. 1992)	
NASS-89	Sei	Northeast Atlantic, Eastern stock.	No (Christensen *et al*. 1992)	No sightings.
NASS-89	Sei	Icelandic and Faroese survey area, Iceland-Denmark Strait stock.	Yes (Cattanach *et al*. 1993)	
NASS-89	Pilot	Northeast and central Atlantic.	Yes (Buckland *et al.* 1993, NAMMCO 1998)	
NASS-89	Humpback	Norwegian survey area.	Yes (Christensen *et al*. 1992)	
NASS-89	Humpback	Icelandic survey area.	No	
NASS-89	Blue	Norwegian survey area.	No (Christensen *et al*. 1992)	Too few sightings to derive an estimate.
NASS-89	Blue	Icelandic survey area.	Yes (Sigurjónsson and Víkingsson 1998)	Partial estimate for north of 60.

SURVEY	SPECIES	AREA/ STOCK	ESTIMATE AVAILABLE ? (Yes/No Ref.)	COMMENTS
NASS-89	Sperm	Norwegian survey area.	Yes (Christensen *et al.* 1992)	
NASS-89	Sperm	Icelandic survey area.	Yes (Sigurjónsson and Víkingsson 1998)	Partial estimate for north of 60.
NASS-89	Killer	Northeast and central Atlantic.	Yes (NAMMCO MS 1993)	The NAMMCO Scientific Committee has accepted an estimate with CV. The result has not been published in a peer-reviewed journal.
NASS-89	Harbour porpoise	Norwegian survey area.	No	
NASS-89	Harbour porpoise	Icelandic survey area.	Yes (Sigurjónsson and Víkingsson 1998)	Partial estimate for north of 60, offshore.
NASS-89	Small delphinids	Norwegian survey area.	No	
NASS-89	White-beaked dolphin	Icelandic survey area.	Yes (Sigurjónsson and Víkingsson 1998)	Partial estimate for north of 60, offshore.

SURVEY	SPECIES	AREA/ STOCK	ESTIMATE AVAILABLE ? (Yes/No Ref.)	COMMENTS
NASS-89	White-sided dolphin	Icelandic survey area.	Yes (Sigurjónsson and Víkingsson 1998)	As above.
NASS-89	Unid. Dolphins	Icelandic survey area.	Yes (Sigurjónsson and Víkingsson 1998)	As above.
NASS-87	Minke	Norwegian survey area, Northeast Atlantic stock.	Yes (Øien 1989)	Partial coverage.
NASS-87	Minke	Icelandic aerial survey area, Central stock.	Yes (Hiby *et al.* 1989)	
NASS-87	Fin	Eastern Atlantic, North Norway stocks.	Yes (Christensen *et al.* 1992, IWC 1992)	
NASS-87	Fin	Icelandic and Faroese survey areas, East Greenland-Iceland stock.	Yes (Butterworth and Punt 1992, Gunlaugsson and Sigurjónsson 1990, IWC 1992)	
NASS-87	Sei	Northeast Atlantic, Eastern stock.	No (Øritsland *et al.* 1987)	Insufficient sightings to derive estimate.

SURVEY	SPECIES	AREA/ STOCK	ESTIMATE AVAILABLE ? (Yes/No Ref.)	COMMENTS
NASS-87	Sei	Icelandic and Faroese survey area, Iceland-Denmark Strait stock.	Yes (Gunlaugsson and Sigurjónsson 1990)	
NASS-87	Pilot	Northeast and central Atlantic.	Yes (Buckland *et al.* 1993)	
NASS-87	Humpback	Norwegian survey area.	No (Øritsland *et al.* 1987)	Insufficient sightings to derive estimate.
NASS-87	Humpback	Icelandic and Faroese survey areas.	Yes (Gunlaugsson and Sigurjónsson 1990)	
NASS-87	Blue	Norwegian survey area.	No (Øritsland *et al.* 1987)	Insufficient sightings to derive estimate.
NASS-87	Blue	Iceland and Faroese survey area.	Yes (Gunlaugsson and Sigurjónsson 1990)	
NASS-87	Sperm	Norwegian survey area.	No (Øritsland *et al.* 1987)	29 sightings.
NASS-87	Sperm	Iceland and Faroese survey area.	Yes (Gunlaugsson and Sigurjónsson 1990)	Uncorrected for diving.

SURVEY	SPECIES	AREA/ STOCK	ESTIMATE AVAILABLE ? (Yes/No Ref.)	COMMENTS
NASS-87	Killer	Norwegian survey area.	No (Øritsland *et al.* 1987)	19 sightings.
NASS-87	Killer	Iceland and Faroese survey area.	Yes (Gunlaugsson and Sigurjónsson 1990)	
NASS-87	Harbour porpoise	Northeast and central Atlantic.	No	
NASS-87	Small delphinidae	Northeast and central Atlantic.	No	
NASS 87+89	Northern bottlenose	Northeast and Central Atlantic.	Yes (NAMMCO 1996)	
West Greenland Aerial 1993	Minke	West Greenland	Yes (Larsen 1995, IWC 1998)	As above.
West Greenland Aerial 1993	Fin	West Greenland	Yes (Larsen 1995, IWC 1995)	As above. Estimate considered partial due to low coverage.
West Greenland Aerial 1987 and 1988	Minke	West Greenland	Yes (Hiby *et. al.* 1989, IWC 1990)	The IWC Scientific Committee has accepted an estimate with CV.
West Greenland Aerial 1987 and 1988	Fin	West Greenland	Yes (Hiby *et. al.* 1989, Hiby and Lovell 1990, IWC 1990, 1992)	As above.

SURVEY	SPECIES	AREA/ STOCK	ESTIMATE AVAILABLE ? (Yes/No Ref.)	COMMENTS
West Greenland Aerial 1993	Minke	West Greenland	Yes (Larsen 1995, IWC 1998)	As above.
West Greenland Aerial 1993	Fin	West Greenland	Yes (Larsen 1995, IWC 1995)	As above. Estimate considered partial due to low coverage.

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 cooperation 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.

The Council asked the Scientific Committee to develop a full proposal for a scientific research program within the Scientific Committee, and to bring it to the Council for consideration at the next annual meeting. A draft proposal was developed by the Chairman and the Scientific Secretary, and was presented to the Scientific Committee as SC/8/8.

The purpose of the Science Fund would be to enable the NAMMCO Scientific Committee to conduct research projects that would assist in the deliberations of the Scientific Committee. The projects could either be directly relevant to specific requests, or of importance for the development of techniques, methods, models or background information pertinent to the work of the Scientific Committee. A project could also involve the development and formulation of a primer for a larger project. Proposals could either be developed with the involvement of Scientific Committee members, or by others at the invitation of the Scientific Committee. Uninvited proposals would not be accepted. The Scientific Committee would administer the Science Fund, and would be responsible for proposal approval, funding and project monitoring.

Applications for funding would be considered annually at the annual meeting of the Scientific Committee. Projects that were considered urgent by the Chairman could be dealt with intersessionally through conference calls or correspondence. The Scientific

Committee would evaluate project proposals against specific and listed criteria. If a member were an applicant, that member would not be involved in the evaluation of any proposals in that year.

Approved and funded projects would be monitored by a steering committee established by the Scientific Committee, which would monitor the progress of the project, make decisions about contracts and the release of funding instalments, specify the reports and reporting schedule required by the Scientific Committee, and report back to the Scientific Committee on the progress of the project. The Scientific Committee would report annually to the Council on the progress of projects supported by the Science Fund.

The Council would approve funding for the Science Fund as an addition to the Scientific Committee budget. Unused funds could be carried over from year to year. It was proposed that the initial funding level for 2001 would be NOK 1,000,000. The document (SC/8/8) also provided details of application procedures, proposal evaluation and administrative and reporting requirements.

The Scientific Committee was generally positive to the proposal for a Science Fund, and felt that it could be very useful in enabling the Scientific Committee to respond to requests from the Council in a timely and efficient manner. However, the Committee stressed that funding for the Science Fund must be in addition to the general operational budget of the Scientific Committee. With this proviso, the Scientific Committee agreed to forward a proposal for a NAMMCO Science Fund to the Council of NAMMCO.

12. DATA AND ADMINISTRATION

Storage and handling of marine mammal catch data in the Secretariat

The Scientific Secretary presented document SC/8/9, which detailed the status of catch databases held by the Secretariat.

In 1998, the NAMMCO Council agreed to instruct the Secretariat to prepare a report on the storage and handling of marine mammal catch data in the Secretariat. This report, prepared by the Scientific Secretary, outlined existing procedures for data submission and handling, and assessed the implications of different types and extent of data storage in the Secretariat.

The Council at their meeting in 1999 considered the issue. While noting the conclusion of the Scientific Committee that the Catch Database was not detailed enough for use in stock assessment, and that such data should be compiled on a case-by-case basis by national research institutes, the Council decided that a catch database should be maintained at the Secretariat. This was to enable the Secretariat to respond to enquiries about the harvesting activities of member countries. The Council further decided that the catch database be expanded to include species not covered so far, that catch data be transmitted to the Secretariat on an annual basis through the National Progress Reports.

The Scientific Committee took note of the Council decision of a continued need for catch data in the national Progress Reports.

13. PUBLICATIONS

13.1 NAMMCO Scientific Publications

The following volumes of NAMMCO Scientific Publications are presently in progress:

i. Minke whales, harp and hooded seals: Major predators in the North Atlantic ecosystem

Co-editor Gísli A. Víkingsson informed the Scientific Committee this volume was now in the final printing stage, and that it would be available within weeks.

ii. Sealworm Infections

Co-editor Geneviève Desportes informed the Scientific Committee that 8 of 10 papers have been completed and reviewed. She anticipated that the volume could be ready for publication late in the year 2000.

iii. Harbour Porpoises in the North Atlantic

Co-editor Tore Haug informed the Scientific Committee that up to 20 contributions are expected for this volume, which resulted from the recent International Symposium on North Atlantic Harbour. Some papers have already been approved and are out for review. It is expected that this volume will be ready for publication sometime in 2001.

iv. Population Status of Narwhal and Beluga in the North Atlantic

Co-editor Mads Peter Heide-Jørgensen noted that some contributions for this volume have been received and are out for review. The volume is expected to be published in 2001 or early in 2002.

The Scientific Committee considered the idea of publishing all or part of the NAMMCO Scientific Publications series on the internet. This would make the papers in the volumes available to a wider audience. However, it might also negatively affect the sale of the volumes themselves, and make their publication less viable. Also, it was noted that most authors still preferred to have their papers published in a printed format. The Scientific Committee agreed as an experimental approach to publish the titles and abstracts of the first two volumes on the NAMMCO web site, and directed the Secretariat to pursue this as soon as was practical.

14. BUDGET

The Scientific Secretary presented a draft budget for the Scientific Committee for 2000. He noted that the budget allocation of the Scientific Committee was fully committed, with the major part of the expenses attributable to the travel of invited experts to working group meetings. Any increase in the activities of the Scientific Committee will require an increase in budget allocation.

The Scientific Committee with minor changes accepted the draft budget.

15. FUTURE WORK PLANS

15.1 Scientific Committee

It was decided that Norway will host the next meeting of the Scientific Committee, at a location yet to be determined. The Scientific Committee noted that the short separation between the meetings of the NAMMCO Council in 1999 and the Scientific Committee in 2000 allowed inadequate time to respond to requests for advice from the Council. It was therefore decided that the next Scientific Committee meeting should occur in mid-September 2001, to precede the meeting of the Council.

15.2 Working groups

Working Group on the Economic Aspects of Marine Mammal-Fishery Interactions

See item 8.1.

Working Group on North Atlantic Fin Whales

This Working Group will await future requests for advice.

Working Group on the Population Status of Narwhal and Beluga in the North Atlantic

See items 9.4 and 9.5.

Working Group on Abundance Estimates

See item 10.2.

Harbour Porpoise Symposium Steering Committee

This Committee will continue to act as the editorial board for the volume of NAMMCO Scientific Publications on North Atlantic harbour porpoises.

15.3 Other matters

No other matters were identified.

16. ELECTION OF OFFICERS

Gísli Víkingsson was elected as chairman of the Scientific Committee, and Nils Øien was elected as vice-chairman.

17. ANY OTHER BUSINESS

On behalf of the Committee, the Chairman thanked Dorete Bloch for arranging to have the meeting at such a beautiful location. He also thanked the Secretariat for their assistance with practical arrangements, reporting and contributions to the meeting.

The Scientific Committee and Secretariat thanked the Chairman for efficiently leading the way through the agenda, and for his 3 years of outstanding service as chairman.

18. ADOPTION OF REPORT

The report was adopted by correspondence on 25 July 2000.

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Appendix 1 - LIST OF PARTICIPANTS

Faroe Islands
Dr Dorete Bloch
Dr Geneviève Desportes

Greenland
Dr Mads Peter Heide-Jørgensen (Retiring chairman),
Mr Aqqalu Rosing-Asvid
Dr Lars Witting

Iceland
Mr Þorvaldur Gunnlaugsson
Ms Droplaug Ólafsdóttir
Mr Gísli A. Víkingsson (Chairman)

Norway
Dr Tore Haug
Dr Nils Øien (Vice Chairman)

Ex-Officio Members
Dr Grete Hovelsrud-Broda
Mr Daniel Pike

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. Cooperation 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- reply from Council
7. Update on Status of Marine Mammals in the North Atlantic
8. Role of marine mammals in the marine ecosystem
    - 8.2 Economic aspects of marine mammal-fishery interactions
    - 8.3 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
9.4.1 Update on progress
9.4.2 Future work
9.5 Beluga
9.5.1 Update on progress
9.5.2 Future work
9.6 Fin whales
9.6.1 Update on progress
9.6.2 Future work
9.7 Minke whales
9.7.1 Update on progress
9.7.2 Future work
9.8 White-beaked, white-sided dolphins and bottlenose dolphins
9.8.1 Update on progress
9.8.2 Future work
10. North Atlantic Sightings Surveys
10.1 Status for analyses and presentations of previous NASS surveys
10.1.1 Minke whales
10.1.1.1 Minke whales in the East Atlantic (Norway)
10.1.1.2 Minke whales in central Atlantic (Iceland)
10.1.1.3 Minke whales in West Greenland
10.1.2 Fin whales
10.1.2.1. Fin whales in the East Atlantic (Norway)
10.1.2.2. Fin whales in central Atlantic (Iceland)
10.1.2.3. Fin whales in West Greenland
10.1.3 Other baleen whales
10.1.4 Harbour porpoises
10.1.5 Dolphins and bottlenosed whales (other surveys included)
10.1.6 Killer whales
10.1.7 Pilot whales
10.1.8 Other toothed whales
10.1.9 Prospects for a NAMMCO Publication of previous surveys
10.2 Co-ordination of future sighting survey, their analyses and presentation
11. NAMMCO Science Fund
12. Data and administration
13. Publications
13.1 NAMMCO Scientific Publications
13.2 Other publications
14. Budget
15. Future work plans
15.1 Scientific Committee
15.2 Working groups
15.3 Other matters
16. Election of officers
17. Any other business

Appendix 3 - **LIST OF DOCUMENTS**

SC/8/1	List of Participants
SC/8/2	Provisional Annotated Agenda (Draft)
SC/8/3	List of Documents
SC/8/NPR-F	National Progress Report – Faroe Islands
SC/8/NPR-G	National Progress Report – Greenland
SC/8/NPR-I	National Progress Report – Iceland
SC/8/NPR-N	National Progress Report – Norway
SC/8/4	Status of Marine Mammals in the North Atlantic – Update
SC/8/5	Report of the Scientific Committee Working Group on the Economic Aspects of Marine Mammal – Fishery Interactions
SC/8/6	NAMMCO International Symposium on Harbour Porpoises in the North Atlantic – Proceedings
SC/8/7	Report of the Scientific Committee Working Group on North Atlantic Fin Whales
SC/8/8	Proposal for a research fund to be administered by the Scientific Committee
SC/8/9	Catch Database – Update on status
SC/8/10	Scientific Committee – Budget 2000

Annex 1

REPORT OF THE WORKING GROUP ON THE ECONOMIC ASPECTS OF MARINE MAMMAL - FISHERIES INTERACTIONS

Copenhagen, 16-17 February, 2000

The Working Group on the Economic Aspects of Marine Mammal – Fisheries Interactions met in Copenhagen 16-17 February, 2000. The participants in the Working Group are listed in Appendix 1.

1. CHAIRMAN'S WELCOME AND OPENING REMARKS

Aqqalu Rosing-Asvid welcomed the members to the meeting (Appendix 1), and noted his pleasure at the wide array of expertise brought to the meeting. He suggested that, since he was an ecologist and felt himself less than qualified to chair some portions of the meeting, a co-chair should be elected. This suggestion was accepted and Trond Bjørndal was selected as co-chair for the Working Group.

2. REVISION AND ADOPTION OF AGENDA

The draft agenda (Appendix 2) was adopted without change. Appendix 3 provides the list of documents for the meeting.

3. APPOINTMENT OF RAPPORTEUR

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

4. HISTORICAL BACKGROUND AND THE REQUEST FROM NAMMCO COUNCIL

Grete Hovesrud-Broda, General Secretary of NAMMCO, presented SC/8/EC/19, which outlined the background and context of the present request before the Working Group.

The precursor to this Working Group was the Working Group on the Role of Minke Whales, Harp Seals and Hooded Seals in the North Atlantic Ecosystem, which met in 1996. The terms of reference of this Working Group were to report on present knowledge of the consumption by these three species in the North Atlantic, and the potential implications this might have for commercially important fish stocks.

The 1996 Working Group looked at the feeding ecology of the three species and estimated their consumption levels, cautioning that there were many uncertainties involved in the estimates. It also considered the use of a multi-species models to look at species interactions in the Barents Sea and in the 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. The Council endorsed the Scientific Committee's recommendation that it was necessary to pursue this line of study in order to better understand these effects.

As a follow-up to the 1996 request and to the results presented by the Scientific Committee, the Council, at the annual meeting in 1997, 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, the precursor to the present Working Group. This Working Group considered bio-economic models of varying complexity and ecosystems, 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.

The Council responded, at the 1998 annual meeting, by forwarding a more specific request for advice to the Scientific Committee:

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 input for the models;
iii. to discuss specific cases where the present 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?

At the Seventh Meeting of the Scientific Committee in April 1999, the Committee decided to reactivate the Working Group on the Economic Aspects of Marine Mammal - Fisheries Interactions to deal with this request. It was agreed to separate the request into two sections. At the first Working Group meeting items i) and ii) were to be considered, while treatment of item iii) was to await the conclusions on the first two.

5. CONSUMPTION BY MARINE MAMMALS IN THE NORTH ATLANTIC- AVAILABLE DATA

Consumption estimates for marine mammals in various areas of the North Atlantic were presented in SC/8/EC/4-7. In addition, SC/8/EC/9, 13, 15 and 16 gave consumption estimates for specific periods and areas. The Working Group noted that in most cases, the consumption estimates were point estimates that represented the best approximations available based upon current information, without estimates of associated uncertainty (e.g. confidence intervals). Although the amount of uncertainty associated with these estimates has not been provided, it will result in a wide range of possible consumption values.

In order to estimate consumption of prey species, data on abundance, daily energy requirements, seasonal distribution and geographical and temporal variation in the diet are required. Unfortunately, the data required to estimate consumption by these species are limited and significant uncertainty exists.

Abundance data for large cetaceans in the Northeast Atlantic are available from the NASS surveys. Estimates of the abundance of small cetaceans are not available in most areas. Information on the abundance of seal species varies greatly among regions and species. For example, estimates of the abundance of harp seals in the Northwest Atlantic and White Sea are relatively recent and precise, while that for harp seals in the Greenland Sea is out of date. For some areas and species, for example grey seals in the Faroe Islands, no estimates of abundance are available.

Although the geographical distribution of some species at specific times of the year is available, information on the seasonal distribution of most species is not. Good data on the movements of North Atlantic harp and hooded seals have been obtained using satellite telemetry but even these data are limited seasonally and for some age groups. Given the spatial variation observed in diets, changes in assumptions related to seasonal distribution can result in significant changes in estimates of consumption (e.g. Northwest Atlantic harp seals SC/8/EC/16).

Diets of marine mammals vary greatly geographically and seasonally. Although the diets of some species in specific areas are well known (e.g. minke whales in the Barents Sea, pilot whales in the Faroes), little is known about diets of most species in the majority of areas. Diet also responds to the relative abundance of prey, which can change dramatically on seasonal, annual or decadal scales. SC/8/EC/13 showed extreme shifts in the consumption by Barents Sea harp seals in response to changes in the abundance of capelin, and similar shifts have been observed for minke whales in response to changes in the abundance of herring and capelin (SC/8/EC/9). Estimation of consumption by these mammals therefore requires either long-term monitoring of diet throughout the year and study area, and/or the estimation of predation functions to predict consumption under various prey abundance scenarios. The latter approach requires the simultaneous collection of prey abundance and marine mammal diet data.

Most consumption models assume that the daily energy requirements of an individual are met. The amount of energy required can be estimated using various methods. Depending upon the assumptions used, the estimated daily requirements can vary significantly. Also, many marine mammals exhibit seasonal changes in food requirements, undergoing periods of increased consumption to store energy and periods of decreased consumption during periods of fasting. Our understanding of these seasonal variations in feeding is lacking for many species.

The calculation of the consumption of individual prey species depends on knowledge of the energy value of the prey. However, the energy content of prey species can vary greatly both geographically and temporally (Mårtensson *et al.* 1996). For example, the energy content of most species is much higher immediately before spawning than immediately after. This can greatly affect the calculation of the mass and number of prey items consumed.

These limits to our knowledge result in significant uncertainty in the current estimates of consumption for virtually all species. In some instances (e.g. abundance data based on surveys) the degree of uncertainty can be quantified while for others (e.g. seasonal distribution, diet, energy requirement, energy density of prey) the level of uncertainty cannot be estimated at this time. The degree of uncertainty associated with estimates of consumption must be quantified before these estimates can be used in multi-species and/or economic models. The Working Group therefore recommends the uncertainty associated with estimates of consumption should be quantified, and that uncertainty should be integrated in future multi-species and multi-species-economic models.

i. Northeast Atlantic- Barents and Norwegian Sea

The consumption by marine mammals in the Barents and Norwegian Seas was summarised in SC/8/EC/4 (Fig. 1). Harp seals and minke whales were clearly the most important marine mammal predators in the area, together accounting for about 70% of the total consumption by marine mammals. In addition, the quality of the available data was far better for these species than for any others. About 70% of the diet of minke whales was composed of finfish, with capelin, herring and cod being the most important species. For harp seals, about 65% of the diet was composed of finfish, with polar cod, capelin, herring and cod the most important species.

The diet composition of both minke whales and harp seals changed with fluctuations in the abundance of their major prey species. For harp seals, the disappearance of capelin was compensated for by an increase in the consumption of cod, polar cod and other fish. The occurrence of harp seal “invasions” of Norwegian coastal waters may be related to fluctuations in the abundance of capelin. During such invasions, the consumption of Norwegian coastal cod may be significant.

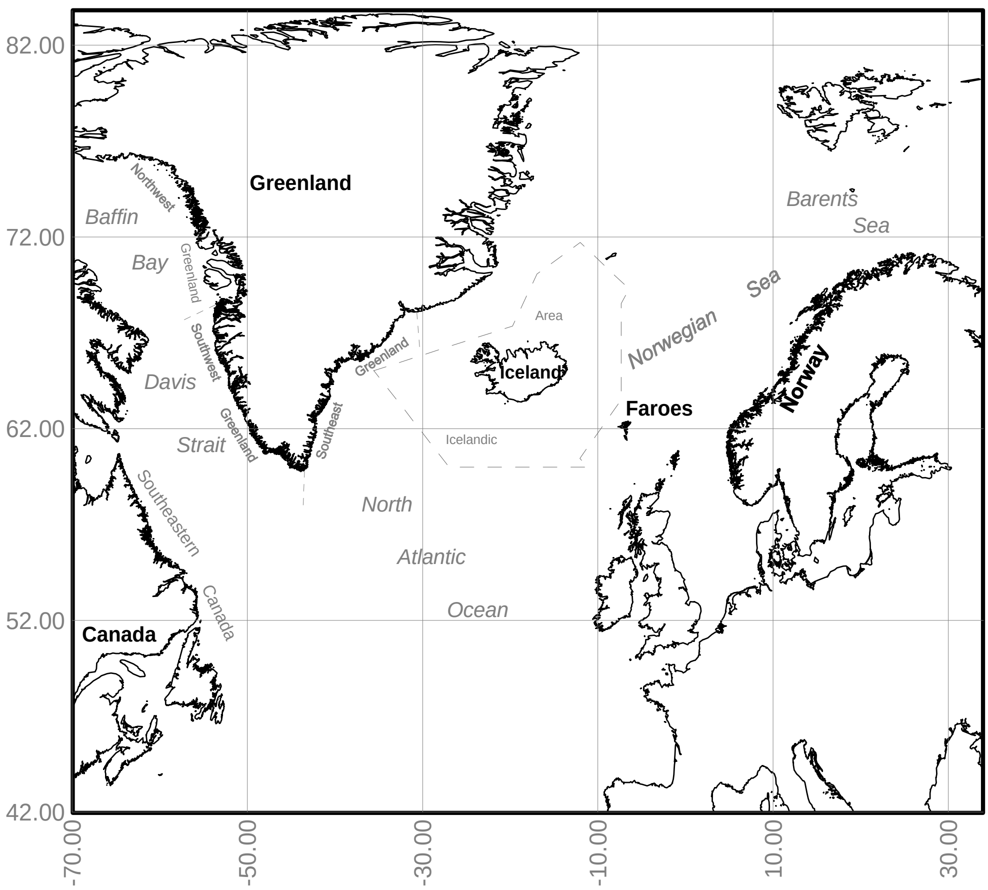
For other species, data quality was much lower and the consumption estimates were really only qualified guesses. Particularly lacking was information on seasonal distribution and diet composition for most species. Fin whales may be important consumers in the area, but finfish may comprise a minor part of their diet. Sperm whales were also identified as significant consumers, but there was no information available on their diet in this area. They consume mainly finfish around Iceland (SC/8/EC/15). Other potentially important consumers in the area included white-beaked dolphins, humpback whales and killer whales.

ii. Northeast Atlantic- Faroe Islands

The consumption by marine mammals in the area around the Faroe Islands was summarised in SC/8/EC/5. Point abundance values were available for only two species, fin whales and pilot whales. Abundance was estimated for other species by “best guesses” and by comparison with densities observed in Icelandic waters. It was noted that the abundance of several cetaceans and pinnipeds varied on a seasonal basis in Faroese waters, but no data were available to assess the magnitude of this seasonality. Consumption was calculated using methods similar to those used in SC/8/EC/6 and 15.

Bottlenose whales and pilot whales were likely the most important marine mammalian consumers in the area, feeding almost entirely on cephalopods. Pilot whales were also important consumers of finfish, as were minke whales, white-sided and bottlenose dolphins. Hooded seals may also be important consumers of finfish, perhaps even Atlantic salmon, in the area, but little is known about their seasonal abundance or diet in Faroese waters.

Fig. 1. North Atlantic Ocean, showing areas referred to in the text.



iii. Central Atlantic- Iceland

The estimates of consumption for cetaceans around Iceland (SC/8/EC/6) (Fig. 1) were based on previously published estimates (SC/8/EC/15), while those for seals were new. The Working Group noted that while the information on abundance and seasonal distribution was adequate for some species, information on diet was very limited for all species. It was also noted that there were significant discrepancies between the estimates of daily ration used in these calculations, and those used in SC/8/EC/4 and 5.

Minke whales were the most important marine mammalian consumers around Iceland, and their distribution overlapped with important Icelandic fisheries to a greater degree than most other species. Much of their consumption of finfish concentrated on capelin and sandeel while cod was also among the identified prey items. Fin whales, pilot whales and northern bottlenose whales were also important consumers, but most of their consumption was of crustaceans (fin whales) or cephalopods (northern bottlenose whale, pilot whale). Dolphins of the genus *Lagenorhynchus* were likely next in importance to minke whales in terms of their consumption of valuable fish species. It was also considered that their abundance, as that of other small cetaceans, has probably been considerably underestimated by previous surveys.

Consumption by pinnipeds was generally of far less magnitude than that by cetaceans in Icelandic waters. Consumption by harbour seals and grey seals was not of great magnitude, but they are likely of some importance in terms of their direct conflict with fishers. The seasonal distribution of hooded and harp seals in Icelandic waters is very poorly understood, so their consumption can only be very roughly estimated.

iv. Northwest Atlantic – Greenland

SC/8/EC/5 summarised consumption estimates in 3 areas around Greenland: Southwest, Northwest and Southeast Greenland (Fig. 1). The Working Group noted that information on abundance, seasonal distribution and diet was generally poor for all areas, and that the consumption estimates were generally qualified guesses that gave a qualitative indication of the relative importance of various species in terms of their consumption.

The marine ecosystem around Southwest Greenland is affected by dramatic environmental changes on a decadal scale, switching between a cold environment dominated by Arctic species to a warmer one dominated by boreal species. The area is presently dominated by Arctic species, with harp seals being far more abundant in the area than they were previously. Harp seals accounted for almost 80% of the consumption by marine mammals in the area, with most of this consumption consisting of capelin, polar cod and other small fish species. Hooded seals were of far less importance in terms of total consumption, but much of their diet is composed of valuable fish species such as cod, redfish and Greenland halibut. Minke whales were also of some importance, consuming mainly capelin in the area.

The marine ecosystem is more stable around Northwest Greenland, although fluctuations of lesser magnitude have been experienced. Once again harp seals are the most important consumers in the area, accounting for over 60% of the consumption by marine mammals in this area. Capelin, Arctic cod and other small fish species are important items in the diet, but invertebrates such as *Parathemisto* spp. and prawns may also be more important in this area. Ringed seals are next in importance in terms of consumption, with most of their diet consisting of invertebrates and Arctic cod. Hooded seals were potentially important consumers of valuable finfish such as Greenland halibut and redfish in this area, but little is known about their seasonal distribution. The area is an important wintering area for narwhal, which probably consume Arctic cod and Greenland halibut.

The Greenland Sea stock of hooded seals has a breeding and moulting concentration off Southeast Greenland, and they are likely the most important marine mammal predator in the area. Little is known about their diet, but redfish appear to be an important prey item in this area. Harp seals occur in Southeast Greenland, but virtually nothing is known about their seasonal abundance or diet. Other species such as ringed seal are likely of lesser importance in the area.

v. Northwest Atlantic – Southeastern Canada

The consumption by harp, hooded, grey and harbour seals in southeastern Canadian waters was summarised in SC/8/EC/16. Good information on abundance, seasonal distribution, energy requirements and diet was available for harp seals and grey seal. Abundance estimates for hooded and harbour seals were dated and uncertain. Little information was available on the diet of hooded and harp seals in most areas. The seasonal distribution of hooded seals was also very uncertain.

Harp seals were by far the most important pinniped predator in southeastern Canadian waters, consuming about 8 and 10 times more than hooded and grey seals respectively. Harbour seals were of much less importance. However the seal species concentrated their consumption in different areas. Harp seals consumed most in northern areas, while hooded seals were more important in the offshore area. Consumption by grey seals was concentrated in the southern part of the area.

Fish accounted for 74% of the diet of harp seals, and capelin, sand lance and Arctic cod were the most important fish species in terms of consumption. Consumption of invertebrates, mainly shrimp, by harp seals was significant and probably underestimated due to poor preservation in the stomach. A higher proportion (88%) of the diet of hooded seals consisted of fish, and Greenland halibut and Atlantic cod were the most important fish species consumed. Grey seals consumed a still higher proportion of fish (97%), eating mainly Atlantic cod and herring.

The working group noted that cetaceans such as minke whales, pilot whales, humpback whales and fin whales were of unknown but significant abundance in this area, but their consumption could not be estimated with the information available at present.

6. CONSUMPTION BY MARINE MAMMALS IN THE NORTH ATLANTIC- MAJOR INFORMATION GAPS

SC/8/EC/5-8 and 16 present consumption estimates using the best available data for marine mammals in the North Atlantic. The Working Group concluded, however, that with few exceptions, the data were not of sufficient quality to warrant their use in multi-species or multi-species-economic models. In many cases, the final consumption estimates are really no more than “guestimates”, with the magnitude of uncertainty unknown but certainly large. Table 1 presents an assessment of the quality of the data available to calculate the consumption by marine mammals in various areas of the North Atlantic.

Based on their assessment of the magnitude of consumption by marine mammals in various areas, and on the quality of the available data, the Working Group concluded that it would be most productive to focus on the consumption by minke whales, harp seals and *Lagenorhynchus* spp. (white-sided and white beaked dolphins) on capelin, cod, herring and shrimp. *Lagenorhynchus* spp. dolphins were included because of the magnitude of their consumption in some areas, however it was recognised that very little information was available about their abundance, distribution and diet.

i. Northeast Atlantic- Barents and Norwegian Sea

Table 2 shows the estimated consumption by minke whales and harp seals. Separate estimates are provided for the East Ice stock in periods of high and low capelin abundance. The Working Group concluded that there was insufficient information to calculate the consumption of West Ice harp seals and *Lagenorhynchus* spp. dolphins.

Harp seals are clearly the most important mammalian predators in these waters. Most of this predation is concentrated on capelin when it is available, but cod, herring and other species become more important in years when capelin stocks are at a low level. Minke whales prey primarily on herring, but also take significant quantities of cod and capelin.

Consumption by marine mammals is of the same order of magnitude as fishery landings. There has been no fishery for capelin in this area since 1993, however catches exceeded 1,000,000 tonnes before that time. Total landings of Norwegian Arctic Cod were between 187,000 – 771,000 tonnes from 1990-97 (Bogstad 1998), compared with total consumption by harp seals and minke whales of about 360,000-550,000 tonnes. Total landings of Norwegian Spring Spawning Herring were between 78,400 – 1,428,000 tonnes from 1990-97 (Røttingen 1998), while total consumption by harp seals and minke whales was about 800,000 – 1,000,000 tonnes

ii. Northeast Atlantic- Faroe Islands

While it was considered that consumption by minke whales and white-sided dolphins may be important in this area, there was simply too little data on abundance, seasonal distribution, energy requirements and diet to quantitatively assess consumption by these species. Consumption by harp seals is likely not significant in the area.

iii. Central Atlantic – Iceland

Consumption by minke whales and *Lagenorhynchus* spp. dolphins in Icelandic and adjacent waters is calculated in Table 3. The Working Group concluded that there was insufficient information to calculate the consumption of harp seals in Icelandic waters.

Minke whales are the most important mammalian predators in Icelandic waters in terms of ingested biomass. However the major part of their diet was made up of species other than those listed in Table 3, mainly euphausiids and sandeel (SC/8/EC/6). Minke whales also appear to consume a significant amount of capelin in Icelandic waters. While cod were a relatively minor component of the diet, preliminary assessment of multi-species interactions indicates that cod consumption by minke whales may significantly reduce the long-term yield of the Icelandic cod stock (Stefánsson et al. 1997). *Lagenorhynchus* spp. dolphins were far less important as predators than minke whales in Icelandic waters. However consumption by *Lagenorhynchus* spp. dolphins was concentrated on teleost fish, making them potentially important in terms of interactions with fisheries. Consumption of cod by *Lagenorhynchus* spp. dolphins slightly exceeded that by minke whales. Thus, according to the limited available data both minke whales and *Lagenorhynchus* spp dolphins appear to be significant consumers of cod in Icelandic waters and may be in direct competition with the fishery. In order to assess these effects with more certainty it is therefore of great importance to acquire more data on the feeding ecology of these species, in particular the diet of minke whales and the population size of the two dolphin species.

Consumption of cod and capelin by these three marine mammal predators was somewhat less than the fisheries landings for these fish species combined. Landings of Icelandic cod were between 169,000-335,000 tonnes from 1990-1998, while consumption by minke whales and *Lagenorhynchus* spp. dolphins was about 127,000 tonnes (Anonymous 1999). Landings of capelin by Iceland were between 258,000 – 1,561,000 tonnes from 1990-98, while consumption by the three mammalian predators totalled 585,000 tonnes. However other cetacean species, including humpback and sei whales, may also be important predators of capelin in these waters, so the total consumption by marine mammals might be considerably more than this (SC/8/EC/6). Landings of herring, between 65,000 – 134,000 tonnes from 1990-98, were considerably more than the estimated consumption by the three marine mammal species. However, killer whales have been estimated to consume over 100,000 tonnes of herring annually in Icelandic waters (SC/8/EC/6).

iv. Northwest Atlantic – Greenland

Consumption by minke whales in inshore and offshore areas of West Greenland is calculated in Table 4. Although harp seals are seasonally abundant in the area and their consumption is likely several times that of minke whales, there was insufficient data on seasonal abundance and diet in Greenlandic waters to estimate consumption with any degree of certainty. Consumption by *Lagenorhychus* spp. dolphins is likely not significant in the area.

Minke whales consume mainly capelin in the area, while consumption of cod, herring and shrimp is not significant. There is presently a very small fishery for capelin and cod in Greenland, and no fishery for herring. Therefore interactions between minke whales and commercial fisheries are likely of no importance in this area. However, the abundance of, and fishery for cod varies dramatically in Greenland, so such interactions may be important in the future.

7. EXISTING MULTI-SPECIES MODELS FOR THE NORTH ATLANTIC

i. Description of models

MULTSPEC

MULTSPEC is a simulation model for the Barents Sea that includes capelin, herring, cod, harp seal and minke whale (Tjelmeland and Bogstad 1998). Within the model, the Barents Sea and surrounding area is divided into 7 areas. In general the model is aggregated temporally on a monthly basis, with discontinuous processes such as reproduction handled annually. Recruitment of cod and capelin is modelled using a Beverton-Holt function, while a special function is used for herring. Migration follows a fixed pattern for all species except mature capelin, for which migration is modelled based on the observed distribution in cod stomachs.

Predation by the fish species depends on their size distributions, the relative abundance of prey, and temperature. The predation by harp seals and minke whales is modelled based on their energy requirements and their observed diets.

The model requires input data on the relative abundance and distribution of cod by size and age, and the absolute abundance and distribution by size and age for capelin and herring. Predation by cod and seasonal distribution of capelin are determined from annual sampling of cod stomachs throughout the area. The abundance and distribution of the marine mammals is based on the latest available survey data, and their seasonal distribution is modelled qualitatively. Sea temperature affects growth, maturation and predation by fish, and annual synoptic measurements are included in the model.

MULTSPEC has been used to study the effects of varying the stock size of minke whales and harp seals in the area (Bogstad *et al.* 1997). The stock of herring was found to be negatively associated with the abundance of minke whales, while the capelin stock had a negative association with the abundance of harp seals. Capelin had a positive association with the abundance of minke whales, as their abundance was strongly influenced by predation by maturing herring. The cod stock had a negative association with the abundance of both minke whales and harp seals. However, because of the aforementioned minke whale – herring – capelin interaction, the association between the cod stock and minke whale abundance was weaker than that between cod and harp seals.

It is unlikely that the MULTSPEC model will be maintained in its present form due to lack of resources. It is planned to convert the model into the same code used in

BORMICON, however it is not certain when this will be completed.

Table 1: Quality of data used to derive consumption estimates for marine mammals in the North Atlantic. Species are listed in order of the magnitude of their consumption of finfish in the area, and only those species accounting for 90% of the consumption of finfish by marine mammals in the area are listed. Quality is assessed based on the statements below:

- Estimate is biased and the direction of known bias is not known.
- Estimate does not apply directly to the entire area and/or species in question.
- Variance not available directly.
- Plausible range cannot be inferred.
- For factors subject to short-term, temporal change (e.g. abundance), estimate is not recent (<6 yrs).

