SECTION 4 - SCIENTIFIC COMMITTEE

4.1
REPORT OF THE FOURTEENTH MEETING OF THE NAMMCO SCIENTIFIC COMMITTEE

EXECUTIVE SUMMARY

The 14th meeting of the NAMMCO Scientific Committee was held at Reykjavik, Iceland, 21-23 November 2006. In addition to members, observers from Canada and the Russian Federation attended the meeting. This year, for the first time, the Committee conducted a full review of previous requests for stock assessments and other advice put to it by the Council, paying particular attention to recommendations for research required to provide better advice. The purpose of this review was to identify in which areas the Committee could now provide better advice, and areas of research that had not yet been fully addressed.

MARINE MAMMAL – FISHERIES INTERACTIONS

The Committee has been monitoring progress in this area since the last meeting of the Working Group in 2004, with the goal of holding a Working Group meeting to finalize models for the Barents Sea and assess models for other areas, if sufficient progress had been made on the identified research and modelling priorities has been sufficient to warrant such a meeting. Last year the Committee tentatively decided to hold a meeting of the Working Group on Marine Mammal – Fisheries Interactions in 2007. Unfortunately little progress has been made in modelling efforts for the Barents Sea or Iceland. Once again the Scientific Committee was forced to conclude that it could not provide the requested advice on 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. As in the past, the Scientific Committee emphasized that progress in this area will not be made unless significant additional resources are dedicated to it. Given the lack of progress, the Committee considered that it would be premature to hold a Working Group meeting in 2007, and recommended that it be postponed to 2008 at the earliest.

HARP SEALS

In 2005 the Management Committee recommended that the Scientific Committee evaluate how a projected decrease in the total population of Northwest Atlantic harp seals might affect the proportion of animals summering in Greenland. In addition the Management Committee requested the Scientific Committee to specify harvest levels for two (*i.e.* Barents/White Sea and Greenland Sea) harp seal stocks that would result in a population reduction of 20% over a period of 20 years.

With regard to the latter issue, new modelling results were available for both stocks. For the Barents/White Sea stock, projections indicated that the requested stock size would be reached in 20 years with a total quota of either 35,482 1+ animals or 70,964 pups per year (if one 1+ animal is balanced by 2 pups, as in the current management regime). For the Barents/White Sea stock, the equivalent projections suggest quotas of

either 98,490 1+ animals or 246,225 pups per year (one 1+ balanced by 2.5 pups, as in the current regime). In both cases the uncertainty of the predicted population size at the end of the period is very large, so it was recommended that such a harvest programme should not be considered without a careful monitoring programme, involving surveys at intervals of 5 years or less.

With regard to the question of how a projected decrease in the total population of Northwest Atlantic harp seals might affect the proportion of animals summering in Greenland, the Scientific Committee noted the most recent survey conducted in 2004 suggests that the abundance of Northwest Atlantic harp seals may be stabilizing after a period of rapid increase. It might therefore be expected that the numbers summering off West Greenland would also stabilize. However the proportion of animals migrating to Greenland may not be constant and may change in response to environmental conditions. In addition the age structure of the population will change as it stabilizes, and this may also affect the numbers summering in Greenland. Once again, detailed information on harp seal migratory patterns will be required to assess this. The Scientific Committee again recommended that the ICES-NAFO Working Group be asked to address this request and recommended that Greenland forward this request to ICES. If that is not possible, the Committee will have to organise a special working group, with active participation by Canada, to address the issue.

HOODED SEALS

Greenland Sea stock status

The ICES/NAFO Working Group on Harp and Hooded Seals (WGHARP) met in June 2006 to consider the status of hooded seal stocks, and their report was used by the Committee to provide advice for the species. Results from a pup survey conducted in 2005 suggested that current pup production there is about 38% lower than that found in 1997. In the most recent two decades, the stock appears to have stabilized at a low level which may be only 10-15% of the level observed 60 years ago. An assessment model estimated the following 2006 abundance for Greenland Sea hooded seals: 71,400 (95% C.I. 38,400-104,400) 1+ animals with a pup production of 16,900 (95% C.I. 10,200-23,600). Mainly because of the observed decline in the stock, WGHARP concluded that harvesting should not be permitted with the exception of catches for scientific purposes from 2007 on.

In the past 25 years, the average annual catch level has remained less than 5,000 animals (almost exclusively pups), which is considerably lower than the TACs given for the period. Annual removals by Greenland hunters from the Greenland Sea stock were between 3 and 67 animals per year.

The Scientific Committee supported the conclusions of WGHARP with regard to the status of the stock. However there was some discussion of the conclusion by WGHARP that harvesting of the Greenland Sea population of hooded seals should not be permitted with the exception of catches for scientific purposes from 2007 on. It is clear that the low levels of recent harvests cannot have been the sole reason for the apparent decline in the stock. Recent harvests in East Greenland (Scoresbysund) are

very low, and continuation of harvests at these levels will not appreciably affect the status of the stock. The Committee therefore recommended that catches in the Greenland Sea be restricted to necessary scientific catches and to satisfy local needs at roughly current levels. This should be accompanied by a careful monitoring programme as recommended by the Working Group. It was also recommended that biological samples for determination of vital parameters be collected from the Greenlandic hunt in Ittoqqotoormiit. It was noted also that a new abundance survey will be carried out in 2007, after which this recommendation can be revisited.

NW Atlantic stock

Surveys of all 3 whelping areas in the Northwest Atlantic were also carried out in 2005. Total pup production in the northwest Atlantic was 116,900 (CV = 6.8%). Comparison with previous estimates suggests that pup production may have increased since the mid 1980s. However, any understanding of changes in abundance is hampered by a lack of understanding of the relationship among whelping areas.

GREY SEALS

The Scientific Committee has established two working groups to provide assessment advice on this species, in 1995 and again in 2003. The last working group in particular was tasked with providing assessment advice on grey seals throughout the North Atlantic, and gave management and research recommendations for grey seals in Iceland, the Faroes and Norway. The Committee considered that sufficient new information has and will be collected in both Iceland and Norway to warrant new assessments for these areas, and that these could be carried out by the Working Group as soon as 2008. For the Faroe Islands, the Committee reiterated its previous recommendation that immediate efforts be made to obtain better information on the population of Faroese grey seals, and on the nature and impact of the take in the Faroes.

HARBOUR SEALS

The Scientific Committee was requested in 2005 to review and assess the status of harbour seals throughout the North Atlantic, including survey methods, stock delineation, ecology and fisheries interactions. A Working Group with emphasis on expertise on the North Atlantic and adjoining seas, notably the North Sea and Baltic was convened in Copenhagen, 3-6 October. The full report of the Working Group is included as Annex 1.

The Committee supported the conclusions of the Working Group with regard to the status of all stocks, and the recommendations for research and monitoring. There was concern about the status of the population at Iceland, which has decreased substantially over the past 26 years. The Committee stressed the importance of better by-catch recording and strongly recommended that monitoring of the stock, with surveys at 2-3 year intervals, be continued. The Committee also recommended that a formal assessment of this stock be conducted as soon as is feasible.

It appears that harbour seals have disappeared over much of their former range in West Greenland, and that the remnant population in the extreme south may be small. The Committee concluded that a total cessation of harbour seal hunting in all of West Greenland should be considered and research should be undertaken to estimate the size of the remaining southern population.

For Norway it was noted that the current harvest, when combined with likely levels of by-catch and possible unreported levels of struck and lost, was probably not sustainable, and that the allocated quotas, if taken, were certainly not sustainable. The Committee recommended better monitoring of by-catch in all fisheries, and for continued and frequent abundance surveys.

In general there is a need for the establishment of clear management objectives for this species in all NAMMCO member countries where the species is extant. The Committee recommended that clear management objectives for harbour seals be developed for Norway, Iceland and Greenland, as well as a plan for the Faroe Islands in case there was recolonization.

WALRUS

Assessments of North Atlantic walrus populations have been carried out by the Committee in 1995 and in 2005. In 2005 the Committee concluded that present removals were likely not sustainable for the North Water and West Greenland stocks, and recommended that new assessments for these stocks be completed as soon as identified research recommendations were fulfilled. These included completing analyses of previous surveys, carrying out new surveys in both areas, analyses of stock structure using genetics and tagging, and developing complete catch series with appropriate corrections. The Committee noted that considerable progress was being made by Greenland in collecting vital information on abundance, distribution, stock structure and catch, and for implementing hunting regulations and quotas that should improve the conservation status of walrus in the area. The Scientific Committee welcomed the Greenlandic research plan on walruses and recommended that they be fully supported. The Committee encouraged Canada to fully support Greenland in their research efforts as it is now confirmed that the “West Greenland” walrus are in fact shared between eastern Baffin Island and West Greenland.

It is anticipated that results from the survey carried out in 2006 and the one to be carried out in 2007 will be available late in 2007. A new catch series may also be finalized at that time, and this information, combined with the new abundance estimates and estimates from past surveys, could be used to develop new assessment models for the Davis Strait stock. The Scientific Committee therefore considered that a Working Group could provide a detailed assessment of the stock in 2008.

In 2005 the Scientific Committee was asked to provide advice on the effects of human disturbance, including fishing and shipping activities, in particular scallop fishing, on the distribution, behaviour and conservation status of walrus in West Greenland. It is hypothesised that walruses can be negatively affected either directly by fishing

activity causing habitat degradation (trawling and other activities damaging the sea floor and depleting walrus prey resources) or indirectly through masking of walrus underwater communication during the breeding season through noise from fishing activities. To be able to evaluate how these factors may affect walruses, the Committee would require detailed information on the following: spatial and temporal distribution of walrus, fishing operations, including characteristics of noise produced, walrus feeding ecology, habitat quality and the effect of trawling, and walrus vocalizations. There are no immediate plans to conduct studies with the purpose of specifically providing this information, although some ongoing research activities may provide information relating to some of the elements. Due to the present lack of information the Committee found itself in a position where it could not respond to the request of the Council, and it is unlikely to be able to do so in the near term. The Committee will monitor progress in this area annually.

FIN WHALES

A Joint NAMMCO/IWC Scientific Workshop on the Catch History, Stock Structure and Abundance of North Atlantic Fin Whales was held in March 2006 (Annex 2). The main objective of the Workshop was to consider the available information on stock structure, catch history, biological parameters and abundance and trends in order to advance the fin whale assessments ongoing in the two organisations.

The main uncertainty concerning fin whales in the North Atlantic remains stock structure. Several hypotheses with respect to stock structure (feeding and breeding areas) were discussed, and it was noted that the discriminatory evidence among the different hypotheses is weak. The Committee agreed that the stock structure question remains open, and that the set of possible hypotheses range from one stock covering the whole North Atlantic to five or more separate stocks. There is strong evidence that fin whales in the Mediterranean represent a separate stock.

Estimates of abundance for the Northeast and Central Atlantic (EGI stock) were discussed and accepted: for the latter area these differed little from previous estimates accepted by the Committee. Estimated abundance in the whole EGI area has increased at 3% (95% CL: -1% - 7%) per year, *i.e.* this rate of increase is not significant at the 5% level. There was no evidence of any trend in abundance in the eastern North Atlantic.

A number of papers detailing catch series for the Northeast and Central Atlantic were presented to the Workshop. It was agreed that the information and the uncertainty in the catch series could be used as a basis to develop a ‘high’ and a ‘low’ series containing the maximum and minimum catches.

A new assessment model of the EGI fin whale population, similar to that considered in 2005, modelled as 4 sub-populations with movement between areas, was presented. For the base case and most sensitivity tests, the overall recruited population is increasing and above 80% (base case 84%) of pre-exploitation abundance.

Based on the new information presented the Committee found no reason to change its advice provided in 2005, that projections under constant catch levels suggest that the West Iceland sub-stock (the "inshore sub-stock") will maintain its present abundance (which is above MSY level) under an annual catch of about 150 whales. It is important to note that this result is based on the assumption that catches are confined to West Iceland, *i.e.* to the grounds from which fin whales have been taken traditionally. If catches were spread more widely, so that other stock components were also harvested, the level of overall sustainable annual catch possible would be higher than 150 whales.

The Workshop provided a series of recommendations for future work that are detailed in Annex 2. The Committee emphasized that stock delineation remained the most important outstanding issue hindering our understanding of the status of fin whale stocks. Recommendations related to stock delineation were therefore emphasized, particularly the collection of genetic samples from areas where they are lacking, and satellite tagging once an acceptable success rate is achieved. It was recommended that some effort be allocated to these activities, if possible, during the TNASS in 2007. It was agreed that all documents submitted to the respective Scientific Committees pertaining to the assessment of fin whales in the North Atlantic, and the Reports of the respective Committees, would be exchanged in the future. The first joint meeting between the NAMMCO and IWC Scientific Committees was considered successful, efficient and productive, and it was hoped that this level of cooperation on issues of common importance could be continued.

West Greenland

Estimates of fin whale abundance from ship and aerial surveys conducted off West Greenland in September 2005 were reported to the Committee; these were presented to the IWC Scientific Committee at their last meeting. The Scientific Committee concurred with the view of the IWC Scientific Committee (IWC 2006) that the estimates from the aerial survey were more reliable because the realised coverage of the ship-based survey was low and unevenly distributed within strata. A line-transect abundance estimate of 1,724 (cv: 0.37) was obtained from this survey. This abundance estimate is negatively biased as no corrections were applied for whales missed by observers or for submerged whales.

Status of fin whales with respect to CITES and IUCN criteria

At the July 2006 meeting, the CITES Animals Committee decided to undertake periodic reviews of species listed on the CITES Appendices, and the North Atlantic central stock of fin whales had been nominated for review with Iceland agreeing to undertake this before the next CITES Animals Committee meeting in February 2008. The NAMMCO Council requested the NAMMCO Scientific Committee to undertake a review of the appropriateness of the current CITES listing of this fin whale stock. A NAMMCO *ad hoc* Working Group undertook this review and reported back to the Scientific Committee (Annex 3).

On the basis of biological information including population distribution and abundance and stock structure, with reference to CITES criteria A, B and C, the Committee concluded that the fin whale population in the region of the Central North

Atlantic (the EGI stock) does not meet any of the biological criteria for listing under CITES Appendix I (threatened with extinction). However this conclusion may have to be reviewed in the future depending on progress made in determining the stock structure of fin whales.