**** None true.
*** 1 true
** 2 true
* 3 or more true.

Species	Abundance	Residence Time	Energy Require-ment	Diet
Barents and Norwegian Seas				
Harp Seal, East Ice	****	***	***	**
Minke whale	****	**	***	***
Harp Seal, West Ice	*	*	***	*
Sperm whale	**	*	*	*
White Beaked Dolphin	*	*	*	*
Southwest Greenland				
Harp seal, NW Atlantic	*	*	*	**
Hooded seal, NW Atlantic	*	*	*	**
Minke whale, W Greenland	*	*	**	**
Northwest Greenland				
Harp seal, NW Atlantic	*	*	*	*
Hooded seal, NW Atlantic	*	*	*	*
Ringed seal	**	*	*	**
Narwhal	**	*	*	*
Southeast Greenland				
Hooded seal	*	*	*	*

Species	Abundance	Residence Time	Energy Require-ment	Diet
Iceland and Adjacent Waters				
Minke whale	****	***	*	**
Lagenorhynchus spp.	*	*	*	**
Pilot whale	****	**	*	*
Killer whale	***	**	*	*
Humpback whale	***	***	*	*
Sperm whale	**	***	*	**
Faroe Islands				
Pilot whale	****	**	*	***
Minke whale	*	*	*	*
White-sided dolphin	*	**	*	*
Bottlenose dolphin	*	**	*	*
Hooded seal	**	**	**	*
Southeastern Canada				
Harp seal	****	***	***	***
Hooded seal	**	**	***	**
Grey seal	****	***	***	***
Harbour seal	*	***	***	**

Table 2: Consumption by minke whales and harp seals in the Barents and Norwegian Seas (Fig. 1). CV – Coefficient of Variation, NA – Not available.

Minke whale, North East Atlantic stock Barents and Norwegian Seas April 15 to October 15 Low Capelin, high herring abundance period (1992-1995[1])						
Abundance [CV]	**Residence Time (mean days/year) [CV]**	**Energy Requirement (kJ/day/ind) [CV]**	**Diet (% mass)**		**Diet (tonnes/year) [CV]**	
84,761[2] [0.131]	180[3] [NA]	618,170[4] [NAMMCO]	Cod	14	Cod	255,622
			Capelin	8	Capelin	142,408
			Herring	35	Herring	633,361
			Shrimp	0	Shrimp	0
			Others	43	Others	781,723
				[All NAMMCO]	**TOTAL**	**1,813,114**[5] [All NA]
Harp Seals, East Ice stock, Barents Sea All year Capelin abundant (period 1990-1992)[6]						
2.19[7] mill [0.09]	365[8] [NA]	25,600[9] [NAMMCO]	Cod	3.0	Cod	100,500
			Capelin	24.1	Capelin	807,800
			Herring	6.3	Herring	212,400
			Shrimp	NAMMCO	Shrimp	NAMMCO
			Others	66.6	Others	2,233,300
				[All NAMMCO]	**TOTAL**	**3,354,000**[10] [All NA]
Harp Seals, East Ice stock, Barents Sea All year Capelin depleted (period 1992-1996)[11]						
2.19[12] mill [0.09]	365[13] [NA]	25,600[14] [NAMMCO]	Cod	8.5	Cod	296,300
			Capelin	0.7	Capelin	22,900
			Herring	11.3	Herring	392,500
			Shrimp	NAMMCO	Shrimp	NAMMCO
			Others	79.5	Others	2,762,400
				[All NAMMCO]	**TOTAL**	**3,474,100**[15] [All NA]

[1] The estimated diet composition is based on stomach contents analyses of 223 minke whales sampled in Norwegian scientific whaling operations in 1992-1995.This period was characterised by low abundance of Barents Sea capelin and the highest abundance levels of herring since the late 1960'es. After a peak in the early 1990'es, most of the Barents Sea capelin stock died after spawning in 1992. Only whales sampled well after the spawning period of capelin in 1992 were included in the diet composition and energy requirement analyses in SC/8/EC/9, which is the source of information for this table.
[2] The abundance covers the three management areas EB, ES, EC ("the Greater Barents Sea"). The population estimate is based on data from dedicated shipboard surveys in 1989 and 1995 (for details see, Schweder *et al.* (1997)).
[3] The migration pattern of northeastern Atlantic Minke whales is very poorly known , but recent estimates of consumption are based on a presumed minimum residence time of 180 days in the Greater Barents Sea.
[4] This estimate is an average value based on the total energy requirements of northeastern Atlantic Minke whales from mid April to mid October calculated in SC/8/EC/9. The original estimate was stratified with respect to season and reproductive classes.
[5] As no CV's are available on energy requirements, diet composition and energy density of prey, no overall CV could be calculated for the estimated total annual consumption. However, the CV of the abundance estimate alone suggests a confidence range of the consumption estimate between 1.4-2.1 million tonnes.
[6] As no CV's are available on energy requirements, diet composition and energy density of prey, no overall CV could be calculated for the estimated total annual consumption. However, the CV of the abundance estimate alone suggests a confidence range of the consumption estimate between 1.4-2.1 million tonnes.
[7] The abundance estimate used in SC/8/EC/13 is based on an estimate of total population size given in Anonymous (1999b) corrected for a 30% pup mortality. The calculation of total population size is based on a high quality aerial survey of pup production performed in 1998 (Anonymous 1999b).
[8] According to Haug et al (1994) and unpublished satellite telemetry data (Erling Nordøy, pers. comm.) the migrations of East Ice harp seals are largely confined to the Barents Sea, West Spitsbergen and the North Norwegian coast. In the consumption model, it is assumed, that the East Ice population stays in the Barents Sea all year round.
[9] In SC/8/EC/13, energy requirements are modelled separately for different length groups in different seasons. This is in contrast to earlier and simpler studies in which an avarage individual daily energy requirement s were estimated and scaled up by the total population size and residence time to give total annual consumption. The value given here is taken from Nordøy et al (1995) and is based on average daily energy requirements of 4 bedlamers measured in captivity for 1 year. The resulting estimate of total annual consumption for the East Ice harp seal stock was 3.51 mill tonnes (No CV given).
[10] The total consumption estimate is taken from SC/8/EC/13 and is based on monthly averages for energy requirements and a multiplication factor of 2 from basal metabolic rate to field metabolic rates. No overall CV is given, since CV's for energy

requirements, diet composition or energy density of prey were not available. However, a confidence range based on the CV of the abundance estimate alone was estimated at 2.69-3.96 million tonnes, when capelin is abundant. Based on different assumptions regarding activity levels and prey availability scenarios SC/8/EC/13 suggested a range of possible annual consumption estimates between 3.35 and 5.05 mill. tonnes for East Ice harp seals.

[11] The consumption estimates are based on SC/8/EC/13. 491 Stomachs collected from October 1992 to August 1996 were used for estimating relative diet composition in a period with low abundance of Barents Sea capelin (see fig.2a).

[12] See note 8

[13] See note 9

[14] See note 10

[15] See note 11

Table 3: Consumption by minke whales and *Lagenorhychus* spp. dolphins in Icelandic and adjacent waters (Fig. 1). CV – Coefficient of Variation, NA – Not available.

Minke whale North Atlantic Central stock (part) Icelandic and adjacent waters (Fig. 1).						
All year, most abundant during summer						
Abundance [CV]	**Residence Time (mean days/year) [CV]**	**Energy Requirement (kJ/day) [CV]**	**Diet (% mass) [CV]**		**Diet (tonnes/year) [CV]**	
62,507[1] [0.28]	219[2] [NAMMCO]	710,042 (mean) 1,793,720 (summer)[3] 168,201 (winter) [NA]	Cod	3[4]	Cod	62,430
			Capelin	23	Capelin	478,630
			Herring	0	Herring	0
			Shrimp	0	Shrimp	0
			Others	73	Others	1,539,940
				[All NA]	**TOTAL**	**2,081,000** [All NA]
***Lagenorhynchus* spp. Icelandic and adjacent waters (Fig.1). Throughout the year.**						
76,635[5] [NA]	365 [NAMMCO]	L. acutus: 51,297 Unidentified: 68,619[7] L. albirostris: 86,192 [NA]	Cod	20[6]	Cod	64,739
			Capelin	33	Capelin	106,820
			Herring	0	Herring	0
			Shrimp	0	Shrimp	0
			Others	47	Others	152,137
				[All NA]	**TOTAL**	323,696 [All NA]

[1] From SC/8/EC/15.
[2] Calculated from migration curves given in SC/8/EC/15.
[3] Different summer and winter feeding rates (SC/8/EC/15).
[4] Based on a small sample size (n=68), no CV available.
[5] These calculations are based on SC/8/EC/15 except that lower body weight has been applied to *L. acutsus* (Bloch pers. communication).
[6] Around 1/3 of gadoids assumed to be cod. A guestimate.
[7] Unidentified dolphins assumed to be equal numbers of *L acutus* and *L.albirostris*

Table 4. Consumption by minke whales in Greenlandic waters (Fig. 1).

Abundance[1] [CV]	**Residence Time[2] (mean days/year) [CV]**	**Energy Requirement (kJ/day)[3] [CV]**	**Diet[4] (% mass) [CV]**		**Diet[5] (tonnes/year) [CV]**	
Minke Whale West Greenland stock West Greenland May – October 1987/88						
3266	180	1,227	Cod	1	Cod	1,434
			Capelin	70	Capelin	100,409
[.31]	[NAMMCO]	[NA]	Herring	0	Herring	0
			Shrimp	0	Shrimp	0
95% CI			Others	29	Others	41,598
1702-5718				[All NA]	**TOTAL**	143,441 [All NA]
Minke Whale West Greenland stock (inshore) West Greenland May – October 1993						
5619	180 days/year	1,227	Cod	1	Cod	2,468
			Capelin	70	Capelin	172,751
[.36]	[NAMMCO]	[NA]	Herring	0	Herring	0
			Shrimp	0	Shrimp	0
95 % CI:			Others	29	Others	71,568
2815-11214				[All NA]	**TOTAL**	246,787 [All NA]

[1] Minke whale abundance surveys Off West Greenland hav been carried out during ten summers (1982-85, 1987-89, 1991-93) by the Greenland Fisheries Research Institute in co-operation with foreign research agencies (Born 1999). The first two attempts were ship-borne surveys, while the remaining surveys were airborne. Of the ten attempts only two were relatively successful (1987/89 & 1993) (Born 1999). The abundance estimates used in the following two tables are from Hedley *et al.* (1997) and they are based on cue counting with a surfacing rate of 53 surfacing per hour. In 1993 an estimate of 5619 minke whales was found in the coastal area (CV 36% and 95% CI 2815-11214) whereas an estimate of 6385 was found when an offshore block

was included (CV 41%, 95% CI 2942-13855). Only the coastal estimate is used here because no new data on prey selection in offshore waters are available.

[2] Residence time is estimated as 180 day (from May to October). Catch records shows that the first minke whales are caught in April, but the number of catches and probably also the number of whales increases until June. From early October the catch-number starts to decrease, but some whales are caught until December.

[3] Energy requirement is estimated as four month of summer and two month of winter energy consumption, using the consumption rates from SC/8/EC/15. This gives a mean of 299.2 Kcal / day (1,227 KJ) in the 6 month period.

[4] Diet (% mass / day) is data from hunter's reports (n = 563) from the period 1992-96 (Neve 2000). The distribution of the samples is not adjusted to match the distribution of the whales, which only is known at the time of the survey. Capelin is the dominant prey species and this was also the case in a similar dataset from 1955-79, although krill seemed to be more important by then (Larsen and Kapel 1981). Greenlanders kill their minke whales close to the coast and the diet data therefore only represents the consumption in coastal waters. Data from the Norwegian whaling in the offshore area during 1979-81 found sand eel to be the most important prey item here (Larsen and Kapel 1981, 1982).

[5] Diet kg / year is found with the assumption that 80% was fish with the conversion factor 1.3 kcal/g (Steimle and Terranova 1985) and that the rest was crustaceans with a conversion factor of 0.93 kcal/g (Lockyer 1987). This gives mean food consumption with a conversion factor of 1.226 kcal/g and a mean daily consumption of 244 kg.

AGGMULT

AGGMULT is a simplified and highly aggregated version of MULTSPEC that has been used in combination with the economic model ECONMULT to study the economics of Barents Sea fisheries under various management regimes. However, the interactions with marine mammals have not yet been considered in these models.

BORMICON

Bormicon (Boreal migration and consumption model) was developed at the Marine Research Institute in Iceland as an assessment tool in which species interactions and spatial effects could be taken into account. The modelled species are divided according to area, age and length. The formulation of both biological processes and likelihood functions are rather flexible, allowing for a wide range of models to be described. Bormicon has been implemented for Icelandic waters and is also being implemented for the Barents Sea and Bering Sea ecosystems. A new assessment tool for Northeast Arctic cod developed at Institute of Marine Research in Bergen also builds to a large extent on the Bormicon code. Mammals have not been included in the model yet in either of the three ecosystems for which it is being implemented.

Bormicon is at present the most advanced analysis tool for boreal ecosystems. However, the high level of disaggregation and the need for specifying and estimating a migration model puts high demands on skill, manpower and knowledge of the ecosystem for effective use of the model.

Scenario Barents Sea

This model is described in SC/8/EC/14 and in Schweder et al. 1998. It differs from some other models in that it does not attempt to predict the actual future state of the ecosystem; rather, it is a tool for investigating management regimes for fish and marine mammals. The model therefore incorporates a probabilistic model for the dynamics of the ecosystem and of the catches determined by the catch rules for fisheries, and investigates the effects of changing various parameters in the catch rule. Variability is incorporated explicitly through stochasticity in fish recruitment and abundance estimates fed to the catch rule. Other uncertainty due to lack of information is handled through multiple simulation over a grid of plausible values for the uncertain parameters.

The model is aggregated spatially into Barents Sea and Norwegian Sea areas. Recruitment in cod, herring and capelin are modelled through a Beverton-Holt functions, and cod and herring are set to produce exceptionally good year classes once every 10 years on average. Predation by minke whales is based on predation functions derived from observations of minke whale stomach contents in relation to prey abundance. Predation by cod is dependent on fish size and relative abundance of prey items. In years with an abundance of herring in the Barents Sea, recruitment of capelin is impaired because of predation by herring.

SC/8/EC/14 demonstrated the use of this model to investigate the effect on cod, herring and capelin fisheries of varying the stock size of minke whales in the Barents and Norwegian Seas. The effects on catch quotas were modelled through the management regimes and catch rules presently in place for the three fisheries. Catches of cod, herring and capelin declined linearly with increasing whale abundance, by about 5 tonnes/whale for cod and herring, and 2.5 tonnes/whale for capelin. For cod, the direct effect on the catches of an extra minke whale in the system is a direct loss of some 2.5 tonnes due to minke whale consumption of cod, and an additional loss of some 2.5 tonnes due to predation on capelin and herring. For herring, the indirect effects seem to be positive, probably due to decreased predation on herring by cod. The direct negative effect from predation is, however, stronger.

The effect on cod and herring fisheries of retuning the Revised Management Procedure of the IWC has also been investigated by Scenario Barents Sea experiments (Schweder et al 1998). The result suggests that Northeast Atlantic cod catches will be increased by some 100 thousand tonnes annually by retuning from a target carrying capacity for minke whales of 72% to one of 60%.

Icelandic bioeconomic model
This model is described in detail in Baldursson et al. (1996) and Danielsson et al. (1998). The biological component has a Beverton and Holt model of the cod stock and a Ricker recruitment function. The shrimp stock is estimated using a stock-production model, CPUE data and the estimated biomass of juvenile cod. The capelin stock is modelled using random recruitment and a random stock collapse occurring on average once every seventh year. All biological relationships are modelled using stochastic variables representing the uncertainty of these relationships.

The economic component of the model is rather crude, as is the estimation of costs and revenues. Efforts were made to estimate the price elasticity on the basis of the price of cod on the world market, but the price of shrimp and capelin was assumed to be constant. The wages of the seamen at the time (1993) were assumed to reflect accurately the opportunity cost of their labour, but this cost was assumed to remain constant during the simulation period of 25 years. This means that the sharing rule for renumerating seamen was assumed away and that technological progress in the fisheries and in the rest of the economy was assumed to be equal and equal to the increase in real wages. No uncertainties were included in the economic part of the model, although this has been done to some extent in unpublished work.

Simulation models of this kind need catch rules for the stocks involved. The catch rule for capelin in Iceland is to leave 400,000 tonnes of mature capelin to spawn each spring. The catch rule devised for shrimp was to increase or decrease the catch of shrimp as the cod decreased or increased their consumption of shrimp. This has since been improved by introducing a catch rule that aims at catching the increment in shrimp biomass less the consumption by cod and including uncertainty into the rule.

The main object of the project was to devise a catch rule for cod which was reasonably close to giving optimal economic benefits from the exploitation of these stocks. The catch rules considered expressed the catch of cod as a function of the cod stock biomass only. As the model included stochastic variables, efforts were made to measure economic benefits in terms of aversion to fluctuations in income and maintaining the present value of profits. As Iceland was experiencing some unemployment at the time, the model was used to analyse economic benefits from the fishery assuming that the opportunity cost of labour was zero for an 11 year adjustment period. The model showed that economic benefits (resource rents) were maximised by allowing the cod stock to grow, which increased profits as the cost of catching cod decreased.

CAPSEX

Capsex is an age distributed model for Barents Sea capelin, where the maturation is modelled by maturity ogives calculated from yearly age-length estimates using a length-dependent maturation model. The model also includes a dynamic sub-model for cod and the influence of herring on capelin recruitment. Capsex generates input to the spreadsheet model CapTool, which is used in the management of the capelin stock. At present, work is being undertaken to include harp seals in the model, which would make it a possible tool for studying the economics of harvesting in the cod-capelin-seal system of the Barents Sea.

ii. Limitations of models

The Working Group noted that multi-species models, while useful and informative, suffered from several limitations:

- Some models (MULTSPEC, BORMICON) have very high input data requirements, requiring costly annual surveys of fish abundance, distribution and stomach contents.
- Updating and maintenance of some models is costly and time consuming.
- Such models have not yet proven to be predictive for most fish species in the medium or long term.
- Multi-species models are dependent on the quality of the input data, and in the case of consumption by marine mammals, these data are not very good.
- Uncertainties are not always fully incorporated into the models.
- The levels of spatial and temporal aggregation are not always appropriate for use with marine mammals, or for linkage with economic models.
- In order to be linked with economic models, multi-species models must incorporate fixed “catch rules” for fisheries, and cannot deal with variable or other management strategies. However the assumption of a fixed catch rule over a long period is probably not realistic.

iii. Future directions in multi-species modelling

Multi-species models have multiple uses. In the present context, their use as testbeds for proposed management strategies are particularly important. When used as a testbed, the model should capture the main dynamics and interactions in the biology/economy in the system under various management strategies, and also the main stochasticity. It is not necessary for the model to give a very detailed representation of the system. A rough and flexible model that is cheap enough to be run in hundreds of replicates might be more useful than a more detailed and realistic model that is expensive to run and maintain and for which input data may not exist. The more realistic the model is the better, however.

As a testbed, the model must have an adequate representation of the interplay between the fishermen and the resources. It is important that the fishing-related mortality and catch rates resulting from a given management strategy in a given situation are reasonably modelled. The fishing mortality, and collateral mortality associated with fishing, are the main interactions between fishermen and the resource. In some contexts, habitat impacts like destruction of coral reefs might also be of interest. In the present NAMMCO context where the issue is the indirect effect on finfish fisheries of a change in sealing or whaling, it is vital that the predation structure of the model is realistic. It is mainly through predation and competition for food that a change in marine mammal populations leads to changes in fishery performance.

For the North Atlantic, the following species seem to be natural candidates in a scenario model: minke whales, harp seals, cod, capelin, herring and shrimp. We have inadequate knowledge of diet preferences for several of these species. The situation is perhaps worst for harp seals. Stomach contents have been sampled, but only in areas where the seals are hunted, which is only a small part of their range. Only through behavioural studies may it be possible at present to learn about diet preferences in harp seals. In recent years, A.S. Blix and his colleagues in Tromsø have obtained extensive telemetric data on harp seals from satellite tagged individuals. By correlating the distribution in time and space of harp seals and various prey items, one might obtain valid estimates of the predation function of the harp seal. The same approach might be taken for minke whales, but for this species the sampled stomach data represents a more unbiased picture. There is thus a need to obtain temporal/spatial abundance data for the various potential predator and prey species. The statistical work involved in estimating predation functions might well be done outside the multi-species model. The same is true for other statistical work necessary to obtain a satisfactory model for recruitment and other biological processes. Much of this work is already done or is underway, and need not be replicated.

The model should incorporate important economic relationships to realistically translate management strategies to realised mortalities and catches. There is insufficient knowledge concerning how fishermen, whalers and sealers adapt to a given situation with respect to resources, management decisions and other economic realities. Substantial work is needed to obtain good data and to estimate production functions, cost functions, investment behaviour and other related activity.

Uncertainty and stochastic variability are key terms in marine resource management. Fluctuation in the resource must be modelled in stochastic terms. Statistical uncertainty in abundance estimates and other estimates that feed into the management strategy and influences management decisions are also most naturally represented stochastically. However, in addition to uncertainties surrounding the scenario model itself, both in its structure and its parameterisation that can be represented stochastically, there are often more profound and unquantified uncertainties due to lack of data or even lack of theory. Whether a Bayesian approach is taken with replicate runs of the model based on drawings from a subjective prior distribution, or whether a less formal approach is taken with replicate runs chosen according to an experimental design representing plausible scenarios, is a matter of choice and of convenience.

8. ECONOMIC EVALUATION OF MARINE MAMMAL FISHERIES

i. The harp seal fishery

Northwest Atlantic

SC/8/EC/20 used a simple bioeconomic model to measure the loss to a fishery from the reduced harvesting of economically important species resulting from an increase in the stock of a mammalian predator, using the example of the harp seal – cod – capelin interaction in the Northwest Atlantic. As well as direct losses, when the economically important species is the prey, there may be indirect losses when the mammal and a fish predator compete for prey. The economic losses depend critically on the management of the predator and prey fisheries. However, when both predator and prey fisheries are managed so as to maximise the combined fishery rents, a simple formula for the cost of predation can be developed. Using recent data on seal predation developed by the Canadian Department of Fisheries and Oceans, it was estimated that, including compensation to sealers, the permanent cost to the capelin and cod fisheries from a renewed ban on sealing upon recovery of these fisheries is in the range $10-19 million, 3-7 percent of the 1990 value of the cod and capelin harvests. An additional loss of $1.4 to $3.6 million applies for each year that seal predation delays the recovery of the stocks in question.

This model was considered by the Working Group to be a useful first step in evaluating the economic impacts of predation and competition in a fishery. However, the Working Group noted that uncertainties were not incorporated explicitly into the model and that these were likely considerable. To calculate economic losses, it is assumed that the fisheries are managed optimally to maximise economic benefits. Although this is never realised in practice it is an important benchmark. Finally, the valuation of the harp seal fishery itself was questioned, as there have been several estimates published, some of which differed by orders of magnitude (see below). It was suggested that it may have been undervalued in this case.

<u>Economic value of the Canadian seal hunt</u>

There were several estimates of the net economic benefit of the Canadian seal hunt during and subsequent to the 1982 seal product boycott. The 1986 Canadian Royal Commission on Seals and Sealing, for example, estimated a net economic benefit to Newfoundland of $2.3 million (Canadian dollars) and to the Canadian Atlantic region of $3.2 million (all values given are nominal for the given year). An important assumption underlying these estimates was that the opportunity cost of labour for sealers was zero; meaning that if they weren't sealing there was no alternative occupation of any value (even leisure or education).

With the recent increase of the harp seal quota to 275,000 animals, the issue of the net benefit of sealing has resurfaced. The Canadian Department of Fisheries and Oceans (DFO) prepared benefit estimates relating to the 1996 and 1997 seasons. They found that $10.8 million was spent by the harvesting, processing and transportation sectors in respect of the 1996 seal hunt, of which $9.1 million was the final processed value, rising to $11.9 million in 1997. The processing sector spent $9.0 million in 1996 on labour, transport and operating expenses. Although there is no explicit net benefit figure given, the study implies that the 1996 benefit to Canada was at least $9 million. This relates only to the direct benefits of hunt itself, and does not include any indirect benefits for fishing communities.

An alternative (and much lower) estimate of 1996 seal hunt benefits has been prepared by Clive Southey of the University of Guelph in Canada (Southey MS 1999). His $8.96 million processed value compares with the $9.1 million from DFO, but he correctly subtracts $2.65 million in purchases from the rest of the economy on the part of the harvesting, transport and processing sectors to get value added of $6.31 million, which represents the gross returns for labour and capital in all three activities. He does this because value added represents the true contribution of each sector to the economy, avoiding the double-counting involved with inter-sectoral purchases. He then subtracts $1.72 million in meat subsidies and $1.67 million in government expenditures directly related to sealing (both items paid by taxpayers) to get net value added of $2.91 million, which compares with the Royal Commission estimate above.

Value added is not, however, an estimate of true net economic benefit because the latter subtracts the opportunity cost of keeping the labour and capital in the sealing industry. If labour and capital could earn more than $2.91 million in another occupation, then this is preferred to sealing and the NEB of sealing would be zero. Southey does not attempt to estimate the opportunity cost of labour and capital, except to point out that the NEB from sealing would be zero if people could earn at least 46% of their sealing income somewhere else. If the value of seal organs (penises) is subtracted from value added on ethical grounds, then the cut-off opportunity cost is 31% of value added. However, he also shows that entry into the sealing industry is open, which implies low economic returns. Southey’s net benefit estimate for the 1996 seal hunt is thus somewhere below $2.91 million, depending on assumptions about the alternatives for sealers and the true social value of the trade in seal organs.

Northeast Atlantic

There was no economic information available to the Working Group on the harp seal fisheries in the Northeast Atlantic.

ii. The minke whale fishery

SC/8/EC/17 described the economics of the Norwegian minke whale hunt, while SC/8/EC/21 updated that report to the year 1999. The hunt has been generally profitable for participants since its resumption in 1993. However, gross revenue per whale in the traditional fishery has declined from a high of over NOK 90,000 in 1993 to NOK 41,000 in 1999, mainly due to a decline in the price of whale meat as a consequence of increased quotas, and a lack of market for other whale products. This decline in revenue per whale has been partially offset by higher vessel quotas. In 1999, the average number of whales harvested per vessel was 17.32 as compared to

5.7 in the traditional hunt in 1993. Net revenue per vessel has remained at a reasonable level.

iii. Identification of information gaps

The most important information gap identified was the lack of data on the economic status of the Northeast Atlantic harp seal fisheries, both from Norway and Russia. It is likely that price data would be available from both jurisdictions, but that information on costs would be more difficult to obtain.

9. DEVELOPMENT OF A PREDICTIVE MODEL

i. Modelling framework and specifications

The Working Group considered that it was possible to incorporate consumption by marine mammals in an existing multi-species model, and to link it to an economic component describing the performance of fisheries. Indeed, this had already been done in some limited cases. However, the utility of the model would be limited by the quality of the input data, and this was problematic especially for the estimates of marine mammal consumption in most areas.

It was noted that the multi-species and economic models generally operated on different time scales: monthly for the ecological models, and annually for the economic models. However, it was considered that there would be little loss in aggregating the time scale of the ecological models to facilitate linkage.

The issue of incorporating the behaviour of fishers as "profit maximising agents" was discussed briefly by the Working Group. Fishery regulations, catch rules, international agreements and codes of conduct influence and modify the behaviour of fishermen. At present it will be of interest to incorporate different management strategies into economic models.

The Working Group noted that reliable consumption data was available only for minke whales and harp seals, and then only in certain areas. The main fish species for which significant fishery interactions are likely to occur with these species of marine mammals, are herring, capelin, cod and shrimp. It was therefore decided to limit consideration of multi-species-economic models to these species only.

ii. Data needs

The Working Group noted that the following types of economic data were needed to define the economic components of a multi-species-economic model:

- Prices for fish and marine mammal products
- Catch rates/time series for fish and marine mammals over as many years as feasible
- Costs, including:
    - input prices- trip costs
    - days fished, fuel, bait, etc
    - allocation of costs to various fisheries, by season length, days fished, fuel consumption or other
    - the above costs should consider vessel size as a co-variate if relevant

- Catch rates and costs should be expressed by vessel for as many vessels and years as feasible
- Management regime, quota structure, ITQ's, and catch rules for relevant fisheries
- Information on relevant subsidies
- Other data relevant to the economic evaluation of marine mammal - fisheries interactions.

The availability and accessibility of these data for each jurisdiction is described below.

Northeast Atlantic – Norway

Sealing

The sealing industry has been in decline for many years. In the last few years, only two-three boats have participated annually. It has been indicated that new licences may be given to shrimp trawlers, which would involve a change in technology. Up-to-date cost data are not available for Norway, however price data and information on subsidies to sealers are available.

Whaling.

"Traditional" whaling was resumed in 1993. For the subsequent period, price data are available. Cost data are available for a small annual sample of boats; however, it is not possible to separate costs from whaling from costs from other fisheries. Whale blubber is currently mainly put into storage. A future export of blubber (and also whale meat) to, for example, Japan would imply a substantial outward shift in the total demand curve facing the whaling industry, resulting in an increase in prices and values. It should be possible to provide some assessment of these effects.

Shrimp, cod and capelin.

Price data are available both for primary and secondary product forms.

Different technologies are represented in these fisheries. Furthermore, boats will generally be harvesting several species. The Directorate of Fisheries collects data on an annual basis for a sample of boats (different technologies) in different fisheries. For each individual boat there is data on variables such as

- total harvest and harvest by species (quantities as well as revenues)
- costs (fuel, labour, capital, maintenance etc.) and
- some technical attributes (boat size, engine hp etc.).

The Centre for Fisheries Economics has used data of this kind to estimate cost functions for other fisheries. There are some problems with the data set:

- no information is available on quantities of inputs (i.e. there is information about fuel expenditures, but not quantity of fuel used)
- the costs are annual costs and not seasonal, which makes it difficult to | distinguish between fisheries for different species.

These constraints need to be taken into consideration when it comes to estimating cost functions.

Northeast Atlantic – Faroes
No information was available from the Faroe Islands.

Central Atlantic – Iceland
Very detailed and recent data were available from Icelandic fisheries. Catch, effort, costs and earnings data, sorted by fleet sector, were available up to the year 1997. Information on the Icelandic management regime for each species was also readily accessible.

Northwest Atlantic – Greenland
Data on the Greenlandic fishing fleet, sorted by region and vessel size, were available up to and including 1997. The data included harvest, prices and gross income to participants. Catch/effort data were also available for some of the main shrimp and finfish fisheries. However, no data on operating costs or the allocation of effort to various fisheries were available.

Northwest Atlantic – Canada
Prices for fish and marine mammal products are available from the Department of Fisheries and Oceans and/or Statistics Canada.

Fishing cost data are old for many of the major fisheries. There have not been recent surveys because many Atlantic fisheries such as that for Northern cod have been closed for a decade.

Catch rates for fish and marine mammals are available from the Department of Fisheries and Oceans, as are season length and days fished. Information on management regime, quota structure, ITQ's, catch rules and subsidies are also readily available. However, there is a major problem for the bioeconomic modelling of the major Canadian Atlantic fisheries in the lack of consistent stock size information. This problem must be solved before modelling of these fisheries is possible.

iii. Pilot project
Having reviewed the available information on consumption by marine mammals, multi-species models and the availability of economic data for fish and marine mammal fisheries, the Working Group concluded that the most efficient way to proceed would be to develop a pilot project limited to a specific area and a few species/fisheries. The specifications for the pilot study could be developed by a sub-committee of the Working Group, and the results evaluated at the next meeting of the Working Group.

The following candidates for a pilot study were considered, based on data availability, model availability and the likelihood of significant marine mammal – fishery interactions:

1. Consumption by minke whales and harp seals in the Barents and Norwegian Seas. Likely fishery interactions are with capelin, herring and cod. The major information gap identified is likely the lack of predation functions applicable under various conditions of prey availability.

2. Consumption by minke whales around Iceland. Likely fishery interactions are with capelin and cod. The major data gaps identified were a lack of area- and season- specific diet data for minke whales, and a lack of data on energy consumption by minke whales. However, this last could likely be addressed with data from other areas.
3. Consumption by harp seals around southeastern Canada. Likely fishery interactions are with capelin and cod. The major data gap identified was the apparent unreliability of recent fishery assessment data for this area, and the lack of multi-species fishery models for this area.

The Working Group concluded that candidates 1. and 2. offered the best chance of providing meaningful and important information on marine mammal-fisheries interactions.

10. CONCLUSIONS

The Working Group concluded that significant uncertainties remained in the calculation of consumption by marine mammals, and that this uncertainty was the most important factor hindering the development of models linking consumption with fishery economics. Data quality was highest for minke whales and harp seals in the Barents and Norwegian Seas, pilot whales around the Faroes and for harp, hooded and grey seals off southeastern Canada.

Harp seals and minke whales are the most important marine mammalian consumers of finfish in the Barents and Norwegian Seas. Minke whales are likely the most important consumers around Iceland although the data on diet composition are very limited. Dolphins of genus Lagenorhynchus are likely of importance also, but there are too few data on abundance, distribution and diet to assess this quantitatively. Pilot whales are the most important consumers around the Faroes, but here again white-sided dolphins and bottlenose dolphins are probably important consumers. The harp seal was the most important consumer in most areas of Greenland, but here data were too sparse to express data quantitatively. Harp seals were the most important pinniped predator off southeastern Canada, but the importance of cetaceans in this area has not been assessed.

In addition to these species that undoubtedly are important because of their large consumption, there are also species that might be in more direct conflict with fisheries, because of their consumption of valuable fish species of commercial size. The hooded seal is known to be in this category, but both narwhal and sperm whales are also known to eat commercially interesting fish. This potentially makes narwhal important consumers in the Baffin Bay, and sperm whales so in the Norwegian Sea, but no data on their diets are available from these areas. Killer whales appear to be important predators on herring in Icelandic and adjacent waters and humpback, pilot and sperm whales may also be important consumers of commercial fish species.

Consumption by marine mammals was similar to fisheries landings in some areas.

While this does indicate that there is at least a potential for interaction between marine mammal predation and fisheries, the magnitude of marine mammal predation must be put into the context of total natural mortality for the target species. For example, while minke whales and harp seals may be important predators on cod and capelin in some areas, cod are likely of far greater importance as predators for both species (SC/8/EC/8).

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, and preliminary investigations in this area have already been conducted (e.g. SC/8/EC/14, Stefánsson et al. 1997). Furthermore, such models can be linked to fisheries economic models to assess the impact on fisheries. The Working Group concluded that, for certain selected areas and species, there was sufficient data on marine mammal consumption, stock dynamics of prey species, and the economics of the fisheries themselves, to make this a realistic proposition.

The Working Group therefore recommended that the next logical step in addressing the request from the NAMMCO Council should be for NAMMCO to lead or assist in the development of a multi-species-economic model for a candidate area. A subcommittee of the Working Group could be tasked with developing the specifications for such a model. The candidate species/areas identified, in order of preference, were:

1. Consumption by minke whales and harp seals in the Barents and Norwegian Seas. Likely fishery interactions are with capelin, herring and cod. The major information gap identified is likely the lack of predation functions applicable under various conditions of prey availability.
2. Consumption by minke whales around Iceland. Likely fishery interactions are with capelin and cod. The major data gaps identified were a lack of area- and season- specific diet data for minke whales, and a lack of data on energy consumption by minke whales. However, this last could likely be addressed with data from other areas.

11. ADOPTION OF REPORT

The Report was adopted by correspondence on May 9, 2000.

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Appendix 1 - LIST OF PARTICIPANTS

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Ms Anne Kristine Frie (Norway)
Dr Porter Hoagland (USA)
Dr Grete Hovelsrud-Broda (NAMMCO)
Dr Erling S. Nordøy (Norway)
Mr Daniel Pike (NAMMCO)
Mr Aqqalu Rosing-Asvid (Greenland, Chairman)
Dr Carl-Eric Schultz (Norway)
Dr Tore Schweder (Norway)
Dr Garry Stenson (Canada)
Dr Ken Stollery (Canada)
Mr Gísli A. Víkingsson (Iceland)
Dr Lars Walløe (Norway)

Members Not Attending:

Dr Jon M. Conrad
Dr Sigurd Tjelmeland

Appendix 2 - AGENDA

1. Chairman's welcome and opening remarks.
2. Revision and adoption of Agenda
3. Appointment of Rapporteur
4. Historical background and the request from NAMMCO Council

Part 1 – Who eats whom in the North Atlantic?

5. Consumption by marine mammals in the North Atlantic- Available data
    i. Northeast Atlantic- Barents and Norwegian Sea
    ii. Northeast Atlantic- Faroe Islands
    iii. Central Atlantic- Iceland
    iv. Northwest Atlantic
6. Consumption by marine mammals in the North Atlantic- Major information gaps.
7. Existing multi-species models for the North Atlantic
    i. Description of models
    ii. Limitations of models
    iii. Future directions in multi-species modelling.

Part 2 – Linking the ecology with the economy

8. Economic evaluation of marine mammal fisheries
   i. The harp seal fishery
   ii. The minke whale fishery
   iii. Identification of information gaps.
9. Development of a predictive model
   i. Modelling framework and specifications
   ii. Data needs
   iii. Pilot project
10. Conclusions
11. Adoption of report.

Appendix 3 - LIST OF DOCUMENTS

SC/8/EC/1	List of Participants
SC/8/EC/2	Draft Annotated Agenda
SC/8/EC/3	Draft List of Relevant Documents
SC/8/EC/4	Frie, A.K. Consumption tables for the Barents and Norwegian Seas.
SC/8/EC/5	Rosing-Asvid, A. Consumption tables for Greenland waters (Year 2000).
SC/8/EC/6	Víkingsson, G.V. and Þórðarson, G. Consumption tables for Icelandic waters.
SC/8/EC/7	Bloch, D. and Mikkelsen, B. Consumption tables for Faroese waters.
SC/8/EC/8	Bogstad, B., Haug, T. and Mehl, S. 2000. Who eats whom in the Barents Sea? NAMMCO Sci. Publ. 2: In Press.
SC/8/EC/9	Folkow, L.P., Haug, T., Nilssen, K.T. and Nordøy, E.S. 2000. Estimated food consumption of minke whales Balaenoptera acutorostrata in Northeast Atlantic waters in 1992-1995. NAMMCO Sci. Publ. 2: In Press.
SC/8/EC/10	ICES International Council for the Exploration of the Sea. 1999. Report of the Working Group on Marine Mammal Population Dynamics and Trophic Interactions. ICES CM 1999/G:3
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SC/8/EC/14	Schweder, T., Hagen, G.S. and Hatlebakk, E. 2000. Direct and indirect effects of minke whale abundance on cod and herring fisheries: A scenario experiment for the Greater Barents Sea. NAMMCO Sci. Publ. 2: In Press.

SC/8/EC/15	Sigurjónsson, J. and Víkingsson, G.A. 1997. Seasonal abundance and estimated food consumption by cetaceans in Icelandic and adjacent waters. J. Northw. Atl. Fish. Sci. 22:271-287.
SC/8/EC/16	Hammill, M.O. and Stenson, G.B. Estimated prey consumption by harp seals (Phoca groenlandica), hooded seals (Cystophora cristata), grey seals (Halichoerus grypus) and harbour seals (Phoca vitulina) in Atlantic Canada.
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SC/8/EC/18	Flaaten, O. and Stollery, K. 1996. The economic costs of biological predation. Environmental and Resource Economics 8:75-95.
SC/8/EC/19	Hovelsrud-Broda, G. Re. Agenda Item 4: Background and request from NAMMCO Council.
SC/8/EC/20	Stollery, K. The economic costs of predatory competition: Theory and application to the case of harp seal (Phoca groenlandica) predation on fish Stocks in the North-West Atlantic

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ANNEX 2

INTERNATIONAL SYMPOSIUM ON HARBOUR PORPOISES IN THE NORTH ATLANTIC

PROCEEDINGS

MS "Nordlys", 10-14 September, 1999

PREFACE

In 1997, the NAMMCO Council recommended that the Scientific Committee should carry out a comprehensive assessment of the harbour porpoise throughout its North Atlantic range, to include distribution and abundance, stock identity, biological parameters, ecological interaction, pollutants, removals and sustainability of removals. 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 Scientific Committee formed a steering committee, consisting of Tore Haug, Gísli Víkingsson, Lars Witting and Geneviève Desportes who, in concert with the NAMMCO Secretariat, made the International Symposium on Harbour Porpoises in the North Atlantic a reality.

The International Symposium on Harbour Porpoises in the North Atlantic was held on board the Norwegian Coastal Steamer *MS Nordlys* enroute from Bergen to Tromsø, September 10-14, 1999. It was attended by 31 delegates and included 22 presentations (see Appendix 1 and 2). The Symposium agenda was structured around four theme sessions, each led and chaired by an invited keynote speaker. The keynote speakers also had the responsibility of summarising the discussions around their respective themes, and synthesising conclusions and recommendations. These were presented and discussed on the final day of the Symposium.

This report includes summaries of each presentation provided by the authors, followed by brief notes on the discussion that followed each presentation. The summary presentations for each theme were developed by the keynote speakers during the Symposium. The report concludes with a list of recommendations for research, cooperation and management.

The NAMMCO Scientific Committee will use this report to develop assessment advice and research recommendations for the NAMMCO Council. In addition, many of the Symposium delegates have been invited to contribute their papers for a future volume of *NAMMCO Scientific Publications*, which should be ready for publication late in the year 2000.

Finally, this report would not be complete without commenting on the austere beauty of the Norwegian coast and the exceptionally fine weather we were privileged to enjoy. While it was sometimes difficult to concentrate on the subject at hand without gazing out the windows, the atmosphere was conducive to relaxed and open discussion. I know that the Scientific Committee of NAMMCO joins me in thanking all participants for a productive and enjoyable meeting.

Daniel Pike,
Scientific Secretary,
NAMMCO.

WELCOMING ADDRESS: TORE HAUG

At the Seventh Meeting of the Council of NAMMCO (Torshavn, Faroes, 1997), the Management Committee 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 Management Committee recommended that the Scientific Committee (SC) be requested to perform such an assessment, which might include distribution and abundance, stock identity, biological parameters, ecological interaction, pollutants, removals and sustainability of removals.

In order to provide the best possible basis to address this request, the NAMMCO SC decided to arrange an international symposium on harbour porpoises in the North Atlantic, involving experts working on this species throughout its North Atlantic range. The symposium is intended to provide a forum for the presentation of results of recent research, and is organised around several main theme topics which will be addressed in non-parallel sessions, each beginning with an invited key review presentation: 1) Distribution and stock identity; 2) Biological parameters; 3) Ecology and pollutants; 4) Abundance, removals and sustainability of removals.

It should be noted that the IWC Scientific Committee reviewed many of these same topics in 1995, and published their findings in a special volume. Harbour porpoise have since been a regular item on the IWC agenda. Other organizations such as ASCOBANS and ICES also address harbour porpoise issues. NAMMCO wishes to further, not duplicate, these efforts.

It is intended that both the invited review papers and submitted papers of sufficient quality will be offered the possibility to be published as a separate symposium volume of *NAMMCO Scientific Publications*.

I will use this opportunity to welcome all participants to the symposium. Particularly, I am proud to welcome you to this very special venue, M/S”Nordlys”, which is one of the coastal steamers that sails year-round along the Norwegian coast. During the symposium, ”Nordlys” will take us from Bergen to Tromsø. The symposium program includes contributions from many of the pre-eminent researchers in this field. Thus, with the help of all participants, NAMMCO staff, and the crew of the ship, I am quite sure that we will have a jolly good time on what many regard as ”the most beautiful sea journey in the world”!

THEME 1: DISTRIBUTION AND STOCK IDENTITY

1.1 Andersen, L.W. (KEYNOTE): Harbour porpoises in the North Atlantic: Distribution and stock identity.

Information on the distribution and stock delineation of harbour porpoises in the North Atlantic was reviewed comprehensively by Gaskin (1984) and later revised by the IWC (1996). This review builds on these documents by integrating more recent genetic and distributional studies.

Studies of the genetic structure of harbour porpoise populations tend to be concentrated in areas where samples are available, i.e. areas where there are incidental or directed catches, or stranding events. Genetic studies suffer from the inconsistent application of diverse techniques, which makes valid comparative analyses between studies impossible. Many distributional studies are optimised for species other than harbour porpoises, so their results tend to be imprecise for this species. For some areas, particularly those in the southeastern North Atlantic, there is virtually no information on distribution or population structure.

On a large geographic scale, genetic evidence indicates that there is little or no exchange of harbour porpoises between the Northwest and Northeast Atlantic (Rosel *et al.* 1999). The higher genetic diversity in the Northwest Atlantic may indicate that the Northeast Atlantic was more recently colonised. Genetic studies (Andersen 1993, Andersen *et al.* 1997) also suggest that harbour porpoises in West Greenland are 1 or perhaps 2 separate stocks. Harbour porpoises occur around Iceland and the Faroe Islands, but the stock identity of these animals has not been addressed. They were considered to be separate stocks by the IWC (1996) because of a probable lack of exchange between the areas. However, sightings of harbour porpoises have been reported in the deep waters between Greenland and Iceland and between Iceland and the Faroe Islands (IWC 1996), so the stock identity of these animals remains uncertain. Harbour porpoises are also observed throughout the year in more southern areas, including the Bay of Biscay, the Iberian coast and the African west coast from southern Morocco to Cape Verde, but there is as yet no information on the stock identity of these animals.

Results from sighting surveys and genetic studies in the Northwest Atlantic generally support the model of 3 stocks in the area proposed by Gaskin (1984): 1) Gulf of Maine/Bay of Fundy; 2) Gulf of St. Lawrence; and 3) eastern Newfoundland and Labrador.

The situation is more complicated in the Northeast Atlantic, where at least 6 stocks are thought to exist, with strong potential for distributional overlap and exchange (IWC 1996). Newer information from genetic studies indicates the situation may be even more complex than this. The general picture is one in which stock divisions are maintained by philopatry to distinct breeding areas, with a high degree of mixing the rest of the year. For example, for the North Sea, it is likely that there are northern and southern components to the population (Walton 1997). Furthermore, it has also been suggested that the North Sea may have an east-west division, rather than a north south division, where porpoises may be associated with the coasts of either Scotland, east England or the Danish North Sea and Norway (Andersen, unpubl.). This information suggests that, despite the high probability of mixing in middle of the North Sea, porpoises may be associated with breeding areas near the coast. If females are more philopatric than males, such a division in stocks may be maintained in spite of this mixing.

A similar situation may exist for other areas, such as the Kattegat, Skagerrak, Belts and Baltic. However, there has been confusion among various researchers over the geographical definitions of these areas, leading to further confusion over stock delineation. The population structure suggested by the IWC (1996) of a separate combined Kattegat-Skagerrak-Belts stock and a North Sea stock has so far not been addressed genetically. Wang and Berggren (1997) studied the population structure of porpoises sampled in the Swedish Baltic, Kattegat-Skagerrak waters and the Norwegian west coast without defining whether the Kattegat-Skagerrak sample belonged to the North Sea or the inner Danish/Swedish stock. In the first case the obtained result of three significantly different stocks indicates the existence of three sub-populations, a Norwegian west coast, a North Sea (Skagerrak-Kattegat) and a Swedish Baltic Sea sub-population, which is supported to a certain extent by Andersen et al. (1997), who placed Skagerrak animals with Danish North Sea animals. The stock delineation of Andersen *et al*. (1997) supported the population structure hypothesis of a genetically different Inner Danish Water (Kattegat + Belts + Øresund) and a Danish North Sea subpopulation. In the latter case, Wang and Berggren (1997) indirectly assume two different sub-populations within the Kattegat-Skagerrak-Belt and Baltic Sea region, i.e. a Swedish Baltic Sea and an inner Danish/Swedish water sub-population. The existence of a separate German Baltic population has been supported by Tiedemann *et al*. (1996).

There is genetic evidence that porpoises in the Western British Isles/Irish Sea are separate from the North Sea animals (Walton 1997).

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Points Raised in Discussion

- Subadults, especially males, tend to move more extensively than adults. It is therefore possible that there might be age-related differences in genetic structure.
- No genetic studies on Faroese or Icelandic harbour porpoise have yet been published, but these are now being carried out.
- Samples from Newfoundland have all come from the S. coast. Other areas of Newfoundland and Labrador might have different stock affinities.
- A minimum of about 30 samples per stratum are needed for genetic analyses using microsatelites.
- There was general discussion on the definitions of the terms population and subpopulation, and these were considered to imply differing degrees of relatedness.
- It was noted that all studies tend to confirm or reject pre-defined groups, but that it might be preferable to look for natural genetic groupings.
- Harbour porpoises are very rarely caught in E. Greenland.

1.2 Teilmann, J., Larsen, F. and Desportes, G.: Satellite tracking of harbour porpoise in Kattegat/Skagerrak. Movement and diving behaviour.

An estimated 5-10,000 harbour porpoises are taken annually as by-catch in the Danish gillnet fishery. Concern has been expressed that this by-catch may not be sustainable. The reason why harbour porpoises become entangled in these gillnets is not well known. Studies on harbour porpoises movements and preferred habitats as well as studies on the diving behaviour of these animals in areas with gillnets are therefore essential in order to understand the processes that govern susceptibility to by-catch.

To address this problem we mounted satellite-linked time-depth-recorders (SDR-T10, Wildlife Computers) on 16 harbour porpoises to study their movements and diving behaviour. The porpoises were live by-caught in pound nets in 1997-99 in the Danish Belt seas. Information on the movements and diving behaviour were collected over the period March to December. Contact with individual porpoises remained for 110 days (by mid July 1999).

Immature porpoises were observed to move up to 800 km along the Swedish west coast to the southeast of Norway, frequently diving to the seabed throughout the day. The maximum depth and duration was 84 metres and 7 minutes, respectively. Three mother/calf pairs moved back and forth along a 100 km coastline of northwest Sealand (the largest Danish island), where extensive gillnetting takes place. These animals also dove to the seabed frequently to a maximum of 44 metres and with a dive duration up to 9 minutes. The adult males were observed to be more stationary than the adult females and the immature animals, staying within an area of a few kilometres for several weeks during the summer period. By use of GIS mapping we estimated the home-range of each porpoise as well as the time spent near the bottom. This was used to analyse the potential interaction between harbour porpoises and gillnets.

Points Raised in Discussion

- Larger animals may be better able to detect pound nets, as they are more rarely caught in pound nets. The difference does not seem to relate to age segregation of the animals. Most animals caught in (Danish) gillnets are young (<2yr).

1.3 Tolley, K.A., Sundt, R.C., Rosel, P.E., Bjørge, A. and Øien, N: Population genetic structure of harbour porpoises (*Phocoena phocoena*) from the North Sea and Barents Sea.

The harbour porpoise (*Phocoena phocoena*) is subject to a high rate of incidental mortality in fisheries world wide. In some areas, these rates are sufficiently high to warrant concern over population sustainability. Thus, the definition of subpopulations is paramount to conservation of this species. To investigate the population structure in Northeastern Atlantic waters, genetic sequence variation in mitochondrial DNA was examined in porpoises incidentally killed or stranded. The first 200 base pairs of the control region were sequenced in 36 females and 47 males from Norwegian waters of the Barents and North Seas. In addition, 35 female and 31 males from United Kingdom waters, sequenced in a previous study (Walton, 1997) were included as a third study group. One haplotype was found to be common in all geographic groups, accounting for 49% of all individuals sequenced. An analysis of molecular variance showed no significant difference among males from these regions. However, females from these areas showed a greater degree of genetic differentiation for both haplotype frequencies (F_{ST}) and molecular diversity (ϕ_{ST}) than males. There was a significant difference (α=0.05) in haplotype frequencies between the Barents Sea and North Sea UK female porpoises when adjusted for multiple comparisons. Haplotype frequencies showed a significant difference between the North Sea UK and North Sea Norway females only after porpoises from the Shetland Islands were excluded from the North Sea UK sample. A phylogenetic tree revealed two main haplotypic clades for females, although there was little geographic structuring among these clades.

These results are consistent with findings from other areas and suggest females compose genetically distinct groups, while males are less philopatric. In spite of the lack of significant phylogenetic structuring, differing haplotype frequencies suggest that the North Sea UK and the Barents Sea subpopulations should be considered separate management units. In addition, haplotype frequency differences among the North Sea Norway and North Sea UK females (excluding Shetlands) also suggest the presence of separate management units within the North Sea.

Reference

Walton, M. J. 1997. Population structure of harbour porpoises *Phocoena phocoena* in the seas around the UK and adjacent waters. *Proc. R. Soc. Lond*. B 264: 89-94.

Points Raised in Discussion

- mt DNA is maternally inherited, and heterogeneity of female but not male animals is often observed. This is indicative of female phylopatry. Ideally, males and females should be modelled simultaneously. Female phylopatry has significant management implications.
- Care must be exercised in the inclusion of stranded animals in analyses, as these may have drifted in from elsewhere. Many strandings originate as discards or dropouts from by-catch.

THEME 2: BIOLOGICAL PARAMETERS

2.1 Lockyer, C. (KEYNOTE): Harbour porpoises in the North Atlantic: Biological parameters.

Biological parameters for harbour porpoises are reviewed throughout their range in the North Atlantic. The area of the North Atlantic includes several populations / subpopulations of harbour porpoise, *Phocoena phocoena;* perhaps 14 or more (Gaskin, 1984, IWC, 1996). In terms of geographical regions, this should include everywhere between the Arctic and south to the equator, and especially the coastal areas of eastern Canada and the USA, Greenland, Iceland, Faroe Islands, British Isles (including Ireland), France, Norway (including Svalbard), the North Sea-bordering countries of Germany, Netherlands, Belgium, Sweden, Denmark, all Baltic Sea-bordering countries, and the eastern Atlantic bordering countries Spain, Portugal, Morocco and Mauritania, and for completeness, the Mediterranean and Black seas. Some areas have been more studied than others, some we know almost nothing about, and certain areas have a generally low abundance of harbour porpoises so that very little is known at all.

Most information on biological parameters comes from studies of animals from a combination of directed catches, by-catches and strandings. All these sources are valuable for providing biological information, but each carries some bias when it comes to the interpretation of parameters. For example, strandings often tend to include predominantly the very young and very old members of the population, while younger juveniles tend to be taken more often as by-catch, and directed catching may often focus on the older and larger members of the population, often resulting in a bias in the sex ratio. Trends over time can also affect the assessment of biological parameters. Fluctuating external factors, such as food supply, exploitation, and disease, can change the profile of a population. Therefore, in dealing with biological parameters, a long term monitoring strategy is advisable.

Information on age-related parameters (longevity, recruitment and survival), reproduction (age at sexual maturity, first birth, and ovulation, and pregnancy rates, seasonal breeding, gestation period, foetal sex ratio, post-natal sex ratio, neonatal size and duration of lactation) and growth (models for length and weight, asymptotes, age at physical maturity, foetal growth and size at weaning) is presented and assessed by region and / or population (Lockyer, this symposium). Among age-related parameters, maximum longevity recorded is 24 yr; maximal rate of population growth is probably 9.4% but in the range 5-10%; mortality is highest in year 1, and <5% of the population live beyond 12 yr. An estimate of 0.867 with a maximum age of 23 yr has been given for survival (Kinze 1980). Among reproductive parameters, age at sexual maturation falls between 3-4 yr for both sexes; age at first parturition is probably 4-5 yr; age at first ovulation is >3 yr; ovulation rates fall in the range of 0.66 – 1.01 corpus per yr, and reproductive interval is 0.99 - 1.57 yr; pregnancy rates are generally in the range 0.74 – 0.98 per yr, meaning that not all females produce a calf every year; there is a seasonal breeding / mating in the period June – August; gestation lasts 10-11 months; parturition generally occurs between mid-May - mid-July; duration of lactation is uncertain, but is probably at least 8 months; size at birth is usually in the range 65 - 70 cm with a maximum size of ca 80 cm. Sex ratio is biased to males throughout life: 1.1 males : 1.0 females in the foetal stage, 1.4 males : 1.0 females in year 1, and a slight excess of males in later life (1.1 / 1.2 males : 1.0 females). Growth parameters indicate an asymptotic length and weight that varies with population, but usually falls in the range 153 – 164 cm and 55 – 65 kg for females, and 140 – 153 cm and 46 – 50 kg for males. Growth models used for length and weight are typically based on von Bertalanffy and Gompertz models. Length at sexual maturity also varies with population, but is usually in the range 140 – 147 cm for females and 130 – 135 cm for males. There is no information based on vertebral epiphyseal fusion to indicate age at physical maturity. Foetal growth appears normal, but uncertainty exists regarding the proposed existence of embryonic diapause (Read 1990). Size / age at weaning may be ca 115 cm but exceeds 90 cm, and occurs at an age >8 months; however, entirely independent feeding may not occur until an age of ca 10 months.

This review indicates that while overall quite a lot is known about biological parameters for harbour porpoises, there remain several aspects of life history that are unknown: for example, duration of pregnancy, weaning and lactation. There are also several areas and populations for which almost nothing is yet reported: for example, Gulf of St Lawrence in Canada, Faroes, North Africa, Spain, Portugal, and the Mediterranean and Black seas. Information on porpoises is similarly lacking from the Baltic, and although effort is and has been directed there, the low abundance of porpoises makes any study very difficult.

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Points Raised in Discussion

- Simultaneous tagging of mothers and calves could be helpful in determining the age of weaning. However, mothers and calves may continue to travel together after weaning.
- The possibility of delayed implantation in harbour porpoise should be looked at. A first indication would be an anomolously high gestation period relative to the size of the animal.
- Excess births of males are observed in many mammals, as is differential mortality of males and females.

2.2 Desportes, G., Kristensen, J.H., Siebert, U., Korsgaard, B., Driver, J., Amundin, M., Labberté, S. and Andersen, K.: Multiple insights into the reproductive game of male and female harbour porpoises.

The harbour porpoises kept at the Fjord and Belt Centre offer a unique opportunity to gain a better understanding of the reproduction in this species, especially of the physiological cycle and its association with concomitant behavioural traits. An integrated approach to behavioural, morphological, histological and hormonal assessment of reproductive status is seldom possible in cetaceans, but offers the best tool for understanding and monitoring reproductive events.

In this preliminary analysis, the behaviour of the male was examined in relation with testosterone levels (enzyme immunoassay), testis development and vaginal cytology.

Plasma testosterone concentrations in 1997-98 varied from 0.5 to 34.8 ng/ml, showing two peaks at the same period in the two consecutive years (May-August). Testosterone concentrations peaked at 11.9 ng/ml on May 14, 1997, and 34.5 ng/ml on June 8, 1998, and stayed below 1ng/ml from September to March in both years.

Testis development to July 1999 showed a dramatic increase in May and a decrease in September.

Infrequent erections have been observed since the arrival of the porpoises at the Centre in April 1997. Mating attempts were first observed in October 1997, and continued throughout the winter, in spite of very low levels of testosterone, (<1ng/ml). Sexual activity increased during June-August 1998. The cessation of sexual activity at the end of August 1998, clearly seen in all three types of observations, corresponded to the attainment of very low testosterone levels (<1ng/ml).

The peak of testosterone level appeared to precede the period of highest frequency of sexual activity and preceded the June-July peak in testis mass and the July-August mating period given by Sørensen and Kinze (1994). Mating attempts between Eigil and Freja resumed in April 1999 and were still ongoing in September, showing a peak in the latter part of July and early August.

Vaginal cytology performed monthly in 1997-98 and weekly in 1999 showed the presence of sperm in the vagina of the female only in July and August 1998 and in the first half of August 1999. This observation, combined with the observed daily frequency of mating attempts and the apparent responsiveness of the female in the summer period, suggest that successful matings only took place during July and August (Desportes *et al.* forthcoming).

The male testosterone and testicular activity peaks in summer, as previously described for wild porpoises. In this perspective, it is interesting that Eigil started to show signs of sexual activity in the fall of 1997, and continued "testing" himself throughout the winter, in spite of having low levels of testosterone. This may be at least in part a captivity artifact, caused by the constant proximity of a female. However it may also be a normal "training" exercise for a pubertal male. It is indeed noticeable that Eigil has not shown, apart from a few erections, any sign of sexual activity the next fall and winter (September - April 1998), although the proximity to the female is the same and grooming was observed over the whole period.

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Desportes, G., Kristensen, J.H., Siebert, U., Korsgaard, B., Amundin, M., Driver, J., Labberté, S. and Andersen, K. Multiple insights into the reproductive game of a male and a female harbour porpoise, *Phocoena phocoena*: An ongoing study. Proceedings of the Annual Meeting of the European Cetacean Society, April 1999, Valencia, Spain.

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Points Raised in Discussion

None.

2.3 Ólafsdóttir, D., Víkingsson, G.A., Halldórsson, S. and Sigurjónsson, J.: Studies on growth, age and reproduction in harbour porpoises (*Phocoena phocoena*) in Icelandic waters.

Autopsies of 482 female and 796 male harbour porpoises were undertaken on by-catches in Icelandic waters during 1992-97. Date, location, body length, body weight and a preliminary estimate of sexual condition were noted, and samples of teeth and reproductive organs were collected from most animals.

Teeth were used for age-determination and sexual condition was estimated by analysing corpora in female ovaries and tubules in male testes.

The oldest animal was a 20 year old pregnant female and the oldest male was 16 years old.

Pregnant females were observed in September to June, but few samples were obtained in June and no samples were taken in July and August. The exact time of the birth period is therefore not known, but is expected to peak in June. The largest foetus was found in April and was 77cm long.

Body lengths varied greatly around the mean in all age classes. Females seem to grow slightly faster and attain greater lengths than males. Asymptotic length is reached at age 6.1 years and length 158cm in females and at age 7.6 years and length 152cm in males.

Mean age at sexual maturity in females was 3.1 years (range: 1-6) and 2.8 years (range: 1-5) in males.

Points Raised in Discussion

- The virtual absence of anoestrous mature females in the sample may indicate very low rate of spontaneous abortions, but might also be due to capture bias, i.e. increased vulnerability of pregnant females.
- The interpretation of corpora albicans can be misleading. It is possible that animals with more scars or anomolously high numbers of scars for their age may actually be less successful at producing and maintaining calves. Pregnant animals do not ovulate and lactating animals ovulate infrequently. Many corpora albicantia may therefore mean that the animal has not been pregnant or lactating for long periods.

2.4 Lockyer C., Desportes, G., Anderson, K., Labberte, S. and Siebert, U.: Monitoring growth and energy utilisation of harbour porpoise in captivity.

Two harbour porpoises were taken into captivity in April 1997, after rescue from pound nets set in inner Danish waters. They, and a third animal rescued in April 1999, are presently housed in a semi-natural outdoor pool, which is a penned-off area of Kerteminde fjord. Their growth has been monitored regularly since capture by means of the parameters of total body length, girth, body weight and blubber thickness as well as dietary intake by weight of fish and dietary composition. A sample of fish from each new food batch was retained for biochemical analysis. The general activity of the animals was recorded in relation to gradual release from the indoor holding tank to the outside holding pool and finally the entire pool area at regular intervals, including occasional 24-hour long observations. In addition, tetracycline antibiotics were administered periodically for the purpose of time-marking the teeth for age calibration in the future.

The initial period in captivity resulted in major weight losses, especially in the dorsal thoracic and trunk regions because of refusal to feed from the hand. Such losses were sudden and dramatic in just the first few days – with about 5 kg being lost by Freja (female) and 4 kg by Eigil (male) who continued to lose a further 2.5 kg until day 60, around the time of release into the entire open pool. Initial body weights were 40.5 kg for Freja and 37.5 kg for Eigil. Body weight increased steadily over the few months during winter, reaching a peak of 51.6 kg for Freja and 44.75 kg for Eigil in late January/early February 1998. Body weight then diminished to 47.2 kg for Freja and 43.55 kg for Eigil in July 1998, with further weight loss in the summer. An increase in winter 1998/9 attained a peak of 55.5 kg in Freja and 44.5 kg in Eigil. In early July 1999, weights were 47.7 kg for Freja and 41.9 kg for Eigil, thus establishing a clear seasonal fluctuation in body weight over >2 yr period. Girth and blubber thickness mirrored the seasonal weight fluctuations. Food intake also fluctuated seasonally, but increases in food intake preceded weight gains. Daily food consumption in Freja and

Eigil ranged from 3.5 – 4.5 kg (ca 7 – 9.5% body weight), but was as much as 17.6% body weight in the yearling Nuka. During the period of 28 months since capture, the length increased steadily from 127.5 cm to approximately 149 cm in Freja, and from 130.5 cm to approximately 139 cm in Eigil.

The estimated ages at first capture were about 2-3 yr for Freja and Eigil. The current lengths of the animals are as estimated for a wild animal from this region, about age 4-5 yr. The estimated age at first sexual maturation for this species in the region is 3-4 yr, so we assume Freja is sexually mature. Evidence of active sperm in ejaculate of Eigil during summer 1998 indicates that he is mature. The body weights are similar to expected weights determined from by-caught porpoises in the region. The initial weight loss was not unexpected because of the lack of feeding at first, stress of capture, and reduction in swimming activity. However, the losses were not expected to be so sudden. This suggests that the energy reserves of the animals may only be short term. The large weight increase in both the 1997/8 and 1998/9 winter months with the cold water temperatures also suggests that energy reserves and blubber fat as insulation may be important. The measurements of girth and blubber thickness correlate well with observations on weight, so that the interpretation of fat deposition appears to be likely.

The results so far indicate that the animals are growing as predicted for wild porpoises in the region.

Points Raised in Discussion

- Seasonal variation in energy content of prey may also lead to seasonal weight variation in predators, but this has not been looked at for harbour porpoises.
- Seasonal changes in activity levels may be involved, and this is being looked at. The male appeared to lose all interest in feeding when he became sexually active. The activity level is being quantified but these data have not yet been analysed.
- Some other marine mammals, such as harp seals, show similar seasonal patterns of weight loss, even when sexually immature.

2.5 Lockyer, C. and Kinze, C.: Status and life history of harbour porpoise, *Phocoena phocoena*, in Danish waters.

This paper reviews historical published and unpublished records relating to distribution and abundance of harbour porpoise in Danish waters, and draws on information from directed catches, by-catches and strandings. Biological information is reviewed for the region on diet, parasites, pollutants, biological parameters (age and reproduction), and body condition, and incorporates both earlier and new information derived from the period 1996-98. The basis of the biological analyses is a comprehensive database containing nearly 1,900 records since 1834 to the present.

Longevity is recorded as up to 23 yr, and in both sexes, the first year suffers the highest mortality, but apparently more males die than females in the second year. The foetal sex ratio indicates that males consistently outnumber females 1.1:1.0, and the larger number of males in the first year class also indicates a bias to males. However, the difference is not significant.

It is clear that maximum length in females exceeds that for males. Mean adult lengths for females and males appear to be about 160 cm and 145 cm respectively. Maximum lengths recorded are 189 cm for females and 167 cm for males. Mean adult body weight is about 65 kg in females and 50 kg in males. The absolute maximum weight recorded for each sex was 89 kg for females and 79.5 kg for males.

Body weight plotted against total length for each sex provides curves that are similar for both sexes, and a logarithmic regression of weight on length for both sexes combined is:

(1) $$W = 0.0000814 \cdot L^{2.672}$$

where W = body weight in kg, L = body length in cm.
Standard error for exponent is $\pm$ 0.027; r^2 correlation coefficient is 0.908.

The presence of at least one *corpus luteum/albicans* was used as a criterion for sexual maturity. Other criteria used for assessing maturity were evidence of pregnancy and/or lactation. The youngest animal with a *corpus* was 3 yr, and the oldest recorded was 19 yr with 12 *corpora*. A fitted regression of ovarian *corpora* number against age is calculated for just 25 animals. Only females with 1 *corpus* or more were included in this calculation:

(2) $$\text{No. corpora} = 0.638 \cdot \text{Age} - 1.116$$

In males, the maturity criterion of total testes weight >200 g was used. Sexual maturity occurs at slightly over age 3 yr in both females and males. These ages correspond to lengths of about 135 cm in males and about 143 cm in females. Limited data suggest an average ovulation interval of about 1.5 yr or a reproductive interval of alternately one year or two. A fertile female might expect to produce 5 young in a lifetime of 10 yr. Conception most likely occurs during August, and peak births take place in June after about 10 months' gestation. There may be a predominance of males in the foetal stage, and they appear to be slightly larger than females at a given time during gestation.

The likely minimum birth weight is about 3.5 kg at a length of 60 cm. The Danish data indicate a wide overlap of lengths for near-term foetuses and neonates from 60 - 89 cm. The largest foetus recorded was from a dead-stranded female on Funen during summer 1998. The foetus was 89 cm and weighed nearly 10 kg. The reason for the death of the mother was diagnosed as birth difficulties because, although the foetus still remained within the uterus, the uterus had ruptured with ensuing problems. It is considered that most neonates are within the size range 65 - 75 cm, based on Danish neonate records.

There is a seasonal hypertrophy of testes in the male harbour porpoise with a peak in August. The maximum size of testes in mature males in season is 2.65 kg. This peak suggests that mating, and probably conception, may be especially likely at this time.

A histogram plot of foetal lengths by month where both sexes are combined, indicates a peak of size in June, and minimum size in September. This would indicate a likely gestation time of 10 months, and the size distribution fits with the onset of male fertility in August.

The timing of mating, conception and parturition may be a little protracted, so that births could occur in March through to August .

Points Raised in Discussion

- The relationship between parasite load and age may offer a means of determining the time of weaning.
- Most animals with high parasite loads appear healthy

2.6 Lockyer, C., Heide-Jørgensen, M.P., Jensen, J., and Walton, M.J.: Life history and ecology of harbour porpoises from West Greenland.

During 1988, 1989 and 1995, predominantly in the months of July, August and September, a total of 187 harbour porpoises (*Phocoena phocoena*) were sampled from the catches off West Greenland. The samples were taken in three areas between 62°N and 70°N: northerly (n=134, Maniitsoq and locations Kangaamiut, Qeqertarsuaq and Qasigiannguit further north), southerly (n=30, Nuuk) and southernmost (n=23, Paamiut). Measurements of body length, collection of teeth for age determination, and gonads were made for this study. In addition, during 1995, girths, blubber thickness, body and organ weights, organ and tissue samples including blubber for lipid analysis, and stomach contents for diet analysis were also taken. The data and samples were analysed for biological parameters, and compared with similar data for porpoises from the eastern North Atlantic and the North Sea, where genetic studies have shown population differences, and with Canadian Atlantic animals.

Comparison of age and length distributions between years and areas, indicated that while there were no statistical differences between the Maniitsoq and northerly samples in different years, with a modal age in both sexes of about 2 yr and a longevity of 17 yr, the southerly Nuuk and Paamiut samples were biased to younger age classes, with a modal age in both sexes being the first year (age class 0 yr) and a longevity of 12 yr.

Females ovulated from age 3-4 yr at a length of about 140 cm; testes weights >200 g indicated maturation in males from age 2 yr upwards at a length >125 cm. Several small embryos were found, consistent with a mating season in late summer. Testis hypertrophy in August also supported a late summer breeding. The youngest female in this sample with a *corpus* was 3 yr, and the oldest recorded was 12 yr with 11 *corpora*. A regression analysis of ovarian *corpora* number against age was performed for 31 animals:

(1) $$\text{No corpora} = 0.731 * \text{Age} - 0.628$$

The implied ovulation interval is about every one and a third years. In reality, because the data indicate a strong seasonality of reproduction, females may either ovulate each year or every two years. The coefficient above has a S.E. of $\pm$ 0.157, so that the ovulation interval could fall in the range 1.13 to 1.74 yr. Probably the mean reproductive interval of over a year means that the breeding season may be protracted over a few summer months in order to enhance the success of late season breeders.

Application of growth models indicated an asymptotic length of 154 cm in females and 143 cm in males and a corresponding weight of 64 kg and 52 kg respectively. Body weight and length correlate well, where the formula is

(2) Males + Females $W = 0.00058\ L^{2.281}$

where W = body weight in kg, L = body length in cm. Standard error for the exponent is $\pm$ 0.092.

Further investigation showed that there is a close correlation ($r^2 > 0.93$) between length, L in cm, mid-girth (G_3 in cm) and weight, W in kg. Weight can be predicted from a length-girth and weight formulation:

(3) Males $W = 0.00008\ L^{1.57}\ G^{1.21}$

(4) Females $W = 0.00025\ L^{1.69}\ G^{0.83}$

The weight estimation is improved by inclusion of the mid-girth factor, as it takes into account the body fat condition of the animal.

Indicators of body condition such as girth (mid-girth, G_3) and blubber thickness (mid-lateral, L_3), showed that the pregnant females were fattest. Blubber thickness is significantly greater in juveniles than adults, and this is reflected in the diminishing relative blubber mass to body size. The excess blubber may be unnecessary both for insulation and as energy reserves in adults. Porpoises in West Greenlandic waters are generally living in water close to freezing year-round, and fatness, especially noted in calves, may contribute to insulation and survival.

Stomach content analysis for 92 animals indicated regional differences, although capelin (*Mallotus villosus*) was predominant in all samples, as reported off north Norway, but different from the predominantly benthic species off Denmark. The presence of fish, squid and crustaceans indicated opportunistic feeding. Indicators of body condition showed that the pregnant females were fattest, as reported from Canada and British Isles. Animals were significantly heavier and fatter for length than the Canadian and North Sea animals. The blubber lipid content was generally 92-95% wet weight of tissue, a higher level than for British animals (83-87%).

While indicators of body condition may reflect seasonal biases and local ecology, and also origins of the animals (strandings or take), certain biological parameters do indicate differences between West Greenland and eastern North Atlantic populations in concert with the genetic findings.

Points Raised in Discussion
None.

THEME 3: ECOLOGY AND POLLUTANTS

3.1 Bjørge, A. (KEYNOTE): The harbour porpoise in the North Atlantic: Habitat use, trophic ecology and contaminants.

General assumptions about harbour porpoise ecology and pollution status may be summarised by the following statements:

- harbour porpoises tend to inhabit murky waters, such as are found in bays and estuaries, in areas of coastal up-welling and tidal races (Martin 1990);
- harbour porpoises are fish feeders, and a range of fish species contribute to the diet. (e.g. Aarefjord *et al*. 1995)
- harbour porpoises are coastal dwellers, feed at high trophic levels and have relatively small body size: these three factors combine synergistically to place the species in an ecological situation where it is highly exposed to environmental contaminants. (Aguilar and Borrell 1995)

However, when looking behind these general statements we find that there are large variations in harbour porpoise habitats, diet composition and contaminant burdens over relatively small spatial scales. In this introduction to the session on Ecology and Pollution, I will therefore elaborate on the variability observed with regard to habitat use, foraging ecology and exposure to contaminants. I will focus on the Northeast Atlantic, but examples from other areas will also be used, in particular examples from the extensively studied porpoise population in the Bay of Fundy (BoF) and Gulf of Maine (GoM) area.

Habitat Use and behaviour

Otani *et al*. (1998) explored the diving behaviour of harbour porpoises in Funka Bay, Hokkaido, Japan. They used time-depth recorders and successfully retrieved the instruments from two animals. Their animals carried out V-shaped dives assumed to be transit dives. These dives were normally less than 20m deep and clearly different from U-shaped 70m-100m deep dives assumed to be foraging dives. The depth range of 70m-100m corresponds well to the water depths of Funka Bay (Otani *et al*. 1998). From this study it may be concluded that porpoises dive to less than 20m when travelling and that they forage at or near the sea floor at depths of up to 100m. However, looking at studies conducted in other areas with different bathymetry, we find recordings of dives beyond 200m depths (Read and Westgate 1998).

Nine porpoises were tracked in the BoF-GoM area using satellite telemetry (Read and Westgate 1998). The porpoises were captured near Grand Manan in August of 1994 and 1995 and the mean tracking period was 50 days (+/- 65) with a maximum of 212 days. These porpoises displayed considerable variability in their movement patterns. Four remained in the BoF while five travelled to the GoM. However, they also showed some similarities: all were most frequently located in water depths between 92m and 183m (55% of all locations) and least (12%) in depths of more than 183m. When exiting from the BoF, the porpoises followed the 92m isobath, which may represent an important movement corridor for porpoises, at least in this particular area. The estimated home range of GoM porpoises determined using satellite transmitted data was about 50.000km^2 (Read and Westgate 1998) as compared to 210km^2

estimated from VHF data (Read and Gaskin 1985). The new information showed that at least some of the GoM-BoF porpoises could integrate contaminants from prey over a much larger area than previously anticipated. This demonstrates that knowledge on habitat use is of importance for understanding the exposure to environmental pollution.

Despite their predominantly coastal habits, harbour porpoises may occur far offshore over water depths of some thousand meters. Bjørge and Øien (1995) reported sightings of porpoises midway between mainland Norway and the island of Jan Mayen. It is not known if these porpoises were foraging over deep waters or crossing oceanic waters between more shallow coastal foraging grounds. In May 1999 satellite transmitters were attached to three porpoises in Varangerfjord, North Norway. Preliminary results indicate that these porpoises utilised both offshore shelf waters in the Barents Sea (one porpoise) and very near-shore waters as foraging grounds (two porpoises) (Tolley and Bjørge, unpublished data).

These examples underline the importance of using adequate methods and technology when studying movements and habitat use of harbour porpoises. Further, the examples illustrate the problems associated with extrapolation from one area to another, and with generalising from a small sample size to the population level with regard to behaviour and habitat use in harbour porpoises.

Diet composition.

The harbour porpoise is a relatively small endothermic predator with limited energy storage capacity (Koopman 1994, cited in Read and Westgate 1998). It may be assumed that the porpoises are dependent on foraging throughout the year without prolonged periods of starvation. Spatial and temporal differences in diet may therefore be expected. This is demonstrated in BoF-GoM porpoises. In the summer season porpoises congregate in relatively small areas in the Bay of Fundy where they feed almost exclusively on herring. During autumn the porpoises disperse over the wider Gulf of Maine, and important prey species include herring, silver hake and pearlsides. During the winter season porpoises are assumed to disperse more widely and forage in coastal waters from New England to North Carolina, and the diet is not well documented (Gannon *et al*. 1998; Trippel *et al*. 1996).

The diet may also vary between neighbouring areas within seasons. A total of 247 porpoises taken as by-catch in Norwegian and adjacent coastal waters showed regional differences. The porpoises were taken primarily during May-July of 1988, however, some animals were stranded or by-taken as by-catch by other fisheries throughout the year. At the Norwegian Barents Sea coast, capelin, herring, saithe, haddock, blue whiting and greater argentine were the most frequently occurring prey species. At the Alantic coast of Mid-Norway, herring, saithe, blue whiting, poor cod, argentine and pearlsides occurred most frequently, as did herring, gobiids, ammotydids, sprat, whiting and cod in North Sea and Skagerrak waters (Aarefjord *et al*. 1995). These differences in diet show a shift from pelagic prey species in the deeper northern waters to more benthic prey species in the relatively shallow North Sea and Skagerrak waters. The mesopelagic species normally occur in deep waters and may become available to the porpoises during nocturnal vertical migrations. The lesson to be learned by these observations is that, in addition to the migration and distribution of potential prey species, the local bathymetry may also affect the diet composition of harbour porpoises.