It was noted that the IUCN Cetacean Specialist Group would be meeting in January 2007 to review species status, and Iceland pointed out that in discussions on the status of species within this group, information from NAMMCO appeared never to have been taken into consideration. The Committee tasked the NAMMCO Secretariat with contacting the Chair of this IUCN group and drawing attention to the availability of information from NAMMCO on species status, especially with reference to North Atlantic fin whales.

HUMPBACK WHALES

In 2004 the Scientific Committee was requested to continue its assessment of humpback whale stocks in the North Atlantic, assessing the long-term effects of annual removals of 0, 2, 5, 10 and 20 whales for West Greenland, and providing estimates of sustainable yield for other stocks. In all cases the management objective would be to maintain the stocks at a stable level. Last year the Committee decided to postpone the provision of advice for West Greenland until a new abundance estimate was available, and to delay the assessment in other areas until after the completion of the NASS-2007 survey.

The Committee reviewed abundance estimates from ship and aerial surveys conducted off West Greenland in September 2005 (see above). The estimate from the aerial survey of 1,246 (CV 0.56) was considered most reliable because the realized coverage of the ship-base survey was low and unevenly distributed within strata. This estimate is negatively biased, probably substantially so, as no corrections were applied for whales missed by observers or for whales submerged during the passage of the survey platform.

To provide conservative interim advice on the number of humpback whales that could be safely taken in West Greenland waters, the Committee decided to apply a replacement yield estimate of 2% to the lower confidence limit of 429, which provides an estimated sustainable annual removal of 8.6 whales. The replacement yield of 2% used in this calculation is appreciably lower than observed rates of increase in other areas of the North Atlantic. Therefore the Scientific Committee concluded that a removal (including by-catch) of up to 10 animals per year would not harm the stock in the short or medium term. This advice should be considered interim in nature, and should be revisited once the abundance estimate from the 2005 survey is revised and a new estimate from the planned 2007 survey is available. At that time enough data should be available to support a more formal modelling approach that would enable the Committee to address more specifically the request put to it by the Council.

NARWHAL

The Committee last provided advice on the status of narwhal stocks in West Greenland and Canada in 2005. Since then an aerial survey covering the index area for wintering belugas and narwhals off West Greenland was conducted in March and April 2006. Observations included 119 groups of beluga, 68 groups of narwhals, 36 groups of bowheads, 21 groups of walrus, 9 groups of polar bears, 25 ringed seals, and 111 groups of bearded seals. Abundance estimates for narwhal and beluga are expected in the spring 2007. A monitoring plan from 2007 to 2011 covering both wintering beluga and narwhals off West Greenland, as well as summering aggregations of narwhals in Northwest Greenland and East Greenland, and stock identification studies of all major aggregations of narwhal and beluga in Greenland has been developed by the Greenland Institute of Natural Resources (see Table 1). The execution of the full plan, however, is dependent on external funding from the Danish Ministry of Environment. The Committee welcomed and fully supported the research plan for narwhal, beluga and walrus in Greenland and recommended it be supported and implemented.

Considering that a new estimate from the March 2006 survey will be available early in 2007, in addition to possible new information from satellite tagging and other initiatives, the Committee considered that the Joint Working Group should meet to review the stock status of narwhal in late 2007. Alternatively the Working Group could wait until 2008 when the results of the summer 2007 survey become available.

In 2006 the Council requested the Committee to provide advice on the effects of human disturbance, including noise and shipping activities, on the distribution, behaviour and conservation status of belugas, particularly in West Greenland. It was noted that some information on this topic had been discussed at the last meeting of the JWG, in response to a request from the JCNB. The Committee referred this request to the joint NAMMCO/JCNB Working Group to address at their next meeting.

The Scientific Committee was informed that the narwhal quota for West Greenland will be 260 in 2006/7, plus 115 in Melville Bay, plus 10 to be distributed in the spring, if necessary. The Committee remained concerned that the narwhal quota had been increasing since it was introduced and that total removals have remained above the recommended level for West Greenland of 135. It advised that delay in implementing catch reductions to the recommended levels will result in delay in stock recovery and probably in lower available catches in the medium term. For Melville Bay, no specific recommendations on sustainable removals have been provided, but the Committee remained concerned that this may be a small stock, and that the quota of 115 might not be sustainable. It looked forward to the results of the planned 2007 survey in this area (see 7.10.3).

BELUGA

The new request referred to under narwhal applies also to beluga. The Committee referred this request to the joint NAMMCO/JCNB Working Group to address at their

next meeting.

The research plan presented under narwhal (Table 1) applies also to beluga, as does the response of the Committee to that plan.

Considering that a new estimate from the March 2006 survey will be available early in 2007, in addition to possible new information from other sources, the Committee considered that the Joint Working Group should meet to review the stock status of beluga most optimally in late 2007.

The Scientific Committee was informed that the beluga quota for West Greenland will be 140 for West Greenland plus 20 for Qaanaaq in 2006/7. The Committee commended Greenland for their management efforts to improve the conservation status of beluga in this area, and noted that the quota had been reduced since its introduction in 2004. Nevertheless the Committee remained concerned that the total removals were still above the recommended level for West Greenland of 100. Maintaining higher catches reduces the probability of halting the decline, and delay in implementing harvest reductions will increase the risk of continued stock decline.

KILLER WHALES

The Scientific Committee has had two requests for advice on killer whales: for a general assessment in 1993 (NAMMCO 1993), and another in 2004 with emphasis on killer whales in West Greenland and Eastern Canada (NAMMCO 2005). In both cases it was not possible for the Committee to complete the assessments because of a lack of information on stock structure, abundance and ecology in different areas. The situation for West Greenland is particularly difficult because killer whales appear to make only occasional forays into the area. In 2004 the Committee agreed to review new information on killer whales annually with the aim of completing the assessment once sufficient information becomes available for a particular area. The Committee provided several recommendations for research to address this lack of knowledge, including expansion of photo-identification studies and establishment of a central photo-ID catalogue, satellite telemetry, genetic sampling and sampling of all animals harvested in Greenland.

The Committee reviewed recent and planned research activities on killer whales in the North Atlantic. While noting that considerable progress will likely be made in the next few years, the Committee concluded that the information was still not sufficient to conduct an assessment in any area. The Committee will review progress under this item annually with the view of conducting an assessment when sufficient information becomes available.

PILOT WHALES

The Committee last considered this species in 1996, operating under a general request to provide an assessment and advice on the sustainability of Faroese catches. Many of the recommendations for research concerned improving surveys to obtain better

estimates of abundance, particularly by expanding spatial coverage and addressing inter-annual variability. Other recommendations included satellite telemetry to assess movements, and research on social structure, ecology and multi-species interactions. It was strongly recommended that a long-term research and population monitoring strategy be developed related to the Faroe Islands fishery, which should include both longer term monitoring which would help improve understanding of the status of the harvest animals, and short-term monitoring to detect more rapid changes as might occur.

The Committee was concerned that NASS conducted since 1987/89 had not provided comprehensive estimates of abundance for this species, mainly because of coverage, timing and technical issues. A major priority should therefore be to obtain a better estimate from the TNASS. The Committee was also concerned that the recommended monitoring programme had not been instituted in the Faroes, although some samples are collected from most *grinds* on an *ad hoc* basis. It was therefore recommended that such a programme be developed as soon as possible under the auspices of the Committee. The Committee noted that there had been no assessment of this species, which is harvested annually in the Faroes, since 1996.

WHITE-BEAKED, WHITE-SIDED AND BOTTLENOSE DOLPHINS

The Management Committee has asked the Scientific Committee to carry out assessments of these species, but to date insufficient information has been available on stock delineation, distribution, abundance and biological parameters to initiate the work. This year the Committee concluded that while some progress had been made on the identified research priorities, there was still insufficient information to warrant an assessment at this time. This may become feasible once feeding, genetic and life history studies have been completed in Iceland, the Faroes and Norway, and when new abundance estimates become available from the TNASS, CODA and other sightings surveys. Such an assessment could probably be conducted by 2008 at the earliest.

HARBOUR PORPOISE

The Committee last reviewed this species in 2000, using information provided by the International Harbour Porpoise Symposium, including presentations on genetics, satellite telemetry, demographic parameters, ecology, abundance and removals, many of which were compiled into the Volume 5 of NAMMCO Scientific Publications. The most important identified need is clearly for estimates of abundance from all areas other than that covered by SCANS-II. Records of recent directed catch are available from Greenland, but there is no reliable estimate of by-catch from Iceland or Norway, although it may be considerable in these areas. Both Iceland and Norway have recently taken steps to improve this situation.

The Committee commended the efforts of Norway to establish a monitoring system that will provide estimates of by-catch for this species, but noted that the situation with regard to the Icelandic system had not improved since it was reviewed by the

Committee in 2003. It also noted that the directed catch in Greenland was nearly 3,000 animals in 2004, and that this removal may not include struck and lost animals. In order to estimate the sustainability of the ongoing by-catch and directed catch in these areas, better estimates of the present removal levels of harbour porpoises in Iceland, Norway and Greenland as well as estimates of absolute abundance for all areas, are required. The Committee considered that formal stock assessments for this species were warranted for Greenland, Iceland and Norway, but that there was insufficient information on abundance in all areas and removals in Iceland and Norway to conduct assessments at this time.

NORTH ATLANTIC SIGHTINGS SURVEYS

Report of the Planning Committee for the Trans North Atlantic Sightings Survey (TNASS)

The Planning Committee has held two meetings in 2007, in March and in November. The meetings have included participation from Canada, the USA, the Faroes, Greenland, Iceland, the Russian Federation and Norway, plus representatives from the SCANS-II and CODA projects and the IWC. Reports from the meetings are presented in Annexes 4 and 5.

Survey coordination

It was agreed coordinated surveys greatly enhanced the value of each individual survey by allowing synoptic estimates to be produced, thus providing the best value in terms of information for money spent. Ideally this coordination should extend to survey timing, spatial contiguity, target species, field methodology and analyses.

With regard to survey timing the Committee agreed that all surveys should ideally occur in the same time period, and that this should be similar to previous surveys to maintain comparability in the time series. All previous NASS, except 1989, have been conducted in July. The preferred timing of the Greenlandic survey (August/September) was considered problematic, because the possible movements of whales between survey areas between July and September would make interpretation of the results difficult. September was preferred by Greenland because fog was generally less prevalent then than in July, and it was considered that the chances of a successful survey were much higher in September than in July. It was recognized that the national obligations of participants, in terms of maximizing the probability of obtaining a good abundance estimate for their area, played an important role in survey planning. Nevertheless the Committee recommended that participants make every effort to coordinate the timing of the surveys to the extent possible and that NAMMCO support this effort.

It was agreed that all jurisdictions, including the USA and the CODA survey, would cooperate fully in maximizing the spatial coverage of TNASS and in making the border of their survey areas contiguous. The Norwegian plan to survey the eastern Barents Sea in 2007 was considered problematic as this area is not contiguous with the remainder of the survey area. The Committee recognized that Norway has a survey programme in place that is based on providing optimal estimates of minke whale

abundance for use in the RMP, and that this is their first priority in scheduling surveys. Nevertheless the Committee recommended that Norway fully consider the added value that could be obtained by linking their survey directly with the TNASS, as it is a rare opportunity to obtain more extensive synoptic coverage linked to neighbouring areas in the North Atlantic.

Permission and funding have already been sought to place dedicated cetacean observers on the MAR-ECO (North Atlantic Ridge, one UK and one US vessel) and the Redfish surveys (area south and west of the Icelandic Area, one German and one Russian vessel). Permission will be sought to place observers on the Norwegian/Russian mackerel survey to be conducted in the Norwegian Sea in July 2007.

Survey area

The projected survey area is shown in Annex 5 Fig. 1.

Methods

The methodological problems encountered in previous surveys were reviewed both for aerial surveys and shipboard surveys. In addition the methodological advances from SCANS-II were reported, including the successful improvements made in obtaining more accurate event timing, sighting angles and distance estimates.

A Working Group was established for developing the optimal survey design for the survey as a whole and each specific block (incl. optimal block boundaries, effort distribution and track design). It was also agreed that a secondary fjord stratum could be developed for Icelandic waters to be surveyed on a pilot/opportunistic basis, primarily for harbour porpoises, without substantially compromising the efficiency of the survey for minke whales.

It was agreed that the primary searching mode for the shipboard survey should be the BT mode (double platform with tracking) with high powered binoculars for the tracking platform. The detailed protocol will be developed by a Working Group on shipboard protocols. To the extent possible the same methods will be used by observers on "opportunity" ships. Similarly a Working Group was designated for designing protocols for the aerial surveys. It was agreed that while data would be collected in such a way to enable a variety of analytical approaches to be used (*e.g.* cue counting, standard line transect), cue counting will be the primary method for obtaining abundance estimates for minke and fin whales. Special consideration was given on how to accommodate the coastal and cryptic harbour porpoise as a target species in the Icelandic and Greenlandic aerial surveys.

Funding

A summary of the budget is provided in Table 2, Annex 5. The total project cost will be approximately 34 million DKK, of which 48% was confirmed at the time of the meeting. Four proposals have been sent out in 2006 for funding different common sub-projects with answers expected from mid-December to mid-January; these are detailed in Annex 5. The requested funding is for survey coordination, planning and

analyses, placement of observers onboard "opportunity" vessels, and purchase and operation of equipment for acoustic survey on all vessels.

Future meetings

The next meeting should be held in March, after the subcommittees on design and protocol have completed their work (probably mostly email correspondence).

The Committee was very pleased to see that the planning for the TNASS was well underway. It was particularly encouraging that Canada, Greenland and the Russian Federation were full participants, and that the USA was willing to work so closely with the TNASS to coordinate their surveys with it. The cooperation of the CODA survey was also acknowledged.

BY-CATCH OF MARINE MAMMALS

In 2004 the Scientific Committee carried out an evaluation of the data collection and estimation procedures used in the Icelandic by-catch monitoring programme. This programme relies on self-reporting through logbooks, and does not cover all Icelandic fisheries. The Scientific Committee concluded that the estimates of by-catch from the system were likely negatively biased, because of poor coverage and possible under-reporting. The Committee made a number of recommendations to improve the estimation of by-catch in Icelandic fisheries and strongly recommended that other member countries establish by-catch reporting systems for their fisheries. The Committee was informed that there had been little improvement in the Icelandic monitoring system, and that it still does not cover all inshore fisheries, particularly the lumpfish fishery which may have a high by-catch of seals and other species.