Exposure to pollution

The harbour porpoise is exposed to chemical pollution primarily through food ingestion, and they feed at high trophic levels (Pauly *et al*. 1998). Of particular concern to the health of porpoises are the fat-soluble organochlorines (OC's) that accumulate through the food webs to reach relatively high concentrations in top predators. In porpoises, gradients of OC levels and changes in relative concentrations of major compounds are observed over short distances, e.g. from Newfoundland to BoF-GoM (Westgate *et al*. 1997), and along the Norwegian coast (Kleivane *et al*. 1995).

The production and application of some of the classical OC's is now banned in the North Atlantic region. The ratio between DDT and PCB seems to have changed in recent years. The highest levels of DDT are invariably found in porpoises sampled before 1975. However, these compounds are very persistent in the environment, and the PCB levels remain high and represent a standing health hazard for marine top predators such as porpoises (Aguilar and Borrell 1995). New groups of compounds (e.g. the brominated flame retardants) which may cause similar effects as the classical OCs, are at present entering the marine biota at an increasing rate.

Mercury is also of concern with regard to porpoises. Siebert *et al*. (1999) found that concentrations of mercury and methylmercury were higher in the German North Sea porpoises than the German Baltic Sea porpoises, and that high concentrations of mercury were correlated with higher prevalence of parasitic infections and certain pathological diseases such as pneumonia.

Conclusion

The harbour porpoise is mainly coastal in its distribution. However, information on habitat use, diet and exposure to contaminants may not readily be extrapolated from one area to another. The coastal environment may vary tremendously over short distances in bathymetry, availability of prey and contaminant levels. Point sources of pollutants may cause local but dramatic effects, and such effects may add to by-catch mortality of porpoises in coastal gill net fisheries, which are significant in many areas throughout the range of the species. Taking into account the evolving information on the population and sub-population structure in harbour porpoises, management plans should be based on local knowledge in order to ensure appropriate conservation of this abundant but still vulnerable small cetacean species.

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Points Raised in Discussion

None.

3.2 Siebert, U. Bruhn, R., Wünschmann, A. and Benke, H. (Presented by <u>Lucke, K.</u>): Investigations on health status of harbour porpoise from the German North and Baltic Seas.

Since 1991 all harbour porpoises by-caugth or stranded on the coast of the German North and Baltic Sea have been dissected as part of national research project on small cetacean populations in German waters.

Pathological examinations were carried out on all harbour porpoises according to the recommendations of the First European Cetacean Society Workshop on Cetacean Pathology. Depending on what the state of preservation permitted, histological, microbiological, parasitological, serological and chemical investigations were performed. For comparison a limited number of harbour porpoises from waters around Greenland were examined.

ΣCB concentrations in North Sea immature specimens were similar (14.9 µg/g lipid) to those from the Baltic Sea (17.0 µg/g lipid) and exceeding those in Greenland specimens by an order of magnitude (1.3 µg/g lipid). The concentrations of HCB, p,p'-DDE, p,p'-DDD and a-HCH were in the order Greenland < North Sea < Baltic Sea. The highest concentrations of a-HCH (0.14 µg/g lipid) were found in the Greenland population, and p,p'-DDT was detected only in this group.

The respiratory tract was found to be the organ system with the highest incidence of pathological lesions. Two thirds of the animals were affected by lungworms (*Pseudalius inflexus* and *Torynurus convolutus*). The majority had nematodes in the bronchial tree and the pulmonary blood vessels. Associated with the parasites, there were different types of pneumonia of varying degree and extension. They were caused most probably by secondary infections with various bacteria, among which streptococci were prevalent.

Unlike the harbour porpoises from the German waters, animals from the waters around Greenland showed milder parasitic infestation of the respiratory tract and generally no pneumonia. Whether that is due to a reduced function of the immune system in harbour porpoises from the German waters caused by high burdens of organochlorines or not needs further research.

Currently a project funded by the Federal Ministry of Environment has been started, with the aim of providing information for harbour porpoises on the influence of pollutants known to have endocrine disrupting effects. This will help to determine if these pollutants influence the endocrine and immune systems to such an extent that they endanger the population of this species.

Points Raised in Discussion
There may be a relationship between contaminant levels (metals) and parasite loadings in the North and Baltic seas.

3.3 Donovan, G. Effects of chemical pollutants on cetaceans: can the harbour porpoise help us move from speculation to determination?

Since 1993, the International Whaling Commission has shown an increased interest in environmental matters. Its Scientific Committee agreed to focus its consideration of such matters on two areas: pollution and environmental change. The author traces the history of the Committee's consideration of chemical pollutants and cetaceans, beginning with a Workshop held in Bergen in 1995 and culminating in a research proposal agreed in 1999.

The 1995 Workshop concluded: 'that there are sufficient data on the adverse effects of pollutants on the health of other marine mammal and terrestrial species to warrant concern for cetaceans. However ……a considerable amount of fundamental research is needed before it will be possible to adequately address the question of the effects of chemical pollutants on all cetaceans…… it is clear that if any progress is to be made within a reasonable timeframe, a multidisciplinary, multinational focused programme of research is required that concentrates on those species/areas where there is most chance of success.'

The agreed programme will focus on harbour porpoises and bottlenose dolphins. The harbour porpoise component involves field collections from several countries including Iceland, Norway, Denmark and the USA. Fresh harbour porpoises taken accidentally during commercial fishing operations will provide the majority of samples and will require the co-operation of fishermen and biologists from several institutions.

The PCB's were chosen as model compounds because of their overwhelming anthropogenic origin, very high concentrations in some cetacean populations, recognised effects upon wildlife and the substantial background information already available on patterns in variation, geographical distribution, tissue kinetics and mechanisms of action. The short-term aims of the project are:

(a) To select and examine a number of biomarkers of exposure to and/or effect of PCBs and try to determine whether a predictive and quantitative relationship with PCB levels in certain tissues exists;

(b) to validate/calibrate sampling and analytical techniques to address such questions for cetaceans, specifically
   - i. determination of changes in concentrations of variables with post-mortem times;
   - ii. examination of relationships between concentrations of variables obtained from biopsy sampling with those of concentrations in other tissues that can only be obtained from fresh carcasses.

The work will be divided into two phases - information from Phase 1 is important in providing the calibration/validation tools necessary to better focus and design Phase 2. Data from Phase 1 will provide information not only essential for completing Phase 2 of POLLUTION 2000+ but also of fundamental importance to many research programmes examining issues of chemical pollutants and cetaceans. Phase 1 concentrates largely on sub-objective (b) above and comprises two sub-projects: (1) effect of post-mortem time; and (2) relationship between information obtained from biopsy samples with that obtained from live-captured animals or carcasses (either from by-caught or freshly stranded animals).

Highest priority is to be accorded to sub-project 1. Changes in levels of contaminants and indicators of exposure are known to occur after death due to the inevitable physiological changes and breakdown of tissue (e.g. see Workshop Report). It is essential that these changes are quantified to determine the effect of post-mortem time on levels in the various tissues if the implications of measured levels of these in animals whose time to death is uncertain are to be correctly interpreted with respect to concentrations in the living animal.

The post-mortem experiment can be carried out on a selected sub-set of the biopsy calibration experiment animals. The absence of a suitable source of fresh carcasses of bottlenose dolphins means that the calibration experiments will be carried out on harbour porpoises.

Points Raised in Discussion

- It may be difficult to ascertain exact post mortem times of by-caught animals. Estimates can be obtained by observers and experienced fishermen. There is also the potential to utilise cooling curves for carcasses to estimate time of death. In some cases, the animals die during net handling, which gives an exact time of death.
- Given seasonal variations in condition, seasonality must also be taken into account in contaminant studies.
- Samples for phase 1 could more easily be collected from direct catches in the Faroes and/or Greenland.

3.4 Møller, P.: Evidence of a defined shift in the fatty acid composition along the blubber-profile of harbour porpoise (*Phocoena phocoena*): The physiological significance.

In this investigation, a simultaneously pregnant and lactating 6-year-old by-caught female harbour porpoise (*phocoena phocoena*) from the north sea was analysed for fatty acid composition along blubber cross-sections using a one-step extraction and trans-esterification method. Blubber was sampled at twelve defined body sites and the fatty acid composition analysed in blubber layers of 2-mm, through from epidermis to muscle. A defined and dramatic shift in the fatty acid composition occurred over a 2mm transition zone, 8-10 mm in from the epidermis, separating a homogenous outer superficial zone from a homogenous inner deep zone. Only a very weak stratification was apparent at the posterior dorsal position, suggesting that this blubber functions mainly as a structural support, optimising the hydrodynamic shape of the animal. For the remaining eleven sites, representing the abdominal-thoracic region, the superficial zone was characterised by high and dominating levels of short-chained endogenous fatty acids and very low levels of diet-related fatty acid. In contrast, the deep zone was characterised by high dominating levels of long-chained diet-related fatty acids and low levels of endogenous fatty acids. These findings suggest that the deep zone is the only site of storage and that the superficial zone is mainly functioning as an insulation layer. Based on these findings a critical blubber thickness of 8-10mm is hypothesised. The physiological significance is discussed.

Points Raised in Discussion

- It should be possible to directly measure the thermal conductivity of the blubber layers.
- There does not appear to be differential storage in over different areas of the

body (e.g. abdomen) as is observed in some seals.

3.5 Møller, P.: Distinguishing between foraging patterns and sexual maturity of harbour porpoise (*Phocoena phocoena*) from West Greenland and the North Sea, utilising blubber fatty acid composition and classification regression trees.

A new tool that combines fatty acid signatures and classification trees was applied in a study on foraging patterns and sexual maturity in harbour porpoise (Phocoena phocoena). Animals from the three districts of Maniitsoq (n=50), Nuuk (n=27) and Paamiut (n=19) along SW-Greenland and from the NE- and central North Sea (n=19) were analysed for blubber fatty acid composition using a one-step extraction/trans-butylation method and for stomach content using otolith identification. A large difference in diet composition between harbour porpoise from the North Sea and Greenland was confirmed from tree analysis, which distinguished between animals from the two areas using only one diet-related component (C18:2n-6). A less convincing differentiation was found between the districts along SW-Greenland, but this was also suggested to result from diet, which differed only in the frequency of specific prey. Differentiation between districts was improved dramatically when sexually mature and sexually immature harbour porpoises were analysed in isolation. Apart from an array of diet-related fatty acids, the unique endogenous isovaleric acid (iso-C5:0) single-handedly distinguished between sexually mature and immature animals. Studies on lipid dynamics need to be conducted before the full potential of this new tool can be exploited.

Points Raised in Discussion

- There is a potential to use biopsy sampling to determine the maturity stage of the animal. However it will have to be determined if the entire blubber core or just the outer layer is required.

3.6 Víkingsson, G.A., Ólafsdóttir, D. and Sigurjónsson, J.: Diet of harbour porpoise (*Phocoena phocoena*) in Icelandic waters.

Until recently, no systematic studies had been conducted on harbour porpoises in Icelandic waters. As a part of its multi-species research efforts, the Marine Research Institute, Reykjavik, initiated in 1991 an organised sampling scheme for harbour porpoises incidentally caught in gillnets. Stomach samples from 1035 animals by-caught during 1991-1997 were analysed. Although samples were obtained from areas all around the country, most samples originate from southeastern and southwestern Iceland. Males comprised 64% of the sample, while 35% of the total sample were mature animals.

Some food remains were found in 95% of the examined stomachs. The amount of stomach contents, as judged by visual assessment and calculated from otolith size - fish length relationships, indicated a reduced feeding rate during summer and a marked increase in stomach content during winter. Larger amounts of stomach contents were found in females than in males, and pregnant females contained the most food remains.

While more than 40 species of prey were identified, 90% of males and 80% of females contained only one or two prey species. 99.8% (by reconstructed weight) of the stomach contents consisted of fish, 76% of capelin, 14% sandeel, 4% gadoids and 3.5% redfish. There was considerable variation in diet composition. In the southern areas, capelin and sandeel dominated the diet, while there was more diversity in the northern areas. Within the SW area, marked seasonal fluctuations in diet composition were evident. Capelin was the dominant prey species in February through April, while sandeel was the most important prey in the latter half of the year. Diet composition of pregnant females appears to be more diverse than that of other reproductive classes, where capelin and sandeel were overwhelmingly dominant. The calculated size of fish prey varied considerably

Points Raised in Discussion

- The energetic value of prey may be important in determining seasonal and life stage prey preferences. It appears that pregnant females put more effort into selective foraging.
- The apparent higher foraging effort of pregnant females may lead to more frequent entanglement in nets.
- Harbour porpoises are not purely opportunistic feeders as there is some structuring by age and reproductive status.
- It was not possible to distinguish between the species of sandeels in the stomach samples.

3.7 <u>Ólafsdóttir, D.</u>: *Anisakis simplex* (Nematoda) infestations in harbour porpoises (*Phocoena phocoena*) in Icelandic waters.

Anisakis simplex nematodes were collected from 47 and 37 by-caught harbour porpoises from SW Iceland in February to May and October to December respectively, and from 30 porpoises from NE Iceland in February to May.

All developmental stages of the worm were found in the porpoises, but mature worms did not grow large and female worms carried few eggs. The harbour porpoises may therefore be considered a poor host for the parasite.

Observations of high worm abundance and high proportions of immature larvae give indications of intervals with increased accumulation of worms. These intervals can be linked to areas and seasons where/when capelin is a prominent food item.

Information on *A. simplex* infestations in porpoise populations may add information to traditional diet analyses by giving indications of the importance of capelin in the diet during the last weeks prior to capture. No such conclusions can be drawn about other prey species, as they have similar worm density levels.

Points Raised in Discussion

- It is not known what makes a host “good” for this parasite. The “goodness” of the host can also be ascertained from the proportion of mature worms in the final host. There are mature worms in harbour porpoises, but they are small and produce few eggs.

3.8 Zaslavskiy, G. Echolocation and hearing in the Black Sea harbour porpoise.

The Black Sea harbour porpoise (*Phocoena phocoena*) used to be a popular subject of hearing and sonar studies in the former USSR. It was frequently caught in fishing nets and relatively cheap to obtain for experiments. Because of distinct differences between echolocation clicks of the harbour porpoise and the bottlenose dolphin (*Tursiops truncatus*), we found it very important to compare characteristics of their hearing and sonar systems. As far as target discrimination cues are concerned, it is still not clear whether dolphins process a target echo in the time or frequency domain. For broad band echolocation clicks of Tursiops, both options are equally appropriate. For a relatively narrow band harbour porpoise click, the time domain echo representation appears to fit better. Because harbour porpoises are difficult to maintain in captivity, dozens of electrophysiological experiments were carried out, however few behavioural studies on hearing and echolocation have been attempted. Remarkable similarity in the Northern and Black Sea harbour porpoises' echolocation clicks suggests the same signal processing in the auditory system. Therefore, our behavioural results on the Black Sea harbour porpoise could be directly applied to the Northern harbour porpoise. Using a multi-channel recording system, we measured transmission directivity pattern in the harbour porpoise. Target discrimination, target detection in reverberation, hearing sensitivity and temporal summation were also studied. Time resolution and integration time constants of harbour porpoise are comparable to those of bottlenose dolphin. Echolocation and hearing in the Black Sea and Northern harbour porpoises will be compared.

Points Raised in Discussion

- Porpoises may become accustomed to sounds quickly, thus reducing the effect of deterrent devices.
- It is likely that porpoises can detect most nets. Putting certain materials in nets may increase their sonic "visibility".
- It is possible from these data to approximately predict the detection distance of nets to harbour porpoises.
- Bottlenose dolphins can probably detect nets at much longer distances because they use louder detection clicks.
- A difference has been reported in ear anatomy between northern and Black Sea harbour porpoises, which may account for the difference in hearing sensitivity.
- As expected, harbour porpoises are most sensitive in the frequency range of their own clicks.
- Harbour porpoises could be trained to perform these tests within a matter of a few days, using a reward system.

THEME 4: ABUNDANCE, REMOVALS AND SUSTAINABILITY OF REMOVALS

4.1 Stenson, G. (KEYNOTE): Harbour porpoises in the North Atlantic: Abundance, removals and sustainability of removals.

Serious concerns have been raised about the status of harbour porpoise populations in the North Atlantic. Although a number of potential limiting factors have been identified, the focus has been on the impact of removals, primarily due to incidental catches in fishing gear. As a result, considerable efforts have been made to determine the levels and/or impact of by-catch in a number of areas. Currently, harbour porpoise have been listed, or are proposed to be classified, as threatened, vulnerable or endangered in many parts of their range. In order to determine if the current levels of removals are sustainable, information on population identity and seasonal movements, population parameters, abundance, and the magnitude of removals are required.

A good understanding of the population structure is necessary in order to define the area being considered by both the abundance estimates and removals on the appropriate geographical and temporal scales. Although there has been considerable research on population identity there is still some confusion about some areas (e.g. the North Sea, Skaggerrak, Kattegat, Belt and Baltic) that should be clarified to ensure that removals in these areas are assigned to the appropriate biological unit.

Information on biological parameters is available from a number of populations. However, the extent of potential biases in reproductive parameters determined from catches should be examined on a population specific basis. Also, survival estimates are required.

Although abundance surveys have been carried out in some areas, population estimates are not available for many areas in the of the North Atlantic including Newfoundland, Greenland, Faroe Islands, Iberia, NW Africa, western UK areas. Information on the abundance of harbour porpoise in the Gulf of Maine/Bay of Fundy area is obtained from American surveys. A series of abundance estimates from 1991, 1992 and 1995 resulted in an average estimate of 54,000 porpoises in this population. A fourth survey was carried out this year. Estimates of 12,000 and over 21,000 resulted from surveys of the entire Gulf of St. Lawrence in 1995 and the northern area only in 1996, respectively. These are underestimates since they were not corrected for visibility biases. Population estimates are available for Iceland (27,000) and northern Norwegian waters (11,000) but these surveys are more than 10 years old and refer to offshore populations only. The SCANS surveys, carried out in 1994, provided good estimates for the North Sea (280,000), Kattegat, Skagerrak and Belt area (37,000) and Celtic Sea (36,000). An estimate of 599 porpoise has been reported for the western Baltic but the survey details are unknown. A concerted effort throughout the entire range is required in order to obtain reliable estimates of current abundance of harbour porpoise in the North Atlantic.

Information on the level of removals can be obtained from a variety of sources, each subject to potential biases that can affect the usefulness of estimates. Different methods may be required for individual situations, but reliability checks should be incorporated into whichever method is used to provide a basis for evaluating the estimates obtained. Since these checks have not be carried out for most methods, the most reliable technique currently available for obtaining quantitative estimates of removals is through the use of independent observer programs.

Directed catches occur in Greenland (1,700 in 1994 and 1,135 in 1995) and to a much lower extent, in the Faroe Islands (3 in 1996). Incidental catches are thought to be very low in the Faroes and included in the catch statistics in Greenland.

Incidental catches have been reported in all other areas of the North Atlantic although there are no quantifiable estimates of total removals for Gulf of St. Lawrence, Newfoundland, Iceland, Norway, Baltic Sea and Northwest Africa. Since the early 1990s, catches are thought to have been reduced in the Gulf of St. Lawrence and Newfoundland areas due to decreased fishing effort.

Estimates of removals based on observer programs are available from the Danish (6,800/yr 1992-98) and UK (800-900/yr 1995-97) fisheries in the North Sea, Skaggerak (>100/yr 1996-97), Celtic Sea (2,200/yr 1993) and western Scotland (~100/yr 1995-97) areas. However, these are considered to be underestimates since observer coverage is not complete for all fisheries conducted in these regions. Major efforts have been made to estimate incidental catches affecting the Gulf of Maine/Bay of Fundy population. Based on observer coverage of the major fisheries, an average of almost 1,900 porpoise are estimated to have been removed from this population annually from 1993-97.

Attempts to assess the status of harbour porpoise have been based on trends in sightings or, in areas where information on abundance and by-catch are available, on models using arbitrary criteria and/or theoretical estimates of potential population growth (e.g. removals expressed as a percentage of population size, Potential Biological Removals). Detailed case-specific population models have been proposed but are not yet available. The choice of a critical limit beyond which removals are considered unsustainable is dependent upon the management objectives chosen.

Although substantial progress has been made to improve our knowledge in the last decade, significant gaps still exist and the information required to assess the status of harbour porpoise populations is still not available for most areas. There are no quantitative data on abundance or removals in Newfoundland and Labrador, Iberia and Bay of Biscay or Northwest Africa. Data on abundance exist for the Gulf of St. Lawrence, Iceland, Northern Norway / Barents Sea, and Baltic areas but estimates of removals are not available. In contrast, estimates of removals, but not abundance, exist for the Greenland and Faroe Islands populations. Incidental catches in the Swedish Skaggarak have been estimated to exceed 4% of the population but a better understanding of the population structure, total removals and seasonal movements of porpoise in the Kattegat, Baltic and North Sea areas is needed before the impact of removals can be properly assessed. Estimated removals in the Danish and UK North Sea fisheries are approximately 3% of the total abundance estimated in 1994.

Additional removals occur from other fisheries in this area. Recorded catches in the Celtic Sea is approximately 6% of the estimated abundance for this area but recent changes in fishing effort may affect this estimate. Therefore, the levels of incidental catches should be reassessed before the sustainability of removals can be determined. Annual removals from the Gulf of Maine/Bay of Fundy population are approximately 3.5% of the mean population size and well above the estimate of PBR.

The most important factor limiting our ability to assess the impact of removals on harbour porpoise in the North Atlantic is a lack of knowledge. In almost all areas, information on abundance and/or removals is either lacking or out of date. In order to assess the sustainability of removals, efforts must be made to monitor fishing effort, catch levels and abundance on a regular basis. These are especially critical in areas that are undergoing significant changes in fishing effort or environmental conditions. We must also define what is meant by the term “sustainability” in a biologically meaningful manner and in the context of clearly stated management objectives.

Points Raised in Discussion
None.

4.2 Brodie P.F. The Bay of Fundy/Gulf of Maine harbour porpoises: The ecological/energetic approach to issues of habitat, versus the bio-politics of marine mammals in fisheries management.

During the late 1980’s, numbers of harbour porpoise (*phocoena phocoena*) within the Bay of Fundy/Gulf of Maine were considered to be declining as a consequence of by-catch in the sink gillnet fisheries of both Canada and the United States. Evidence for a decline was based upon decreased sightings and a diminishing by-catch in areas considered to be a traditional habitat. Observed changes in the individual growth rates of porpoises were also attributed to decreased density.

In 1991 the Canadian Department of Fisheries and Oceans announced the formation of a Harbour Porpoise Recovery Team. Departmental scientific advice suggested that this action was not justifiable based upon the field evidence, nor did it take into consideration the observations of the fishers affected. This paper demonstrates that it is possible to interpret the same information regarding the BOF/GOM harbour porpoise in quite different ways, and that an alternative interpretation, described here, was more consistent with what was actually observed by researchers and commercial fishers. The lessons from this exercise underscore the increasing influence of high-profile crises management, in preference to common-sense ecological approaches when marine mammals are involved.

This paper describes the process by which the harbour porpoise by-catch issue was examined in terms of energetics, the dynamics of the habitat, fluctuations in distribution and energy content of prey, as well as the possibility of enhanced survival through reduction of predatory sharks. It also alludes to the diminishing role of ecologists and multi-disciplinarian approaches in fisheries management.

Points Raised in Discussion

- The distribution pattern changes from year to year in some harbour porpoise populations. This affects the design parameters of surveys, as survey effort cannot necessarily be allocated on the basis of previous surveys.
- This also leads to variability in estimates of by-catch, as areas may experience extreme fluctuations in catch from year to year.
- There is very little information on the natural predators of harbour porpoises.
- In most cases, effort data are not gathered with by-catch data, which makes these data difficult to interpret in terms of distribution and abundance.
- Fishing itself is never static, and the fishing patterns also change from year to year.

4.3 Kuklik, I. and Skora, K.: Status of harbour porpoise (*Phocoena phocoena*) and threats for the population in Polish Baltic Waters.

At present, Polish waters appear to be the eastern border of the zoogeographical distribution of harbour porpoise in the Baltic Sea. There was apparently a high abundance of porpoises here at the beginning of this century and earlier, but it has decreased significantly since the 1940's.

The investigations of the last decade indicate the present abundance of harbour porpoises in this area is extremely low, in comparison with that at the beginning of the century. There is an annual average of 6 reports of observed, stranded and/or by-caught animals. A total of 58 reports were collected between 1990-1998, of which 42 (72%) were by-caught in fishing nets, 11 (19%) were reported as sightings and 5 (9%) were found stranded on the beach.

The majority of by-catch (57%) was reported from a relatively small area of the Puck Bay. The "semi" drift nets used to catch salmon in this region appear to be the most serious threat to porpoises. However, the relatively recent increase in the use of the cod bottom set has also become a serious threat during last few years.

The majority of by-caught porpoises were young specimens up to two years old. There is no data on the reproduction of these animals in this region, although one lactating and one pregnant female have been found.

Stomach content analyses show that the porpoises in the Polish coastal zone feed mainly on herrings, sprats and gobies. Additional food items were eelpout, cod, eel, ruff and sandeel.

Concentrations of Hg (mercury), Cd (cadmium), Pb (lead), Ag (silver), Zn (zinc), Cu (copper) and Mn (manganese) in the liver, kidney, muscle, lung, heart and diaphragm of the harbour porpoise were determined. Distinct inter-tissue differentiation in metal concentrations was noted: liver showed maximum concentrations of Ag, Cu and Mn; kidney had the greatest concentrations of Cd and Pb, while diaphragm had the greatest concentration of Zn. The concentrations of Zn, Cu, Hg and Cd in the liver, kidney and muscle found in our study are generally comparable with those reported for individuals of the same species inhabiting other regions such as British, German and

Danish waters.

The population of harbour porpoise in Polish waters needs urgent protection measures to prevent its extirpation, especially in light of the latest investigation based on analyses of German and Polish samples from the North and Baltic Seas, respectively, which indicate that these two stocks could be genetically separated.

Points Raised in Discussion

- Although live animals are sighted by fishermen and others, there have been no systematic surveys in the area. There are also sightings of white-beaked and striped dolphins in the area.
- There is a great need for further genetic analyses of samples from this area.

4.4 Desportes, G., Amundin, M., Goodson, D., Lockyer, C. and Larsen, F.: Update on the EPIC project: "Elimination of harbour porpoise incidental catches", with emphasis on experiments conducted with captive harbour porpoises.

EPIC is a co-operative research project carried out by the Danish Institute for Fisheries Research (Denmark, project co-ordinator), the Fjord and Belt Centre (FBC, Denmark), Kolmårdens Djurpark (Sweden) and the Lougborough University (UK), with partial collaboration of the University of Odense. It started in June 1998 for a two year period, and is 50% funded by the EU.

The main objective of the EPIC project is to reduce by-catch of harbour porpoises in set gillnets, by a logical sequential integration of five objectives. This summary presents the progress achieved in the first 12 months, with emphasis on the experiments carried out with captive porpoises at the Fjord and Belt Centre.

Objective 1

Investigate porpoise foraging behaviour, both visual and acoustic (fish detection, interception and capture), in controlled conditions in relation to changes in the environment (sand and rock bottom), reaction to obstacles (net head rope) and behaviour of fish prey.

Experiments have shown that the behaviour of an animal focussing on prey and disregarding obstacles, may be a reason for entanglement in the wild. However there is great individual variation among porpoises in their response to obstacles.

Objective 2

Investigate porpoises behavioural response to deterrent stimuli in enclosed situation (FBC) and semi-controlled conditions in the wild (porpoises trapped in pound-nets).

Task 2.1

Investigate deterrent sound characteristics that induce an avoidance response in harbour porpoises in a controlled situation (FBC), e.g. spectral characteristics, waveform, pulse duration, intensity, repetition rate, etc.

Only the effect of shortening the duration of selected sounds was tested. This is of particular interest since it prolongs the battery life of the alarm, thereby reducing the operating cost and simultaneously minimising the total noise energy contributed to the environment. The shorter signal durations tested retained the effect of displacing animals from the transducer, with a weaker response than that of the longest. Marked individual differences in the reactions were observed. Changes in the heart rate pattern during the test sound periods could also be detected, but further analysis is required to quantify these changes.

Task 2.2
Investigate how porpoises respond to an interactive, acoustically triggered type of deterrent in the presence of fish prey. (Planning stage)

Task 2.3
Test masking porpoise sonar echoes in order to create ”non-foraging” zones. (Planning stage) If porpoises are prevented from detecting fish close to fishing nets, they may be discouraged from remaining in the area and choose to search for other, ”safer” foraging places.

Task 2.4
Investigate the distance at which an acoustic deterrent may be effective (planning stage). Harbour porpoises are regularly trapped in pound nets in inner Danish waters. A porpoise will be exposed to sound emissions from a deterrent device at 100 m distance intervals.

Objective 3
Develop efficient deterrents for use in bottom set gillnet fisheries, by improving existing devices and developing new ones (Planning stage).

Objective 4
Porpoise by-catch monitoring and biological sampling.

Task 4.1
Estimation of current by-catch rates in the Danish fishery (Comparison with BYCARE results)

There has been 4 - 8% observer coverage of certain set gill-net fisheries in the North Sea, with 147 observer-trips in the period June 98 May 1999. About 74% of these trips targeted cod. Other target species were plaice, flounder and sole and lump-fish. Reporting is carried out using standard reporting forms developed during BYCARE. Observer reports suggest a rate of about 5% “drop-out”of porpoise carcasses, much lower than the rate of as much as 30% reported from similar fisheries elsewhere in the North Atlantic.

Task 4.2
Collect and analyse biological samples, and data from porpoise by-catches in Danish fisheries, especially to get information on population structure and diet. During May

1998 - May 1999, 65 carcasses were collected, 29 by-caught and 34 strandings. There was a clear juvenile predominance in the by-catches (0-2 year). The oldest by-caught animal was 8 years, whereas the oldest stranded animal was a 24 yr old female.

Task 4.3
Establish a database on by-catch data. All biological data on by-caught and stranded porpoises have been added to the Access database at DFU built under BYCARE of c. 1900 porpoises, together with date, ICES position, source (stranding or by-catch), net type if appropriate, and other fisheries-related information.

Objective 5
Dissemination of information on cetacean by-catch mitigation research.

Task 5.1
To prepare a database of publications relating to cetacean by-catch mitigation research and set up an electronic access to this information via internet or CD-ROM. A database of 643 relevant references was collated on PAPYRUS, an electronic database for library references. From these, 447 reprints were acquired to the EPIC library. This database will continue to grow and be updated throughout the next 12 months, and a final report and a CD-ROM will be produced.

Task 5.2
Prepare multi-lingual information material for the fishing industry about the relative use and efficiency of different methods used to reduce by-catch

Points Raised in Discussion

- Pingers have been observed to affect fish catch in some areas, but this has not so far been reported in Danish fisheries.
- Observers may miss “drop-outs” if the animals fall out of the net before they reach the surface, or if the observers are busy with other tasks. The rate of missed drop-outs is not known.
- Deterrent devices will exclude marine mammals from feeding in prime habitat, and may reduce the carrying capacity of the habitat for marine mammals.

4.5 Uhd Jepsen, P. Action plan for reducing incidental by-catches of the harbour porpoise

Both in the North Sea and in Danish domestic waters, incidental by-catches of harbour porpoises occur in connection with many types of fishery, though especially in connection with the use of gillnets, which are put out to catch turbot and cod .

In 1993, the Danish Fisheries Research Institute made a provisional investigation of the total incidental by-catch of harbour porpoises in the North Sea, covering gillnet fishery for sole, cod and turbot. Seen in relation to these three types of fishery, the figures in connection with registered by-catches were estimated to correspond to a total annual incidental by-catch of between 4,000 and 5,000 harbour porpoises, 42% of which were caught in turbot nets.

The present Action Plan for the reduction of incidental by-catches of harbour porpoises has been prepared by the members of the Task Group on Marine Mammals in 1998, including recommendations for reduction of incidental by-catch of harbour porpoise in line with ASCOBANS recommendations on sustainable take.

Further, the Action Plan outlines the ideal objectives and sets up an operational objective for the reduction of incidental by-catches, the main elements of which are the use of acoustic alarms, the regulation of certain types of fishery and the provision of information.

Points Raised in Discussion

- The common objectives of having "clean fisheries" and "ecosystem-based management" may be in conflict, as extraction from one trophic level will naturally affect the productivity of the next trophic level. In this sense, marine mammal by-catch may be acceptable from the standpoint of ecosystem-based management, as long as it occurs at a sustainable rate.
- If by-catch is considered as simply a part of a mixed fishery, an obvious way to reduce by-catch is through quota or effort reduction.
- The views and concerns of fishers have to be considered in any program to reduce by-catch.

5. SUMMARIES AND DISCUSSION

5.1 Distribution and stock identity

Distribution

Although the general distribution of harbour porpoises in the North Atlantic has been described (IWC 1995, 1996), little information is available on the movements of porpoises within and between areas. Information on the extent of movements made by porpoises, whether there is any temporal variation in their movements, and whether there are differential movements made by females and males, or mature and immature individuals, are essential to understand the dynamics of the different stocks. Fortunately, recent advances in satellite telemetry have been successfully applied in several regions, allowing for an initial examination of these variables (Read and Westgate 1998, Teilmann et al. this symposium, Tolley unpublished data).

Movements

Sixteen satellite tagged harbour porpoises have revealed that porpoises are capable of extensive movements in the western Baltic, inner Danish waters, Kattegat and Skagerrak. Immature porpoises were observed to move from the inner Danish waters up to 800 km along the Swedish west coast to the southeast of Norway during April-July. Mother/calf pairs tagged in the same area moved back and forth along a 100 km coastline of west and north Sjælland in Denmark. Adult males were observed to be more stationary than the adult females and the immature animals, staying within an area of a few kilometres for several weeks during April-June and November-December. Only immature porpoises entered the northern Kattegat and Skagerrak.

Contact was maintained with the porpoises throughout the reproductive season from late March to early December. The adult animals stayed within the inner Danish waters and the western Baltic in the period of contact, suggesting that these areas contain animals from the same breeding stock (Teilmann *et al.* this symposium).

Three adult harbour porpoises tagged in Varangerfjord in northern Norway have also exhibited extensive movements both along the Russian coast and into the Barents Sea (Tolley unpublished data).

Data on the movements of harbour porpoises on the east coast of America are also available from satellite tagged animals (Read and Westgate 1998).

Stock Identity

<u>*Genetics*</u>

Genetic techniques have been widely used in studies of population structure in a variety of species including cetaceans. Within the last decade, genetic techniques have provided valuable information regarding harbour porpoise population structure, and much of this information is described in Table 1 in Andersen (this Symposium). Unfortunately, there has been an inconsistent application of diverse techniques, such as RFLP analysis of mtDNA, sequencing of mtDNA, isozyme electrophoresis and microsatellites, in the different areas. This means that a valid comparative analysis between nearby areas, which would contribute to a more coherent picture of the harbour porpoise sub-populations/populations, cannot be performed. Nevertheless, the population genetic studies applied in the different regions do to some extent support the existence of genetically different harbour porpoise sub-populations/populations in the North Atlantic.

Although the International Whaling Commission (IWC) has divided the North Atlantic into 13 putative sub-populations (Fig. 1), several new studies suggest that a revision of this putative structure is in order. In the Northeast Atlantic, the study by Walton (1997) suggested that the North Sea may be divided into a northern and southern region. Further, it has been suggested that the northern North Sea may have an east-west division where porpoises may be associated with the coasts of either Scotland and Norway (Tolley et al. in press). Additionally, unpublished information (Andersen, pers comm.) also suggests that the North Sea may be divided into eastern and western stock areas. This information suggests that, despite the high probability of mixing in middle of North Sea, porpoises may be associated with breeding areas near the coast. If females are more philopatric than males, then such a division in stocks may be maintained in spite of this mixing.

Great confusion about the definition of the North Sea and inner Danish Waters (IDW) exists. Gaskin (1984) included Skagerrak in both the North Sea and the Baltic Sea, and the latter approach was adopted by the IWC (1996). The population genetic study by Andersen (1993) and Andersen *et al*. (1997) includes the Skagerrak in the North Sea and not in the inner Danish waters. Nevertheless, both studies were able to distinguish between the IDW and the North Sea. Another study by Wang and Berggren (1997) detected significantly different haplotype frequencies between samples from the Kattegat-Skagerrak area, the Swedish Baltic Sea and the Norwegian west coast. It was not clear whether the authors considered the Kattegat-Skagerrak sample to represent the North Sea or the inner Danish waters or Swedish waters. In the latter case, they indirectly assume 2 different sub-populations within the Kattegat, Skagerrak and Belt waters, i.e. a Swedish Baltic and a inner Danish water or Swedish water sub-population.

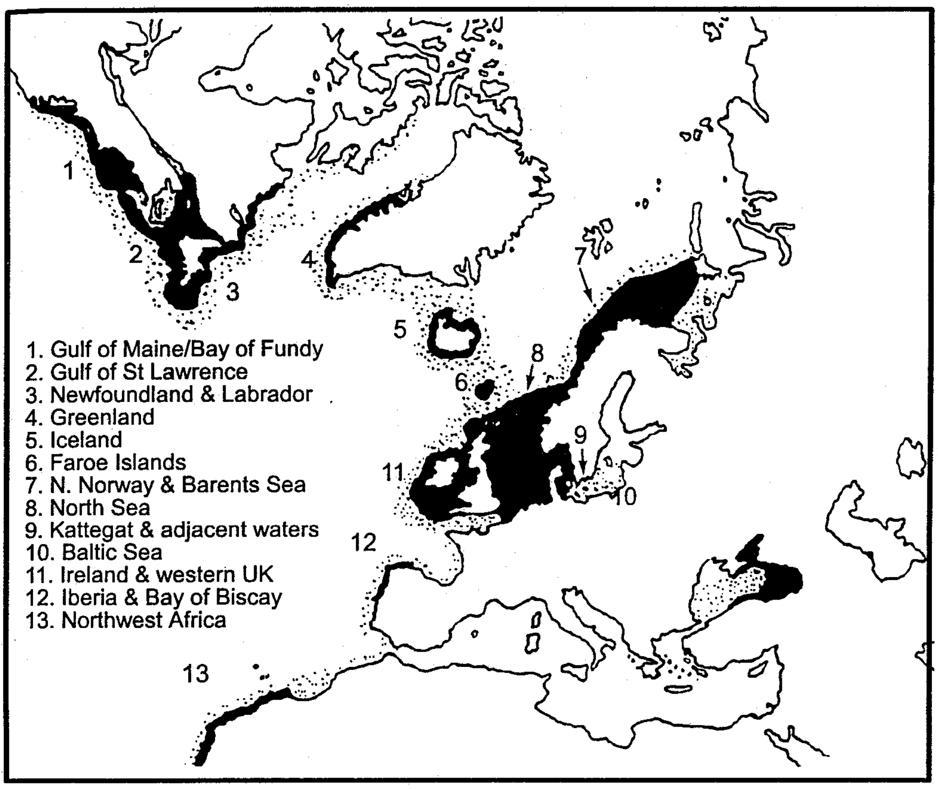

Fig. 1 Putative stock divisions of harbour porpoises in the North Atlantic. (from Donovan and Bjørge 1995, p. 5)

In Icelandic, Faroese, Iberian and West African waters, no genetic population structure studies have been applied to test the proposed population structure model of harbour porpoises in these regions.

Recommendations

<u>Distribution</u>

- Revision of the IWC distribution map to include all harbour porpoises sightings from all available survey records. Such information will be useful in identifying corridors between land masses in which harbour porpoises occur either regularly or occasionally.
- It is recommended that the present satellite telemetry studies continue and

that new telemetry studies are initiated in all areas where the stock structure is unclear. It is particularly important that a greater temporal range is covered.

- It is important that abundance and distributional studies should be correlated with the simultaneous examination of environmental variables. An understanding of the factors governing harbour porpoise distribution, including factors influencing prey distribution, will be important to our understanding of geographical and temporal mixing of animals from different areas.
- Exact position of all sampling, especially by-catches, should be emphasised in all areas to reduce the potential mixing of animals from different areas when genetic projects are planned.

Genetics

- Application of identical genetic markers to different studies of population structure so a world-wide comparison of the genetic relationships can be performed.
- For the nuclear markers, such as microsatellites, identical loci should be evaluated and calibration between laboratories through exchanges of DNA and results of genotyping should be conducted.
- For mtDNA, sequencing of the D-loop should be performed and a minimum length of the sequence should be agreed upon. Preferentially, DNA should also in these circumstances be exchanged between laboratories for calibration.
- It is recommended that in areas where genetic population structure studies have not yet been undertaken, such studies should be encouraged. These studies should utilise both the nuclear and mtDNA markers as recommended above.
- Information relevant to stock identity questions is available from a suite of techniques. It is important that a theoretical framework to integrate these various data types is developed. This must take into account the context in which the stock concept is to be used (e.g. management).
- Cooperative work should be undertaken in the areas around Denmark and into the Baltic to clarify population structure using both genetic and satellite tagging information, as well as other information.

Other methods

- Results from other studies, such as geographic variation in morphometrics, pollutant levels, and fatty acids should be combined with the results of genetic and telemetry studies to provide a more complete picture of the population structure.
- Methods for analysing satellite tagging data need to be adapted from terrestrial studies, focussing especially on assumptions required, and on the statistical properties of estimates of such things as home range.

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Points Raised in Discussion

- There is a great need for cooperation between jurisdictions for both genetic and satellite tracking studies.
- There is a need for ways of combining various types of data (e.g. data from tracking, genetic and contaminants studies) to get a better picture of stock identity and boundaries.
- There is a need for a coherent theoretical framework for analysing stock identity and determining sustainability.

5.2 Biological parameters

There were six papers presented in this session, covering aspects of reproduction, growth and life history. The keynote paper presented a review of current and published information. Further, new information was provided on parameters for harbour porpoise from Iceland, West Greenland and Denmark, and brief summaries of these papers are presented. A summary of the most current biological parameter data is provided in the Table 1.

Recommendations

Key factors that still require research input are listed below, and form the basis of the recommendations.

1. Basic biological parameters are needed for populations 2 (Gulf of St Lawrence), 6 (Faroe Islands), 11 (Ireland and western UK), 12 (Iberia / Bay of Biscay) and the Black Sea – see Fig.1.
2. Some additional data are needed for all other populations; especially 10

(Baltic) – see Fig.1.

3. Precise data needed are for length of suckling, and age and size at weaning.
4. Analyses of data should consider origins of data and the likely resulting biases introduced, including possible temporal trends, as well as the limitations of the methodology used.
5. Embryonic diapause – is this a real phenomenon in harbour porpoise?
6. Age and length at physical maturity – studies on vertebral epiphyseal fusion should be performed.
7. More information on fecundity, birth rate, and production is required.
8. More information on sex-specific survival and sex ratios is desirable.

Captive studies have a great potential for answering many biological parameter questions: age verification (tetracycline time-marking of teeth), reproductive information, and growth of individuals.

Table 1. North Atlantic Harbour porpoises: Biological parameters summary

Age-related parameters:

Longevity - max. 24 yr
Recruitment - few data but maximal rate of population growth 9.4%, in range 5-10%
Survival / Mortality - highest mortality in year 1; <5% population live beyond 12 yr; Kinze (1990) gave estimate of 0.867 with max. age of 23 yr

Reproductive parameters:

Age at sexual maturation - 3-4 yr usually for both sexes
Age at first parturition – probably 4-5 yr
Age at first ovulation - >3 yr

Ovulation rates / Reproductive interval - 0.66 – 1.01 corpus per yr; 0.99 - 1.57 yr
Pregnancy rates - most likely range 0.74 – 0.98 per yr
Seasonal breeding / mating - June - August
Gestation period – 10-11 months
Seasonal parturition - mid-May - mid-July generally
Lactational duration – uncertain, but probably 8 months

Foetal sex ratio – 1.1 males : 1.0 females (Lockyer and Kinze this symposium)
Post-natal sex ratio – 1.4 males : 1.0 females (year 1); slight excess of males in later life (1.1 / 1.2 males : 1.0 females) – Lockyer and Kinze this symposium)
Neonatal size - most likely range 65 - 70 cm; max. size probably 80 cm

Growth parameters:

Growth models for length and weight – von Bertalanffy and Gompertz (Kaufman 1981)
Asymptotic length and weight – variable with population, but usually
153 – 164 cm and 55 – 65 kg for females;
140 – 153 cm and 46 – 50 kg for males
Length at sexual maturity - variable with population, but usually
140 – 147 cm for females;
130 – 135 cm for males
Age at physical maturity – no information based on vertebral epiphyseal fusion

Foetal growth – uncertain growth model; depends on validity of embryonic diapause
Size / age at weaning – ca 115 cm? but >90 cm; >8 months, but entirely
Independent feeding ca 10 months?

References

Kaufmann, K.W. 1981. Fitting and using growth curves. *Oecologica* 49:293-299.

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Points Raised in Discussion

- The possibility of determining sexual maturity from biopsy samples (see 3.5) should be thoroughly investigated, as this would aid greatly in determining the structure of wild populations.
- Satellite-tagged mother-calf pairs may give good information on time of weaning. However genetic samples must be collected to confirm the mother-calf relationship.

5.3 Ecology and Pollutants

Harbour porpoises are inhabitants of coastal waters and their habitat includes some of the most polluted waters of the North Atlantic. Harbour porpoises have a small body size, and therefor a relatively high metabolic rate, and they feed at high trophic levels. These three factors combine synergistically to place the species in an ecological situation where it is highly exposed to environmental contaminants (Aguilar and Borrell 1995).

Harbour porpoises are most frequently observed in areas with water depths of less than 200 m. This is confirmed by the recent findings on the distribution and movements of animals equipped with satellite-linked tags. Harbour porpoises tend to travel between feeding areas along the approximate 90 m isobath (Read and Westgate 1998). However, harbour porpoises have also been observed over deep oceanic waters during offshore sighting surveys (Bjørge and Øien 1995, NAMMCO 1998).

Harbour porpoises feed at or near the sea bed in shallow waters (e.g. Otani *et al.* 1998), and benthic fish species constitute a large proportion of their diet (e.g. Aarefjord *et al.* 1995).

Temporal and spatial changes in diet compositions have been observed (e.g. Gannon *et al.* 1998, Aarefjord *et al.* 1995, Víkingsson *et al.* this symposium). These changes possibly reflect seasonal changes in the relative abundance of prey stocks, and differences in prey communities according to local bathymetry and other environmental factors.

Harbour porpoises forage almost exclusively on fish. However, a wide range of fish species are represented in the diet. Fish in general have little capacity to metabolise some important pollutants, such as organochlorines, and therefore act as an effective mechanism in the transfer of pollutants to piscivorous marine mammals such as the harbour porpoise.

Some of the classical organochlorines, such as PCB's, are still abundant in the marine biota, and represent a continuing health hazard for top marine predators (Aguilar and Borrell 1995). Harbour porpoises feed at approximately the same trophic level as grey and harbour seals and white sided dolphins (Pauly *et al.* 1998). In Norwegian waters, the foraging habitats and diets of harbour porpoises and harbour seals overlap almost completely. However, mean levels of total PCB and DDT in harbour porpoises were 2-3 times those of harbour seals from the same areas (Kleivane *et al.* 1995), possibly reflecting a poorer capability of harbour porpoises to metabolise these compounds. Gradients in levels of organochlorines in harbour porpoises have been observed over short distances both in the Northwest (Westgate *et al.* 1997) and Northeast (Kleivane *et al.* 1995) Atlantic.

Recent deployments of satellite-linked transmitters on harbour porpoises (e.g. Read and Westgate 1998; Bjørge, this symposium; Teilmann, this symposium) revealed large variability in individual movement patterns and habitat use. Some individuals travelled long distances in short periods of time (at the scale of hundreds of kilometres) between foraging sites. This underlines the importance of careful consideration of spatial and temporal scale in studies of harbour porpoise habitat use. Knowledge of habitat use is a prerequisite for an improved understanding of exposure to pollutants, and the pathways of compounds from the environment to the tissues and organs of the harbour porpoise.

Recommendations

1. There is a need for case studies on the effects of variations in the abundance of prey stocks on harbour porpoise population dynamics.
2. Information is needed on the predation on harbour porpoises by sharks and other predators. This could be partially assessed by comparing the distribution patterns of harbour porpoises and potential predators.
3. There is a need for integration of research plans to consider harbour porpoise distribution, prey abundance and distribution, ecotoxicology and the biological effects of pollutants simultaneously. Such collaborative efforts will make more efficient use of data and samples. An example would be the use of distribution information from satellite tagging programs to understand exposure to pollutants.
4. NAMMCO should join IWC in supporting the Pollution 2000+ program. No single organization has sole responsibility for this work, and collaboration is required both in terms of scientific expertise and funding.

References

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Points Raised in Discussion

None.

5.4 Abundance, removals and sustainability of removals

Issues and Data Gaps

Stock Identity:

In order for stock assessment and management to be effective, it is necessary to understand the relationship between animals that are being caught and the animals that are surveyed. This is particularly important for areas/stocks subject to high removals. The relationship between putative populations in one such area, the North Sea, Skaggerrak, Kattegat, Belt and Baltic, is unclear.

Biological Parameters:

Unbiased estimates of reproductive parameters are required on a population specific basis. The extent of potential biases in reproductive parameters determined from catches should be therefore be examined. In particular, unbiased and precise estimates of survival/mortality are needed.

Abundance estimates:

Estimates of abundance for harbour porpoise are rarely available, and the confusion over stock identity in many areas makes interpretation difficult. No estimates are available for Newfoundland, Greenland, Faroe Islands, Iberia, NW Africa, western UK areas. Partial estimates only are available for Baltic area. Estimates from Icelandic and Norwegian surveys are more than 10 old and refer to offshore populations only. Surveys from the North Sea, Kattegat and area, and Celtic Sea are now >5 years old.

Removals:
Estimates of anthropogenic removals are crucial, as this is usually the only parameter that can be affected by management. Yet such estimates are difficult to obtain and are unavailable for many areas, even those where removals are substantial. There are no quantifiable estimates of total removals for Gulf of St. Lawrence, Newfoundland, Iceland, Baltic, NW Africa. Estimates of removals are available from some areas but are of unknown quality or are old. This applies to Greenlandic, Faroese, and Norwegian fisheries. The North Sea, Kattegat and Irish Sea/Western UK areas have some observer coverage, but it is not complete for all fisheries.

Estimates of by-catch may be affected by very rapid shifts in fishing effort or better methods of estimating incidental catches. It is important to involve fishermen to ensure that they understand the issue and participate in the monitoring programs. Without it there will be no acceptance of the estimates and/or mitigation methods. Projects currently underway (e.g. EPIC) may provide some methods of mitigating incidental catches.

Ecological Factors
We do not understand the relationship between environmental /ecological factors and the distribution of porpoises. Such knowledge would improve the efficiency of surveys, and might also lead to ways of mitigating by-catch. In addition, the impact of predators on porpoise population, and how changes in the abundance of predators (or prey) affect harbour porpoise population dynamics, is unknown.

Recommendations
1. In order to assess the sustainability of removals we require better information on the stock structure of harbour porpoise, particularly in the North Sea/Skagerak/Kattegat/Baltic Sea area, on a seasonal basis.
2. We also require unbiased estimates of biological parameters on a population specific basis in order to determine population dynamics.
3. Current estimates of abundance and removals are absent or out of date for virtually all populations. Efforts must be made to monitor fishing effort, catches and abundance on a regular basis. These are especially critical in areas that are undergoing significant changes in fisheries or ecological conditions.
4. We must define what is meant by the term sustainability in a biologically meaningful manner and with clearly stated objectives.
5. We must investigate the relationship between ecological factors and the distribution of harbour porpoise populations and/or catches

Points Raised in Discussion
- There is considerable uncertainty about the precise meanings of terms like “stock”, “population” and “sub-population”, especially as they are used by researchers in different fields and by resource managers. The Scientific

Committee of the IWC established a Working Group on Stock Identity in 1998, to develop operational definitions of stock. NAMMCO should follow developments in this area. Collaborative, often international work is required, particularly for stock identification and abundance estimation.

- Abundance surveys should be carried out as part of an overall monitoring strategy with clear objectives. The objectives of the strategy often help to determine the design of the surveys. Consistency is sometimes more valuable than precision when comparing a series of abundance surveys.

6. SUMMARY OF RECOMMENDATIONS FROM THE SYMPOSIUM

6.1 Distribution and stock identity

Distribution

i. Revision of the IWC distribution map to include all harbour porpoises sightings from all available survey records. Such information will be useful in identifying corridors between land masses in which harbour porpoises occur either regularly or occasionally.

ii. It is recommended that the present satellite telemetry studies continue and that new telemetry studies are initiated in all areas where the stock structure is unclear. It is particularly important that a greater temporal range is covered.

iii. It is important that abundance and distributional studies should be correlated with the simultaneous examination of environmental variables. An understanding of the factors governing harbour porpoise distribution, including factors influencing prey distribution, will be important to our understanding of geographical and temporal mixing of animals from different areas.

iv. Exact position of all sampling, especially by-catches, should be emphasised in all areas to reduce the potential mixing of animals from different areas when genetic projects are planned.

Genetics

v. Application of identical genetic markers different studies of population structure so a world-wide comparison of the genetic relationships can be performed.

vi. For the nuclear markers, such as microsatellites, identical loci should be evaluated and calibration between laboratories through exchanges of DNA and results of genotyping should be conducted.

vii. For mtDNA, sequencing of the D-loop should be performed and a minimum length of the sequence should be agreed upon. Preferentially, DNA should also in these circumstances be exchanged between laboratories for calibration.

viii. It is recommended that in areas where genetic population structure studies have not yet been undertaken, such studies should be encouraged. These studies should utilise both the nuclear and mtDNA markers as recommended above.

ix. Information relevant to stock identity questions is available from a suite of techniques. It is important that a theoretical framework to integrate these various data types is developed. This must take into account the context in which the stock concept is to be used (e.g. management).

x. Cooperative work should be undertaken in the areas around Denmark and into the Baltic to clarify population structure using both genetic and satellite tagging information, as well as other information.

Other methods

xi. Results from other studies, such as geographic variation in morphometrics, pollutant levels, and fatty acids should be combined with the results of genetic and telemetry studies to provide a more complete picture of the population structure.

xii. Methods for analysing satellite tagging data need to be adapted from terrestrial studies, focussing especially on assumptions required, and on the statistical properties of estimates of such things as home range.

6.2 Biological parameters

i. Basic biological parameters are needed for populations 2 (Gulf of St Lawrence), 6 (Faroe Islands), 11 (Ireland and western UK), 12 (Iberia / Bay of Biscay) and the Black Sea (Fig.1).

ii. Some additional data are needed for all other populations; especially 10 (Baltic) –Fig.1.

iii. Precise data are needed for length of suckling, and age and size at weaning.

iv. Analyses of data should consider origins of data and the likely resulting biases introduced, including possible temporal trends, as well as the limitations of the methodology used.

v. It should be determined whether or not embryonic diapause occurs in harbour porpoises.

vi. Studies on vertebral epiphyseal fusion should be performed to determine the age and length at physical maturity.

vii. More information on fecundity, birth rate, and production is required.

viii. More information on sex-specific survival and sex ratios is desirable.

6.3 Ecology and pollutants

i. There is a need for case studies on the effects of variations in the abundance of prey stocks on harbour porpoise population dynamics.

ii. Information is needed on the predation on harbour porpoises by sharks and other predators. This could be partially assessed by comparing the distribution patterns of harbour porpoises and potential predators.

iii. There is a need for integration of research plans to consider harbour porpoise distribution, prey abundance and distribution, ecotoxicology and the biological effects of pollutants simultaneously. Such collaborative efforts will make more efficient use of data and samples. An example would be the use of distribution information from satellite tagging programs to understand exposure to pollutants.

iv. NAMMCO should join IWC in supporting the Pollution 2000+ program. No single organization has sole responsibility for this work, and collaboration is required both in terms of scientific expertise and funding.

6.4 Abundance, removals and sustainability of removals

i. In order to assess the sustainability of removals we require better information on the stock structure of harbour porpoise, particularly in the North Sea/Skagerak/Kattegat/Baltic Sea area, on a seasonal basis.

ii. We also require unbiased estimates of biological parameters on a population specific basis in order to determine population dynamics.

iii. Current estimates of abundance and removals are absent or out of date for virtually all populations. Efforts must be made to monitor fishing effort, catches and abundance on a regular basis. These are especially critical in areas that are undergoing significant changes in fisheries or ecological conditions.

iv. We must define what is meant by the term sustainability in a biologically meaningful manner and with clearly stated objectives.

v. We must investigate the relationship between ecological factors and the distribution of harbour porpoise populations and/or catches.

vi. Abundance surveys should be carried out as part of an overall monitoring strategy with clear objectives. The objectives of the strategy often help to determine the design of the surveys. Consistency is sometimes more valuable than precision when comparing a series of abundance surveys.

vii. There is considerable uncertainty about the precise meanings of terms like "stock", "population" and "sub-population", especially as they are used by researchers in different fields and by resource managers. The Scientific Committee of the IWC established a Working Group on Stock Identity in 1998, to develop operational definitions of stock. NAMMCO should follow developments in this area.

Appendix 1 - LIST OF PARTICIPANTS

Dr Liselotte W. Andersen (Denmark)
Dr Arne Bjørge (Norway)
Dr Dorete Bloch (Faroe Islands)
Dr Paul F. Brodie (Canada)
Dr Genevieve Desportes (Faroes)
Dr Greg Donovan (UK)
Dr Sarah Duke (Ireland)
Mr Sveinn Gudmundsson (HNA)
Mr Sverrir D. Halldórsson (Norway)
Dr Tore Haug (Norway)
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Dr Palle Uhd Jepsen (Denmark)
Dr Iwona Kuklik (Poland)
Dr Christina Lockyer (Denmark)
Dr Klaus Lucke (Germany)
Ms Diana R. McIntyre (USA)
Per Møller (Denmark)
Ms Droplaug Ólafsdóttir (Iceland)
Mr Daniel Pike (NAMMCO)
Dr Jim Rice (USA)
Ms Tine Richarsen (NAMMCO)
Ms Tiu Similä (Norway)
Dr Krzysztof Skora (Poland)
Mr Tim Smith (USA)
Dr Garry Stenson (Canada)
Dr Jonas Teilmann (Denmark)
Dr Krystal Tolley (Norway)
Mr Gísli Víkingsson (Iceland)
Dr Lars Walløe (Norway)
Dr G. Zaslavskiy (Israel)

Appendix 2- PROGRAMME

Friday 10 September
1500-2000 BOARDING
2000-2200 REGISTRATION: M/S Nordlys
2230 WELCOME RECEPTION

Saturday 11 September
0915 Haug, T.: Welcome address

Theme 1: Distribution And Stock Identity
0930 Andersen, L.W. (KEYNOTE): Harbour porpoises in the North Atlantic: Distribution and stock identity.
1015 Coffee
1045 Teilmann, J., Larsen, F. and Desportes, G. : Satellite tracking of harbour porpoise in Kattegat/Skagerrak. Movement and diving behaviour.
1115 Tolley, K.A., Sundt, R.C., Rosel, P.E., Bjørge, A. and Øien, N: Population genetic structure of harbour porpoises (*Phocoena phocoena*) from the North Sea and Barents Sea.
1145 Lunch break

Theme 2: Biological Parameters
1430 Lockyer, C. (KEYNOTE): Harbour porpoises in the North Atlantic: Biological parameters.
1515 Desportes, G., Kristensen, J.H., Siebert, U., Korsgaard, B., Driver, J.,

Amundin, M., Labberté, S. and Andersen, K.: Multiple insights into the reproductive game of male and female harbour porpoises.
1545 Ólafsdóttir, D., Víkingsson, G.A., Halldórsson, S. and Sigurjónsson, J.: Studies on growth, age and reproduction in harbour porpoises (*Phocoena phocoena*) in Icelandic waters.
1615 Coffee
1645 Lockyer C., Desportes, G., Anderson, K., Labberte, S. and Siebert, U.: Monitoring growth and energy utilisation of harbour porpoise in captivity.
1715 Lockyer, C. and Kinze, C.: Status and life history of harbour porpoise, *Phocoena phocoena*, in Danish waters.
1745 Lockyer, C., Heide-Jørgensen, M.P., Jensen, J., and Walton, M.J.: Life history and ecology of harbour porpoises from West Greenland.
2030 Dinner

Sunday 12 September
Theme 3: Ecology And Pollutants
0930 Bjørge, A. (KEYNOTE): The harbour porpoise in the North Atlantic: Habitat use, trophic ecology and contaminants.
1015 Siebert, U. Bruhn, R., Wünschmann, A. and Benke, H. **(**Presented by Lucke, K.): Investigations on health status of harbour porpoise from the German North and Baltic Seas.
1045 Coffee
1115 Donovan, G. Effects of chemical pollutants on cetaceans: can the harbour porpoise help us move from speculation to determination?
1145 Lunch break
1430 Møller, P.: Evidence of a defined shift in the fatty acid composition along the blubber-profile of Harbour Porpoise (*Phocoena phocoena*): The physiological significance.
1500 Møller, P.: Distinguishing between foraging patterns and sexual maturity of harbour porpoise (*Phocoena phocoena*) from West Greenland and the North Sea, utilising blubber fatty acid composition and classification regression trees.
1530 Víkingsson, G.A., Ólafsdóttir, D. and Sigurjónsson, J.: Diet of harbour porpoise (*Phocoena phocoena*) in Icelandic waters.
1600 Coffee
1630 Ólafsdóttir, D.: Anisakis simplex (Nematoda) infestations in harbour porpoises (*Phocoena phocoena*) in Icelandic waters.
1700 Zaslavskiy, G. Echolocation and hearing in the Black Sea harbour porpoise.
2030 Dinner

Monday 13 September
Theme 4: Abundance, Removals And Sustainability Of Removals
0930 Stenson, G. (KEYNOTE): Harbour porpoises in the North Atlantic: Abundance, removals and sustainability of removals.
1015 Brodie P.F:: The Bay of Fundy/Gulf of Maine harbour porpoises: The ecological/energetic approach to issues of habitat, versus the bio-politics of marine mammals in fisheries management.

1045 Coffee
1115 Kuklik, I. and Skora, K.: Status of harbour porpoise (*Phocoena phocoena*) and threats for the population in Polish Baltic Waters.
1145 Desportes, G., Amundin, M., Goodson, D., Lockyer, C. and Larsen, F.: Update on the EPIC project: "Elimination of harbour porpoise incidental catches", with emphasis on experiments conducted with captive harbour porpoises.
1215 Uhd Jepsen, P. Action plan for reducing incidental by-catches of the harbour porpoise
1245 Lunch break
1500 Whale watching, crossing the Vestfjord enroute to the Lofoten islands
2030 Symposium dinner

Tuesday 14 September
Summaries and Discussion
0930 Andersen, L.W. Distribution and stock identity
1000 Lockyer, C. Biological parameters
1030 Bjørge, A. Ecology and Pollutants
1100 Coffee
1130 Stenson, G. Abundance, removals and sustainability of removals
1200 Lunch break
1330 Final Discussion
1500 Arrival in Tromsø.

Time schedule for the coastal vessel tour:
Fri 10 September: Departure from Bergen at 2230.
Sat 11 September: Arrive in Ålesund at 1200, dep. At 1500; arrive in Kristiansund at 2300.
Sun 12 September: Arrive in Trondheim at 0600, dep. At 1200; arrive in Rørvik at 2115.
Mon 13 September: Arrive in Bodø at 1230, dep. At 1500; Arrive in Svolvær 2100.
Tue 14 September: Arrive in Tromsø at 1445

NAMMCO SCIENTIFIC COMMITTEE WORKING GROUP ON THE POPULATION STATUS OF NARWHAL AND BELUGA IN THE NORTH ATLANTIC

Oslo, 15-17 June, 2000

1. OPENING REMARKS

Chairman Øystein Wiig welcomed all participants to the meeting (see Appendix 1). He reviewed the terms of reference for the Working Group.

At its 7th meeting in May 1997, the Council of the North Atlantic Marine Mammal Commission (NAMMCO) requested its Scientific Committee to "examine the population status of narwhal and beluga (white whales) throughout the North Atlantic." The Scientific Committee convened a Working Group on the Population Status of Narwhal and Beluga in the North Atlantic, 1-3 March 1999 to address this request. In considering the report from that Working Group (NAMMCO 2000), the Scientific Committee noted that index surveys conducted in the Southwest Greenland beluga wintering area since 1982 were indicative of a decline of more than 60% in abundance, and that the aggregation was likely declining due to overexploitation. The Scientific Committee found that there was insufficient information assess the status of narwhal stocks off West Greenland, but noted some concern about the aggregation in the Ummannaq area, which is subject to substantial catches in some years.

At the 1999 meeting of the Management Committee of NAMMCO, the Committee noted its appreciation for the comprehensive status reports on beluga and narwhal in the North Atlantic. 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 that is lacking in order to answer the same question proposed in respect to beluga.

2. ADOPTION OF AGENDA

The Draft Agenda (Appendix 2) 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 3. In addition, a paper on the use of tooth morphology in stock differentiation (Lockyer *et al.* MS 1999) was introduced for consideration under item 5.1, and a paper concerning the deposition of growth layers in beluga teeth (Hohn and Lockyer MS 1999) was introduced for consideration under item 5.3.

5. LEVELS OF SUSTAINABLE HARVEST OF BELUGA IN WEST GREENLAND

5.1 Evidence of population structure in West Greenland

Heide-Jørgensen described the seasonal pattern of beluga harvesting in West Greenland, which is illustrative of the temporal and spatial distribution of beluga in the area. Beluga are harvested in the Qaanaaq area (Fig. 1) beginning in September. Subsequently they are harvested in the Upernavik district in October, Ummannaq in November, and in the Disko Bay settlements from November through April. There is winter harvesting in communities to the south of Disko Bay as far as Maniitsoq and Nuuk. The Upernavik and Qaanaaq areas again harvest beluga on a smaller scale beginning in April. The pattern is suggestive of a southward migration of beluga along the West Greenlandic coast beginning in September, overwintering in Davis Strait to the south of Disko Bay, and a return migration to the north beginning in April. Particularly the fall migrations are often very predictable in timing.

SC/8/BN/6 addressed the stock discreteness of beluga in West Greenland, based on studies involving satellite tracking of instrumented whales, genetics, comparisons of organochlorine profiles and tooth morphology. All evidence suggests that beluga wintering in the North Water should be treated as a separate stock, that apparently has no exchange with beluga wintering in West Greenland. All beluga that are subject to harvesting in West Greenland presumably summer in the Canadian High Arctic. For the wintering grounds in West Greenland, a northern and a southern stock component was tentatively identified with a proposed stock delineation around 67°30'N. Genetic evidence does not confirm such a splitting but organochlorine contaminant profiles and to some extent tooth morphology provide some support for it. No clear spatial separation of these proposed stocks can be demonstrated, although there is some evidence from the index surveys for a hiatus in beluga distribution between northern and southern concentrations. Based on this it was tentatively proposed that the autumn harvest in Qaanaaq, Upernavik and Ummannaq is taken from a northern stock, whereas the harvest south of Disko Bay at Sisimiut, Maniitsoq and Nuuk is taken from a southern stock. The harvest in Disko Bay is likely composed of a mix of the stocks since the northern stock probably winters near Disko Bay and the southern stock passes Disko Bay on its spring and fall migrations.

The Working Group concluded that there was insufficient information to divide the stocks at present, although there is some indication that such a division may be warranted. It was noted however that division into two stocks would result in a lower sustainable yield than that from the single stock situation, and that the Working

Group's conclusion was not conservative in this regard. If more than one stock exists, the risk of overharvest of any one stock could be reduced by spreading the harvest throughout the present hunting area, rather than concentrating the harvest in any one area.

5.2 Harvest statistics and age and structure of harvest

SC/8/BN/4 provided data on catch statistics for beluga in West Greenland from 1862 through 1998. For the period 1862 to 1891, when catch reports did not discriminate between the species, catches south of Sisimiut were assumed to consist exclusively of beluga, whereas for the area north of Sisimiut it was assumed that 70% of the catches were beluga and the rest were narwhal. For the period prior to 1954, catches from Maniitsoq, Nuuk, Paamiut and Qaqortoq were excluded, as these were taken outside the present range of beluga in West Greenland, and may therefore have belonged to a different, now extirpated stock. After 1954, catch levels were evaluated on the basis of official catch statistics, trade in mattak (whale skin), sampling of jaws and reports from local people and other observers. Three options were given for correction of catches based upon auxiliary statistics on trade of mattak and observations of catches (low and medium options) and on likely levels of killed-but-lost rates (KBLR) in different hunting operations (high option). The high option for the catch statistics included a correction of the drive fishery in the northern municipalities (Qaanaaq and Upernavik) with a KBLR of 10% and a KBLR in all other areas where open water hunting is practised of 30%.

The Working Group noted that the KBLR of 30% was probably low given that estimates of KBLR for narwhal hunts in Canada using similar hunting techniques range from 10% to 50% (Roberge and Dunn 1990, Weaver and Walker 1988), and that estimates of KBLR in Alaskan open water beluga hunts exceed 50% in some years (Suydam, R., pers. comm., Burns and Seaman 1986). However, no direct information on KBLRs in the Greenlandic hunt was available.

It was also noted that SC/8/BN/8 indicated that catches in the Canadian High Arctic were very high around the turn of the last century, and that some proportion of this catch may have consisted of West Greenlandic animals. However, there is no way to assess what this proportion was, and it was thought that these catches likely had little influence on the present status of West Greenland beluga.

The catch statistics provided in SC/8/BN/4 were accepted by the Working Group as appropriate for use in the modelling studies detailed in SC/8/BN/8, 10 and 12.

5.3 Population parameters

SC/8/BN/5 provided information on the age and sex distributions of the catches of beluga in West Greenland and – for comparison – in western Russia. Beluga age was determined from counts of annual growth layer groups where an annual deposition of two growth layer groups was assumed. Sex was determined by DNA analysis of skin samples extracted from the lower jaws. All sex and age classes of beluga are subject to harvesting in West Greenland. Sampling during ten years between 1985 and 1997 resulted in an overall mean age of 7.7 years in females and 6.5 years in males of the harvested population older than 1 year in all municipalities and minimum (worn teeth without neonatal line) and complete (teeth with neonatal line) ages combined. More females than males were sampled (712 vs. 596), but there was an equal proportion of both sexes among calves less than 1 year old (44 females, n=89). There was a clear segregation of whales in the drive fishery conducted in the autumn in Qaanaaq and Upernavik. Primarily immature whales of both sexes together with mature females were taken. The mean and median ages increased slightly in both sexes from Upernavik from 1985 through 1994. Both immature and mature whales were taken on the wintering grounds from Disko Bay and south. Estimation of survival was confounded by the large number of whales for which only a minimum age could be assigned because of tooth wear. The apparent survival rates for beluga from West Greenland was estimated as 0.81 and 0.79 for females and males respectively. Correction of these estimates for an observed population decline of 4.7 % per year resulted in estimated true survival rates of 0.85 and 0.82 for females and males, respectively. A sample of 570 whales was collected from the commercial hunt in the White and Kara seas in the 1970s and early 1980s. The observed potential minimum life span of 30 years in beluga from West Greenland was similar to that from the White and Kara seas. Immature beluga constituted the largest number of samples in West Greenland and mature whales of more than 7 years in age constituted the majority of the samples from the White and Kara seas, where the mean ages also deviate significantly from West Greenland. The estimates of true survival rates in West Greenland beluga are less than those determined for beluga populations in the White and Kara seas and in Alaska for comparable age truncations. Since the exploitation levels are much lower in these areas the low apparent survival rate from West Greenland is consistent with the other evidence of a population decline there.

A synopsis of the biological parameters of West Greenland beluga relevant to population modelling is presented in Heide-Jørgensen and Teilmann (1994), and the Working Group accepted these estimates as the best available for use at present (Table 1). However, the information presented in Hohn and Lockyer (MS 1999) suggests that there is now some uncertainty as to whether beluga deposit two tooth growth layer groups (GLG) per year as is now generally accepted, or just one. As this could have profound implications for the calculation of certain biological parameters, the Working Group recommended that this matter should be resolved on an urgent basis.

5.4 Trends in abundance

SC/8BN/7 provided results from past surveys for beluga wintering off West Greenland as well as a detailed description of surveys conducted in 1998 and 1999. The coastal area between Disko Island and Nuuk in West Greenland has been identified as an important wintering area for beluga (Fig.1). During winter this area is characterised by a coastal strip of open water extending up to 80 km from the coast and limited to the west by the heavy consolidated pack ice that dominates Baffin Bay and Davis Strait. To assess trends in relative abundance of beluga, visual aerial surveys were conducted over their wintering grounds in West Greenland in March 1981, 1982, 1990, 1991, 1993, 1994, 1998 and 1999. Estimates of relative abundance and their associated variances were presented from these surveys. To collect data for the estimation of correction factors for animals missed by the observers or submerged during the surveys in 1998 and 1999, continuous video surveillance of the track line was conducted. The 76 and 47 sightings of beluga pods in 1998 and 1999, respectively, had a distribution similar to previous surveys with the highest concentration at the northern edge of Store Hellefiske Banke. No beluga were seen in the southernmost area between Maniitsoq and Paamiut in surveys in 1994, 1998 and 1999. The index estimate of the abundance of beluga comparable to previous surveys was 929 (95%CI: 563-1533) in 1998 and 735 (95%CI: 436-1239) in 1999. When analysing the sightings as a line transect survey and correcting the abundance estimate for whales that were either submerged or at surface but missed by the observers an estimate of total abundance of 7941 (95%CI: 4264-14789) beluga wintering in West Greenland in 1998-1999 was derived. The correction factor, g(0), derived for the 1998-99 line transect survey of total abundance was 0.175.

Parameter	
Length at birth (cm)	150-160
Length of gestation (days)	330
Period of implantation	May
Period of births	April – May
Length at sexual maturity (cm)	
Females	345
Males	390
Length at physical maturity (cm)	
Females	386
Males	483
Age at sexual maturity (yrs)	
Females	4 – 7
Males	6 – 7
Pregnancy rate	0.31
Sample size	36

Table 1. Biological parameters of West Greenland beluga. From Heide-Jørgensen and Teilmann (1994).

It was noted that there were some beluga observations at the western edge of the survey blocks in 1998 and 1999. Additionally, beluga are known to occur in small numbers north of Disko Island. This indicates that the surveys did not cover the complete winter distribution of beluga in the area, and therefore underestimated the number of beluga to some unknown degree. Compared to surveys conducted in the 1980s, the frequency of large groups (>10) has decreased, while the frequency of small groups has increased. Therefore, the comparison of relative abundance from the index surveys may be affected by changes in pod size which also influence the sightability of pods.

5.5 Population assessment

The Working Group considered 3 assessment models of the West Greenland Beluga, as reported in SC/8/BN/8, 10 and 12. Each paper approached the assessment from somewhat different perspectives, with differences in input data and analytical methods.

HITTER model

SC/8/BN/12 reported an assessment using the HITTER-FITTER technique (de la Mare 1989, Punt 1999). This requires, at a minimum, a single abundance estimate for a particular year and a catch series. A stock trajectory is computed to "hit" the abundance estimate given assumptions about Maximum Sustainable Yield Rate (MSYR) and certain biological parameters. It was assumed that beluga were recruited to the fishery at age 1, had first parturition at age 7, a natural mortality of 0.1, and a Maximum Sustainable Yield Level (MSYL) of 60% of the pristine population size. Values of MSYR from 1% to 4% were considered, with results computed to "hit" the best estimate and lower 95% confidence limit for the total abundance estimate for 1999. Both the single stock case and the two stock case outlined in SC/8/BN/6 were considered.

The results indicate that the stock is severely depleted, ranging from a worst case ($MSYR^{1+}$=1%, lower 5%-ile of survey abundance estimate) of 6% to a best case ($MSYR^{1+}$=4%, estimated survey abundance) of 20% of pre-exploitation size. For the two stock case, the levels of depletion for each stock were even greater. Projections with a constant catch of 100 to 700 whales per year indicated that, with $MSYR^{1+}$=1%, a catch of 100 animals per year would not allow the stock to recover, and catches of 400 and 700 animals would cause extinction of the stock within 20 years. For $MSYR^{1+}$=4%, an annual catch of 100 did allow stock recovery, while a catch of 400 did not and a catch of 700 caused extinction within 20 years.

The authors also attempted to calculate $MSYR^{1+}$ directly from the index survey series. It was determined that the decline in the survey index was most consistent with an $MSYR^{1+}$ of between 1% and 2%.

Innes Model

SC/8/BN/8 presented a population model developed by Stuart Innes in a Bayesian inference framework to estimate stock sizes and yields for the North Water and West Greenland overwintering populations of Baffin Bay beluga. The population model incorporated changes in recruitment with respect to the stock's size relative to its carrying capacity. The analysis used the series of stock index surveys conducted off the west coast of Greenland (1981 to 1998), one population estimate of the combined North Water-West Greenland stocks in their summering area in the Canadian High Arctic from 1996, and a catch series from Canada and Greenland (1862-1998) to provide estimates of yield and stock size for West Greenland and North Water beluga stocks.

The stock size for the beluga wintering off West Greenland in 1997 was estimated as 5,230 (3,090 – 8,910, 95% Credibility Interval (CrI)) whales which is nearly identical to a recent survey estimate (see 5.4). Projected to 1999 this stock can sustain a median landed catch of about 100 whales (96; 21 – 271, 95% CrI) with a total removal of 160

(27-489, 95% CrI). The catches of beluga from West Greenland have been higher than the estimated 97.5% Credibility Level of the maximum net productivity since about 1968 when catches, or at least reports of catches increased by an order of magnitude. These catches have reduced the West Greenland stock size to about 10% of the estimated stock size in 1861. The March 1998 survey estimated 6,722 (SE=2,281) beluga, corrected for whales missed by observers and for whales not at the surface (Heide-Jørgensen and Acquarone MS 1999).

The population estimate for the North Water stock of beluga in 1999 was 23,130 (5,580-39,200, 95% CrI) and just about 4000 animals less than the stock's estimated carrying capacity. The median estimated maximum sustainable yield was 581 (36 – 2,105, 95% CrI).

The model also provided estimates of two parameters that have been very difficult to determine directly. These are the adjustment factor for the survey index estimates and the number of whales that are killed but not recorded in the catch statistics.

The parameter for killed-but-lost and underreporting suggests that a considerable adjustment is necessary to move from the catch statistics to the number of beluga killed. The median of the posterior distribution for the parameter that accounted for killed-but-lost and non-reported catch was 1.60 (1.06 – 2.56, 95% CrI) whales killed for each whale landed and recorded. Since the parameter incorporates both killed-but-lost and whales that are landed but not reported, it does not correspond to a KBLR.

The posterior distribution of the adjustment factor that converts the index for the surveys off West Greenland to an estimate of absolute abundance had a median of 0.151, somewhat less than the mean of 0.175 which was the correction factor developed empirically for the 1998-99 surveys. However, this adjustment factor also adjusts for whales that were outside of the index survey area, and so does not correspond directly to the empirical survey correction.

The posterior distribution of the estimate of maximum rate of population increase (R_{max}) was right-skewed with higher density on values near 1, and a median estimate of 1.048 (1.013 – 1.091, 95% CrI).