In 2005 Norway began a monitoring programme for inshore fisheries for cod and anglerfish, details of which are provided in Annex 1, Section 8. The programme relies on "index fishermen" selected and contracted to observe and report detailed statistics on effort, catch and by-catches.

There has been no progress in estimating by-catch in Greenlandic and Faroese fisheries, although by-catch in the Faroes is likely low due to the absence of a gill net fishery in shallow waters.

The Committee noted and commended the progress that had been made in instituting a programme for estimating by-catch in Norway, particularly in inshore fisheries. However there has been little progress in improving the systems in other areas. Noting that by-catch may constitute an appreciable proportion of the total removals of coastal seals, harbour porpoises and dolphins in some areas, the Committee strongly recommended that all member countries establish by-catch monitoring systems for their fisheries.

PUBLICATIONS

Vol. 6 of NAMMCO Scientific Publications, *Grey Seals in the North Atlantic and the Baltic*, is nearly complete, and will be published early in 2007. It will contain 17 primary papers in addition to the Introduction and Preface. Progress has been slower on Volume 7 on the North Atlantic Sightings Surveys, but it is likely that the volume will be published in 2007, and contain as many as 19 papers.

The recent Working Group on Harbour Seals was positive to the idea of publishing a volume with the central theme of the status of harbour seals in the North Atlantic. A total of 28 working papers were presented at the meeting, so it is likely that there is ample material for a volume. The volume likely could not be published before 2008.The Committee recommended that the proposed volume on harbour seals be supported.

FUTURE WORK PLANS

It was decided that the next meeting will be held in Greenland in early October, at a place to be decided.

The following working groups will hold meetings during 2007/8:

- TNASS Planning Group, March 2007
- TNASS Planning Group (post survey), October 2007
- Beluga/Narwhal, late 2007 or 2008
- Walrus Working Group, 2008
- Marine Mammal-Fisheries Interactions, possibly 2008 depending on progress
- Dolphins, 2008 depending on progress
- Grey Seals, 2008.

Other meetings may be held depending on requests received from the Council.

OTHER BUSINESS

The Scientific Committee expressed its sadness on the pending departure of Daniel Pike from his position as Scientific Secretary, noting that he had contributed substantially to the work of the Committee over the last 8 years.

REPORT OF THE FOURTEENTH MEETING OF THE NAMMCO SCIENTIFIC COMMITTEE

1. CHAIRMAN'S WELCOME AND OPENING REMARKS

Chairperson Geneviève Desportes welcomed the members of the Scientific Committee to their 14th meeting (see Section 6.1), held at Reykjavik, Iceland, 21-23 November 2006. She especially welcomed Erik Born (Greenland) as a new member of the Committee. She also welcomed the Observers from Canada, Lei Harris and Jack Lawson, and the Observer from the Russian Federation, Vladimir Zabavnikov. Aqqalu Rosing-Asvid (Greenland) was unable to attend the meeting due to acute transport difficulties.

This year, for the first time, the Committee conducted a full review of previous requests for stock assessments and other advice put to it by the Council, paying particular attention to recommendations for research required to provide better advice. The purpose of this review was to determine whether assessments made in the past were still valid, to identify past requests for which the Committee could now provide better advice, and to identify areas of research that had not yet been fully addressed. It was hoped that the Council could use this review to frame future requests for advice.

2. ADOPTION OF AGENDA

The Draft Agenda (Appendix 1) was adopted with minor changes. The order of species dealt with under Item 7 has been changed to deal first with all seals, then with all whales, to reflect the formation of a separate Seal Management Committee within NAMMCO.

3. APPOINTMENT OF RAPPORTEUR

Daniel Pike, Scientific Secretary of NAMMCO, was appointed as Rapporteur for the meeting, with the help of other members as needed.

4. REVIEW OF AVAILABLE DOCUMENTS AND REPORTS

4.1 National Progress Reports

National Progress Reports for 2005 from the Faroes, Greenland, Iceland, and Norway were presented to the Committee. In addition the Scientific Committee was pleased to receive progress reports from Canada and the Russian Federation. The Progress Reports are discussed further under item 14.

4.2 Working Group Reports and other documents

Working Group Reports and other documents available to the meeting are listed in Appendix 2.

5. COOPERATION WITH OTHER ORGANISATIONS

5.1 IWC

The 58th meeting of the Scientific Committee of the International Whaling Commission was held in St Kitts from 26 May to 6 June 2006. Daniel Pike attended as observer for the NAMMCO Scientific Committee.

In March 2006, work was continued on the Pre-Implementation Assessment (PIA) of North Atlantic fin whales through a joint workshop with the NAMMCO Scientific Committee (See Annex 2). The IWC-Scientific Committee (IWC-SC) endorsed the conclusions and recommendations from the Joint Workshop and agreed that all future materials pertaining to the assessment of fin whales in the North Atlantic would be exchanged between the Committees. In the period since the Joint Workshop some new genetic analyses were completed, which generally suggested some stock differences between feeding areas, but also a high degree of mixing. The IWC-SC found no reason to modify any of the existing stock hypotheses identified at the Joint Workshop, or to suggest new ones.

The IWC-SC accepted that the fin whale abundance estimates from NASS and Norwegian surveys were of sufficient quality for use in assessments. It will be necessary to develop alternate catch series to encompass the range of uncertainty in catches. The Committee also reviewed a new compilation of biological parameters and agreed that the available information was sufficient for implementation.

The IWC-SC concluded that the PIA had been completed and that a full Implementation Assessment (IA) could begin this year. However it was decided to delay initiation of the IA until after the 2007 meeting, as completion of the North Pacific Brydes whale IA had first priority.

The IWC-SC reviewed results from two surveys carried out off West Greenland in September 2005 (See 7.7.2). The IWC-SC could not accept the results of the ship survey, mainly because of the low realized effort in important minke and fin whale habitat, resulting from unsuitable weather conditions. However the IWC-SC accepted the preliminary abundance estimates from the aerial survey for minke and fin whales, while noting that the latter is likely negatively biased as it was not corrected for diving animals. Both of these estimates are believed to represent only parts of the stocks that are exploited. The IWC-SC also reviewed new assessment models for West Greenland minke and fin whales, and agreed that these would be revised and considered again in 2007. For the first time, the IWC-SC was able to provide *ad hoc* management advice for these two species based on the new abundance estimates and other information. The range of advice provided included current harvest levels. It is expected that firmer advice may be provided next year.

New information on Eastern Arctic bowheads, from satellite tagging, genetics and surveys, was presented. Results from satellite telemetry and some genetic analyses suggest that there is only one stock summering in the Canadian Eastern Arctic, not two as previously thought. Some of these animals occur off West Greenland in the Spring.

An abundance estimate from surveys carried out between 2002 and 2004 was 7,309 (95% CI 3,161-16,900); this included only part of the summer range and is therefore partial. This is far higher (*ca*. 10x) than previous estimates for this stock. Some technical issues with the survey estimate were identified, among them the fact that the entire estimate is based on only 17 primary sightings.

A document detailing plans for the Trans North Atlantic Sightings Survey (TNASS) in 2007 was presented, and the IWC-SC endorsed the survey. Phil Hammond and Greg Donovan were designated to provide IWC oversight in the planning process.

Norway provided some background and simulation testing of changes to the Catch Limit Algorithm (CLA) it first proposed in 2004. The main changes proposed are that the MSYR should refer to the 1+ component of the population instead of the mature component, and that simulations should be run for 300 years, by which time the population has equilibrated, rather than 100 years as in the past. The IWC-SC adopted the set of requirements for simulation trials to be conducted to evaluate proposed amendments to the CLA. In addition it decided to conduct a review of MSY rates for baleen whales at the next annual meeting, using published and unpublished information.

The IWC-SC held a 2 day pre-meeting on the potential and demonstrated effects of noise due to seismic surveys on cetaceans. The meeting discussed *inter alia* potential impacts of seismic activities, distribution of activities and their overlap with cetaceans, and potential mitigation measures.

The IWC Subcommittee on Small Cetaceans will carry out a review of the population structure, systematics and status of killer whales at the 2007 meeting.

The IWC-SC was invited to nominate experts for consideration by FAO for invitation to an FAO Expert Consultation on modelling ecosystem interactions for informing an ecosystem approach to fisheries.

Discussion

The Committee thanked Pike for his report. Noting their extensive work on marine mammal – fishery interactions, the Committee considered that they could contribute to the FAO Expert Consultation described above, if invited. The Secretariat will raise this matter with the FAO.

5.2 ASCOBANS

Daniel Pike attended the 13th meeting of the ASCOBANS Advisory Committee (AC) as the observer for NAMMCO.

The second Small Cetaceans in the European Atlantic and North Sea survey (SCANS-II) was conducted in summer 2006, and preliminary results were presented to the Committee AC. Pike presented a briefing on plans for the Trans North Atlantic Sightings Survey (see 8.2) and requested a statement of support from the AC, noting that this might help in obtaining external funding for the project. The AC declined to give such a statement of support. No reason for this was provided.

A draft recovery plan for harbour porpoises in the North Sea was presented to the AC in 2005 and several changes in structure and content were recommended. A new draft was presented this year, and will form the basis of a final plan to be recommended for acceptance by ASCOBANS. The title was changed to "Conservation Plan" as there is no firm evidence that North Sea porpoises are in fact depleted. The main objective of the plan will be to restore and/or maintain populations at 80% or more of the carrying capacity. To this end the Plan includes recommendations for the reduction of by-catch, and reduction of the impacts of other activities such as shipping, hydrocarbon exploration and construction.

France and Lithuania have now acceded to the ASCOBANS agreement. The agreement establishing ASCOBANS has been amended to cover a larger area, extending west to 15 degrees W and south to 36 degrees north, but not including the area around the Faroes. It is hoped that the amendment will be ratified this year. The AC also considered the implications of extending the ASCOBANS agreement to include all cetaceans, not just toothed whales other than sperm whales as at present. Advisory documents provided on this subject suggested that this could have conservation benefits, was compatible with relevant international law and need not result in jurisdictional problems. Nevertheless there was concern among the parties that extension would dilute ASCOBANS' focus on small cetaceans and overburden the organisation. The AC agreed to consider this issue further at their next meeting.

ASCOBANS will host a workshop in Bonn, Germany at a time to be announced, on genetic stock delineation of small cetaceans. The first day of the 3-day workshop will focus on harbour porpoises in the Baltic Sea, while the remainder will focus on small cetaceans in the rest of the ASCOBANS area.

NAMMCO was the only organisation that provided an opening statement to the meeting. The AC was made aware of the dates of relevant upcoming NAMMCO meetings, but decided that they would not send observers to these meetings but would request reports. The next meeting of the AC will be in 2007 at a date and place yet to be determined.

Discussion

The Committee found it unfortunate that the AC of ASCOBANS had declined to support the TNASS, as it is obviously in the interests of any organisation dealing with the conservation and management of cetaceans to obtain reliable estimates of abundance. It also noted that the TNASS will be coordinated closely with the CODA survey and will provide information on distribution and abundance for stocks that are within the mandate of ASCOBANS.

5.3 ICES

Tore Haug reported on the activities of ICES in 2006. The ICES Working Group on Marine Mammal Ecology (WGMME) met in January 2006 to review any new information on population sizes, by-catches and mitigation measures for fisheries that have a significant impact on small cetaceans and other marine mammals. Additionally, so far as it was possible, the working group summarized the planned observations to

meet requirements of EU Regulation 812/2004 (implementation of onboard monitoring schemes and observers to monitor and estimate the scale of by-catch of marine mammals in certain fisheries) by ICES area member states for 2006. The working group also reviewed the information on the diets of marine mammals in the ICES area and provided an overview of the difficulties and methods in studying diet. For 10 defined regions of the Northeast Atlantic and the Mediterranean, the 4-6 most important species in terms of biomass and the available information on their diets were summarized. Furthermore, planning for a workshop on environmental quality and marine mammal health continued. The workshop should address the biological effects at the level of the individual, explore the subsequent impacts at the population and community levels, and finally elaborate on the relevance for integrated chemical-biological assessment of ecosystem health and implications for management.

The Joint ICES/NAFO Working Group of Harp and Hooded Seals (WGHARP) met in June 2006 to consider recent research and to provide catch advice on the North Atlantic stocks of hooded seals (see 7.2.1).

The 2006 ICES Annual Science Conference (ASC) was held in Maastricht, The Netherlands in September 2006. Several ICES committees (*e.g.* Living Resource and Marine Habitat) deal with marine mammal issues. Thus, both present and future theme sessions at the ASC are designed with marine mammals included as an integral part. At the 2006 ASC, one theme session was devoted particularly to marine mammals: Theme session L ("Marine Mammals, Seabirds, and Fisheries: Ecosystem Effects and Advice Provision"), where 13 oral presentations and 3 posters addressed issues such as distribution, abundance, reproduction, prey consumption and trophic interactions, interactions with fisheries, by-catches and strandings of seals and whales. Preliminary results from the SCANS II survey (July 2005) were presented.

Upcoming theme sessions, relevant to marine mammal issues, intended for the ASC in 2007 in Helsinki, Finland, in 2008 in Halifax, Canada, or later, include, but may not be restricted to: "Stock Identification – Applications for Aquaculture and Fisheries Management" (2007), "The Role of Sea Ice in Polar Ecosystems" (2008), "The Life History, Dynamics and Exploitation of Living Marine Resources: Advances in Knowledge and Methodology" (2008), "Mitigation of Seal-Induced Catch and Gear Damages" (2008 or later) and "Impact of Antropogenic Noise on Marine Organisms" (2008 or later).

Lockyer informed the Committee that discussions are still ongoing on developing a Memorandum of Understanding covering cooperation on scientific matters of mutual concern with ICES. In addition NAMMCO has requested formal partnership in the ICES-NAFO Working Group on Harp and Hooded Seals. This request has been refused by NAFO and deferred by ICES.

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

The tenth meeting of the Canada/Greenland Joint Commission on the Conservation and Management of Narwhal and Beluga (JCNB) was held in Iqaluit, Nunavut,

Canada in April 2006. Unfortunately no observer from NAMMCO was invited to the meeting, and no Report was available to the Committee.