RISKASS model

SC/8/BN/10 presented a population model developed by Carlos Alvarez and Mads Peter Heide-Jørgensen, also in a Bayesian inference framework, to determine the status of the West Greenland beluga. To evaluate the dynamics of the population a discrete logistic model was fit to estimates of absolute and relative abundance using catch data. The analysis was conducted under the assumption that only one stock was present off West Greenland. Relative abundance estimates (index surveys) from 1991 through 1999 were used. In a first approach, the available estimates of relative abundance for 1981 and 1982 were not included because the numbers led to parameter estimates that were inconsistent with beluga life history information. The reason for this inconsistency may be explained by changes in the conditions under which the surveys were conducted. The abundance data included correction factors that allowed for an estimate of total abundance of 7,941 beluga in 1998. The catch series consisted of the reported catches corrected for underreporting and killed-but-lost whales. The average between a medium and the highest estimate (see 5.2) was used as a best estimate of the catch.

Estimation of the original population size, the intrinsic rate of increase and the level of depletion was conducted with maximum likelihood estimation and by Bayesian integration through Markov Chain-Monte Carlo simulation. The abundance conversion factor was applied to the expected absolute abundance to evaluate the observed indices. Normal error distributions were assumed for both the relative indices and the absolute abundance. For the Bayesian analysis, semi-informative prior distributions were used for all parameters except for the re-scaling of abundance which was uninformative.

To evaluate the effect of future catch limits the change in population size after 5 and 10 years of harvest was measured. Two types of catch limits were applied: 1. constant annual removals of 150, 200, 300 and 500; and 2. removals based on harvest rates, specified as for the U.S. Potential Biological Removals (PBR) with recovery factors of 1.0 and 0.5, or simply as $0.5R_{max}$ and $0.75R_{max}$.

The initial population size in 1954 was estimated at about 30,000 beluga. The intrinsic rate of increase was estimated to be between 0.03 and 0.04. The population was consistently estimated to be under 30% of its size 50 years ago and can be considered depleted.

If removals are set to be half the intrinsic rate of increase the results suggest a sustainable harvest of 130 beluga for the first five years. This removal rate would be adjusted to new estimates of abundance thereafter. Results also indicate that utilisation of harvest rates to calculate potential harvest levels minimises the risk of population decline. The harvest rates that balance the risk of decline and acceptable harvest levels are the PBR with recovery factor of 1 and $0.5R_{max}$.

If harvesting continues at present levels, the probability that the population will become extinct in 20 years was calculated to be near 70%. A constant catch level of 100 beluga per year still results in a maximum risk of 15% that the population may disappear after 50 years.

The effect of application of a gradual catch reduction program over four years was explored. Catch limits over the period were 500, 300, 150 and 100. Constant catches of 100 were then applied for 50 years. The results indicate that recovery is possible within the specified time frame, but the uncertainty in the data is reflected in wide probability distributions for the abundance in the future, even if no catch is allowed after the gradual reduction.

It was not possible to apply a hypothetical two stock situation to the abundance and catch data, possibly because of the uncertain splitting of catch and abundance into stocks.

Comparison of models

The Working Group carried out a detailed comparison of the input data and conclusions reached by the HITTER, Innes and RISKASS models, and this comparison is presented in Table 2.

<u>Availability bias for surveys</u>

This is defined as the combined effect on the survey index of diving whales not visible to observers, and visible whales missed by observers. This was input data for the HITTER and RISKASS models, and estimated independently in the Innes model. The estimated value from the Innes model included a correction for whales outside of the survey area. The values are very similar and it was concluded that this has a negligible influence on the conclusions of the models.

	HITTER	RISKASS	Innes
Availability Bias	0.175[2]	0.175[2]	0.151[3]
Killed/lost and underreporting	1.2[4]	1.2[4]	1.6[5]
Depletion ratio	.25[6]	0.27[7]	.04-.23[8]
R_{max}	NAMMCO	.047	.048

Table 2: Comparison of parameters used as input or developed by assessment models.

<u>Killed-but-lost and underreporting</u>

For the HITTER and RISKASS models, these were incorporated into the input catch series, whereas a correction factor was calculated independently in the Innes model. The catch series used was an average of the "medium option" (corrected for underreporting) and the "high option" (corrected for underreporting and killed-but-lost) described in SC/8/BN/4. The correction factor derived from the Innes model is much higher, but it also corrects for years in which no whales were reported killed.

[2] Input data, developed empirically from 1998/99 surveys (SC/8/BN/7).
[3] Developed in model. Also corrects for whales outside the survey area.
[4] Mean of medium and high catch series in SC/8/BN/4.
[5] Developed in the model. Also corrects for years in which no harvest was reported.
[6] Ratio of population of mature females in 2000 to that in 1954 with MSYR=2%. Stock size estimates are the mean survey estimate for 1998 and 1999, and the lower 5th percentile.
[7] Model incorporating separate estimates of q (parameter which re-scales relative abundance in relation to the estimate of absolute abundance) for 81, 82 and other surveys. Bayesian mean of the ratio of the total population in 1999 to that in 1954.
[8] Ratio of total population estimate in 1999 to that in 1861, 95% credibility interval.

Depletion ratio
The estimates of depletion ratio reported by the three models were very similar.

R_{max}
The estimates of R_{max}, which is defined as the maximum potential rate of increase of the stock, was almost identical for the Innes and RISKASS models.

General conclusions
All three assessment models reach the conclusion 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. While minor discrepancies between the analyses remain, the Working Group could find no reason to reject these general conclusions. While it is conceivable that the apparent depletion of the stock could have been caused by a shift in winter distribution out of the survey area, there is no evidence to support this hypothesis. The distribution of beluga in the core index survey area has not changed over the 18 years surveys have been conducted. The surveys have been extended to the south to Paamiut and Kap Farvel, but no additional animals have been found in this area. There are no observations from other sources or surveys to indicate that beluga are occurring in significant numbers outside the survey area. The Working Group therefore concluded that the West Greenland stock was indeed substantially depleted, and that the most likely reason for this depletion was harvesting above sustainable levels, particularly over the past 40 years. No quantitative information on hunting effort was presented to the Working Group, but there is little doubt that hunting effort has increased over the period, with the increasing number of boats, improved communication and navigation technology and improved landing, storage and processing facilities (Statistisk Årbog 1997).

Sustainable harvest levels
The Working Group chose to use the RISKASS model to provide estimates of sustainable yield for the stock. It was considered however that any of the three models could provide similar and valid results, and the choice of models was based on availability at the meeting.

The Working Group chose as a base case a model that specified separate values of q (the fraction of the expected absolute abundance that is represented by the survey index) for the 1981, 1982 and later surveys. The observers in the surveys conducted in the 1981, 1982 and later were not the same, which may have lead to differences in detection efficiency. In addition, changes in pod size over the period may have influenced detectability (see 5.4).

Catch levels for 1998 and 1999 were not available to the Working Group. It was decided to allocate a catch of 700 to 1998, given that 487 were reported caught by September 1998 and additional catches could be expected after that, and to use the same catch figure for 1999. This was done to make the estimate of abundance current to 1999.

The Working Group decided that the average of the high and medium options for catch series as utilised in WG/8/BN/10, which resulted in a correction factor of 1.2 to correct for killed-but-lost whales and underreporting, was most realistic. It was considered that the killed-but-lost ratio might justify a higher correction factor (see 5.2), but it was also noted that a significant number of ice-entrapped whales were harvested periodically. If ice-entrapped whales are fated to die, their harvest should be considered a part of natural mortality, and these catches should be subtracted from the catch statistics. Thus the factor of 1.2 was chosen as a compromise between a higher catch option incorporating a more realistic estimate of killed-but-lost whales, and a medium option which did not include killed-but-lost whales.

The Working Group decided that the primary management objective to be addressed should be to arrest the decline of the West Greenland beluga, and that all catch options should be judged against this objective. It was also decided to present options incorporating a delayed or gradual reduction in catch, since these were considered the most realistic alternatives from a socio-economic point of view and the most likely options to be adopted.

Table 3 shows the probability that the stock size in 2011 will be lower than the stock size in 2001 under the various catch options considered, and Fig. 2 shows the probability distributions of stock size in 2011 under these options. To address the management objective of arresting the decline in beluga numbers, the best option is to cease harvesting immediately (Option 6). This virtually guarantees that the stock decline will cease by 2011. The worst option is to keep harvesting at present or higher rates (Option 1), which will cause continued stock decline and may cause stock extinction by 2011.

It is apparent that harvest must be reduced to about 100 animals per year to have any significant chance of stopping the decline in the stock within the next 10 years. Options 3, 4 and 5 illustrate the cost of delay of management action in terms of the probability of continued stock decline. For example, for Option 3, which allows a stepwise reduction in harvest to 100 animals over a 4 year period, the risk of continued stock decline is about twice as great as that for Option 4, which implements an immediate reduction to an annual catch of 100 whales. Option 5 shows the increased risk associated with delaying the implementation of harvest reduction compared to Option 3. The benefits of a delayed or graduated reduction in harvest must therefore be weighed against the increased risk of continued stock decline embodied in these options.

Population monitoring
In light of the uncertainties related to the allocation of the catch limits, it will be necessary to conduct frequent surveys to improve model predictions. It is suggested that surveys of the index area should be conducted every 5 years.

Option	2001	2002	2003	2004	2005	2006	2007-2011	Probability
1	700	700	700	700	700	700	700	0.96
2	500	300	300	300	300	300	300	0.61
3	500	300	150	100	100	100	100	0.33
4	100	100	100	100	100	100	100	0.15
5	700	700	500	300	150	100	100	0.66
6.	0	0	0	0	0	0	0	0.00

Table 3: Probability that the abundance of West Greenland beluga will be lower in 2011 than in 2001 under various catch options. Six options for future catches are provided for the period from 2001 through 2011. The probabilities are given in the range from 0 to 1 where 0 is no probability of a decline and 1 is certainty that the population will be lower in 2011. Catch of 700 in 1999 and 2000 is assumed.

Allocation of Harvest

SC/8/BN/9 provided a summary of catches in 1990s as derived from the official catch record system and distributed by municipality. Distribution of future catches were developed based on three catch limit rules:

Catch limits for each municipality in proportion to previous catch levels.

Catch limits distributed on a two stock scenario in proportion to past catches from the two stocks and thereafter on municipalities in proportion to past catches.

Catch limits distributed on three hunting areas and thereafter on municipalities in proportion to past catches.

The Working Group, having not applied the two stock scenario, decided that the most risk-averse option would be catch limit rule 3. above, to split the catch into 3 regions in the same proportion as it has occurred in recent years (see 5.1). The suggested allocation is illustrated in Table 4.

Area	Municipality	Suggested Proportion in future catches
Northern	Qaanaaq Upernavik Uummannaq	0.41
Central	Qeqertarsuaq Ilulissat Qasigiannguit Aasiaat Kangaatsiaq	0.36
Southern	Sisimiut Maniitsoq	0.23

Table 4. Suggested allocation of future catches to three regions in West Greenland, based on the mean proportion of the total catch from 1993 to 1997. Northern – N of 72°; Central – 67.30° to 72°; Southern - 65° to 67.30°.

Seasonal Closures

SC/8/BN/6 indicated that beluga occurred seasonally in large numbers in Southwest and South Greenland before 1930, and that the most simple explanation for the disappearance of these beluga was overharvesting. It was also indicated that beluga were occasionally sighted during the summer in this and other areas of West Greenland. Few beluga are normally caught during these periods, and the occasional stragglers seen at these times should be allowed to establish themselves. To facilitate this, the following seasonal closures are recommended:

Northern: June through August
Central: June through October
Southern: May through October.
For the area south of 65 N, it is recommended that no harvesting of beluga be allowed at any time.

It should be stressed that the seasonal closures will not halt or reverse the recent decline in beluga abundance, but are only proposed to promote the re-colonisation of areas that were formerly inhabited by beluga.

Protection of cow-calf pairs

It was noted that the protection of cow-calf pairs would reduce the number of adult females harvested, which would assist in the recovery of the stock. It is therefore recommended that the harvesting of cow-calf pairs be prohibited.

6. RECOMMENDATIONS FOR FUTURE RESEARCH ON WEST GREENLAND BELUGA

Short-term Research

- Investigate the impacts of ice entrapments on: (1) population (develop model to simulate effects on population) and (2) catch statistics (separate whales taken in ice entrapments from other harvest numbers and rerun models. Ice entrapment mortalities should be accounted for under R_{max} and not harvest.)
- Examine the occurrence of ice entrapment events and the relationship to sea surface temperature (or other environmental factors). Are ice entrapments predictable?
- Examine past aerial survey data for: (1) detection probabilities of small vs. large pods and (2) estimation biases due to differing pod sizes among years. Re-examine the quality of the 1981 and 1982 aerial surveys. Are these surveys useful for trend analysis?
- Review results on the potential stock structure of beluga in west Greenland, specifically evaluate tooth morphology data and tagging data that will be available late in 2000.
- Models currently assume a 50:50 sex ratio in the harvest. Include data on sex ratio of the harvest in the models; evaluate results of the model and predicted impacts on the population of beluga and on recommended quotas.

- Conduct a formal and independent review of the model (formulation and estimation techniques) developed/used by Alvarez and Heide-Jørgensen in SC/8/BN/10 (RISKASS). This research is especially needed if this model or a variation will be used in further analyses by the NAMMCO Scientific Committee.
- Establish a method for formally collecting "anecdotal" data on beluga distribution and abundance in Baffin Bay and Davis Strait. These observations could be from surveys conducted for other projects or from traditional ecological knowledge.

Long-term Research

- Determine where beluga from west Greenland spend the summer and whether they are harvested in Canada.
- Develop an age-structured model and simulate the impacts of the deposition of 1 or 2 growth layer groups per year in beluga teeth on the estimation of various life history parameters.
- A new abundance and trend estimate (index survey) will be needed in 3 to 5 years. The next survey should include areas to the north of Disko Island and to west of the current index survey area. The survey methods should be identical to previous surveys to facilitate comparison. The use of video for the estimation of correction factors should be continued.
- Collect beluga diving data for west Greenland in March. This is needed for estimating correction factors for abundance estimates.
- Further evaluate the stock structure of west Greenland beluga. Determine whether the hiatus in aerial survey sightings (near 67^{o} 30') in March is consistent from year to year and whether the hiatus could delineate distribution of different stocks.
- Determine the availability of skin samples in March from areas north and south of the hiatus (near 67^{o} 30'). If a sufficient number of samples exists, conduct genetic analyses for stock structure.
- Determination whether 1 or 2 growth layer groups (GLGs) are deposited annually in beluga teeth. NAMMCO should provide support for a planned workshop on beluga ageing techniques.
- Estimate R_{max} with life history data and evaluate the impacts of the deposition of 1 or 2 GLGs per year in beluga teeth.

7. RESEARCH NEEDED TO ESTABLISH SUSTAINABLE HARVEST LEVELS FOR NARWHAL IN WEST GREENLAND

The Working Group had access to the 1999 report of the Working Group (SC/8/BN/13), which assessed the status of East and West Greenland narwhal aggregations and provided research recommendations, and SC/8/BN/11, which reported preliminary results for satellite tracking experiments carried out in Greenland and Canada.

Satellite tracking and genetic studies indicate that, in general, narwhal occupy discrete local areas during the summer, and there may be relatively little exchange between these areas. During the winter, they are more dispersed. Although the total numbers of narwhal occupying Baffin Bay and East Greenland waters may be quite large, small local aggregations may still be subject to overexploitation. This was noted as a particular concern for the Ummannaq area, where large harvests occur in some years, and to a lesser extent in Qaanaaq, Melville Bay and Upernavik. The Disko Bay area appears to be a wintering area where two or more stocks may mix.

The Working Group noted that developing recommendations on the sustainable harvest of narwhal in Greenland will require significant additional research and cannot be done at present. However, this may become a priority, particularly in West Greenland where hunting effort may switch to narwhal because of the decline in the beluga stock. The Working Group developed the following research priorities for narwhal:

Catch statistics

1. Improve the collection of current harvest statistics, including information on loss rates. Loss rate may be significant in some areas and times, and all population removals must be considered in stock assessment.
2. Review historical harvest statistics, providing, to the extent possible, corrections for underreporting and killed-but-lost animals. Also, records of harvesting of ice-entrapped whales should be reviewed, and it should be determined if these should be included as removals or as a component of natural mortality. Modelling should be carried out to determine the possible effects of stochastic events such as ice entrapments on estimates of sustainable yield.

Stock identity

1. Sampling should be continued in hunting areas, and genetic analyses should be carried out to determine if there is annual variability in the genetic structure of narwhal in aggregation areas. This will help to determine if significant mixing between aggregation areas occurs.
2. Satellite tracking experiments should be conducted from all aggregation areas, to determine if significant mixing between aggregation areas occurs, and to identify migration routes and wintering areas.

Abundance

1. Abundance surveys should be carried out in aggregation areas, particularly in the Qaanaaq, Melville Bay and Ummannaq areas. It will be necessary to repeat abundance surveys over several years as the numbers in an area can vary significantly from year to year.

8. OTHER BUSINESS

The Working Group suggested that it will be necessary to meet again once the short-term research priorities for beluga are addressed, or other significant information that may affect the general conclusions shown here is brought forward.

9. ADOPTION OF REPORT

The Report was adopted unanimously by the Working Group on June 17, 2000.

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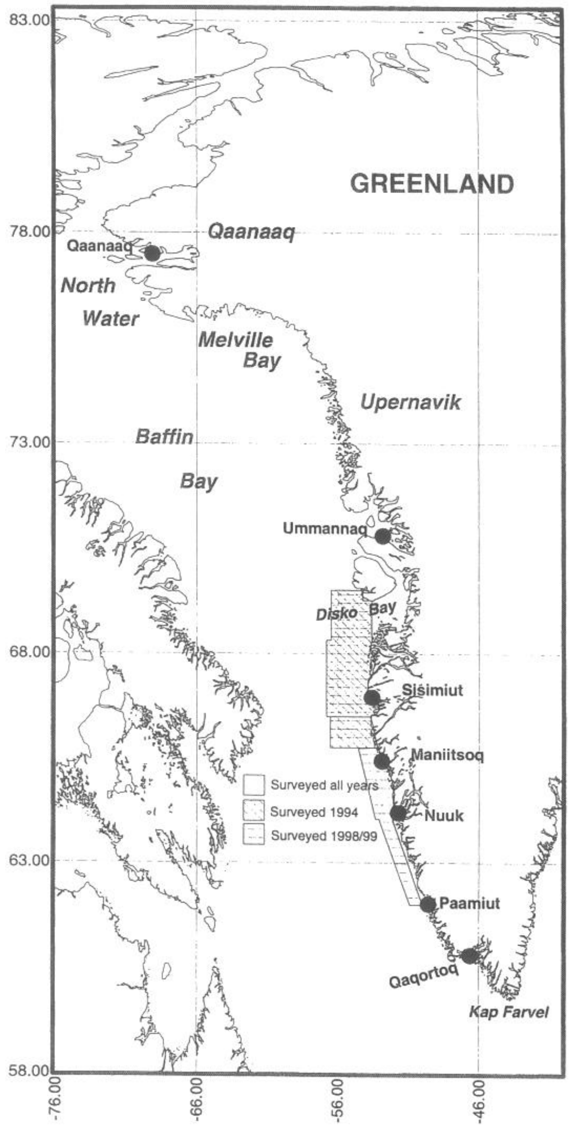
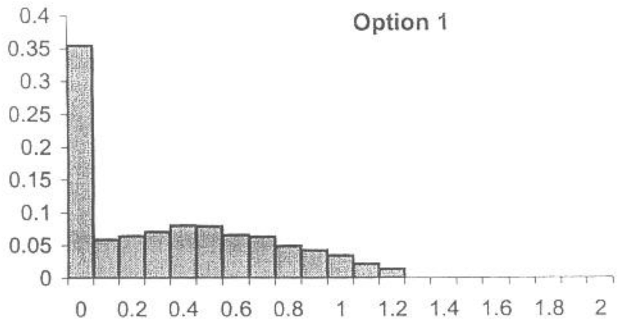


Fig. 1. West Greenland showing locations mentioned in the text, and areas covered in the index surveys for beluga in 1982, 1983, 1991, 1993, 1994, 1998 and 1999.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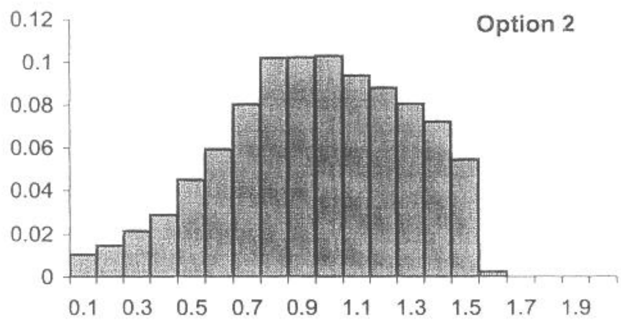
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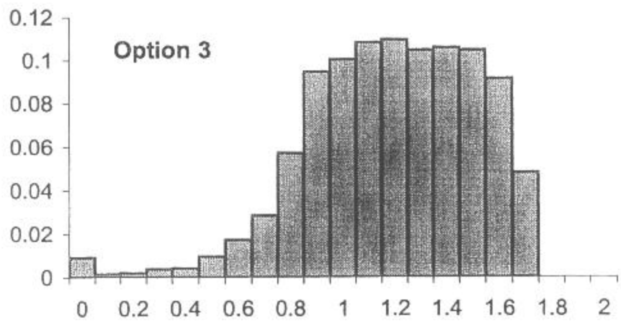
Option 3
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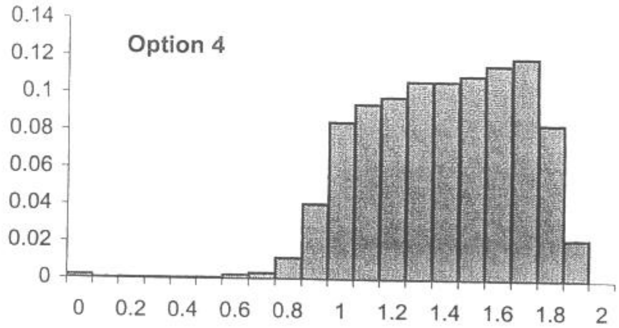
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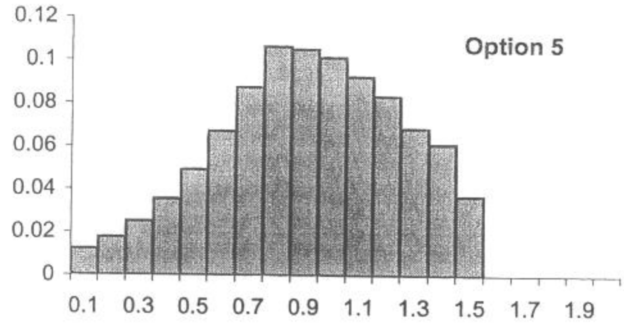
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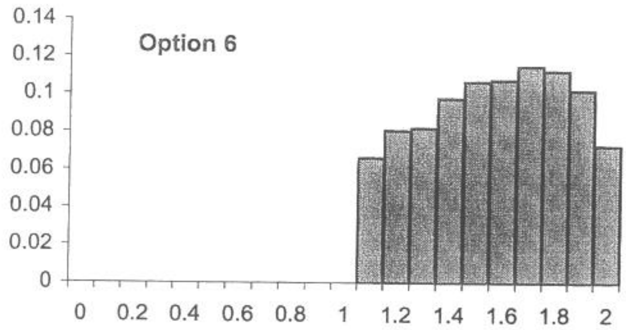
Option 6
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Fig 2. Probability distributions for population change after ten years under different catch schedule options that include alternative gradual reduction programmes. The evaluation is made with respect to year 2001 when the new policy is first applied. The figures show the most likely outcome after application of particular catch schedule.

Appendix 1 - LIST OF PARTICIPANTS

Mr Carlos Alvarez (USA)
Dr Genevieve Desportes (Faroe Islands)
Mr Þorvaldur Gunnlaugsson (Iceland)
Dr Mads Peter Heide-Jørgensen (Greenland)
Dr Rod Hobbs (USA)
Mr Daniel Pike (NAMMCO)
Ms Tine Richardsen (NAMMCO)
Dr Robert Suydam (USA)
Dr Øystein Wiig (Norway)

Appendix 2 - AGENDA

1. Opening remarks
2. Adoption of Agenda
3. Appointment of Rapporteur
4. Review of available documents and reports
5. Levels of sustainable harvest of beluga in West Greenland
   - 5.1 Evidence of population structure in West Greenland
   - 5.2 Harvest statistics and age and structure of harvest
   - 5.3 Population parameters
   - 5.4 Trends in abundance
   - 5.5 Population assessment
6. Recommendations for future research on West Greenland beluga
7. Research needed to establish sustainable harvest levels for narwhal in West Greenland
8. Other business
9. Adoption of report

Appendix 3 - LIST OF DOCUMENTS

SC/8/BN/1	List of participants
SC/8/BN/2	Draft agenda
SC/8/BN/3	List of documents
SC/8/BN/4	Heide-Jørgensen, M.P and A. Rosing-Asvid. Catch statistics for belugas in West Greenland 1862 to 1998.
SC/8/BN/5	Heide-Jørgensen, M.P. and Lockyer, C. Age and sex distributions in the catches of belugas, *Delphinapterus leucas,* in West Greenland and western Russia.
SC/8/BN/6	Heide-Jørgensen, M.P. One or two beluga stocks in West Greenland?
SC/8/BN/7	Heide-Jørgensen, M.P. and Acquarone, M. Size and trend of beluga abundance off West Greenland in 1998-1998.

SC/8/BN/8	Innes, S. Population size and yield of Baffin Bay white whale stocks (*Delphinapeterus leucas)*.
SC/8/BN/9	Heide-Jørgensen, M.P. and Alvarez-Flores, C. Allocation of beluga catch limits to municipalities in West Greenland.
SC/8/BN/10	Alvarez, C. and Heide-Jørgensen, M.P. Assessment and future harvest options for belugas (*Delphinapterus leucas*) in West Greenland.
SC/8/BN/11	Heide-Jørgensen, M.P. and Dietz, R. Preliminary tracking results for narwhals.
SC/8/BN/12	Butterworth, D.S., Plagányi, É.E, and Geromont, H.F. Resource assessment and projections using the HITTER-FITTER population model for the belugas off West Greenland
SC/8/BN/13	Report of the NAMMCO Scientific Committee Working Group on the Population Status of Beluga and Narwhal in the North Atlantic, Oslo, 1-3 March, 1999.

Annex 4

REPORT OF THE NAMMCO SCIENTIFIC COMMITTEE WORKING GROUP ON NORTH ATLANTIC FIN WHALES

Tórshavn, 12-13 May 2000

1. OPENING REMARKS AND TERMS OF REFERENCE

Chairman Gísli Víkingsson welcomed all participants to the meeting (see Appendix 1). He reviewed the terms of reference for the Working Group.

The establishment of this Working Group was in response to the NAMMCO Council's request adopted at the meeting in the Management Committee in 1998, where the Scientific Committee was asked to '...undertake an assessment of the status of fin whales in the North Atlantic based on all available data'. The Working Group first met 8-10 April 1999 to conclude its assessment of the East Greenland - Iceland stock of fin whales (See NAMMCO 2000).

At the 1999 meeting of the NAMMCO Council, the following request to the Scientific Committee was adopted by the Management Committee:
"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 Exclusive Economic Zone (EEZ) 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 EEZ waters;
- Information gaps that may need to be filled in order to complete a full assessment in this area."

In preparation for the assessment, the Working Group was re-established in February 2000, to review the available information and determine computations to be carried out before the meeting.

2. ADOPTION OF AGENDA

The Draft Agenda (Appendix 2) was adopted without changes.

3. APPOINTMENT OF RAPPORTEUR

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

4. REVIEW OF RELEVANT DOCUMENTS AND REPORTS

The documents considered by the Working Group are listed in Appendix 3.

5. REVIEW OF AVAILABLE DATA ON NORTH ATLANTIC FIN WHALES WITH SPECIAL REFERENCE TO THE FAROESE AREA

5.1 Stock structure

The Working Group discussed stock structure of fin whales in the North Atlantic in some detail in 1999 (NAMMCO 2000) and noted that stock delineation was the most critical issue in fin whale assessment in the North Atlantic. While it was evident that the stock structure of fin whales is more complex than reflected by the present stock areas, the details of stock structure were not considered clear enough to identify boundaries between the different North Atlantic fin whale stocks. This applies especially for areas where there is little information on stock identity, as in the case of fin whales found in Faroese waters.

The seasonal distribution of fin whales around the Faroes was described in SC/8/FW/5. The locations of catches and incidental observations of fin whales were plotted on a half-monthly basis to show the apparent changes in fin whale distribution in the area. Some sightings of fin whales have been made in the area year-round. At the beginning of the main catching season in May, whales were caught to the south. Subsequently catches were also taken west to the north-west. Whales on the western side of the island were usually observed in waters over 500 m deep. In June-July, fin whales have been observed from the Faroe Islands over to eastern Iceland. In July-August, catches were concentrated to the north and east of the isles. One interpretation of this is that there is a clockwise movement of fin whales around the Faroes. By October, most catches and observations were to the south-east of the Faroese plateau.

The Working Group welcomed the provision of these data. However, it noted that interpretation of these data requires amongst other things information on whaling/observational effort. Some information on whaling effort might be obtained from an examination of log-books (and see 5.6). Unfortunately, it is not possible from the information available to determine whether the animals observed off the Faroe Islands comprise a separate stock or are part of a larger stock(s) that migrate(s) through Faroese waters.

No new information of relevance to the Working Group's work on stock structure in North Atlantic fin whales has been published since the 1999 meeting of the Working Group. As in 1999, the Working Group noted that stock structure was the most critical issue in developing assessments of fin whales in this and other areas. The Working Group therefore developed research priorities, listed in Section 5.6, to address the issues of stock identification in the Faroes and other areas. The primary objective of this work is to try to determine whether or not the animals found off the Faroese comprise a separate local stock.

Given the paucity of information with which to construct stock boundaries for the Faroese area, the Working Group agreed to take the approach of conducting assessments of arbitrarily defined stock areas. It is important to recognise that these areas are not intended to be realistic alternative stock areas, but are merely areas defined to explore the dynamics of the fin whale population implied by different assumptions. The Working Group therefore agreed to consider three scenarios for stock areas (see Fig. 1)

4. Faroese 200 nmi exclusive economic zone (EEZ)
5. Medium Area, Area A as defined in NASS-95 (NAMMCO 1998)
6. Large Area, including the eastern part of the Icelandic area (blocks 5, 6 and 8), Area A and the West Norway area (block NSC) as defined in NASS-95.

5.2 Biological parameters

The present status of information on the biological parameters of fin whales was reviewed in SC/8/FW/9. All estimates of parameters are now more than 10 years old, and the most recent and reliable come from the East Greenland-Iceland and Iberian areas. It was noted that no estimates of parameters useful for assessment were available for the Norway-Faroes area. Temporal and spatial trends are known to exist in some of these parameters, so they should be applied with caution. However, Butterworth advised that the population model used in the HITTER-FITTER program (de la Mare 1989, Punt 1999) is not very sensitive to minor variations in most parameters (except *MSYR*). Given that little new information was available on biological parameters, the Working Group decided to use the same biological parameter values (based on information for the east Greenland-Iceland area) as used by the IWC in 1991 (IWC 1992), except that they chose to express MSYR in terms of the total population instead of the exploitable population. The biological parameters used by the Working Group are listed in Table 1.

Table 1: Biological/technical parameters for fin whales kept fixed in assessments.

Natural Mortality Rate, M	0.04 (annual)
Age at first parturition	9.5 yrs (50%); 12.5 yrs (95%)
Age at recruitment to fishery, males	5 yrs (50%); 7 yrs (95%)
Age at recruitment to fishery, females	4 yrs (50%); 5 yrs (95%)
MSY level (exploitable component)	$0.6K^E$

5.3 Catch data

Catch data for fin whales was kindly provided by the IWC from their catch dataset. The IWC dataset was itself derived from catch data from the records supplied to the Bureau of International Whaling Statistics (BIWS), except as noted otherwise.

Catch series used in assessments were derived from those extracted for the Comprehensive Assessment Meeting on North Atlantic Fin Whales held in 1991 (IWC 1992), and are shown in Appendix 4. SC/8/FW/7 described these data and some of the assumptions used in their tabulation. For the catch by Faroese land stations, the catch from 1894 to 1915 was calculated from Table 7 in Jonsgård (1977), assuming that fin whales comprised 63% of the total catch over that period. This is approximately equivalent to the proportion of fin whales in the catch from 1894 to 1915 in those years when catch was recorded on a species-specific basis. Catch from 1894-1903 was corrected for an assumed struck-lost rate of 50%. The sex ratio was assumed to be equal in those years when it was not recorded for this and other areas.

An alternative catch series derived from Faroese archival sources was provided in SC/8/FW/5. Pre-1916 catches of fin whales were somewhat lower in this catch series than in the one described above. Given this disparity the Working Group decided to conduct some sensitivity tests to determine if the difference in the catch series would have significant effects on the assessments. The results are reported in section 5.5.

The catch location of the Icelandic catch was not consistently recorded prior to the 1930's. To derive maximum and minimum boundaries for the catch from the eastern Icelandic area, two sets of assumptions were used. At a minimum, it was assumed that 25% of the total Icelandic catch in 1883-1915, as well as that taken in 1933 and 1937 when catching was conducted only in the eastern area, was taken in the eastern Icelandic area. At a maximum, it was assumed that 75% of the total Icelandic catch in 1883-1915, as well as that taken in 1933 and 1937, was taken in the area.

5.4 Abundance estimates

Abundance estimates for the assessment areas were taken or calculated from published sources, and are shown in Table 2. For the Faroese EEZ, the mean density of fin whales in Block A from NASS 87, 89 and 95 multiplied by the area of the EEZ gave the estimate of the number of whales in the area. The boundaries of the other areas were defined by survey blocks, so estimates were available directly.

Table 2. Abundance of fin whales in assessment areas. See 5.1 and Fig. 1 for description of the areas.

Area	**Year**	**Abundance**	**CV**	**Source**
Faroese EEZ	1995	654	0.31	Calculated from mean density of fin whales in Area A of 0.0052 whales/nm (NAMMCO 1998).
Faroese EEZ	1989	345	0.53	As above, 0.0027 whales/nm (IWC 1992)
Faroese EEZ	1987	319	0.41	As above, 0.0025 whales/nm (IWC 1992)
Area A	1995	1184	0.31	2/3 of A+B based on no. of sightings (NAMMCO 1998)
Area A	1989	703	0.53	IWC 1992 p.600
Area A	1987	651	0.41	IWC 1992 p.600
Large area	1995	3603	0.3	Blocks A+5+6+8+NSC (NAMMCO 1998)
Large area	1987	7118	0.4	IWC 1992 p.600

5.5 Assessments

It was decided to base assessments on the HITTER approach (see below). This requires a single abundance estimate for a particular year, which a stock trajectory is computed to "hit". Given that three abundance estimates are available, it was agreed that the HITTER assessments would be based on an average of the three results taken to pertain to an intermediate year (1991). An inverse variance weighting approach was used, effected by weighting the logs of the abundance estimates by the squared inverses of their CV's in the weighting process.

Technical specifications for these assessments are shown in Table 1. MSYL was expressed in terms of the exploitable component of the stock and set to 60% of the corresponding pristine level, with density dependence in fecundity acting on this same component of the stock. It was noted that Punt (1996) shows that variations of this last assumption make little difference to results, provided MSYR is not too high.

It was agreed that results be computed for three different values of MSYR of 1%, 2% and 4%, and also that MSYR be expressed in terms of uniform selectivity harvesting on the total (1+) stock. This convention more readily allows inter-stock comparisons, particularly as this measure of MSYR relates to the growth that an unexploited stock can achieve (a quantity which has been estimated from direct observations for a number of stocks (Best, 1992)).

Sensitivity analyses

Sensitivity analyses were run on the Faroese EEZ area to determine the effect of varying assumptions for the catch series. As noted under 5.3, an alternative catch series, derived from Faroese archival sources, was available. This catch series had generally lower catches prior to 1916 than the one supplied by the IWC. However it did not have catches prior to 1901, so catches from the IWC dataset were used before this date. In addition, analyses were performed under different assumptions about struck-and-lost rates. The following cases were analysed:

i. Base Case: Assumed 50% loss rate prior to 1904, 0% thereafter.
ii. High loss case: Loss rate 50% from 1893 to 1903, and 30% from 1904 to 1920.
iii. No loss case: Loss rate 0% throughout.
iv. Faroese: Data from SC/8/FW/5, pre-1903 data from base case.
v. Combination: Data from SC/8/FW/5, pre-1903 data from no loss case.

Table 3 shows the results of these sensitivity analyses for the Faroese EEZ area. As can be seen, use of the different catch series does not affect the general conclusion for this area that shows a high degree of depletion with the present number of mature females being 11% or less of what it was before exploitation began. The Working Group therefore considered that the use of these different datasets would not materially affect the general conclusions reached, and chose to use the "base case" IWC-supplied dataset for the remainder of the analyses.

Comparison of assessments

Tables 4 and 5 show the results of these analyses for the least (Faroese EEZ) and most optimistic scenarios of those considered (Large area, low Icelandic catch case, see Fig. 1). Figures 2 and 3 show these results graphically – specifically total (1+) historic population trajectories and projections for hits to the weighted average abundance estimates. It is important to note, however, that the "Large Area" scenario considered here is not the most optimistic case that can be developed.

The results for these two cases serve to illustrate the range of results from the cases considered. They are shown both for trajectories hitting the weighted average estimate of the 1+ population sizes for 1991, and the lower 5%-iles of the distribution for these estimates. Tables 4 and 5 show the associated values of MSY, replacement yield RY_{1999} (the 1999 catch which would leave the 1+ population at its 1999 level at the start of 2000), the pristine 1+ population size (K^{1+}) and the current stock status as reflected by the ratio of the present number of mature females to the number present prior to exploitation (N^{mat}_{1999}/K^{mat}). The mature female component of the stock is used for this measure, as it reflects the reproductive component of the resource.

The Working Group considered the results in SC/8/FW/6, which constituted an analysis of the EGI fin whale stock that provided estimates of MSY rates. The best estimate of the MSY rate for the 1+ population indicated by these analyses was 3.4%, with a lower 5%-ile above 1%. The Working Group agreed that this analysis suggested that for the cases considered here, the MSYR values greater than 1% are the more likely, although a value of 1% for MSYR cannot be excluded (given uncertainties about model structure in SC/8/FW/6).

The results shown for the current status of the Faroese fin whale resource range from a worst case (Faroese EEZ, $MSYR^{1+}$=1%, lower 5%-ile of average of survey abundance estimates) estimate of depletion of 0.04 to a best case of 0.29 (Large Area, low Icelandic catch case, $MSYR^{1+}$=4%, weighted average abundance). Thus under any of the scenarios considered here, the extent of depletion is substantial.

The corresponding "worse-to-best" range of current replacement yield estimates is from 5 to 257. This wide range is also evident in the projections under different future constant catch levels (see Fig. 2b and 3b). These values are strongly dependent on the $MSYR^{1+}$ value assumed as well as the area over which the stock is assumed to be distributed (upon which estimates of recent abundance depend- see Table 2).

Population trajectories from 1991 to 2020 under catch levels of 0, 10 and 20 are shown in Figures 2b and 3b. Under the least optimistic projections (Faroese EEZ, *MSYR*=1%), a catch of only 5 animals a year would see a continued slow decline in a resource already heavily depleted, whereas at the other extreme (Large Area, low Icelandic catch scenario), a take of 20 whales per year would hardly impact a rapidly recovering population.