6. ROLE OF MARINE MAMMALS IN THE MARINE ECOSYSTEM

6.1 Working Group on Marine Mammal – Fisheries Interactions

6.1.1 Report on the Bergen Conference on Implementing the Ecosystem Approach to Fisheries

This 3-day conference, sponsored by the Norwegian Ministry of Fisheries and Coastal Affairs in collaboration with FAO, Nordic Council of Ministers, Norwegian Fisheries Directorate and the Institute for Marine Research in Bergen, was attended by NAMMCO Secretariat staff. The conference comprised 5 sessions addressing the following topics: The ecosystem approach: concepts and strategies; The knowledge base for an ecosystem approach; Approaches and tools for managing fisheries as part of the ecosystem approach; Experiences from case studies; Implementing the ecosystem approach to fisheries: the way forward. Chairs of each session were well-known experts in the field, and each session attracted several oral presentations. In addition there were also several posters on display, as well as other information from organisations and projects – including NAMMCO.

The outcome from the conference did not produce anything especially new or innovative, and many definitions of what EAF means were produced and reiterated. However, there was positive evidence of increasing awareness globally about the importance of considering the overall ecosystem in management decisions concerning utilisation and conservation, including many recent projects that have started up in developing countries. Information was presented worldwide and it became clear that regional cooperation was important for many countries with shared waters and resources. The range of focus was extremely broad, encompassing not only the spatial extent of management in the oceans but also the water column from surface to seabed. The importance of maintaining biodiversity with a healthy seabed fauna was discussed, and marine mammals were frequently referred to and included in ecosystem management plans.

One of the main conclusions was that globally, nations are getting started on implementing EAF, and even with inadequacies of poor data, and knowledge generally, there is a definite move forward. Iceland and Norway contributed much to the progress in this field. The underlying message seemed to be that even single species management was acceptable if implemented with reference to and in the context of the ecosystem. Monitoring is important, and also having clear management goals and objectives, and good regional cooperation, and commitment to EAF requires at least a decadal scale. More information can be downloaded at the website: http://cieaf.imr.no/presentations.

6.1.2 Update on progress since the last Working Group meeting in October 2004

In 2004 the Committee tasked Walløe with reporting progress in these areas at future meetings, with the goal of holding a Working Group meeting to finalize models for

the Barents Sea and assess models for other areas, if progress on the identified research and modelling priorities has been sufficient to warrant such a meeting. Last year the Committee tentatively decided to hold a meeting of the Working Group on Marine Mammal – Fisheries Interactions in 2007, depending on progress in modelling for the Barents Sea and Iceland. Specifically, the Committee recommended in 2004 that the "Scenario C" model be finished and its properties thoroughly tested. The Committee also recommended that the GADGET platform be developed as a model capable of simulating management scenarios, and that the template models including marine mammals be developed as soon as possible.

Walløe informed the Committee that little progress had been made in modelling efforts for either area. In Norway, work on the "Scenario C" model for the Barents Sea was initially unsuccessful in that model predictions were implausible, and has now ceased due to lack of funding. There has been some progress in modelling capelin-harp seal interactions, but data on harp seal diet is dated and lacking for important parts of the year (see 6.2). For Iceland, one of the main objectives of the Icelandic Research Programme was to provide information on the diet and consumption of minke whales in the area. It is now expected that sampling will be completed in 2007, not 2004 as planned originally. There has been little progress on incorporating marine mammal consumption in "GADGET" models for the area. Víkingsson noted that there were plans to resume this work in 2008.

6.1.3 Future work

Once again the Scientific Committee was forced to conclude that it could not provide the requested advice on 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. Working groups established by the Scientific Committee have met on five occasions to deal with this and related requests. As in the past, the Scientific Committee emphasized that progress in this area will not be made unless significant additional resources are dedicated to it. Specifically the Committee recommended that work on the "Scenario C" model be resumed in Norway, and that Iceland should continue efforts to incorporate marine mammal consumption in GADGET models for the area. Given the lack of progress, the Committee considered that it would be premature to hold a Working Group meeting in 2007, and recommended that it be postponed to 2008 at the earliest. Walløe will continue to monitor progress in this area.

6.2 Other matters

Feeding ecology of harp and hooded seals

Hooded seal diet

The feeding habits of hooded seals throughout their distributional range of the Nordic Seas (Iceland, Norwegian, Greenland Seas) were studied in 1999-2003. The project pays special attention to the period July-February (*i.e.*, between moulting and breeding), which is known to be the most intensive feeding period for hooded seals. Seals were collected for scientific purposes on expeditions conducted in the pack ice belt east of Greenland in September/October 1999, 2002 and 2003 (autumn), July/August in 2000 (summer), and February/March in 2001 and 2002 (winter).

Results from analyses of stomach and intestinal contents revealed that the diet comprised relatively few prey taxa. The squid *Gonatus fabricii* and polar cod *Boreogadus saida* were particularly important, whereas capelin *Mallotus villosus*, and sand eels *Ammodytes spp* contributed more occasionally. *G. fabricii* was the most important food item in autumn and winter, whereas the observed summer diet was more characterized by polar cod, however with important contribution also from *G. fabricii* and sand eels. The latter was observed on the hooded seal menu only during the summer period, while polar cod which contributed importantly also during the autumn survey, was almost absent from the winter samples. During the latter survey, capelin also contributed to the hooded seal diet. Samples obtained in more coastal waters indicated a varied, fish-based (polar cod, redfish *Sebastes* sp., Greenland halibut *Reinhardtius hippoglossoides*) diet.

Harp seal diet

In 2001 and 2002, Norwegian and Russian scientists performed an aerial survey to assess whether there was an overlap in distribution, and thus potential predation, between harp seals and capelin in the Barents Sea. This experiment is now being followed with boat-based surveys aimed to study pelagic feeding by harp seals in the Barents Sea during summer and autumn. In May/June 2004, in June/July 2005, and in May/June 2006, Norwegian surveys were conducted, designed to study the feeding habits of harp seals occurring in the open waters of the Barents Sea. Very few seals were observed along the coast of Finnmark, and no seals were seen in the open, ice-free areas. In the northwestern parts of the Barents Sea, however, very large numbers of seals were observed along the ice edge and 20-30 nautical miles south of this. In these areas, 33, 55 and 57 harp seals were shot and sampled (stomachs, intestines, blubber cores) in 2004, 2005 and 2006, respectively. Additionally, samples of faeces were taken from the haul out sites on the ice. Preliminary results from the analyses indicate that the summer consumption to a large extent was dominated by krill, whereas polar cod also contributed importantly. All samplings were performed in a period with low capelin abundance – this may have influenced the results.

Both Norway and Russia have expressed concerns over the current size of the Northeast Atlantic harp seal populations and their predation on fish stocks, in particular in the Barents Sea. Previous calculations indicated that the Barents Sea / White Sea population of harp seals consume approximately 3.5 million tonnes of biomass per year, and the species is, with the exception of cod, the most important top predator in the Barents Sea. To be able to assess the ecological role of harp seals by estimation of the relative contribution of various prey items to their total food consumption in the Barents Sea, more knowledge of both the spatial distribution of the seals over time, and their food choice in areas identified as hot-spot feeding areas, is urgently needed. At the last meeting of the Joint Norwegian Russian Fisheries Commission in Tromsø in November 2006, it was discussed how such knowledge could be obtained most conveniently. The two parties concluded that a Joint Norwegian-Russian Research Programme on Harp Seal Ecology should be initiated. It was decided that the main goals of this programme should be to:

- assess the spatial distribution of harp seals throughout the year (including satellite telemetry);

- assess and quantify overlap between harp seals and potential prey organisms on
- hot-spot feeding grounds (use of data from relevant Norwegian and Russian ecosystem surveys and Russian aerial surveys);
- identify relative composition of harp seal diets in areas and periods of particular intensive feeding (sampling of seals for diet studies in dedicated surveys to selected hot-spot feeding areas);
- secure the availability of data necessary for estimation of population size of harp seals (pup production, natality/mortality, catch history);
- estimate the total consumption by harp seals in the Barents Sea (modelling);
- implement harp seal predation in assessment models for other relevant resources (modelling).

Discussion

The Scientific Committee fully supported the research programme, and noted that it will be crucial to its success to obtain samples from the Eastern Barents Sea in Russian waters. The Committee therefore recommended that the Russian Federation participate fully in this programme with Norway.

Age validation workshop

Lockyer presented information on a 5-day workshop on age validation in harp and grey seals that was held at the Institute of Marine Research in Bergen in November 2006. Funding for the workshop was provided by the Norwegian Council of Ministers for 15 participants, and the NAMMCO General Secretary was involved in the organising committee for the workshop. Eighteen participants attended in total from Canada, Denmark, Faroes, Finland, Greenland, Iceland, Netherlands, Russian Federation and Sweden.

The purpose was to gather all workers handling age determination of these two seal species and standardize age methods in all aspects. This was done with reference to blind reading experiments on digital images of a sample of 104 images from 102 known-age harp seals from Canada, Russia and Norway, and 96 images from 78 known-age grey seals from Sweden, Norway and Canada; all age groups and both sexes were included. This work was done before the start of the workshop. Subsequent analyses highlighted problems in growth layer group interpretation and biases, as well as reader expertise. Complete guidelines for collection, handling, preparation and storage of tooth samples were developed for both species during the workshop. Methods of age reading were also detailed in guidelines with tooth examples marked up for age as illustrations.

The final outcome of the meeting will be a report and manual for age reading of the two species with a list of recommendations for improvements in age techniques. The first report of the workshop will be available before the end of 2006 and a publication will come out later during 2007. There is a plan to make a presentation at an international conference during 2007.

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

7.1 Harp seals

7.1.1 Report of the ICES/NAFO Working Group (June 2006)

The Working Group did not deal with harp seals in 2006.

7.1.2 Update on progress

In 2005 the Management Committee recommended that the Scientific Committee evaluate how a projected decrease in the total population of Northwest Atlantic harp seals might affect the proportion of animals summering in Greenland. In addition the Management Committee requested the Scientific Committee to specify harvest levels for two (*i.e*. Barents/White Sea and Greenland Sea) harp seal stocks that would result in a population reduction of 20% over a period of 20 years. In 2006, Greenland specifically stressed the importance of these outstanding requests, and indicated that they would expect a more complete discussion by the Scientific Committee at this meeting.

Haug presented SC/14/23 which addressed the latter issue. The total estimated size of the Greenland Sea stock in 2005 was 724,100 (point estimate, 618,000 adults and 106,100 pups). The requested population in 2026 (80% of the 2005 level) would then be 579,280. With the present proportion of 25.6% adults and 74.4% pups in the catches, the requested stock size would be obtained with an annual quota of 42,036 pups and 14,464 adults. If one 1+ animal is balanced by 2 pups (as in the current management regime), the total quota would be either 35,482 1+ animals or 70,964 pups per year. The uncertainty in the prediction is very large – the 95% confidence interval for the resulting 2026 population of 1+ animals is (0 – 1,264,688).

The Barents Sea / White Sea stock was estimated at a 2005 level of 2,425,900 (point estimate, 2,065,000 adults and 360,900 pups). Requested population in 2026 (80% of the 2005 level) would then be 1,940,720. With a proportion of 11.5% adults and 88.5% pups in the catches, the requested stock size would be obtained with an annual quota of 185,850 pups and 24,150 adults. If one 1+ animal is balanced by 2.5 pups (as in the current management regime), the total quota would be either 98,490 1+ animals or 246,225 pups per year. The uncertainty in the predictions is again very large – the 95% confidence interval for the resulting 2026 population of 1+ animals is (0 – 3 785 780).

The very large uncertainties associated with the 20 year predictions indicate the restricted potential of the population model, with its current population estimates, for long term predictions of the seal abundance under various harvest scenarios.

Discussion

The Committee supported the conclusions of SC/14/23 with regard to removal levels that would result in the specified level of population reduction over 20 years. However it was noted that the predictions of population size at the end of this period were so imprecise that such a harvest programme should not be considered without a careful monitoring programme, involving surveys at intervals of 5 years or less.

7.1.3 New requests and future work

With regard to the question of how a projected decrease in the total population of Northwest Atlantic harp seals might affect the proportion of animals summering in Greenland, the Scientific Committee noted that it had recommended that this question be referred to the ICES-NAFO Working Group. However the group only dealt with hooded seals in 2006.

In order to predict the number of animals that would summer in West Greenland under conditions of reduced population abundance, detailed information on the migratory patterns of different age and sex classes of harp seals would be required. Satellite tagging that might provide this information has been conducted by Canada, but this information (Stenson and Sjare MS 1997) was not reviewed by the Committee at this meeting. The most recent survey conducted in 2004 suggests that the abundance of Northwest Atlantic harp seals may be stabilizing after a period of rapid increase. It might therefore be expected that the numbers summering off West Greenland would also stabilize. However the proportion of animals migrating to Greenland may not be constant and may change in response to environmental conditions. In addition the age structure of the population will change as it stabilizes, and this may also affect the numbers summering in Greenland. Once again, detailed information on harp seal migratory patterns will be required to assess this. The Scientific Committee again recommended that the ICES-NAFO Working Group be asked to address this request and recommended that Greenland forward this request to ICES. If that is not possible, the Committee will have to organise a special working group, with active participation by Canada, to address the issue.

7.2 Hooded seals

7.2.1 Report of the ICES/NAFO Working Group (June 2006)

WGHARP met in June 2006, and their report was available to the Committee as SC/14/9.

Greenland Sea stock status

Results from a pup survey conducted in 2005 suggested that current pup production (15,200 pups, CV = 0.25) was lower than observed in a comparable 1997 survey (23,800 pups, CV = 0.19). Model explorations indicated a decrease in population abundance from the late 1940s and up to the early 1980s. In the most recent two decades, the stock appears to have stabilized at a low level which may be only 10-15% of the level observed 60 years ago. The modelling exercises included the two pup estimates as well as available information about age at maturity and estimates of natural mortality and natality. Based on these inputs the model estimated the following 2006 abundance for Greenland Sea hooded seals: 71,400 (95% C.I. 38,400-104,400) 1+ animals with a pup production of 16,900 (95% C.I. 10,200-23,600).

The Greenland Sea stock of hooded seals is still regarded as “data poor”. For this reason WGHARP has used the concept of the Potential Biological Removal level (PBR) to calculate catch limits. The PBR approach identifies the maximum allowable removals that will ensure that the risk of the population falling below a certain lower limit is only 5% and that would allow a stock that dropped below this limit to recover. Using the PBR approach, the catch limit was calculated as 2,189 animals. However,

WGHARP concluded that even harvesting at the PBR level could result in a continued stock decline or a lack of recovery. WGHARP, therefore, concluded that harvesting should not be permitted with the exception of catches for scientific purposes from 2007 on.

Catches in the Greenland Sea

It was not until after 1920 that a substantial increase occurred in the Greenland Sea hooded seal hunt with average annual catches ranging between 40,000 and 50,000. After a 5 year pause in the sealing operations during World War II, total annual catches quickly rose to a postwar average level of 50,000 to 60,000 in the early 1950s. It was evident that these catch levels were higher than the stock could sustain, and some regulatory measures (mainly to reduce effort) were taken in 1958 (Rasmussen 1957, 1960, Øritsland 1959). The total annual catches have subsequently followed a decreasing trend, primarily due to reduction in effort. The number of operating Norwegian vessels decreased from more than 40 in the 1950s, 10-20 in the 1970s, to a present level of 2-4 ships – Russian effort included 4-6 vessels from 1958 to 1966, and 1-3 vessels in 1975-1994 (ICES 2006). Quotas were imposed in 1971. Average annual catches in the early 1960s were approximately 47,000 individuals, whereas in the early 1980s the level had sunk to *ca*. 8,000 seals. In the past 25 years, the average annual catch level has remained less than 5,000 animals (almost exclusively pups), which is considerably lower than the TACs given for the period (ICES 2006).

Annual removals by Greenland hunters in southeast Greenland (the Denmark Strait and therefore most probably animals from the Northwest Atlantic stock) in the same period varied between 880 and 3,800 individuals, whereas their assumed removals from the Northeast Atlantic stock were between 3 and 67 animals per year (ICES 2006).

Stock identity

A Canadian-Norwegian genetic study has been conducted of the two putative populations of hooded seals in the North Atlantic. Microsatellite profiling of 300 individuals using 13 loci and mitochondrial DNA sequencing of the control region of 78 individuals was carried out to test for genetic differentiation between the four breeding herds (three in the Northwest, one in the Greenland Sea). No significant genetic differences were found between breeding areas, nor was there evidence for cryptic or higher level genetic structure in this species. The Greenland Sea breeding herd was genetically most distant from the Northwest Atlantic breeding areas; however the differences were statistically non-significant. These data, therefore, suggest that the world's hooded seals comprise a single, panmictic genetic population.

Biological parameters

Historical Norwegian and Russian data which describe the trends in fertility rate and maturity at average age (MAM) for hooded seals in the Greenland Sea have recently been subjected to joint Russian-Norwegian analyses. Age at maturity was determined by fitting Richards' curves to age specific proportions of mature females in scientific samples taken by Russian scientists in the Greenland Sea pack ice in May-June in the years 1990-94. Samples from the Denmark Strait (1956-60) and South Greenland

(1970-71) previously analyzed by the back calculation method were also included in the present analyses. Although there were annual differences in MAM among the Greenland Sea samples a common MAM of 4.8 years could be fit to all years. Similarly, a common MAM of 3.1 year could be fit to the two Northwest Atlantic samples. This represents a temporal and a stock specific split in the sample and it cannot be concluded which factor is more important. Ovulation rates of mature females ranged from 0.68 in May 1990 to 0.99 in June 1991 and 1992, but the average ovulation rate of 0.88 was similar to previous estimates for Northwest Atlantic hooded seals. For breeding and moulting patch samples taken in the period 1986-1990, indirect measures of pregnancy rates derived from patterns of alternation in corpora formation between ovaries ranged from 0.74 to 0.97 and were significantly lower in 1987 and 1988 than in all other samples including the older data for the Northwest Atlantic stock ranging from 0.94 to 0.97.

NW Atlantic pup production

Surveys of all three whelping areas in the Northwest Atlantic were also carried out in 2005. Pup production at the Front was estimated to be 107,013 (CV = 7.1%) while 6,620 (CV = 25.8%) pups were estimated to have been born in the Gulf and 3,346 (CV = 66.8%) in Davis Strait. Total pup production in the northwest Atlantic was 116,900 (CV = 6.8%). Comparison with previous estimates suggests that pup production may have increased since the mid 1980s. However, any understanding of changes in abundance is hampered by a lack of understanding of the relationship among whelping areas.

Discussion by the Scientific Committee

The Scientific Committee supported the conclusions of WGHARP with regard to the status of the two hooded seal stocks. However there was some discussion of the conclusion by WGHARP that harvesting of the Greenland Sea population of hooded seals should not be permitted with the exception of catches for scientific purposes from 2007 on. In this regard it was noted that the present population is estimated at 71,400 with a lower 95% confidence limit of 38,400, and that the stock is thought to have declined to levels which may be only 10-15% of the level observed 60 years ago. However it is clear that the low levels of recent harvests cannot have been the sole reason for this apparent decline. Recent harvests in East Greenland (Scoresbysund) are very low, and continuation of harvests at these levels will not appreciably affect the status of the stock. The Committee therefore recommended that catches in the Greenland Sea be restricted to necessary scientific catches and to satisfy local needs at roughly current levels. This should be accompanied by a careful monitoring programme as recommended by the Working Group. It was also recommended that biological samples for determination of vital parameters be collected from the Greenlandic hunt in Ittoqqotoormiit. It was noted also that a new abundance survey will be carried out in 2007, after which this recommendation can be revisited.

7.2.3 Future work

Estimation of harp and hooded seal pup production in the Greenland Sea

Last time harp and hooded seal pup productions were assessed in the Greenland Sea was in 2002 and 2005, respectively. Since abundance estimates of hunted seal stocks

should be obtained no less than every 5 years, the plan was to conduct surveys to obtain data necessary for estimation of the abundance of harp seals of the Greenland Sea stock in 2007. However, the low pup production estimate obtained for hooded seals in the area in 2005 caused WGHARP to recommend that a new hooded seal survey be carried out already in 2007. This will be done and, if possible, a new abundance estimate for harp seals in the area will be obtained during the same survey. Alternatively, a new harp seal survey will be conducted in 2008.

Satellite telemetry

The International IPY programme *Marine Mammal Exploration of the Oceans Pole to Pole* (MEOP), lead by Norway, will deploy state-of-the-art animal-borne CTD tags on strategically chosen, deep-diving marine mammal species to explore their movement patterns, behaviour and habitat utilization in Polar Regions. Concomitant with the sampling of ecological data sets on these top predators, the animals will themselves (via the equipment they carry) collect a vast, high-precision oceanographic data set from logistically difficult areas of ocean in Polar Seas at the fringes of the North and South Atlantic that are strategically important to climate and ocean modelling. Co-operation between other science programmes within IPY will provide MEOP with comprehensive, synoptic oceanographic coverage that will allow us to quantify factors determining habitat selection by key polar marine mammal species in a manner never before possible. MEOP Norway will perform deployments on the deepest diving pinniped species in the Arctic and the Antarctic - hooded seals in the north (West Ice) and southern elephant seals in the south (Bouvet Island). The other nine nations in the MEOP consortium will deploy CTD tags on these species in other areas, as well as deployments on harp seals in the Arctic and crabeater and Weddell seals in the Antarctic.

Collection of biological material from the commercial hunt and dedicated surveys

Biological material, to establish age distributions in catches as well as health, reproductive and nutritive status of the animals, will be collected from commercial catches both in the southeastern Barents Sea and in the Greenland Sea in the future. In 2007, sampling will be performed from commercial vessels in the southeastern Barents Sea and in the Greenland Sea. In the latter area, samples will also be obtained from seals sampled for scientific purposes in a dedicated research cruise in July.

Studies of the ecology of harp and hooded seal pups in the Barents Sea and Greenland Sea will be continued as well. The long term aim of these investigations is to get a better understanding of the underlying mechanisms determining the recruitment success from year to year for the two species. Sampling is performed on commercial vessels – next effort will be in the southeastern Barents Sea and in the Greenland Sea in 2007.

7.3 Ringed seal

7.3.1 Update on progress since the last Working Group meeting in February 1996

The main two recommendations from the last Working Group held on this species (NAMMCO 1998) were 1) that better information on catch, effort, reporting

bias and struck and lost be collected in all areas, and 2) that further studies of stock identity, productivity and abundance of pack-ice ringed seals be conducted.

With regard to the first recommendation, Greenland has instituted a harvest monitoring programme (*Pinniarneq*) that collects reliable information on landed catch, but not effort or struck and lost. However it was pointed out that a large proportion of the catch in Greenland is taken using nets, so struck and lost should be minimal. The Nunavut Harvest Study collected data on ringed seal harvest in Nunavut in the Canadian Eastern Arctic between 1996 and 2001 (Priest and Usher 2004), but again effort and struck and lost information are not available. Harvest in Svalbard is small and new regulations which among other things mandate mandatory reporting of catch were introduced in 2002.

With regard to the second recommendation, no specific projects have been conducted to address the importance of pack-ice breeding ringed seals. However some observations that confirm that ringed seals do breed in the pack ice of the Barents Sea were made by Wiig *et al.* (1999).

7.3.2 Future work

The Scientific Committee noted that information on the abundance of this species continues to be sparse, as it has a very wide and often dispersed distribution and is difficult to survey effectively. There is some evidence that numbers are decreasing in Hudsons Bay, Canada, possibly due to a reduction in ice cover (Ferguson *et al* 2005). Given that reductions in ice cover are expected as a result of human induced global warming, the Scientific Committee concluded that collection of information on pack ice breeding was of continued importance.

7.4 Grey seals

7.4.1 Update on progress since the last Working Group meeting in April 2003

The Scientific Committee has established two working groups to provide assessment advice on this species, in 1995 and again in 2003. The last working group in particular was tasked with providing assessment advice on grey seals throughout the North Atlantic, and gave management and research recommendations for grey seals in Iceland, the Faroes and Norway. The Scientific Committee accepted and conveyed the conclusions of the Working Group to the Council in 2003.

Advice to improve surveys was provided for Iceland and Norway, and this has been followed up by both countries. New survey results are available from both areas since 2003. A major genetic study, covering all North Atlantic areas, has been initiated by Norway. No information on struck and lost is available from any area where harvesting is conducted. There has been some progress on collecting information on by-catch in both Iceland and Norway, but no reliable estimates are available as yet. For the Faroes, the collection of basic information on distribution, genetics, removals and life history was advised, but this has not been done as yet. The recent age validation workshop (see 6.2) follows up on a recommendation given in 2003 that there should be an ongoing exchange and verification of samples among laboratories conducting age determination for this species.

Discussion

The Scientific Committee acknowledged that a management objective for grey seals in Iceland had been implemented in 2004 aiming at maintaining the population at the 2004 level. The Scientific Committee noted that recent information suggested that the decline in grey seal numbers in Iceland had been halted, and that recent harvest levels had been lower than previously. For Norway, the Scientific Committee has noted on two occasions (NAMMCO 2004, 2005) that the quota levels implemented for this area would, if filled, almost certainly lead to a rapid reduction in population in the area. A formal analysis of the effect of recent harvest levels and quota levels on the population, including the risk of extinction and the sensitivity of the survey programme to detect a population decline, was advised for both Iceland and Norway (NAMMCO 2004).

7.4.2 Future work

Norway and the Russian Federation plan to carry out joint surveys in North Norway and the Murman coast.

The Committee considered that sufficient new information has and will be collected in both Iceland and Norway to warrant new assessments for these areas, and that these could be carried out by the Working Group as soon as 2008. For the Faroe Islands, the Committee reiterated its previous recommendation that immediate efforts be made to obtain better information on the population of Faroese grey seals, and on the nature and impact of the take in the Faroes.

7.5 Harbour seals

7.5.1 Report of the Working Group (October 2006)

The Scientific Committee was requested in 2005 to:

- *Review and assess the status of harbour seals throughout the North Atlantic;*
- *Review and evaluate the applied survey methods;*
- *Assess stock delineation using available data on genetics, spatial and temporal distribution and other sources;*
- *review available information about harbour seal ecology;*
- *Identify interactions with fisheries and aquaculture.*

A Working Group with emphasis on expertise on the North Atlantic and adjoining seas, notably the North Sea and Baltic, was assembled under the chairmanship of Geneviève Desportes and convened in Copenhagen, 3-6 October. The full report of the Working Group is included as Annex 1.

Stock delineation

The Working Group noted that certain aspects of the ecology and biology of harbour seals (breeding in discrete colonies with a high degree of site fidelity, a short breeding season, coastal distribution, lack of strong seasonal migrations, a relatively sedentary nature) lead to the expectation of a complex stock structure (*i.e.* many small stocks rather than few large). While the most obvious stock unit might be the breeding colony itself, the Working Group agreed that broad scale stock structure will be more useful in a conservation management context.

The Working Group retained the stock structure indicated in Table 1 and Figure 1 of Annex 1, based mainly on genetic analyses of different markers. It regarded it however as preliminary since it is based on often limited genetic sampling and the level of genetic differentiation detected depends on sample size, genetic markers used and the analytical methods applied. Also many of the samples had not been collected from breeding sites.

Non-genetic evidence, such as comparison of male vocalizations between breeding colonies, individual movement patterns revealed by satellite tagging, photographic identification using the unique pelage pattern and branding techniques all revealed a relatively sedentary, coastal seal, faithful to specific breeding colonies and haulout areas, but with some exchange between areas. Little or no recolonization of extirpated colonies in the Faroes and Greenland further supported the idea of many small separated stocks.

The Working Group provided detailed recommendations for standardization of sampling, methodology and analyses for further genetic studies, so they are more likely to be revealing and compatible, allowing for a better understanding of the overall stock structure. Non-genetic methods, including acoustics and individual-based methods such as photography and branding, also hold promise for establishing stock boundaries at smaller scales.

Review of survey methods

The standard methodology for estimating harbour seal population size involves counting of animals at haulout sites during the pupping or moulting periods when a larger fraction of seals are hauled out. Since only animals hauled out are counted, the counts provide an index of the total population. Daily survey counts are normally made 2 h either side of low tide, particularly midday, when more animals are expected to be out of the water. Counting is most often done via fixed-wing, occasionally helicopter, aerial surveys. Aerial photographic surveys are used in some places and are particularly cost-effective on sandbanks. In areas where seals are cryptic, *e.g.* rocky shores, thermal imaging camera are sometimes used as support to the observers. In some areas, visual surveys were conducted from boats. In some cases counts are adjusted using environmental covariates (wind force, tide height, time to low tide and tidal status - spring or neap tides) which influence the number of seals hauled out at any given time. The frequency of surveys varies and depends on the management goals and the required power to detect trends in abundance.