In considering these results the Working Group noted that in the worst case projections considered (see Fig. 2), combinations of extreme assumptions on MSYR (1%), stock area (Faroes EEZ) and abundance were used. Combining extremes in this manner makes for a scenario that is highly improbable. Nevertheless, even for higher MSY rates, the resource was estimated to be substantially depleted (<30%) for all cases considered.

The Working Group reiterated that the larger areas considered were not intended to reflect the only plausible stock hypotheses. For example, it is possible that the Faroese catch may have come from a stock that extends over a larger area that includes all or part of the East Greenland-Iceland stock area. If such was the case, the extent of depletion would not be nearly so substantial as suggested here. Unfortunately, presently available information did not allow the Working Group to rule out even the least optimistic stock area scenarios.

Table 3: Parameters of population trajectories which hit the inverse variance weighted average (471) total (1+) population size in 1991 for various values of $MSYR^{1+}$ for different Faroese EEZ catch series for Faroese fin whales. Results are shown for *MSY*, RY_{1999}, the pristine (pre-exploitation) total population size (K^{1+}), and the current status of the mature female component of the population relative to pristine (N^{mat}_{1999}/K^{mat}).

$MSYR^{1+}$ (%)	**Faroese EEZ catch series:**				
	Base Case: IWC (50% loss rate 1894-1903)	*High Loss* Base case and 30% loss rate 1904-1920	*Low Loss* (0% loss)	*Faroese* (SC/8/FW/5 data, base case pre-1903)	*Combination* (SC/8/FW/5 data, low loss pre-1903)
MSY					
1	47	53	45	40	40
2	80	91	76	67	66
4	122	142	115	98	96
RY_{1999}					
1	7	7	7	6	6
2	14	14	14	14	14
4	31	31	31	30	30
K^{1+}					
1	8127	9125	7696	6946	6794
2	6746	7678	6378	5650	5533
4	4977	5791	4688	4001	3925
N^{mat}_{1999}/K^{mat}					
1	0.06	0.05	0.06	0.07	0.07
2	0.07	0.06	0.07	0.08	0.08
4	0.09	0.08	0.09	0.11	0.11

Table 4a: Parameters of population trajectories which hit the weighted average (471) and corresponding lower 5%-ile (326) total (1+) population sizes in 1991 for various values of $MSYR^{1+}$ for the Faroese EEZ catch series for Faroese fin whales. This average is obtained under the assumption of log-normal distributions, taking an inverse variance weighted average of the survey abundance estimates for 1987 of 319 (CV=0.41), 1989 of 345 (CV=0.53) and that for 1995 of 654 (CV=0.31) . Results are shown for *MSY*, RY_{1999}, the pristine (pre-exploitation) total population size (K^{1+}), and the current status of the mature female component of the population relative to pristine (N^{mat}_{1999}/K^{mat}).

	N^{1+}_{1991}	
$MSYR^{1+}$ (%)	**471**	**326**
MSY		
1	47	47
2	80	80
4	122	122
RY_{1999}		
1	7	5
2	14	10
4	31	22
K^{1+}		
1	8127	8073
2	6746	6727
4	4977	4975
N^{mat}_{1999}/K^{mat}		
1	0.06	0.04
2	0.07	0.05
4	0.09	0.06

Table 4b: Hitting weighted average (471) and lower 5%-ile (326) total (1+) population sizes in 1991 for various values of $MSYR^{1+}$ for the Faroese EEZ catch series for Faroese fin whales and projecting forward under future annual catches of 0, 5, 10 and 20 animals from 2000 to 2019. Results are shown for the mature female component of the population.

MSYR^{1+} (%)	***N^{mat}_{1999}/K^{mat}***	***N^{mat}_{2020}/K^{mat}***			
		C_{2000+}=0	***C_{2000+}=5***	***C_{2000+}=10***	***C_{2000+}=20***
***N^{1+}_{1991}*=471**					
1	0.06	0.08	0.06	0.05	0.03
2	0.07	0.12	0.10	0.09	0.06
4	0.09	0.28	0.25	0.23	0.18
N^{1+}_{1991}=326					
1	0.04	0.05	0.04	0.03	0.00
2	0.05	0.09	0.07	0.05	0.02
4	0.06	0.20	0.17	0.15	0.10

For cases with a local stock confined to the Faroese EEZ, results shown in Fig. 2 suggest that the fin whale population may have been reduced to levels below 100 animals by 1960. The Working Group noted that examination of available catcher logbooks may provide information as to whether such a decline did in fact occur.

Conclusions

The Working group 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.

It therefore strongly recommends that a research programme is undertaken to elaborate the stock structure of fin whales in this area (see Item 5.6). Highest priority should be given to the determination of whether the animals found in Faroese waters comprise a separate local stock. Under this scenario, the results reveal a severely depleted (11% or less of initial) stock, that even with no catches would take over 20 years, and perhaps much longer, to recover to half its initial estimated abundance.

It should be recognised that this represents a worst case scenario. Should the research programme reveal that these animals do not comprise a separate stock, then the results from the other scenarios show that the depletion level would not be so great. However, a reliable assessment would require elaboration of the relationship of fin whales found in Faroese waters to those adjacent waters. Details of recommended research to address this issue are given under item 5.6.

Table 5a: Parameters of population trajectories which hit the weighted average (4604) and corresponding lower 5%-ile (3105) total (1+) population sizes in 1991 for various values of $MSYR^{1+}$ for the Large Area with the low Icelandic catch series for Faroese fin whales. This average is obtained under the assumption of log-normal distributions, taking an inverse variance weighted average of the survey abundance estimates for 1987 of 7118 (CV=0.4) and that for 1995 of 3603 (CV=0.3). Results are shown for *MSY*, RY_{1999}, the pristine (pre-exploitation) total population size (K^{1+}), the current status of the mature female component of the population relative to pristine (N^{mat}_{1999}/K^{mat}).

	N^{1+}_{1991}	
$MSYR^{1+}$ (%)	**4604**	**3105**
MSY		
1	146	142
2	238	236
4	352	352
RY_{1999}		
1	60	41
2	124	86
4	257	188
K^{1+}		
1	25017	24439
2	20111	19896
4	14372	14342
N^{mat}_{1999}/K^{mat}		
1	0.18	0.12
2	0.22	0.15
4	0.29	0.20

During these discussions it was noted that consideration of what might be considered an acceptable level of risk when examining potential harvesting was essentially a political question that was dependant on the development of specified management objectives.

Table 5b: Hitting weighted average (4604) and lower 5%-ile (3105) total (1+) population sizes in 1991 for various values of $MSYR^{1+}$ for the Large Area with the low Icelandic catch series for Faroese fin whales and projecting forward under future annual catches of 0, 5, 10 and 20 animals from 2000 to 2019. Results are shown for the mature female component of the population.

$MSYR^{1+}$ (%)	N^{mat}_{1999}/K^{mat}	N^{mat}_{2020}/K^{mat}			
		$C_{2000+}=0$	$C_{2000+}=5$	$C_{2000+}=10$	$C_{2000+}=20$
$N^{1+}_{1991}=4604$					
1	0.18	0.24	0.23	0.23	0.22
2	0.22	0.38	0.37	0.37	0.36
4	0.29	0.76	0.75	0.74	0.73
$N^{1+}_{1991}=3105$					
1	0.12	0.17	0.16	0.16	0.15
2	0.15	0.26	0.26	0.25	0.24
4	0.20	0.57	0.56	0.56	0.54

5.6 Recommendations for future research

Stock delineation

As noted previously, determining the stock structure of fin whales in the Faroes and other areas remains the most crucial factor in determining the status of fin whales in the area. Research recommendations relating to stock delineation are therefore of the highest priority for fin whales in this and other areas.

1. Biopsy Collection, Faroes area:

Although some fin whales are observed year-round in the Faroes, most animals are observed in the area from May to October (SC/8/FW/5). Biopsies should be collected throughout this time period and over as wide an area as possible. Within season sampling is particularly important in attempting to determine whether the animals found in Faroese waters comprise a separate local stock. Additionally, since considerable annual variation has been observed in fin whale abundance and distribution, collections should take place over a multi-year period.

Sample collection is likely to be the most expensive component of this program, therefore it will be necessary to utilise samples to the maximum extent possible. Analyses to be carried out, in order of priority, are:

i) Genetic analyses to individually identify whales (and determine their sex). This will give information on stock relationships if whales are re-sampled in other areas, and can also give information on movement patterns, site fidelity and local abundance;

ii) A suite of genetic analyses for stock delineation;

iii) Analyses of pollutants, fatty acids and stable isotope profiles. These approaches provide a reflection of the present-day migration and feeding activities of the animals, rather than the historical reflection inherent in conventional genetic studies.

2. Biopsy Collection, broad area:

Although genetic samples are available from some limited areas, almost none are available from areas adjacent to the Faroes Islands, for example eastern Iceland, the British Isles and Norway. In order to determine the stock relationships of Faroese fin whales, it will be necessary to obtain samples from as broad an area as possible. One way of achieving this would be to add a biopsy collection component to ongoing and planned sightings surveys. In this way, samples could be obtained from areas not normally accessible to shore-based operations, and over a broad area and in a short time in order to obtain a synoptic picture of the distribution of fin whale stocks in the North Atlantic. While this would add to the cost and perhaps the time required to complete sighting surveys, it was considered that the added expense would be a relatively small increment to cost of the survey in relation to the potential value of the information. The same utilisation of samples is suggested as in 1. above.

In addition to the collection of biopsy material, the potential and availability of archival material such as bone, baleen and earplugs to yield useful genetic samples should be explored, particularly in areas such as Western Norway where few whales are presently available for biopsy.

3. Satellite Tagging, Faroes Area:

To date satellite tagging projects have been limited by the relatively short lifespans and high costs of tags, and have provided information on the short- term movements of relatively low numbers of individual whales. Recent advances in satellite tagging technology suitable for large whales will likely make this technique cost effective for larger-scale projects in the near future. With longer term attachments and tag lifespans, as well as reliable application methods and lower tag costs, it will become possible, and likely cost-effective, to apply sufficient numbers of tags in a manner that could yield useful inferences about stock delineation.

In the near term, however, a more limited project would be effective in the Faroese situation. An application of satellite tags in May, when large numbers of fin whales first appear in Faroese waters, and another in September or October when the whales are apparently migrating past the southeast Faroes, should yield useful information about the movements of fin whales around the islands, their relationships to fin whales in adjacent areas, and their movements away from the islands in the fall. In addition, such a project would assist in the development of the technology and expertise necessary to proceed with larger-scale projects in the future.

<u>4.</u> *<u>Acoustics</u>*
The Working Group agreed that the potential of utilising the acoustic data from long-range hydrophones should be explored (Clark and Fristrup 1997).

Abundance
Abundance estimates for fin whales in the Faroes area from the 3 NASS surveys have been extremely variable. Past surveys in this area have set highest priority on other whale species, and have therefore not been optimised for fin or other baleen whales. Future surveys in this area should be carried out in such a way as to optimise their effectiveness in detecting and enumerating baleen whales.

Catch records
The Working Group noted that a careful analysis of the historical records of whaling in the Faroes may be of assistance in determining the realism of some of the stock areas assessed. Some scenarios imply that fin whales were nearly extirpated in the Faroes area by about 1960, which coincides with the cessation of large scale whaling in the area. It would be very useful to know the reasons behind the cessation of whaling in the area, and whether there was as suggested a substantial decrease in fin whale availability at the time. Ideally, some measure of catch per unit effort could be developed from the historical records to provide an index of fin whale abundance in the area. This could prove very useful in determining if the resource has been depleted to the extent suggested in some of these analyses. Economic records should also be inspected to determine whether changes in sale prices might have played some role.

Similarly, the Working Group noted some discrepancies between catch data supplied by the IWC and that derived from Faroese archival sources. While these discrepancies did not have a major impact on the estimates of current status and replacement yield, it would be beneficial to have a "best available" catch series for the area to use in future assessments. This could be developed by a careful re-analysis of the available catch records. In addition, the records should be searched for indications of what struck and lost rates might be appropriate for application to the early and later periods of whaling in this and other areas.

6. OTHER BUSINESS

There was no other business.

7. ADOPTION OF REPORT

The report was adopted on May 13, 2000, on another beautiful, sunny day in Tórshavn.

References
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Punt, A.E. 1999. A full description of the standard Baleen II model and some variants thereof. *J. Cetacean Res. Manage. 1(suppl.): 267-76.*

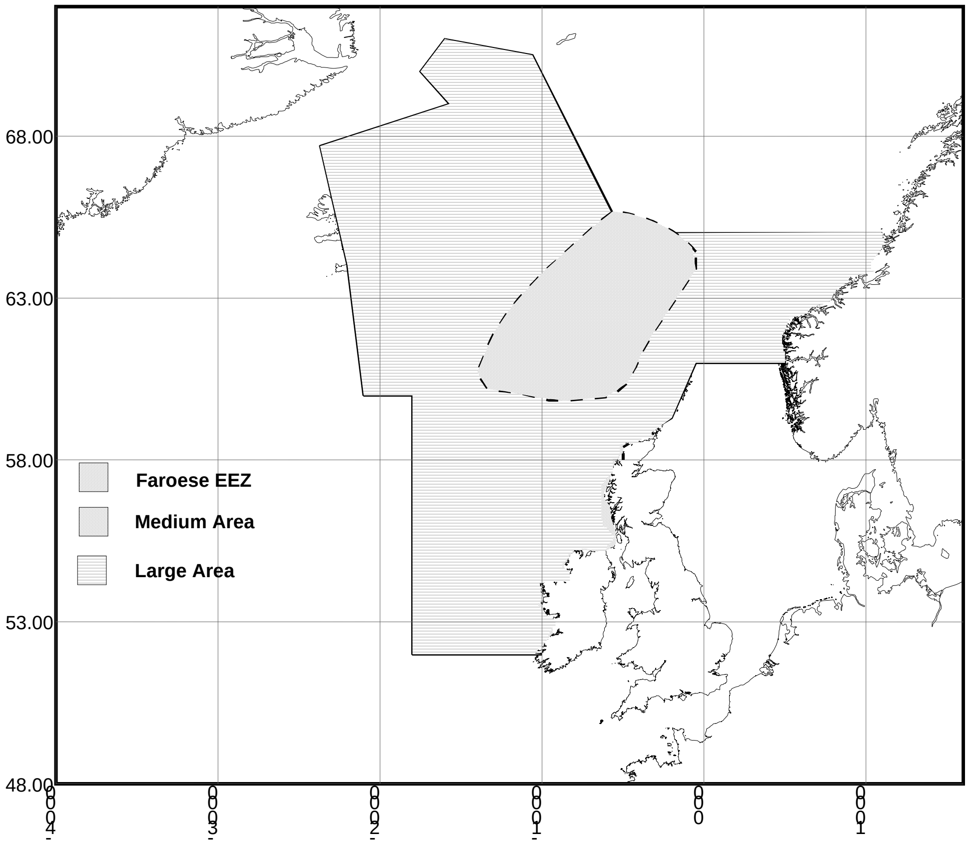

Fig. 1. Stock areas used in assessments of Faroese fin whales. EEZ = Exclusive Economic Zone. Medium Area corresponds to Block A as used in NASS-95 (NAMMCO 1998). Large Area corresponds to Blocks 5, 6, 8, A and NSC as used in NASS-95 (NAMMCO 1998)

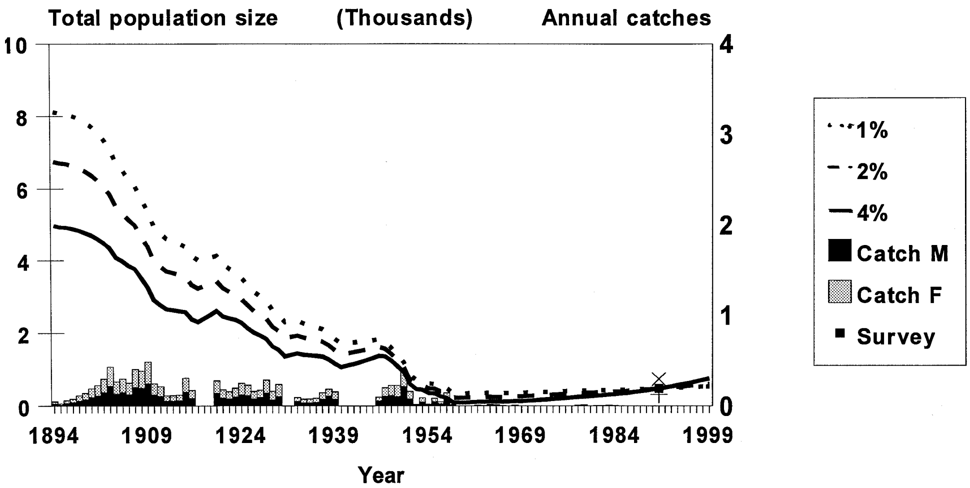

Fig. 2a. Total (1+) population trajectories from 1894 to 1999 in the Faroese EEZ when hitting a total population size of 471 for 1991 for MSYR(1+) values of 1%, 2% and 4%. Annual catches are indicated at the bottom of the plot. The weighted average estimate of abundance is shown with 90% confidence intervals.

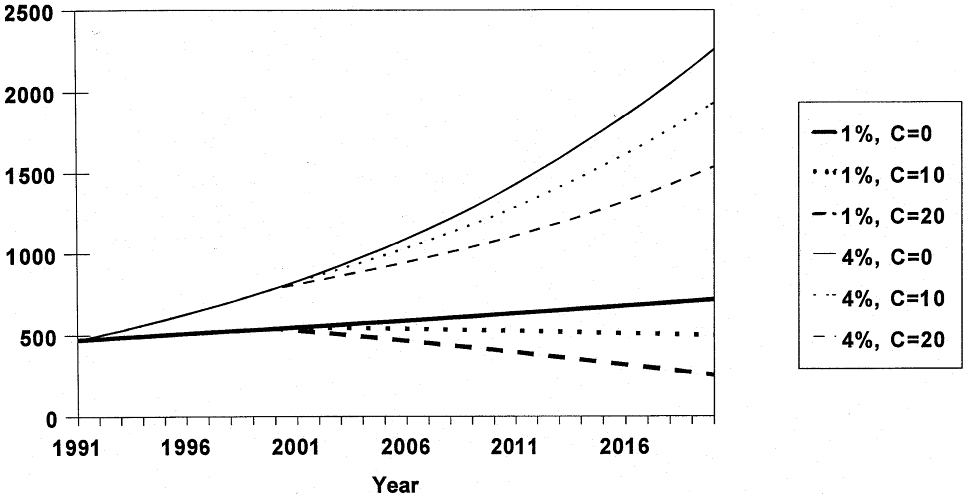

Fig. 2b. Total (1+) population trajectories in the Faroese EEZ when hitting a best estimate of N1+(1991)=471 for MSYR(1+)=1% and 4% for future annual catches of 0, 10 and 20 animals.

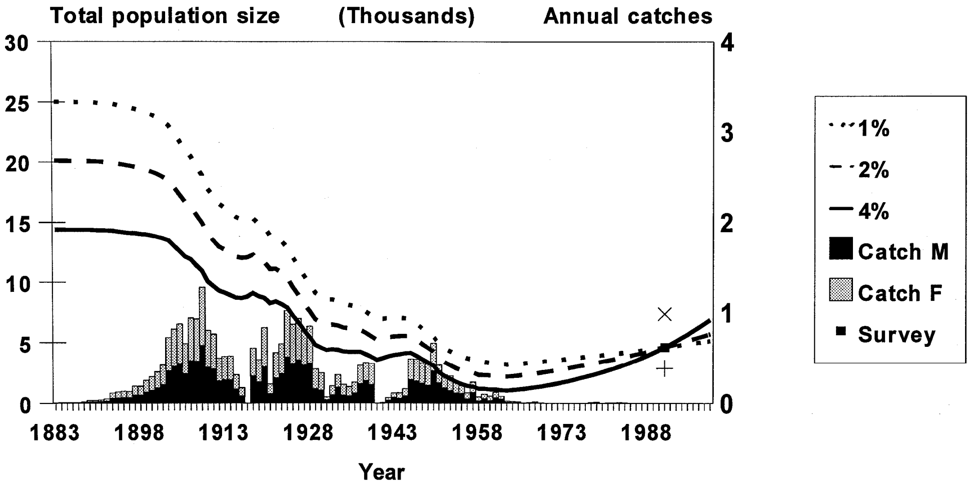

Fig. 3a. Total (1+) population trajectories in the Large Area (see Fig. 1) from 1894 to 1999 when hitting a total population size of 4604 for 1991 for MSYR(1+) values of 1%, 2% and 4%. Annual catches are indicated at the bottom of the plot. The weighted average estimate of abundance is shown with 90% confidence intervals.

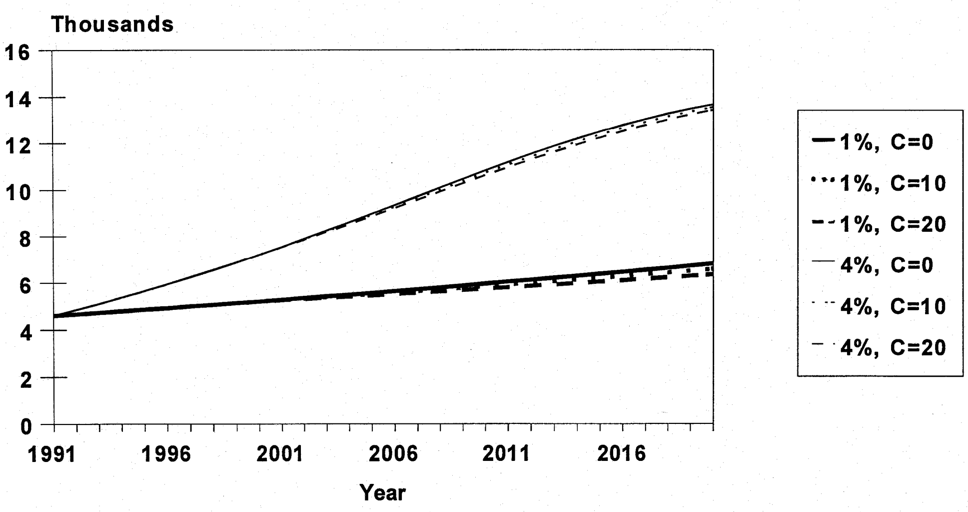

Fig. 3b. Total (1+) population trajectories in the Large Area (see Fig. 1) when hitting a best estimate of N1+(1991)=4604 for MSYR(1+)=1% and 4% for future annual catches of 0, 10 and 20 animals.

Appendix 1 - LIST OF PARTICIPANTS

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Appendix 2 - AGENDA

1. Opening remarks and terms of reference.
2. Adoption of agenda
3. Appointment of rapporteur
4. Review of relevant documents and reports
5. Review of available data on North Atlantic fin whales.
   - 5.1 Stock structure
   - 5.2 Biological parameters
   - 5.3 Catch data
   - 5.4 Abundance estimates
   - 5.5 Assessments
   - 5.6 Recommendations for future research
6. Other business
7. Adoption of report

Appendix 3 - LIST OF DOCUMENTS

SC/8/FW/1	List of Participants
SC/8/FW/2	Draft Annotated Agenda
SC/8/FW/3	List of Documents
SC/8/FW/4	NAMMCO. 1999. Report of the Working Group on North Atlantic Fin Whales.
SC/8/FW/5	Bloch, D. and Ofstad, L.H. 2000. Fin whales in the Faroes
SC/8/FW/6	Butterworth, D.S. and Cunningham, C.L. 2000. Assessment of the East Greenland-Iceland fin whale population based upon a two sub-stock model with mixing.
SC/8/FW/7	Pike, D.G. 2000. Catch series and abundance estimates of fin whales in the Faroe Islands area.
SC/8/FW/8	Geromont, H.F. and Butterworth, D.S. 2000. Assessments and projections of the Faroese fin whale resource using HITTER-FITTER
SC/8/FW/9	Lockyer, C. A brief summary of biological parameters required for assessments of fin whales in the Northeast Atlantic.

Appendix 4

CATCH SERIES USED IN FIN WHALE ASSESSMENTS

See Section 5.1 and Fig. 1 for a description of the assessment areas. See Section 5.3 for a description of the catch series.

Faroese EEZ

Year	**M**	**F**	**Year**	**M**	**F**	**Year**	**M**	**F**
1894	22	22	1916	84	84	1949	101	121
1895	12	12	1920	136	137	1950	211	165
1896	30	29	1921	87	87	1951	78	78
1897	37	37	1922	78	77	1952	15	5
1898	55	56	1923	96	97	1953	43	44
1899	69	68	1924	121	124	1954	6	11
1900	93	93	1925	114	110	1955	46	34
1901	111	111	1926	77	79	1956	22	21
1902	145	146	1927	92	79	1957	71	70
1903	215	214	1928	143	137	1958	7	9
1904	131	131	1929	65	94	1962	5	1
1905	147	147	1930	102	131	1963	0	3
1906	124	124	1933	49	41	1964	4	9
1907	202	201	1934	34	40	1965	5	5
1908	193	193	1935	36	39	1966	3	1
1909	243	243	1936	40	42	1968	4	2
1910	121	121	1937	73	69	1978	5	2
1911	106	105	1938	108	75	1979	4	7
1912	55	55	1939	73	80	1981	2	1
1913	56	56	1946	53	39	1982	1	2
1914	59	59	1947	107	89	1983	1	4
1915	151	151	1948	112	111	1984	2	0

Medium Area

Year	**M**	**F**	**Year**	**M**	**F**	**Year**	**M**	**F**
1894	22	22	1904	149	150	1914	143	142
1895	12	12	1905	186	186	1915	151	151
1896	30	29	1906	134	135	1916	84	84
1897	37	37	1907	250	249	1920	251	253
1898	55	56	1908	228	229	1921	87	87
1899	69	68	1909	383	383	1922	107	104
1900	93	93	1910	203	204	1923	173	174
1901	111	111	1911	203	201	1924	196	198
1902	145	146	1912	119	120	1925	196	192
1903	215	214	1913	133	132	1926	154	156

Year	**M**	**F**	**Year**	**M**	**F**	**Year**	**M**	**F**
1927	169	162	1948	112	111	1964	4	9
1928	166	166	1949	101	121	1965	5	5
1929	65	94	1950	229	180	1966	3	1
1930	102	131	1951	81	88	1968	4	2
1933	49	41	1952	15	5	1978	5	2
1934	34	40	1953	43	44	1979	4	7
1935	36	39	1954	6	11	1981	2	1
1936	40	42	1955	46	34	1982	1	2
1937	73	69	1956	22	21	1983	1	4
1938	108	75	1957	71	70	1984	2	0
1939	73	80	1958	7	9			
1946	53	39	1962	5	1			
1947	107	89	1963	0	3			

Large Area, Low Catch

Year	**M**	**F**	**Year**	**M**	**F**	**Year**	**M**	**F**
1883	1	1	1911	378	380	1941	5	1
1884	3	3	1912	245	247	1942	33	25
1885	3	4	1913	256	256	1943	67	43
1886	3	3	1914	259	259	1944	55	57
1887	4	4	1915	156	157	1945	80	79
1888	6	7	1916	84	84	1946	260	224
1889	14	15	1918	302	303	1947	245	236
1890	14	15	1919	239	238	1948	222	220
1891	17	18	1920	402	429	1949	196	230
1892	23	24	1921	105	106	1950	355	305
1893	53	58	1922	279	275	1951	225	195
1894	60	63	1923	326	326	1952	169	142
1895	63	68	1924	508	510	1953	142	160
1896	62	65	1925	435	435	1954	114	115
1897	91	95	1926	475	457	1955	111	84
1898	90	95	1927	421	372	1956	51	61
1899	123	127	1928	440	407	1957	118	115
1900	143	147	1929	163	215	1958	28	41
1901	169	174	1930	146	187	1959	51	47
1902	206	213	1931	39	30	1960	32	45
1903	357	363	1932	92	98	1961	62	57
1904	404	410	1933	176	139	1962	48	27
1905	433	438	1934	91	115	1963	9	15
1906	324	329	1935	82	98	1964	7	12
1907	466	471	1936	112	117	1965	8	7
1908	459	466	1937	213	202	1966	3	1
1909	634	642	1938	248	196	1967	1	5
1910	397	403	1939	207	228	1968	8	6

Year	M	F
1969	1	1
1978	5	2
1979	4	7
1981	2	1
1982	1	2
1983	1	4
1984	2	0

Large Area, High Catch

Year	M	F
1883	2	3
1884	8	9
1885	9	12
1886	8	9
1887	11	12
1888	19	21
1889	41	46
1890	41	46
1891	50	54
1892	68	73
1893	160	174
1894	135	146
1895	166	179
1896	127	136
1897	198	211
1898	161	172
1899	231	246
1900	242	254
1901	285	301
1902	328	346
1903	525	545
1904	513	529
1905	554	569
1906	406	418
1907	599	615
1908	593	611
1909	815	839
1910	517	534
1911	467	477
1912	274	278
1913	275	277
Year	**M**	**F**
1914	264	264
1915	167	169
1916	84	84
1918	302	303
1919	239	238
1920	402	429
1921	105	106
1922	279	275
1923	326	326
1924	508	510
1925	435	435
1926	475	457
1927	421	372
1928	440	407
1929	163	215
1930	146	187
1931	39	30
1932	92	98
1933	172	143
1934	91	115
1935	82	98
1936	112	117
1937	213	202
1938	248	196
1939	207	228
1941	5	1
1942	33	25
1943	67	43
1944	55	57
1945	80	79
1946	260	224
Year	**M**	**F**
1947	245	236
1948	222	220
1949	196	230
1950	355	305
1951	225	195
1952	169	142
1953	142	160
1954	114	115
1955	111	84
1956	51	61
1957	118	115
1958	28	41
1959	51	47
1960	32	45
1961	62	57
1962	48	27
1963	9	15
1964	7	12
1965	8	7
1966	3	1
1967	1	5
1968	8	6
1969	1	1
1978	5	2
1979	4	7
1981	2	1
1982	1	2
1983	1	4
1984	2	0

SECTION 4 - NATIONAL PROGRESS REPORTS

4.1
FAROE ISLANDS
PROGRESS REPORT ON MARINE MAMMAL RESEARCH IN 1999

Dorete Bloch, Maria Dam and Jústines Olsen

1. INTRODUCTION

This report summarises the Faroese research on cetaceans and pinnipeds conducted in 1999. 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 with assistance from the Faroese Fisheries Laboratory, the Department of Natural Science on the University of the Faroes, the Veterinary Service and in the last years of the Food and Environmental Agency of the Faroes.

2. RESEARCH

2.1 Species and stocks studied

Pinnipeds

* Grey seals (*Halichoerus grypus*) **-** coastal waters of the Faroes
* Hooded seal (*Cystophora cristata*) **-** by-catch

Cetaceans

* Sperm whale (*Physeter macrocephalus*) **-** stranded animals
* Pilot whales (*Globicephala melas*) **-** landed animals
* White-sided dolphins (*Lagenorhynchus acutus*) – 1997 landed animals
* Harbour Porpoise (*Phocoena phocoena*) – stranded animal

2.2. Field Work

Pinnipeds

The fishing boat “Sigmundur” came 18 March 1999 upon a grey seal, immature male of 149 cm and about 75 kg. The seal was found with a hook in chin and therefore shot. Samples were taken.

A juvenile female hooded seal (*Cystophora cristata*) was caught as by-catch on a tunaboat the 17. September 1999 at the position 59°56’N 09°01’W. Full samples were taken and the skeleton is kept at the Faroese Museum of Natural History. This may be the first observation of a migrating hooded seal that far offshore from the normal distribution area of this species.

Questionnaires were prepared for distribution between boats fishing in Faroese waters to examine a possible by-catch of pinnipeds and cetaceans.

Cetaceans

<u>*NAMMCO observation scheme.*</u>

In 1999 the NAMMCO observation scheme was implemented for the first time in the Faroes. In the observation period there was one pilot whale drive hunt, in Bøur 25 July containing 72 pilot whales, Table 1. The observer was a Norwegian veterinarian.

Japanese boats fishing for tuna have Faroese observers on board. These observers have been equipped with observation schemes for reporting on by-catch and observations of marine mammals.

As in the previous years, opportunistic sightings of whales were reported to the Museum of Natural History by numerous local sources. The year 1999 has been characterised by very few whales in all, landed as well as observed. The most common observed baleen whale species in Faroese coastal and offshore waters were fin whales (*Balaenoptera physalus*) - (a pod of five observed as early as 10. January) and minke whales (*Balaenoptera acutorostrata*). Among the toothed whales the most commonly observed were sperm whales (*Physeter macrocephalus*). One pod counted 10 pilot whales (*Globicephala melas*), while a pod of white-sided dolphins (*Lagenorhynchus acutus*) of 15 were observed as late as the 12 December. The harbour porpoise (*Phocoena phocoena*) is permanent in Faroese waters.

<u>*Pilot whales (Globicephala melas)*</u>

Sex, *skin* values and total body length in cm have been recorded from all pilot whales caught in 1999 with kind assistance from the *sýslumen* and the men assessing the whales.

Further monitoring of the time used to kill the pilot whales was performed in 1999 and the time used to secure the whales with the ball pointed hook. The material sampled > 266 pilot whales coming from > 16 drive hunts. A new knife with a longer blade than the traditional knife has been tried with positive results and further examinations will continue.

The project to tag seven pilot whales out of a pod and release these back to the pod is still waiting for the right opportunity.

The Food and Environmental Agency collected samples from pilot whales to examine the levels of heavy metals and organochlorines in meat and blubber respectively. The results are pending further calibration measures and be compared to those found in the 1986-88 study of environmental pollutants.

2.3 Laboratory work

Pinnipeds

<u>*Grey seal (Halichoerus grypus)*</u>

Grey seals sampled for the dietary study in the period 1993 to 1995 (Mikkelsen, 1998) were analysed for heavy metals (Hg, Cd, Pb and Cu) and organic pollutants (incl. PCB, toxaphene and polycyclic aromatic hydrocarbons). The samples were first analysed in pools as part of the implementation of Arctic Monitoring and Assessment Programme (Larsen and Dam, 1999), and later as individuals with funding from the Arctic Environmental Program administrated by the Danish Environmental Protection Agency. The Food and Environmental Agency of the Faroe Islands run the project, and the analyses were completed in 1999. Results will be presented in 2000.

Cetaceans

<u>*Pilot whales (Globicephala melas)*</u>

The Food and Environmental Agency took samples for analyses of environmental pollutants (mercury, cadmium, selenium, PCB, *p,p´*- and *o,p´*- DDT and metabolites, chlordanes, toxaphene and a selection of additional pesticides) from the grind in Tórshavn 14 March 1999. From the *grind* in Hvalvík 25. November 1998, heart tissue as well as the standard muscle tissue samples were taken from 10 individuals in order to assess the mercury content of the heart tissue. Samples from Vestmanna 26. June 1996 (samples from 50 spec.) and Hvannasund 30. June 1994 (samples from 19 spec.) were analysed for dioxins (PCDD and PCDF, not publ.) and flame retarders (PBDE, Lindström *et al*., 1999) in addition to the above-mentioned set of pollutants.

The standard procedure adopted by the Food and Environmental Agency involves sampling of muscle and blubber taken ventrally, caudal to the dorsal fin, ideally from 50 individuals from each *grind*. The subsequent analysis for environmental pollutants are normally done on three pooled samples from each *grind*. The two first samples thus represent the adult females and males, *i.e.* the actively reproducing ones, from the school. In the third pool juveniles of both sexes are combined. The rationale for this is to monitor the concentration of pollutants from the consumers point of view for a minimum cost, and results of earlier studies have shown that the sexually mature females deviate from the other individual in the school in respect to concentrations of especially the lipid soluble persistent organic pollutants.

Blubber samples from Sandavágur 26. August 1997, Leynar 2. December 1997, Hvalvík 25. November 1998 and Tórshavn 24. September 1997 were analysed for flame retarders, PBDE, in co-operation with the University of Umeå, Sweden. The specimens from the first three schools were combined into pools of adults and juveniles females and males (four pools from each *grind*) whereas a selection of 12 samples (3 specimens from each of the four groups) from Tórshavn 24. September 1997 were analysed individually.

Sampling to study adverse effects of cadmium on especially the pilot-whale kidneys were begun in the 1999.

The analysis part of a study of individual contaminant concentrations in 160 individuals of 100 pilot whales, 30 white-sided dolphins and 30 grey seals were completed in 1999,with funding from the Arctic Environment Program. The project is done by the Food and Environmental Agency and the results will be made public in 2000.

2.4 Research results

Cetaceans

Development of new techniques and monitoring of killing time for pilot whales. This research continued in 1999. The ball-pointed hook has been tested and is adopted as equipment in the Faroese pilot whale drive hunt. This hook was tested between 1995-1999 and the Total Killing Time was 29.0 ± 3.88s; range 6-211s; 50% dispatched in 20.0s (N=56). When using the traditional hook the Total Killing Time was 65.7 ± 2.58s; range 8.0-290s; 50% dispatched in 54.3s (N=265).

3. CATCH DATA

Sealing

A few numbers of grey seals are shot every year in connection with salmon farming to prevent the seals to eat the salmons, but there is no systematic reporting of these removals.

Whaling

Two grinds have been mixed with white-sided dolphins, but none of those were taken in 1999.

Table 1: Pilot whale drives in the Faroe Islands, 1999.

Date	Locality	Number of whales
14 March	Tórshavn	132
15 July	Sandavágur	112
25 July	Bøur	72
2 August	Klaksvík*	196
30 August	Vágur	15
4 September	Klaksvík	4
8 September	Vestmanna*	34
28 September	Leynar	43
Total	8 grinds	608 whales

* Mixed grind.

4. PUBLICATIONS AND DOCUMENTS

Scientific Publications

Bavel, B.v., Sundelin, E., Lillbäck, J., Dam, M. and Lindström G. 1999. Supercritical Fluid Extraction of Polybrominated Diphenyl Ethers from Long-Finned Pilot Whale from the Atlantic. Presented at the ”Dioxin 1999” 11-17 September, Venice.

Bloch, D., Dam, M. and Olsen, J. 1999. Faroe Islands - Progress Report on marine mammal research 1998. *North Atlantic Marine Mammal Commission, Annual Report* 1998: SC/9/NPR-F: 1-5.

Larsen, R.B. and Dam. M. 1999. AMAP Phase I. The Faroe Islands. *Heilsufrøðiliga Starvsstovan* 1999: 1-66.

Lindström, G., Wingfors, H., Dam and M. Bavel, B. v. 1999. Identification of 19 Polybrominated Diphenyl Ethers (PBDEs) in Long-Finned Pilot Whale (*Globicephala melas*) from the Atlantic. *Arch. Environ. Condam. Toxicol.* 36: 355-363.

Olsen, J. 1999. Killing methods and equipment in the Faroese pilot whale hunt. *North Atlantic Marine Mammal Commission, report to the working group meeting in hunting methods*: NAMMCO/99/WS-2: 1-14.

Social Science and General Interest

Bloch, D. 1999. 10 tey bestu tølini fyri grindadráp. *Frøði* 1: 27-33.

Bloch, D. 1999. Grindadráp – Pilot Whaling. *Lonely Planet.*

Bloch, D. 1999. *Villini Súgdjór í Útnorðri*. Føroya Skúlabókagrunnur. 1-216.

4.2
GREENLAND
PROGRESS REPORT ON MARINE MAMMAL RESEARCH 1998-99

1. INTRODUCTION

This report summarises the Greenlandic research on pinnipeds and cetaceans done in 1998-99. 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 National Environmental Research Institute (Department of Arctic Environment), Denmark. The catch numbers are from 1997-98, since no newer statistics are available.