Several methods have been employed to derive correction factors which would account for unobserved animals in haulout surveys to convert the counts to estimates of total abundance. These behavioural studies include VHF tagging, satellite tagging, and mark-recapture photo identification studies.

Survey methods used in all the jurisdictions represented at the meeting are summarized in Table 2, of Annex 1, and recommendations to improve surveys are provided in Section 10 of Annex 1.

Size and status of harbour seal population/stocks

The status of harbour seals in all jurisdictions was reviewed and is summarised in Table 3 of Annex 1. Regarding NAMMCO jurisdictions, the conclusion and recommendation of the Working Group are as follows:

Greenland - Harbour seals have been extirpated or reduced to extremely low levels in all areas, except for a small area of extreme south and southeast Greenland. It is very likely that these reductions are due to a combination of unsustainable hunting and environmental changes. Only a total cessation of harbour seal hunting in all of West Greenland would provide any opportunity for recolonization of the area from the remnant population in the extreme south. A research programme focussing on the remnant southern population was recommended (see under 7.1 in Annex 1).

Iceland – There has been a substantial decline in abundance (5% per year between 1980 and 2006) around Iceland, but the Working Group was unable to interpret this without associated information on historic catch. Anecdotal information suggests that by-catch in the lumpfish fishery may be substantial, but there are no data on this. The Working Group recommended as an urgent priority that 1) a document be prepared summarizing all available information on abundance, distribution, historical catch, by-catch and ecology of harbour seals in Iceland; 2) better information on by-catch be collected from all fisheries in which harbour seals are taken; and 3) the NAMMCO Scientific Committee then conduct a formal assessment of the stock.

Faroes - The lack of recolonization, after extermination as a breeding species around 1850, indicates that this was likely a separate stock, with little mixture with other stocks. Genetic samples from museum specimens should be obtained and compared with other areas. If animals do begin to recolonize the islands, they should be protected from hunting and harassment and the event should be carefully monitored.

Norway/Svalbard - Harbour seals number at least 1,000 in Svalbard and are totally protected from hunting. There are no commercial fisheries in the area that could have negative impacts on this population in terms of competing for resources or interaction with fishing gear. As no data on trends in abundance or historical harvests were available, the Working Group could not arrive at any firm conclusions about the status of this stock, but there was at present no basis for concern. The short life expectancy in this population though warrants further investigation.

Norway / Mainland – It was concluded that the current harvest (which is substantially less than the allocated quotas) when combined with likely levels of by-catch and possible unreported levels of struck and lost, was probably not sustainable, even given a likely total population estimate of 10-13,000 animals. There is an urgent need for the estimation of region-specific corrections to translate the counts to total abundance. By-catch was likely a major source of anthropogenic mortality and the present by-catch monitoring system should be expanded to include other fisheries likely to catch seals, including the lumpsucker and recreational gillnet fishery.

The Working Group endorsed the approach outlined in the new HELCOM Recommendation concerning protection of seals in the Baltic Sea. It noted that the general management principles and objectives described by HELCOM are applicable to harbour seal populations in some areas outside the Baltic Sea area and recommends that the HELCOM recommendation be consulted when developing management plans

for harbour seals in areas where no plans exist.

Interaction with Fisheries and aquaculture

By-catch of harbour seals occurs at some level in all areas but the magnitude of the problem is unknown in most. In Norway the by-catch of harbour seals is likely roughly equivalent to or greater than the directed catch. Table 3 in Annex 1 provides information about by-catch monitoring programmes by jurisdiction.

The Working Group recommended that estimates of by-catch be obtained as soon as possible, especially in Iceland and Norway.

Review of available information on harbour seal ecology

The heavy schedule prevented the working group from reviewing this subject in greater detail. In particular, the Working Group did not review any information on biological parameters.

Distribution and movements

Satellite tagging has given a wealth of distributional and behavioural information in several areas, providing data on locations while at sea and on land, as well as diving and haulout behaviour. Tagging studies reveal an overall pattern of frequent relatively short foraging trips (less than 40 km) and less frequent more distant foraging trip (more than 100 km) with exceptionally very long distance trips in excess of 500 km. A degree of site-fidelity and coastal foraging was apparent everywhere. Longer range movements of tagged animals were consistent with seasonal movements between wintering and pupping habitats, at least in the US.

Foraging ecology and diet

A summary of diet studies from several jurisdictions is provided in Table 4, Annex 1. The diet of harbour seals reflects local prey abundance and appears to be opportunistic with seasonal and spatial variation. In general there was little or no overlap in size between harbour seal prey and fish taken in commercial fisheries.

Recommendations for research

In addition to the recommendations relating to specific stocks, listed above and in more detail in Section 7 in Annex 1, general and detailed recommendations for research were provided for studies on stock delineation, surveys for population abundance, and population and Ecological/feeding studies (Section 10, Annex 1).

Discussion by the Scientific Committee

The Committee complemented the Working Group on their thorough review of all North Atlantic and Baltic stocks of harbour seals. The conclusions of the Working Group with regard to the status of all stocks, and the recommendations for research and monitoring, were supported.

There was concern about the status of the population at Iceland, which has decreased substantially over the past 26 years. While direct harvesting has decreased in recent years, there is virtually no information on by-catch, particularly in the fishery for

lumpfish, which is thought to be substantial. The Committee therefore stressed the importance of better by-catch recording and strongly recommended that monitoring of the stock, with surveys at 2-3 year intervals, be continued. The Committee also supported the recommendation of the Working Group that a formal assessment of this stock be conducted as soon as is feasible.

It appears that harbour seals have disappeared over much of their former range in West Greenland, and that the remnant population in the extreme south may be small. The Committee supported the conclusion of the Working Group that total cessation of harbour seal hunting in all of West Greenland should be considered. The recommended research programme for West Greenland was also supported.

For Norway it was noted that the current harvest, when combined with likely levels of by-catch and possible unreported levels of struck and lost, was probably not sustainable, and that the allocated quotas, if taken, were certainly not sustainable. The Committee agreed with conclusion of the Working Group and therefore emphasized the recommendation for better monitoring of by-catch in all fisheries, and for continued and frequent abundance surveys.

In general there is a need for the establishment of clear management objectives for this species in all NAMMCO member countries where the species is extant. For example it appears that there has been a deliberate interest in reducing the populations in some areas of Norway, but the objectives behind this have not been put forth in a management plan. Clearly this poses a risk to the populations. In addition the development of an effective research and monitoring programme is not possible without such clearly stated management objectives. The Committee recommended that clear management objectives for harbour seals be developed for Norway, Iceland and Greenland, as well as a plan for the Faroe Islands in case there was recolonisation.

7.5.3 Future work

Lydersen informed the Committee that a wide-scale genetic study of the species had been initiated, incorporating samples from Svalbard, mainland Norway, Iceland, and Greenland (if available). In Norway, detailed genetic analyses to assess possible regional structuring will also be initiated with sampling from breeding sites in 2007.

7.6 Walrus

7.6.1 Update on progress since the last Working Group meeting in January 2005

One of the first requests for advice given to the Scientific Committee in 1993 was to provide an overall assessment of Atlantic walrus populations, including stock identity, abundance, long-term effects of removals on stocks in each area, and the effects of recent environmental changes (*i.e.* disturbance, pollution) and changes in the food supply. This assessment work eventually led to the compilation of a status report on Atlantic walruses (Born *et al.* 1995, NAMMCO 1995). In 2004 the NAMMCO Management Committee requested the Scientific Committee to provide an updated assessment of walruses, to include stock delineation, abundance, harvest, stock status, and priorities for research. This assessment was carried out by a Working Group in

2005 and considered by the Scientific Committee at their 13th meeting (NAMMCO 2006). The Scientific Committee concluded that present removals were likely not sustainable for the North Water and West Greenland stocks, and recommended that new assessments for these stocks be completed as soon as identified research recommendations were fulfilled. These included completing analyses of previous surveys, carrying out new surveys in both areas, analyses of stock structure using genetics and tagging, and developing complete catch series with appropriate corrections.

Born provided information on research carried out since the meeting in January 2005 by the Greenland Institute of Natural Resources (GINR) in cooperation with the Danish National Research Institute (NERI) and Department of Fisheries and Oceans (DFO). The studies have aimed at providing information on stock identity and abundance of walruses in Central West Greenland.

Stock identity

Telemetry studies are being done to obtain information on the relationship between walruses wintering in West Greenland and walruses in adjacent areas including SE Baffin Island. In March 2005 and 2006, NERI and GINR attached three and five satellite tags, respectively, to walruses in the eastern edge of the Davis Strait-Baffin Bay pack ice off Sisimiut in western Greenland. The tags were anchored to the skin of the animals and lasted up to 2 months. In 2005, an adult female was tracked for about 2 months during which time she moved west to the Cumberland Peninsula on SE Baffin Island. In 2006 when there was very little ice off West Greenland, two animals moved west close to Baffin Island but then returned to Greenland before transmission stopped.

A preliminary analysis of a genetic comparison of walrus samples collected in SE Baffin (2005, Central West Greenland (2004-2006) and Hudson Strait (1998-2000) indicates that there is no genetic difference between walruses from SE Baffin Island and Central West Greenland. However, there was some - although minor - difference between walruses from Baffin Island-West Greenland and in Hudson Strait. The analysis is ongoing and will include a comparison with walruses in other neighbouring areas (*i.e*. "The Northwater stock" in NW Greenland and East Greenland walruses).

So far the studies of movement and genetics support a suspected connection between walruses wintering West Greenland and walruses along eastern Baffin Island. The study is planned to continue in 2007.

Abundance

In August 2005, an aerial reconnaissance with the purpose of finding walrus haulouts was conducted along the coast of Cumberland Peninsula (SE Baffin Island) between Pangnirtung and Qikiqtarjuaq (formerly Broughton Island). On 26 August, four haulouts with a total of 870+ walruses, primarily females and young, were located in the Angijaq Island area, E Cumberland Peninsula. This is the highest concentration of walruses reported from this area.

In March 2006, GINR conducted an aerial survey off Central West Greenland to determine the abundance of narwhal, beluga and walrus. A total of 21 walrus groups were seen. The estimates of abundance are currently being analysed and if possible they will be corrected for animals submerged and not seen during the surveys using dive and activity data from the satellite tags.

An aerial survey conducted in April 2006 by NERI designed for estimating the abundance of sea birds resulted observations of walrus that can be used for estimating abundance. The survey data are currently being analysed and if possible a final estimate will include a correction for submerged animals.

During mid-August – early September, three aerial surveys were conducted over the coastal areas between Iqaluit and Qikiqtarjuaq on SE Baffin Island in order to obtain an estimate of walruses in the summering areas of a suspected Baffin Island-West Greenland sub-population. The survey was conducted as a joint effort by DFO and GINR. The survey data are currently being analysed. However, during the surveys walruses were not observed on land at the haulouts identified on eastern Cumberland Peninsula in August 2005.

Plans for walrus surveys

The Greenland Institute of Natural Resources has developed a plan (2007-2010) for research on walruses in order to obtain the information necessary to provide advice on sustainable exploitation of walruses in Greenland. The plan aims at the determination of stock identity and abundance of the three sub-populations occurring in West, Northwest and East Greenland. In recognition of the substantial funding required for reaching the goals, GINR has applied for economical support from the Danish Ministry for the Environment.

Other areas

Lydersen informed the Committee that a successful walrus survey had been carried out in Svalbard in 2006. Digital aerial photography was used to enumerate all the known land haulouts, and these counts will be corrected using information derived from satellite tagging.

Zabavnikov informed the Committee that during Russian aerial surveys in April 2005 in the Barents Sea (southwest part), 23 walruses were observed in the entrance to the White Sea. This has not been seen in previous surveys and may indicate either an increase in walrus abundance or change in distribution in recent years in the Barents Sea.

7.6.2 New request

In 2005 the Scientific Committee was asked to provide advice on the effects of human disturbance, including fishing and shipping activities, in particular scallop fishing, on the distribution, behaviour and conservation status of walrus in West Greenland.

It is hypothesised that walruses can be negatively affected either directly by fishing activity causing habitat degradation (trawling and other activities damaging the sea

floor and depleting walrus prey resources) or indirectly through masking of walrus underwater communication during the breeding season through noise from fishing activities.To be able to evaluate how these factors may affect walruses, the following information is needed:

(1) Period of walrus occupancy, distribution and numbers in fishing areas in West Greenland.
(2) Amount and type of fishing operations and identification of season and area of fishery activity (period, type and size of vessels, vessel-days, type of fishery, characteristics of cavitation and engine noise sound, source strength and frequency).
(3) Information on the relative importance to walrus of localised feeding areas on the shallow water wintering banks in West Greenland for determination of which areas are critically important to the animals (distribution, type and density of prey).
(4) Information on habitat quality (mechanical degradation of the sea floor due to previous and ongoing trawling and other fishing activity)
(5) Walrus underwater vocalization (period, areas; number of animals involved)

There are no immediate plans to conduct studies with the purpose of specifically providing this information. However, some ongoing research activities may provide information relating to some of the elements.

(1) The ongoing studies by GINR that aim at determining movement of walruses and abundance on the walrus wintering banks in West Greenland address point 1.
(2) Information on number of vessels, their size and season and area of activity may be obtained from fishery registration authorities in Greenland. Information on sound emission from vessels and fishing activity may be obtained from written sources.
(3) Information on prey type, distribution and density is not available and must be collected through new studies of benthos of the shallow water banks in West Greenland. In connection with an impact assessment of the influence of oil exploration and potential exploitation there are plans to determine the distribution and density of benthos in Central West Greenland.
(4) Information on sea floor degradation is not available and must be collected through new studies in West Greenland.
(5) Information on walrus underwater vocalization in West Greenland (period, areas, number of animals involved) is not available and must be obtained though new studies. These studies must include exact position of observation of walruses, recording of walrus underwater vocalisation and background noise (including noise from trawlers and other ships with information on their position during the recording).

Due to the present lack of information the NAMMCO Scientific Committee found itself in a position where it could not respond to the request of the Council, and it is unlikely to be able to do so in the near term. Born agreed to inform the Committee about progress in this area annually.

7.6.3 Future work

The Scientific Committee commended Greenland both for the considerable progress that was being made in collecting vital information on abundance, distribution, stock structure and catch, and for implementing hunting regulations and quotas that should improve the conservation status of walrus in the area. The Scientific Committee welcomed the Greenlandic research plan on walruses and recommended that they be fully supported. The Committee encouraged Canada to fully support Greenland in their research efforts as it is now confirmed that the "West Greenland" walrus are in fact shared between eastern Baffin Island and West Greenland.

It is anticipated that results from the survey carried out in 2006 and the one to be carried out in 2007 will be available late in 2007. A new catch series may also be finalized at that time, and this information, combined with the new abundance estimates and estimates from past surveys, could be used to develop new assessment models for the Davis Strait stock. The Scientific Committee therefore considered that a Working Group could provide a detailed assessment of the stock in 2008. Born agreed to inform the Committee about progress at next year's meeting.

7.7 Fin whales

7.7.1 Report of the Joint NAMMCO/IWC Working Group (March 2006)

A Joint NAMMCO/IWC Scientific Workshop on the Catch History, Stock Structure and Abundance of North Atlantic Fin Whales was held in March 2006 (Annex 2). The main objective of the Workshop was to consider the available information on stock structure, catch history, biological parameters and abundance and trends in order to advance the fin whale assessments ongoing in the two organisations.

Several papers on stock structure, based on both genetic and non-genetic data, were presented at the workshop. A number of key factors emerged that require further work before a full understanding of the contribution of the genetic work to the elaboration of stock structure in the North Atlantic fin whales. The Workshop discussed several hypotheses with respect to feeding and breeding areas, and noted that the discriminatory evidence between the different hypotheses is weak.

The Workshop received a complete review of estimates of biological parameters for fin whales, including age and length at sexual maturity, asymptotic length, length at age 5, age at recruitment, mortality rate, ovulation rate and interval and the proportion pregnant in the mature female catch. It was agreed that there was nothing in the review to necessitate changes to the parameter values used previously by both the IWC and NAMMCO Scientific Committees.

A number of papers detailing catch series for the Northeast and Central Atlantic were presented to the Workshop. It was agreed that the information and the uncertainty in the catch series could be used as a basis to develop a 'high' and a 'low' series containing the maximum and minimum catches.

Several papers detailing abundance estimates from international and Norwegian surveys carried out in the Northeast and Central North Atlantic since 1987, as well as

recent Canadian and Greenlandic surveys. The Workshop found the estimates from the NASS and Norwegian surveys for the Central and Northeast Atlantic to be acceptable for use in assessments (see below).

The Workshop noted that estimated abundance in the area west and southwest of Iceland increased at an annual rate of 10% (95% CL: 6% - 14%) between 1987 and 2001. This is the area where nearly all fin whaling has been conducted since 1915. Estimated abundance in the whole EGI area has increased at 3% (95% CL: -1% - 7%) per year, *i.e.* this rate of increase is not significant at the 5% level. There was no evidence of any trend in abundance in the eastern North Atlantic.

A new assessment model of the EGI fin whale population, modelled as four sub-populations with movement between areas was presented. The model is sex- and age-structured, and is fitted to CPUE, sightings survey abundance split by area, and mark-recapture data using both maximum likelihood and Bayesian approaches. For the base case and most sensitivity tests, the overall recruited population is increasing and above 80% (base case 84%) of pre-exploitation abundance. The Workshop could not draw firm conclusions from this modelling exercise, but noted that the more complex models involving two or more spatial components did fit the historical and modern CPUE and abundance data better than single homogeneous stock models.

The Workshop provided a series of recommendations for future work that are detailed in Annex 2. It was agreed that all documents submitted to the respective Scientific Committees pertaining to the assessment of fin whales in the North Atlantic, and the Reports of the respective Committees, would be exchanged in the future. The first joint meeting between the NAMMCO and IWC Scientific Committees was considered successful, efficient and productive, and it was hoped that this level of cooperation on issues of common importance could be continued.

In a separate NAMMCO Scientific Committee Working Group meeting following the Joint Workshop the Working Group found no reason to change its advice provided in 2005, that projections under constant catch levels suggest that the West Iceland sub-stock (the "inshore sub-stock") will maintain its present abundance (which is above MSY level) under an annual catch of about 150 whales. It is important to note that this result is based on the assumption that catches are confined to West Iceland, *i.e.* to the grounds from which fin whales have been taken traditionally. If catches were spread more widely, so that other stock components were also harvested, the level of overall sustainable annual catch possible would be higher than 150 whales.

Discussion by the NAMMCO Scientific Committee

The Committee accepted the conclusions of the Working Group with regard to stock structure, biological parameters, catch data and assessment modelling. The Committee had previously accepted estimates of fin whale abundance for the Icelandic/Faroese survey areas for the 1995 (NAMMCO 1998) and 2001 (NAMMCO 2004) NASS, and noted that the estimate accepted by the Working Group for 2001, while very close to the one already accepted, was optimized for trend analysis rather than as the most accurate estimate for the area, so the previously accepted estimate is preferred. These

are 19,136 (95% CI 12,235 – 27,497) for 1995 and 24,887 (95% CI 18,186 – 30,214 for 2001 (Víkingsson *et al.* 2007). The best estimate for the eastern North Atlantic is 4,100 (CV=0.210) from the 1996-2001 survey series. It was also noted that the stock appears to be increasing in abundance, particularly in the area west of Iceland where all recent hunting has been done.

Some of the outstanding methodological problems concerning the interpretation of the genetic materials were resolved before the IWC meeting in St Kitts. Even so, the main uncertainty concerning fin whales in the North Atlantic remains the stock structure. The NAMMCO Scientific Committee agreed that the stock structure question remains open, and that the set of possible hypotheses range from one stock covering the whole North Atlantic to five or more separate stocks. There is strong evidence that fin whales in the Mediterranean represent a separate stock.

With regard to research recommendations, the Committee accepted those put forward by the Working Group, but emphasized that stock delineation remained the most important outstanding issue hindering our understanding of the status of fin whale stocks. Recommendations related to stock delineation were therefore emphasized, particularly the collection of genetic samples from areas where they are lacking, and satellite tagging once an acceptable success rate is achieved. It was recommended that some effort be allocated to these activities, if possible, during the TNASS in 2007.

The Committee was pleased that the first joint meeting between the NAMMCO and IWC Scientific Committees had been productive and beneficial to both groups, and noted the commitment to an ongoing exchange of information on fin whales between the two parties.

Relatedness of fin whales

SC/14/39 (previously presented to the IWC as SC/58/PFI9) detailed the screening of a dataset consisting of 15 microsatellite loci from 226 fin whales from several North Atlantic locations for closely related individuals. Five pairs of individuals were identified as being closely related, four of which were consistent with a parent-offspring relationship. Two of these parent-offspring pairs had been conjectured to be mother-calf pairs when the biopsies were obtained. Of the two pairs that were not sampled at the same location, one showed a linkage between North Norway and the area west of Svalbard, and the other between North Norway and West Iceland.

Discussion

The Committee found this methodology very promising, in that it could provide a direct measure of the degree of genetic mixing between feeding areas if sampling was sufficient. It was recommended that samples from other areas, including the Faroes and Greenland, be included in future analyses.

7.7.2 Update on the results of the 2005 Greenlandic survey

SC14/11 reported a ship-based line transect survey of large whales in East and West Greenland that was conducted in September 2005. This survey was reviewed by the NAMMCO-IWC Working Group (see Annex 2) and revised to take account of some

of the recommendations made there. The survey platform primarily targeted capelin using acoustic methods and systematically covered the east and west coasts of Greenland from the coast to the shelf break (approximately 200 m). The surveyed area comprised 81,000 km^2 in East Greenland and 225,000 km^2 in West Greenland. A total of 194 sightings of 13 cetacean species were obtained and standard line transect methods were used to derive abundance estimates of the four most commonly encountered large cetaceans. Fin whales were most abundant in East Greenland (3,140, 95% CI 940-10492) with lower abundances estimated for West Greenland (1,847, 95% CI 855-3989).

SC14/12-13 reported an aerial line-transect/cue-counting survey of large whales in West Greenland that was conducted in August and September 2005 (SC/14/12-13). The survey covered the area between Cape Farewell and Disko Island and from the coast out to the 200 m depth contour, covering 16,3574 km^2. The survey made 78 sightings of fin whales, with a mean group size of 2.96 and largest group size being 50. A line-transect abundance estimate of 1,724 (cv: 0.37) was obtained. The abundance estimates from both the aerial and ship-based surveys are negatively biased as no corrections were applied for whales missed by observers or for submerged whales.

Discussion

For West Greenland, the Scientific Committee concurred with the view of the IWC Scientific Committee (IWC 2006) that the estimates from the aerial survey were more reliable because the realised coverage of the ship-based survey was low and unevenly distributed within strata.

7.7.3 Update on progress

Víkingsson informed the Committee that routine biological sampling had been carried out on the recent catches of fin whales in Icelandic waters.

7.7.4 Future work

The TNASS will provide new estimates for this species in 2007.

7.7.5 Status of fin whales with respect to CITES criteria - report of the *ad hoc* Working Group

At the July 2006 meeting, the CITES Animals Committee decided to undertake periodic reviews of species listed on the CITES Appendices, and the North Atlantic central stock of fin whales had been nominated for review with Iceland agreeing to undertake this before the next CITES Animals Committee meeting in February 2008. The NAMMCO Council requested the NAMMCO Scientific Committee to undertake a review of the appropriateness of the current CITES listing of this fin whale stock. A NAMMCO *ad hoc* Working Group undertook this review and reported back to the Scientific Committee (Annex 3).

The CITES definition of the North Atlantic central stock of fin whales was interpreted as the East Greenland Iceland (EGI) area (IWC 2005). During the last 20 years considerable efforts have been made in monitoring the EGI population of fin whales.

Abundance estimates of between 15,000 (1988) and 24,000 (2001) that have been agreed in the Scientific Committees of both NAMMCO and the IWC, together with catch history data, provide a basis for estimates that show the EGI stock to be above MSY level, with a high probability of being above 70% of its pre-exploitation level. There are no indications of any recent decrease in distribution or abundance. On the contrary the population has been increasing in size over the last two decades.

On the basis of biological information including population distribution and abundance and stock structure, with reference to CITES criteria A, B and C, the Working Group concluded that the fin whale population in the region of the Central North Atlantic (the EGI stock) does not meet any of the biological criteria for listing under CITES Appendix I (threatened with extinction).

The extent and the manner in which the implications of the stock structure hypotheses illustrated in Fig. 1 of Annex 2 could be taken into account in reporting to the CITES Animals Committee in February 2008 would need to be reviewed after the 2007 IWC Scientific Committee meeting in the light of progress and decisions made there concerning the RMP implementation for North Atlantic fin whales. After that meeting, further inter-sessional work on fin whales may need to be planned. The early availability of preliminary results from the TNASS could be advantageous.

Iceland will need to monitor progress on this matter and perhaps request further help from NAMMCO should the IWC North Atlantic fin whale RMP implementation schedule be delayed.

Additional discussion – It was noted that the IUCN Cetacean Specialist Group would be meeting in January 2007 to review species status, and Iceland pointed out that in discussions on the status of species within this group, information from NAMMCO appeared never to have been taken into consideration. The Scientific Committee tasked the NAMMCO Secretariat with contacting the Chair of this IUCN group and drawing attention to the availability of information from NAMMCO on species status, especially with reference to North Atlantic fin whales. Furthermore, permission should be obtained from NAMMCO Council in advance of the Annual meeting in February 2007, to approve and release the report of the *Ad Hoc* Working Group (Annex 3) so that this too could be made available to the IUCN group.

7.8 Humpback whales

In 2004 the Scientific Committee was requested to continue its assessment of humpback whale stocks in the North Atlantic, assessing the long-term effects of annual removals of 0, 2, 5, 10 and 20 whales for West Greenland, and providing estimates of sustainable yield for other stocks. In all cases the management objective would be to maintain the stocks at a stable level. The Scientific Committee was also asked to identify information gaps that must be filled in order to complete the assessments. Last year the Committee decided to postpone the provision of advice for West Greenland until a new abundance estimate was available, and to delay the assessment in other areas until after the completion of the NASS-2007 survey.

7.8.1 Update on the results from the 2005 survey in West Greenland

Humpback whale abundance estimates from a ship-based line-transect survey in 2005 (see 7.7) were 1,316 (95% CI 592-2,927) for West Greenland and 329 (95% CI 45-2,388) for East Greenland. Another abundance estimate of 1,246 (cv: 0.56) humpback whales off West Greenland in 2005 was obtained from an aerial line-transect survey (see 7.6). The estimates from both surveys are negatively biased as no corrections were applied for whales missed by observers or for whales submerged during the passage of the survey platform. For West Greenland the estimate from the aerial survey was considered most reliable because the realized coverage of the ship-base survey was low and unevenly distributed within strata.

Discussion

Noting the arguments above, the Committee agreed that the estimate of abundance from the aerial survey was negatively biased. Notable in this respect is the fact that as many as 359 animals were seen on the survey, while the lower 95% confidence limit of the estimate is 429. To provide conservative interim advice on the number of humpback whales that could be safely taken in West Greenland waters, the Committee decided to apply a replacement yield estimate of 2% to the lower confidence limit of 429, which provides an estimated sustainable annual removal of 8.6 whales. The replacement yield of 2% used in this calculation is appreciably lower than observed rates of increase in other areas of the North Atlantic, such as Iceland (Pike *et al.* 2007) and the Gulf of Maine (Stevick *et al.* 2003). Therefore the Scientific Committee concluded that a removal (including by-catch) of up to 10 animals per year would not harm the stock in the short or medium term. It was noted that the approach used here is similar to that used by the IWC Scientific Committee to provide interim advice on catch limits for fin whales off West Greenland (IWC 2006). This advice should be considered interim in nature, and should be revisited once the abundance estimate from the 2005 survey is revised and a new estimate from the planned 2007 survey is available. At that time enough data should be available to support a more formal modelling approach that would enable the Committee to address more specifically the request put to it by the Council.