2. RESEARCH

2.1 Species and stocks studied

Pinnipeds

- Harp Seals *Phoca groenlandica* – West Greenland
- Ringed Seals Phoca hispida – Northwest Greenland
- Hooded Seals Cystophora cristata – Northwest Atlantic
- Walrus *Odobenus rosmarus* – Northeast Greenland

Cetaceans

- Narwhal Monodon monoceros – Tremblay Sound (Northeast Canada)
- Beluga *Delphinapterus leucas* - West Greenland
- Minke Whale *Balaenoptera acutorostrata* – West Greenland

2.2 Field work

Pinnipeds

In 1998 ten ringed seals were equipped with satellite-linked transmitters near Qaanaaq in Northwest Greenland.

Two hooded seals were equipped with satellite-linked transmitters near Ammassalik in Southeast Greenland in 1998.

An attempt to immobilise 9 walrus with the drug Medetomedin and antidote antiseldan was done in Goose Fjord Jones Sound (Ellesmere Island –Canada) in August 1998. One young walrus male was successfully immobilised and equipped with a satellite-linked transmitter.

In 1999 the number of walrus visiting Lille Snenæs (a walrus haul out in Northeast Greenland), was monitored by a camera taking pictures every six hour during 26 July-26 August and one walrus was equipped with a satellite-linked transmitter on a nearby island Sandøen.

Cetaceans
Five narwhal were equipped with satellite-linked transmitters in Tremblay Sound in Northeast Canada in 1998 and seven in the same area in 1999.

Nine beluga were equipped with satellite-linked transmitters in Cumberland Sound (Southern part of Baffin Island – Canada) in 1998 and seven in the same area in 1999.

One Minke Whale was equipped with a satellite-linked transmitter near Nuuk.

The belugas in the West Greenland ”index area” were surveyed in 1998 and 1999 and in both years a helicopter-survey of the southward migrating belugas was carried out in Northwest Greenland during fall.

2.3 Other Studies

Pinnipeds
Collection of data to a study about harp seal ecology continued in both 1998 and 1999.

Cetaceans
The collection of the lower jaw from the harvested narwhal and beluga was continued in 1998.

Samples to a study of stock identity of minke whales (by means of DNA and the level of various pollutants and stable isotopes), were collected in 1998.

2.4 Research results

Pinnipeds
The ringed seals with transmitters showed movements that mostly were constrained to the eastern part of the Northwater, which confirmed the pattern showed by animals tagged in 1997.

The two tagged hooded seals (an adolescent male and a juvenile female) were tagged just after moult in Southeast Greenland in early July. The male performed a long swim, first to the Hudson Strait, then following the shelf northward in Baffin Bay to the Melville Bay area and from here south to the northern part of the breeding patches off Labrador and then back toward the moulting area off Southeast Greenland. The juvenile female stayed close to the area she was tagged all year from July to June.

The tag on the walrus from Goose Bay lasted for two months where the animal moved eastward into Jones Sound. The tag on the walrus from Sandøen lasted from late August to primo November where the animal moved northward and revealed new potential walrus haul-out sites.

A genetic study on walrus-samples from Northwest and Central West Greenland indicated that these animals are different stocks.

A study on pollutant levels in walrus from Northwest and East Greenland showed that the levels generally were higher in East Greenland and that there was no trend in the levels in Northwest Greenland from 1978 to 1988.

Cetaceans

The transmitters on narwhal worked for up to five months starting in August and gave information on the fall migration from Tremblay Sound to the southern part of Baffin Bay.

The transmitters on beluga worked from primo September and some until primo January, but the animals never left the Cumberland Sound area.

The tag on the minke whale stayed lasted for 10 days during which the animal stayed in the tagging area.

3. CATCH DATA

Pinnipeds

Reported catches in 1997 were; 317 walrus, 295 harbour seals, 2,349 bearded seals, 7,500 hooded seals, 69,663 harp seals, and 64,003 ringed seals.

Reported catches in 1998 were; 610 walrus, 217 harbour seals, 2.354 bearded seals, 6.328 hooded seals, 82,491 harp seals, and 82,108 ringed seals.

Cetaceans

Reported catches in 1997 were; 208 long-finned pilot whales, 797 narwhal, 577 beluga, 1,592 harbour porpoises, 158 minke whales, 11 fin whales.

Reported catches in 1998 were; 365 long-finned pilot whale, 822 narwhal, 746 beluga, 2,131 harbour porpoise, 175 minke whales, 9 fin whales.

4. ADVICE GIVEN AND MANAGEMENT MEASURES TAKEN

None

5. PUBLICATIONS AND DOCUMENTS

Heide-Jørgensen, M.P., P. Richard & A. Rosing-Asvid, 1998. Dive patterns of belugas (*Delphinapterus leucas*) in waters surrounding Eastern Devon Island. Arctic 51: 17-26.

Orr, J., D.J.St. Aubin, P.R. Richard & M.P. Heide-Jørgensen, 1998. Recapture of belugas, *Delphinapterus leucas*, tagged in the Canadian Arctic. Marine Mammal Science 14: 829-834.

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Born, E.W., Riget, F.F., Dietz, R. & Andriashek, D. 1999. Escape responses of hauled out ringed seals (*Phoca hispida*) to aircraft disturbance. Polar Biology 21: 171-178

Witting, L. 1999. Optimization of management procedures with control on uncertainty risk. ICES Journal of Marine Science 56: 876-883

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Heide-Jørgensen, M.P. & C.Lydersen (eds.). 1998. The ringed seal (*Phoca hispida*) in the North Atlantic. Scientific Publications of the North Atlantic Marine Mammal Commission: 273 pp (ISBN 82-91578-04-4).

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Siegstad, H., P.B. Neve, M.P. Heide-Jørgensen & T. Härkönen. 1998. The diet of ringed seals (*Phoca hispida*) in Greenland. North Atlantic Marine Mammal Commission, Scientific Publications vol. 1: 229-241.

Acquarone, M. and M.P. Heide-Jørgensen. 1999. Helicopter surveys for belugas in northern Upernavik, West Greenland, 1998. NAMMCO Working Paper presented to the Working Group On The Population Status Of Beluga And Narwhal In The North Atlantic.

Dietz R. and M.P. Heide-Jørgensen.1999. Satellite radio tracking of narwhals captured in Tremblay Sound in 1997 and 1998. Paper no SC/7/BN/9 presented to the NAMMCO Working Group on Narwhals and Belugas, Oslo 1-3 March 1999.

Heide-Jørgensen, M.P., N. Hammeken, R. Dietz, J. Orr, S. Innes, P. Richard. 1999. Surfacing times for narwhals and belugas. Paper no SC/7/BN/15 presented to the NAMMCO Working Group on Narwhals and Belugas, Oslo 1-3 March 1999.

Heide-Jørgensen, M.P. and M. Acquarone. 1999. Abundance and population trends of belugas (Delphinapterus leucas) and narwhals (Monodon Monoceros) wintering in West Greenland. Paper no. SC/7/BN/10 presented to the NAMMCO Working Group on Narwhals and Belugas, Oslo 1-3 March 1999.

4.3
ICELAND
PROGRESS REPORT ON MARINE MAMMAL RESEARCH 1999

Erlingur Hauksson, Droplaug Ólafsdóttir, Ævar Petersen and Gísli A. Víkingsson

1. INTRODUCTION

The following report concerns 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, Reykjavík, Iceland.

2. RESEARCH

2.1 Species stocks studied

Pinnipeds

Local Icelandic seal stocks, common seal (*Phoca vitulina*) and grey seal (*Halichoerus grypus*), were studied. Occurrence and food of the vagrant species; hooded seals (*Cystophora cristata*) and harp seals (*Phoca groenlandica*), were studied in Icelandic waters.

Cetaceans

In 1999 laboratory work and analysis on feeding ecology, biology and whale-worm (*Anisakis simplex*) infestations of harbour porpoises (*Phocoena phocoena*) were finished and results were presented at harbour porpoise symposium held by NAMMCO in September in Norway. Studies continued on body condition of harbour porpoises and MRI co-operated in thesis projects on histology of reproductive organs and population genetics of harbour porpoises. Long term photo-id studies were continued on blue (*Balaenoptera musculus*) killer (*Orcinus orca*) and humpback (*Megaptera noveangliae)* whales. Monitoring and sampling of stranded and beached cetaceans continued. Assessment of the EGI fin (*Balaenoptera physalus*) whale stock was performed by the NAMMCO Scientific Committee Working Group on North Atlantic fin whales.

2.2 Field work

Pinnipeds

Grey seal haul-out sites were visited, for studying dispersal of grey seals, and time of breeding and moulting.

Sampling of hooded seals continued in connection with a study on the biology and feeding ecology in North Iceland. In 1999 a total of 39 hooded seals were sampled bringing the total sample size in this two-year study to 75 animals.

Cetaceans
Information on stranded and beached whales at the Icelandic coast in 1999 was collected by the MRI and the Icelandic Institute of Natural History. These include three sperm whales (*Physeter macrocephalus*), one Sowerby's beaked whale (*Mesoplodon bidens*), one pilot whale (*Globicephala melas*), one harbour porpoise, one white-beaked dolphin (*Lagenorhyncus albirostris*), one humpback whale (*Megaptera novaeangliae*) and one sei whale (*Balaenoptera borealis*).

A long-term photo-id study on killer whales was continued. In 1999 photos were collected on the herring (*Clupea harengus*) grounds east of Iceland during autumn and around Vestmannaeyjar south of Iceland during summer, the latter in co-operation with the Ocean Futures Society.

A research project on stock identification, migration and possible hybridisation of blue whales was continued in co-operation with Richard Sears and co workers at Mingan Island Cetacean Study, Inc., Canada. During 27. June – 7. July photos were taken for photo identification catalogue and 14 biopsies were collected off W-Iceland.

A pilot project, 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 was initiated in collaboration with whale watching companies.

2.3 Laboratory work

Pinnipeds
Work on age determination from growth annuli in grey seal teeth from the catch of 1999 is at a final stage.

Analysis of diet and body condition of hooded seals collected in 1998-1999 was concluded. The results will be presented as a MS thesis at the University of Iceland in May 2000.

A study on pollutant concentrations in brain tissue of hooded seals was initiated in co-operation with the University of Iceland.

Cetaceans
Analysis of MRI's photo-id catalogue of killer whales was continued. The catalogue now contains around 380 individual killer whales photographed during 1981-1999.

Work continued on the Icelandic photo-id catalogue of blue whales focusing mainly on comparison with blue whales from the western North Atlantic. Genetical analysis of biopsy samples from blue whales sampled west of Iceland continued.

Analysis of mtDNA from harbour porpoises collected off Iceland in 1991-1997 was conducted as a part of a co-operative project between the MRI and the Institute of Marine Research, Bergen, Norway.

Histological analysis of the reproductive organs of harbour porpoises was finished in 1999.
Protein, lipid and energetic contents of muscle and blubber were analysed from 90 harbour porpoises as a part of studies on body condition of harbour porpoises in Icelandic waters.

Analysis of diet, reproductive biology and age composition of white-beaked dolphins sampled off Iceland in recent years is at a final stage.

Analysis of hormone concentrations and other blood parameters in fin and sei whales continued and screening was conducted for morbillovirus in stranded cetaceans.

2.4 Research results

Genetic analysis of blue whale biopsy samples have revealed a blue/fin whale hybrid, the fourth of its kind found in Icelandic waters. No photo-id matches have been made between blue whales off Iceland and animals photographed at other locations in the North Atlantic.

The diet of harbour porpoises in Icelandic waters varies significantly seasonally, and considerable differences between area have also been detected. Capelin is by far the most important food species of the harbour porpoise during March and April in SW and SE Icelandic waters while sand eel (*Ammodytes* sp.) is the dominant prey during late summer and autumn. A large variety of other fish species were also found in the stomachs, redfish and gadoids being the most important of these "secondary" prey species.

Studies on growth and reproduction have shown mean maximum lengths 158cm and 152cm for females and males, respectively. Mean age at sexual maturity is 3.6 year for females and 2.8 years for males.

Preliminary results from studies on nematodes in digestive tract of harbour porpoises indicate that the species is not an important host for *Anisakis simplex.*

There is considerable seasonal variation in the diet of hooded seals in Skjálfandi Bay, N Iceland. During spring cod (*Gadus morhua*) is the primary prey species while redfish (*Sebastes marinus*) dominates the diet completely during autumn. There was also considerable seasonal variation in body condition, the seals being in poorest condition in August when they reappear in Skjálfandi Bay after moulting.

Most of the hooded seals stomachs had some food remains (96%). Food composition changed seasonally, but redfish and cod were the main fish species prayed on by hooded seals

3. CATCH DATA

Pinnipeds
Preliminary catch figures for 1999 are 662 grey seals, 628 common seals and 98 of other species.

Cetaceans
No direct catch of cetaceans took place in Icelandic waters in 1999

4. ADVISE AND MANAGEMENT MEASURES TAKEN

No whaling permits were issued in 1999. A precautionary TAC of 200 fin whales from the EGI stock and 250 minke whales from the Central N-Atlantic stock was recommended by the MRI. No special management measures were taken regarding seals.

5. PUBLICATIONS AND DOCUMENTS

Daníelsdóttir, A.K. 1999. Review on the genetic stock structure of North Atlantic fin whales (*Balaenoptera physalus*). Paper presented at the NAMMCO Scientific Committee Working Group on North Atlantic Fin whales, Copenhagen, Denmark, 8th - 9th April 1999. 7pp.

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Ólafsdóttir, D. 1999. *Anisakis simplex* (Nematoda) infestations in harbour porpoises (*Phocoena phocoena*) in Icelandic waters. International Symposium on Harbour Porpoises in the North Atlantic in Norway 10.-14. September 1999 10p.

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Smith, T.D., J. Allen, P.J. Clapham, P.S. Hammond, S. Katona, F. Larsen, J. Lien, D. Mattila, P.J. Pallsbøll, J. Sigurjónsson, P.T. Stevick, N. Øien 1999: An ocean-basin-wide mark-recapture study of the North Atlantic humpback whale (*Megaptera novaeangliae*). Marine Mammal Science 15 (1): 1-32.

Tolley, K., Rosel, P.E. and Vikingsson, G. 1999. Intra-oceanic population structure of harbour porpoises from the North Atlantic based on

mitochondrial DNA sequence variation. *13th Biennial Conference on the Biology of Marine Mammals, Maui, 28. Nov. - 3.Dec. 1999.*
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4.4
NORWAY
PROGRESS REPORT ON MARINE MAMMAL RESEARCH 1999

Sidsel Grønvik, Tore Haug & Nils Øien

1. INTRODUCTION

This report summarises the Norwegian research on pinnipeds and cetaceans conducted in 1999. 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 Norwegian College of Veterinary Medicine, Department of Arctic Veterinary Medicine in Tromsø (NVH-IAV), the Institute of Marine Research in Bergen (IMR), the Norwegian Institute for Fisheries and Aquaculture in Tromsø (NIFA), the Polar Institute in Tromsø (NP) and RC Consultants, Sandnes (RCC).

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, Greenland Sea
Bearded seals *Erignathus barbatus* - Svalbard

Cetaceans

Minke whales *Balaenoptera acutorostrata* - Northeast Atlantic
Humpback whales *Megaptera novaeangliae* - North Atlantic
Killer whales *Orcinus orca* - Norwegian coastal waters
White whales *Delphinapterus leucas* – Svalbard
Harbour porpoise *Phocoena phocoena* - North Sea, Norwegian coastal waters

2.2 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. (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 in 1999. A research cruise to the pack-ice in the Fram Strait between approximately N82°27'; E33°00 (north of Kvitøya) and the Greenland east coast was performed in the period 23 September - 12 October 1999. Biological material for studies of feeding habits, nutritional status, lipid contents, age, reproduction, genetics and pollutants were collected from harp, hooded and ringed seals in the area. (NIFA, NP)

The Institute of Marine Research (IMR) carried out a research cruise to the West Ice (Greenland Sea) in March-April 1999 to collect material on hooded seal reproduction. Material was obtained from 250 breeding female hoods and corresponding material was also sampled from 98 breeding harp seal females to supplement material collected in 1997. Other research institutions participated in the cruise, taking samples for studies of pollutants, immunology, physiology, bacteriology, genetics, fatty acids, and nutritional aspects of meat and blubber from both species.

Physiological studies of harp and hooded seals were conducted during a research cruise to the Greenland Sea in March/April 1999. Studies of the oxygen storing capacity of adult and juvenile hooded seal were conducted by determining total blood volume, haemoglobin concentration, total skeletal muscle mass, skeletal muscle myoglobin concentration and lung volume in newly killed new-born (n=6) and adult female (n=6) hooded seals. These data will be used to calculate the theoretical aerobic dive limits (ADL) of these animals, which will then be related to the documented dive durations of freely diving animals. Data on dive durations of adult hooded seals have previously been collected by use of satellite-linked dive recorders (Folkow & Blix 1999) and we plan to collect similar data from young animals in future studies. These investigations will also shed light on the ontogeny of diving in this species. This study is a collaboration between UITØ-AAB and University of California Santa Cruz, USA (Dr. Jennifer Moss Burns).

Studies of diurnal variations in plasma levels of melatonin in new-born harp and hooded seals were also conducted. This hormone is secreted from the pineal gland, which is situated in the skull, between the cerebral hemispheres. Pinnipeds have been shown to have particularly high plasma levels of this hormone, and levels in new-borns are even higher than in adults, but the physiological function of melatonin in seals is unclear. Experiments were conducted with new-born harp and hooded seals to elucidate how various light-darkness regimes affect the secretion of the hormone. Several heads of new-born harp and hooded seals were furthermore collected and fixed in formalin, for later histological studies of their pineal gland (UITØ-AAB). Some of these heads (from hooded seals) have also been used in anatomical and histological studies of the middle ear, in order to study adaptations to deep diving in this structure (RiTø/UITØ-AAB).

In addition, 7 hooded seal weanlings were live-captured and brought to UITØ-AAB for laboratory studies of various physiological functions (see below). (UITØ-AAB)

Ten adult harp seals were live-captured and equipped with satellite-linked dive recorders during another cruise to the Greenland Sea in May/June, 1999. The purpose of this study is to monitor the seasonal distribution and diving behaviour of animals from the West Ice stock, of which little is known. Tagging was performed on newly molted animals and in theory, these dive recorders may consequently continue to transmit data until the next molt, in May/June 2000. During the same cruise, another 6 adult harp seals were live-captured and brought to UITØ-AAB for further physiological studies (see below). (UITØ-AAB)

From the West Ice, 10 fat harp seals mothers were collected in March, and 10 skinny harp seal females were collected during the molting season. They are part of a study of distribution of pollutants and fatty acids in the blubber of seals.(NP)

Studies of bearded seals were conducted in the Kongsfjorden area in May, where 18 pups and 3 adults were captured. This is part of a study of energetics, behaviour, vocalisation, diet and pollution.(NP)

Twelve ringed seals were live captured in the Storfjorden area in August, and 8 were equipped with satellite transmitters to study movements and diving patterns. (NP)

Studies of age- and sex composition, body condition and feeding ecology were performed on harp seals invading the coast of North Norway in April. (NIFA)

Aerial photographic surveys of harbour seals were conducted during the moulting season in several counties of southern Norway. In the Oslofjord area, the survey was carried out in co-operation with Swedish authorities to obtain a joint estimate of the harbour seal population inhabiting the Oslofjord and the Swedish west coast. Harbour seal behaviour was studied in connection with aerial surveys on the coast of Møre.(IMR)

Visual, ship-borne surveys of harbour seals were conducted off northern Norway in the moulting period (September). (NIFA)

Studies of harbour seals were conducted in June/July on the west coast of Prins Karls Forland. Here 130 seals were live captured for studies of population dynamics, diets and pollution.(NP)

The biology and ecology of grey seals (demography, condition, diet, reproduction, genetics, pollutants, virus infections) were studied in ship-borne surveys conducted off northern Norway in March and September. (NIFA)

In Rogaland County, ship-borne surveys of moulting grey seals were conducted in March, harbour seal pups were tagged in June and one grey seal were tagged in December. (RCC)

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 commercial whaling season (May-June), stomach samples, body condition data and biological material for studies of demography, reproduction and stock identity were collected from minke whales by scientific personnel on 3 of the participating vessels. Concurrent estimates of prey abundance, using a research vessel fitted with acoustic and trawl gear, were made in the same areas where the sampled whales were caught. 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, UITØ- NFH).

During the summer of 1999 a sighting survey was conducted in the Greenland Sea and the Svalbard area. This was the fourth year of a six-year program to cover the Northeast Atlantic to provide a new abundance estimate of minke whales every sixth year as part of the management scheme established for this species.(IMR)

Biological material and especially material relevant to alternative age determination techniques for baleen whales was collected during the commercial minke whale catch operations in the Jan Mayen area and the North Sea.(IMR)

During the whaling season in 1999 prototype III of a new penthrite grenade, developed in 1997 and field tested in 1997 and 1998, was tested on five vessels. One-hundred and twenty-four minke whales were shot with prototype III. (NVH-IAV)

The pathological studies of minke whales killed by penthrite grenades were continued and expanded in 1999. This research includes both field studies (gross post mortem examinations) and histology of tissues from vital organs. Samples were collected from 32 whales. The brains were preserved with a method of *in situ* formalin fixation developed for the project to preserve the whole brain for later gross and histological examination. (NVH-IAV)

In August and September photo IDs of humpback whales were collected from the Barents Sea area.(IMR)

Capture and satellite tagging studies of harbour porpoises were carried out in Varangerfjord in May-June.(IMR)

Killer whales emit a wide range of biological sound, including high frequency rhythmic clicks used for echolocation. During the autumn 1999, acoustic signals were recorded from killer whales in Vestfjorden, Northern Norway, using a digital system that made recording of both audible signals and high frequency signals up to 120 kHz feasible. (NIFA)

Fifteen white whales were live-captured in Storfjorden in late August. Samples were taken for studies of genetics and pollution, and 6 of the animals were instrumented with satellite transmitters to study movement and diving patterns. (NP)

2.3 Laboratory work

Pinnipeds

Age determinations were completed for harp seals and hooded seals sampled in the West Ice in March-April.(IMR)

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 seals, taken during seal invasions into North Norwegian waters are being analysed. Furthermore, data on body condition of harp and hooded seal pups (from breeding grounds in the Greenland Sea) have been analysed. (NIFA)

Reproductive data from Greenland Sea harp seals are being analysed. (NIFA, UITØ-NFH)

Like all pinnipeds, harp and hooded seals are well adapted for a diving lifestyle. These adaptations involve a large oxygen storing capacity in various tissues, as well as an ability to economise with these stores, particularly during long-diving, by reducing tissue metabolism. A recent study (Odden *et al.* 1999) revealed that brain temperature of both harp and hooded seals may drop by several degrees during simulated diving in the laboratory. This phenomenon may further reduce diving metabolic rate, but the mechanism behind the brain cooling is not known. Studies have been conducted to investigate potential mechanisms that may be responsible. Thus, brain, tympanic, rectal, aortic, and extradural intravertebral venous temperatures were recorded after surgical instrumentation in harp and hooded seals that were subjected to simulated dives lasting for 10-15 minutes. (UITØ-AAB)

Laboratory studies have also been conducted with harp seals in order to determine whether these are able to gain body water from drinking sea water, after having been experimentally dehydrated. (UITØ-AAB)

Laboratory studies have also been initiated to study how deep-diving seals are able to find and catch prey in deep water, where daylight is absent and use of visual sense is severely restricted. These studies include presentation of live and dead prey to seals while in darkness, combined with recordings of potential underwater sound production. (UITØ-AAB)

Analyses of satellite-transmitted data on distribution and dive behaviour of 10 West Ice harp seals that were tagged in May/June 1999 have been initiated (UITØ-AAB).

Studies are also conducted on the effect of salmonella vaccination on West Ice harp seals, in order to investigate whether these animals are able to respond to this pathogen by producing antibodies (IAV/UITØ-AAB).

Data on bearded seal diving behaviour (collected using time-depth-recorders in Spitsbergen waters) have been analysed. (NIFA, NP, UITØ-NFH)

Data on age and body condition and stomach samples from grey seals taken for scientific purposes in North Norway are being analysed. (NIFA)
A project to investigate health problems in harp and hooded seals in captivity was concluded in June 1999. The analyses of data are underway. (NVH-IAV)

Cetaceans
Studies of a number of alternative methods, including an evaluation of current methods for age determination of minke whales have been continued. The use of fatty acids and mandibular growth zones show promising results. The use of digital image analysis as a tool in age estimations is being developed.(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)

A project to develop a satellite linked radio tag for tracking movements of cetaceans, which started in 1997, continued in 1999. (NVH-IAV)

A study of the population structure of North Atlantic harbour porpoises by genetic variation in mitochondrial DNA was continued based on material collected from stranding and by-catch from the North Sea and the Barents Sea in recent years.(IMR)

Tissues sampled for stock identity studies of minke whales have been analysed using DNA techniques. (NIFA)

Data on white whale vocalisation (collected in Spitsbergen waters) are being analysed. (UITØ-NFH)

Data on killer whale behaviour and ecology and problems concerning the use of photo-identification of the animals are being studied. (UITØ-NFH)

Databases containing incidental observations of marine mammals have been updated.(IMR)

2.4 Other work

Pinnipeds

Recaptures of four harp seals and one hooded seal were reported from the West Ice. The harp seals were tagged in 1989, 1990 and 1991, and data will be used to update mark-recapture estimates of harp seal pup production in the West Ice.(IMR)

IMR has received information on recaptures of 11 grey seals and 2 harbour seals in 1999.

Ecological data from harbour seals, collected in North Norway in 1990-1995, and from grey seals, collected in 1993-1995, have been analysed and presented. (NIFA, UITØ-NFH)

Cetaceans

Data on temporal diet variations and prey selectivity of Northeast Atlantic minke whales have been analysed and presented. (NIFA, UITØ-NFH)

The Norwegian market situation for meat from the commercial Norwegian minke whale hunt has been studied. (NIFA)

2.5 Research results

Pinnipeds

Studies of the feeding of harp and hooded seals as observed during April-June 1987-1992 in the West Ice indicated very little niche overlap between the two species. The hooded seal diet was almost completely dominated by the squid *Gonatus fabricii*, whereas harp seals mainly fed on pelagic amphipods of the genus *Parathemisto*, to some extent also krill and polar cod. (NIFA)

Analyses of samples from West Ice female harp seals collected over the period 1958-1997 demonstrated statistically significant changes in mean age at sexual maturity over time. The mean age increased from 6.4 years in the early 1960ies to 7.9 years in the mid 70ies, then declining to 7.0 years in mid 80ies and 6.5 years around 1990, and finally an increase to 7.5 years in 1997. Available length data indicated a decrease in growth from the early 60ies to the mid 70ies.(IMR)

Preliminary results from currently on-going analyses of samples collected during a field cruise to the Greenland Sea in March/April 1999 have shown that adult female hooded seals have very large concentrations of myoglobin in their skeletal muscles. The concentrations vary quite substantially between different muscle groups, but the maximum levels measured represent the highest ever recorded in any mammal. New-born pups have more homogenous levels of myoglobin in different muscles, but levels were generally lower than in adult females. Weight-specific blood volumes and haemoglobin levels were comparable in adults and pups. Further sample analyses are currently under way, and final computations of theoretical aerobic dive limits must await completion of all analyses. (UITØ-AAB)

New-born harp and hooded seals that were subjected to various light-darkness regimes, displayed elevated levels of melatonin during darkness and reduced levels in light, irrespective of at which time the daylight or dark periods occurred. This suggests that the secretion of melatonin is linked directly to light-darkness cycles, while endogenous circadian rhythms have less influence on the secretion pattern. Pineal glands have been dissected from the collected heads that were preserved in fixatives in the field, and are currently analysed and characterised histologically. (UITØ-AAB)

Two of the 10 satellite-linked dive recorders that were deployed on adult West Ice harp seals in May/June were lost within a few weeks after tagging. All remaining tags still transmitted data at the end of 1999, and very interesting migratory patterns have been revealed among the 8 seals with functioning recorders. (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. One study aimed at testing whether tympanic temperature may be used as an index of brain temperature, thus eliminating the need for brain surgery in order to monitor brain temperature changes in future studies, has revealed that this is not possible. Preliminary analyses of other tissue temperature data, which involve correlation of temperature changes in various tissues with those occurring in brain tissue, indicate that cooling is active and depends on peripheral vasodilatation followed by selective distribution of cooled blood to certain body regions. Further studies are, however, needed before firm conclusions may be drawn. (UITØ-AAB)

Dehydrated harp seals that were given seawater were found to be able to gain body water from the ingested seawater. This ability has not been demonstrated in any previous study. (UITØ-AAB)

Ongoing studies of underwater sound production in harp and hooded seals suggest that both species may emit high-frequency clicks. The occurrence of clicks is, however, not well correlated with incidents of chasing and catching prey, and the purpose of these clicks is therefore presently unknown. (UITØ-AAB)

Preliminary results from studies of effects of salmonella vaccination on captive harp seals have shown that the animals are able to produce antibodies against the pathogen. The response is, however, not very strong, and further conclusions must await completion of the sampling program and final analyses. (NVH-IAV/UITØ-AAB)

Analyses of stomach contents and faeces were performed for harbour seals inVesterålen, North Norway in 1990 - 1995. The harbour seals fed mainly on saithe (*Pollachius virens*). Only little variation occurred in the diet throughout the year, probably due to large and stable abundance of saithe in the area. Other prey items that seemed to be important were herring (*Clupea harengus*), cod (*Gadus morhua*), sandeel (*Ammodytes sp*.) and various flatfishes. The harbour seals seemed to prefer small fish, and older seals had a more various diet than the younger seals. In an experiment with captive harbour seals, where whole fish were given to the seal, only 14,8% were recovered as otoliths in faeces. Recovery rates varied between species: 4,6%, 47,7% and 46,6% of herring, haddock (*Melanogrammus aeglefinus*) and cod, respectively. This was used to correct the observed diet, based on faeces, in the present field study. However, the recovery rate for haddock increased to 91,4% when haddock otoliths were implanted in the fish flesh of herring. (NIFA, UITØ-NFH)

The ecological role of grey seals as predators in Faroese waters was assessed, based on reconstruction of the diet composition from stomach contents obtained from animals taken for scientific purposes during summer in 1993-1995. Gadoids, sandeels (*Ammodytes* sp.) and catfish (*Anarhichas lupus*) dominated the seal diet in all three years of sampling. Observed year-to-year variation in diets were generally due to shifts in relative importance among these three main prey groups. Grey seals of different ages were found to have somewhat different feeding habits. Juveniles fed most frequently on sandeels, pre-adults on sandeels and saithe and adults on cod and catfish. Adults also fed on larger prey than the younger seals. The grey seals in Faroese waters were only observed to feed on fish, generally smaller than 30 cm in length, but the size differed among species. (NIFA, UITØ-NFH)

The status of the analyses of photographic material collected from harbour and grey seal localities up to and including 1998 was presented in a report of October 1999. The report summarises investigations conducted in several fields of relevance to the management of coastal seals. IMR has based the estimation of abundance on photographic surveys of moulting harbour seals and breeding grey seals. The updated minimum estimates for harbour and grey seals along the Norwegian coast are 6,700 and 4,400 animals, respectively. IMR recommends that the future management of coastal seals should be based on a survey index established by aerial photography. (IMR)

A preliminary analysis of coastal seal mark-recapture data has been completed. Over the period 1975 to 1998 630 harbour seals and 3571 grey seals have been tagged along the Norwegian coast, nearly all within their first month of life. The recapture data show a wide dispersal of the pups shortly after weaning. The median distances between tagging and recovery sites peaked at 90 km 6-8 months after tagging for harbour seals. For grey seals the distance peaked at about 200 km 9-11 months after tagging. Thereafter, there was a decreasing trend in distance between tagging and recovery for both species. After sexual maturity an annual cycle in distance between tagging and recovery was observed. Recoveries during breeding seasons were made within short distances from the tagging sites. This effect was most pronounced for grey seals.

The recovery rates were 13% of the tagged population for harbour seals and 7% for grey seals. Incidental mortality in fisheries accounted for the majority of the tag returns. Hunting and culling at fish farms accounted for 2% and 1% in harbour and grey seals, respectively. The remaining tags were recovered from seals drowned in fishing gear. Bottom set net was the most important gear type, followed by traps set for cod (*Gadus morhua*).

The seals were most vulnerable to by-catch mortality shortly after weaning, but high incidental mortality prevailed during the first ten months. Thereafter incidental mortality continued at a low level. (IMR)

Result from a ship-borne survey of grey seals in Rogaland County the first week of March, revealed an observed moulting population of 200 animals. The main moulting places were the islands of Kjør where more than 70 % of the population were observed, Spannholmane (Utsira) and Urter. (RCC)

On 23 June, 4 new-born harbour seal pups where tagged on Håstein south of Kvitsøy, and on 13th December, an approximately 10 days old grey seal pup were tagged on Kjør (RCC). In the same area, 9 pups with white coat were observed 21 November. This confirms the presence of a local breeding grey seal population in Rogaland County.(RCC)

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. An alternative method for estimating minke whale abundance based on genetic relationships between individuals in catches has been developed, but needs further refinements and research. (IMR)

It has been observed that minke whale diets in the Barents Sea are subject to year-to-year variations due to changes in the resource base in different feeding areas. Variations in abundance of herring and capelin have particularly been demonstrated to cause changes in minke whale diets. In the northern parts of the Barents Sea, krill appears to replace capelin on the whale diet when capelin stock size is low. In the southern parts of the Barents Sea, year class strength of herring is of very significant importance for the importance of herring on the whale menu. In cases of low abundance of adolescent herring, other fish species (gadoids and capelin) and/or krill increases in importance. Thus, relative distribution of consumption of different prey items by minke whales is highly dynamic. (NIFA)

During the 1998 commercial whaling season (May-June), stomach samples were collected from minke whales on 3 of the participating vessels. Concurrent estimates of prey abundance, using a research vessel fitted with acoustic and trawl gear, were made in the same areas where the sampled whales were caught. Quantitative comparisons of the results from the stomach analyses and resource investigations were performed using bootstrap-techniques in combination with Chessons index of selectivity. The analyses were performed in both small and medium geographical scale. The results, in particular those from the small scale analyses, seemed to indicate that the minke whale diet to a large extent reflected the abundance of the most important prey groups in the sea. Medium scale analyses, however, gave weak evidence for selection of capelin, while herring was more abundant in the water than in the whale stomachs. Cod and saithe were also abundant in the sea, but were virtually absent in the whale stomachs. (NIFA, UITØ- NFH).

Questions concerning the treatment of and market situation for the meat from Norwegian minke whale hunting have been addressed. Consumption of whale meat in Norway has been very much linked to traditions, and has not followed trends in the food marked. Whale meat has usually been sold fresh during the whaling season, or, to a much lesser extent, as frozen beef. To contribute to development of new products, experiments, designed to assess whether whale meat was suitable for distribution in modified atmosphere packaging (MAP), were conducted. The market study discussed both availability, prices and consumers, and was based on information from both the latter and from wholesalers as well as retailers. Advice on how to secure the national Norwegian market for whale meat in the best possible way was given. (NIFA)

The results as to instantaneous death in 124 minke whales killed with prototype III of a new penthrite grenade tested on five whaling vessels in 1999 were superior to all previous results obtained in the Norwegian minke whale hunt. After minor corrections of one of the pyro-technical devices and the trigger system, prototype III was decided to be produced for overall common use on all Norwegian whaling vessels from the year 2000. This grenade is named «Hvalgranat-99». The pre-existing penthrite grenade has now been banned.(IAV-NVH)

Acoustic studies of killer whales have revealed that most of the energy in recorded clicks from the animals was approximately 20-30 kHz, which is lower than other dolphins. Some clicks reached 80 kHz. According to the intervals between the clicks, most of the echolocation was used at short distances, but some clicks were used at distances up to 350-400 meter. (NIFA)

Further analyses have been made of the YoNAH material and other information collected from humpbacks in Norwegian and adjacent waters, and results relating to migration, stock identity and abundance have been published. (IMR)

Experiments to use by-caught harbour porpoises for satellite tagging have been successful. Three animals were tagged and followed for 1 ½ to 2 months. All the tagged porpoises had different patterns of movement: one was relatively stationary within the Varangerfjord, one travelled northwards to Skolpen bank and one travelled along the Kola coast towards the White Sea. (IMR)

The population structure of harbour porpoises in Norwegian waters has been investigated using sequencing of the mitochondrial control region. The studies suggest that females are more philopatric than males and that the North Sea-UK and the Barents Sea sub-populations should be considered separate management units. Separate management units within the North Sea was indicated by haplotype frequency differences among the North Sea-Norway and the North Sea-UK females.(IMR)

3. CATCH DATA

Sealing

Three Norwegian vessels participated in sealing in, two of which operated on a commercial basis in the West Ice (the Greenland Sea) while the third one conducted research-based operations 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 1999. These catches represent only fractions of the quotas: In the West Ice only 3% of the harp seal quota and 29% of the hooded seal quota were taken. In the East Ice the Norwegian vessel caught 21% of its allocated harp seal quota, but the total result based on both Russian and Norwegian catches was 70% of the quota recommended by the the Joint Norwegian-Russian Fisheries Commission (53,500 pups).

Table III.1. Norwegian catches of harp and hooded seals in 1999. 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	608	195	803	173	977	1,150
Hooded seals	3,525	921	4,446			

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 1999 season.

Table III.2. Catches of minke whales in 1999 by management area as defined in RMP.

1999	Management area					
	EB	EN	ES	EC	CM	Total
Small-type whaling	284	122	112	12	59	589

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. At its most recent meeting in the fall of 1998, the Working Group focused on finalising assessments of harp seals in the East Ice and hooded seals in the West Ice, but assessments were presented also for West Ice harp seals and the Working Group provided advice on quotas for all these stocks.

The 1999 TACs were 17,500 harp seals in the West Ice, 53,500 harp seals pups in the East Ice and 11,200 hooded seals in the West Ice, all quotas except East Ice harp seals given as 1+ equivalents. Russia and Norway both participate in the sealing operations in the West Ice and the East Ice and therefore allocate quotas on a bilateral basis. The Norwegian quotas in 1999 recommended by the Joint Norwegian-Russian Fisheries Commission were 14,700 harp seals and 8,700 hooded seals in the West Ice and 12,500 harp seal pups in the East Ice. Since Russia was not able to participate in the West Ice in 1999, the total quota was reallocated to Norwegian vessels. 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.

For the 2000 season the total allowable quotas have been set as follows: Harp seals in the East Ice 31,600 1+ equivalents, harp seals in the West Ice 17,500 1+ equivalents, and for hooded seals in the West Ice 11,200 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. The Norwegian shares of the 2000 quotas will be 15,000 harp seals and 8,400 hooded seals in the West Ice and 5,000 harp seals in the East Ice.

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 1999 quotas were 407 common seals and 373 grey seals. In southern Norway most of the allocated quota was taken, while only a fraction has been reported caught in northern Norway. The quotas set for coastal seals for 2000 are 625 grey seals and 380 harbour seals. In addition a quota of 37 ringed seals have been set for each of the three northernmost counties in Norway.

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 northeast Atlantic and the Jan Mayen area in 1999 was set to 753 minke whales. In addition to the calculated 1999 quota of 613 animals, this quota includes a transfer of 140 animals not taken in previous years. The catch quotas are set for each of five management areas, and allocated on a per vessel basis, in 1999 14-21 whales per vessel for the 36 vessels which participated. Regardless of this, maximum boat quotas of 28 and 40 whales were set for the Jan Mayen and the North Sea management areas, respectively, to stimulate participation in those areas. The basic catching season was from 3 May to 10 July. All the participating vessels had inspectors on board to survey the whaling operation. The quota for 2000 will be 655 minke whales.

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