7.8.2 Update on progress

In 2003 the Committee recommended that photo-id/biopsy studies be carried out in all important habitats around Iceland. It was also recommended that available humpback survey estimates from all feeding aggregations in the North Atlantic should be compiled, and that for future NASS, consideration be given to designs suitable for humpback whale feeding aggregations, and to extending the survey coverage. Víkingsson informed the Committee that a biopsy collection had been attempted off east Iceland but had not been successful. It was noted that abundance estimates had now been calculated for all feeding areas covered by the NASS, Norwegian and Greenlandic surveys. Humpback whales will be a target species of the TNASS (see 8.2).

7.8.3 Future work

The TNASS will provide new estimates of abundance for this species. In Greenland an acoustic array has been installed across Davis Strait to monitor whale migrations, and

short-term tagging is planned to study diving patterns, behaviour and feeding. Norway continues to collect biopsy and photos on an opportunistic basis.

7.9 Minke whales

7.9.1 Update on the Icelandic Research Programme and results

The overall programme has been presented previously (NAMMCO 2005) and assumes a catch of 200 minke whales spread over the Icelandic continental shelf area during May-September and is thus still in an early stage of the sampling phase. For some sub-projects, requiring complex setup for chemical analysis (pollution, genetics) it is considered unfeasible to start the laboratory work until more samples are available. Samples already obtained for most other sub-projects have been analysed or are at a final stage of laboratory analyses. Results will be reported when the total sample has been analysed.

During 4 July – 17 August 2005, 39 common minke whales were caught under special permit. Searching effort was distributed all around Iceland in proportion to known densities of minke whales in the 9 areas as laid out in the original sampling scheme. Males were more frequent than females in the sample (male:female ratio = 20:14) and the preliminary results from the whole programme indicate geographical segregation by sex in June to September. Males outnumbered females in the southwest (areas 1 and 10) whereas the sex ratio was equal or biased towards females in other areas. In June, July and August 2006, 60 minke whales were caught as a part of the programme bringing the total catch up to 161. The objectives, methodology, total sample size and spatial and seasonal distribution of the sample remain unchanged from the original proposal (for details see Marine Research Institute 2003) and the modifications involve only reduced rate of sampling. It is now envisaged that sampling will be completed in 2007.

7.9.2 Update on progress since the last Working Group meeting in November 2003

The Committee last provided an assessment of the Central stock of minke whales in 2003 (NAMMCO 2004), and previous to that in 1998 (NAMMCO 1999). Most of the research recommendations arising from these assessments have pertained to stock delineation, particularly the collection, exchange and analysis of genetic samples. Other recommendations concerned the development of validated ageing techniques and further satellite telemetry studies.

It was noted that issues related to sample exchange and analysis had been addressed, but that many areas, including Greenland and the offshore waters of Iceland, had not been adequately sampled. Some biopsy sampling is underway in Norway, and samples from every animal taken are collected and analyzed. These latter data have been used to address questions about stock structure and work is ongoing to develop methods of population assessment based on genetic relatedness (Skaug and Øien in press). The Icelandic Research Programme also has a genetics component, and samples are collected from all animals taken in Iceland and Greenland.

Satellite telemetry of this species has been attempted in Iceland, Norway and

Greenland with limited success. As has been noted for other species, technical issues related to attachment and tag longevity must be addressed before this methodology can be widely applied.

Age validation is a component of the Icelandic Research Programme, and a study has also been conducted in Norway (Olsen and Sunde 2002).

Discussion

The Committee considered that considerable progress had been made in addressing the research recommendations that had been given previously. The main outstanding gaps in knowledge continue to concern stock delineation, and the collection of samples from areas that have not been sampled should be a priority. TNASS might represent one sampling opportunity.

West Greenland

Minke whale abundance estimates from a ship-based line-transect survey in 2005 (see 7.7.2) were 1,686 (95% CI 179-15,841) for East Greenland and 4,086 (95% CI 1,645-10,150) for West Greenland. Another abundance estimate of 3,474 (cv: 0.42) minke whales off West Greenland in 2005 was obtained from an aerial cue-counting survey (see 7.7.2). The estimates from both surveys are negatively biased as no corrections were applied for whales missed by observers, and as there is no correction for submerged whales for the ship-based survey. For West Greenland the estimate from the aerial survey was considered most reliable because the realized coverage of the ship-based survey was low and uneven within strata.

7.9.3 Future work

Minke whales will be a target species of the TNASS in 2007.

7.10 Narwhal

7.10.1 Update on progress since the last Working Group meeting in October 2005

An aerial survey covering the index area for wintering belugas and narwhals off West Greenland was conducted in March and April 2006, using a Twin-Otter with bubble-window double platforms. Although the survey was on an improved platform relative to earlier surveys, it aimed for compatibility with earlier index surveys following the recommendations of the NAMMCO and JCNB JWG meeting in Nuuk 2005. A planning meeting with the hunter organisation KNAPK was held prior to the survey to discuss possible extensions of the survey area as well as optimal timing of beluga and narwhal aerial surveys. Local knowledge adaptive area-extension was adopted for the survey, with the Greenland Institute of Natural Resources phoning local hunter organisations regularly during the survey to check if hunters were seeing narwhal and beluga concentrations outside the survey area. The spring of 2006 had unusually large areas with open water, with concentrations of belugas and narwhals seen by hunters to the north of the index area. In response to hunter observations the survey area was extended from Disko Bay to the north covering large areas all the way up to Upernavik. Observations included 119 groups of beluga, 68 groups of narwhals, 36 groups of bowheads, 21 groups of walrus, 9 groups of polar bears, 25 ringed seals, and

111 groups of bearded seals. Abundance estimates for narwhal and beluga are expected in the spring 2007.

Discussion

The Committee welcomed these results, noting that that the survey had been planned with consideration of the recommendations of the Committee and that the results will be of use in updating the assessments for West Greenland narwhal and beluga.

7.10.2 New request

In 2006 the Council requested the Committee to provide advice on the effects of human disturbance, including noise and shipping activities, on the distribution, behaviour and conservation status of belugas, particularly in West Greenland. It was noted that some information on this topic had been discussed at the last meeting of the JWG, in response to a request from the JCNB. The Committee referred this request to the joint NAMMCO/JCNB Working Group to address at their next meeting.

7.10.3 Future work

A monitoring plan from 2007 to 2011 covering both wintering beluga and narwhals off West Greenland, as well as summering aggregations of narwhals in Northwest Greenland and East Greenland, and stock identification studies of all major aggregations of narwhal and beluga in Greenland, has been developed by the Greenland Institute of Natural Resources (Table 1). The execution of the full plan, however, is dependent on external funding from the Danish Ministry of Environment.

The Committee welcomed and fully supported the research plan for narwhal, beluga and walrus in Greenland and recommended it be supported and implemented. Noting the recommendation by the Council last year that future surveys for beluga and narwhal should be planned using the international expertise available through the Scientific Committee of NAMMCO, the Committee recommended that the plans for the survey of Inglefield Bredning/Melville Bay scheduled for August 2007 be reviewed by the TNASS Planning Committee at their next meeting.

Considering that a new estimate from the March 2006 survey will be available early in 2007, in addition to possible new information from satellite tagging and other initiatives, the Committee considered that the Joint Working Group should meet to review the stock status of narwhal in late 2007. Alternatively the Working Group could wait until 2008 when the results of the summer 2007 survey become available.

The Scientific Committee was informed that the narwhal quota for West Greenland will be 260 in 2006/7, plus 115 in Melville Bay, plus 10 to be distributed in the spring if necessary. It was noted that the total quota for West Greenland areas had increased every year since it was introduced, from 300 in 2004/5 to 310 in 2005/6 and to 385 in 2006/7. The Committee remained concerned that the total removals remain above the recommended level for West Greenland of 135 (NAMMCO 2005, 2006), and advised that delay in implementing catch reductions to the recommended levels will result in delay in stock recovery and probably in lower available catches in the medium term. For Melville Bay, no specific recommendations on sustainable removals have been

provided, but the Committee remained concerned that this may be a small stock, and that the quota of 115 might not be sustainable. It looked forward to the results of the planned 2007 survey in this area (see 7.10.3).

7.11 Beluga

7.11.1 Update on progress since the last Working Group meeting in October 2005

The update provided under 7.10.1 applies also to beluga.

Zabavnikov informed the Committee that recent surveys have indicated that beluga may be overwintering in the White Sea in areas where they did not do so before. Lydersen noted that a new study on beluga genetics, incorporating samples from several areas in the Northeast and Central Atlantic, has been initiated.

7.11.2 New request

The request referred to under 7.10.3 applies also to narwhal. The Committee referred this request to the joint NAMMCO/JCNB Working Group to address at their next meeting.

7.11.3 Future work

The research plan presented under 7.10.3 (Table 1) applies also to beluga, as does the response of the Committee to that plan.

Considering that a new estimate from the March 2006 survey will be available early in 2007, in addition to possible new information from other sources, the Committee considered that the Joint Working Group should meet to review the stock status of beluga most optimally in late 2007.

The Scientific Committee was informed that the beluga quota for West Greenland will be 140 for West Greenland and 20 for Qaanaaq in 2006/7. The Committee commended Greenland for their management efforts to improve the conservation status of beluga in this area, and noted that the quota had been reduced since its introduction in 2004. Nevertheless the Committee remained concerned that the total removals were still above the recommended level for West Greenland of 100. Maintaining higher catches reduces the probability of halting the decline, and delay in implementing harvest reductions will increase the risk of continued stock decline.

7.12 Bottlenose whales

7.12.1 Update on progress since the last Working Group meeting in February 1995

The Scientific Committee has considered this species, in response to a request for a general assessment, on two occasions: first in 1993 (NAMMCO 1993), and then again in 1995 (NAMMCO 1995). The assessment was hampered by uncertainties about abundance, correction of survey estimates for surface availability, catch data, stock structure and ecology, and recommendations for research were provided to address these issues.

Estimates of surface abundance from the 1995 and 2001 NASS were provided by Pike *et al.* (2003) and revised estimates are being developed. Bloch noted that a new compilation of catch data was made by Jonsgård (1977), a study on morphometrics has been published (Bloch *et al.* 1996) and a study on feeding is in preparation. The main research gaps appear to be related to stock structure and diving behaviour, although some information on the latter has been published from the western Atlantic (Hooker and Baird 1999).

Recent catches of bottlenose whales have been very low, averaging less than one per year in the Faroes. Some strandings have been noted in other areas. As with other beaked whales, there is concern that this species may be affected by low-frequency military sonars, shipping and other sources of marine noise. Some interactions with fisheries have been noted, mainly animals scavenging fish off longlines.

Discussion

The Committee concluded that there was at present no reason to revisit the assessment already conducted, unless significant anthropogenic mortality is noted and/or new information on abundance and stock structure becomes available.

7.12.2 Future work

The Faroes may wish to conduct satellite telemetry studies with this species, to provide information on seasonal distribution, diving and stock structure. This could be done by driving animals ashore, tagging them, and then releasing them.

7.13 Killer whales

7.13.1 Update on progress since the last Working Group meeting in February 1995

The Scientific Committee has had two requests for advice on killer whales: for a general assessment in 1993 (NAMMCO 1993), and another in 2004 with emphasis on killer whales in West Greenland and Eastern Canada (NAMMCO 2005). In both cases it was not possible for the Committee to complete the assessments because of a lack of information on stock structure, abundance and ecology in different areas. The situation for West Greenland is particularly difficult because killer whales appear to make only occasional forays into the area. In 2004 the Committee agreed to review new information on killer whales annually with the aim of completing the assessment once sufficient information becomes available for a particular area. The Committee provided several recommendations for research to address this lack of knowledge, including expansion of photo-identification studies and establishment of a central photo-ID catalogue, satellite telemetry, genetic sampling and sampling of all animals harvested in Greenland.

There has been recent cooperative work between Iceland and Norway on sharing and combining photo-ID databases. An extensive photo-ID catalogue also exists for eastern Canada, but this has not yet been compared with other areas. A graduate student at Aberdeen University has begun a project on the stock structure of North Atlantic killer whales that will use photo-ID and genetic samples from all areas. Some

satellite telemetry work, as well as behavioural studies, has been conducted in north Norwegian waters.

In 2007 the IWC Scientific Committee Subcommittee on Small Cetaceans will conduct a review of killer whales worldwide. A stock status review of Canadian killer whales will be conducted by COSEWIC (Committee on the Status of Endangered Wildlife in Canada) in 2008.

Discussion
While noting that considerable progress will likely be made in the next few years, the Committee concluded that the information was still not sufficient to conduct an assessment in any area.

7.13.2 Future work
In 2004 the Scientific Committee provided a list of research required to conduct an assessment of killer whales, particularly in West Greenland, as requested by the Council in 2004. The Committee will review progress under this item annually with the view of conducting an assessment when sufficient information becomes available.

7.14 Pilot whales
7.14.1 Update on progress since the last ICES SG meeting in April 1996
The Committee last considered this species in 1996, operating under a general request to provide an assessment and advice on the sustainability of Faroese catches. Many of the recommendations for research concerned improving surveys to obtain better estimates of abundance, particularly by expanding spatial coverage and addressing inter-annual variability. Other recommendations included satellite telemetry to assess movements, and research on social structure, ecology and multi-species interactions. It was strongly recommended that a long-term research and population monitoring strategy be developed related to the Faroe Islands fishery, which should include both longer term monitoring which would help improve understanding of the status of the harvest animals, and short-term monitoring to detect more rapid changes as might occur.

It was noted that a successful satellite telemetry programme had been carried out in the Faroes, which had provided valuable new knowledge about the movements of pilot whale pods in the medium term (several months) (Heide-Jørgensen *et al.* 2002, Bloch *et al.* 2003).

Discussion
The Committee was concerned that NASS conducted since 1987/89 had not provided comprehensive estimates of abundance for this species, mainly because of coverage, timing and technical issues. A major priority should therefore be to obtain a better estimate from the TNASS. The Committee was also concerned that the recommended monitoring programme had not been instituted in the Faroes, although some samples are collected from most *grinds* on an *ad hoc* basis. It was therefore recommended that such a programme be developed as soon as possible under the auspices of the Committee.

7.14.2 Future work

The work on satellite telemetry will continue in the Faroes. The Committee recommended that the most recent tagging data be published. This is a target species of the TNASS. The Committee noted that there had been no assessment of pilot whales since 1994.

7.15 White-beaked, white-sided and bottlenose dolphins

7.15.1 Update on the results of SCANS II

The SCANS-II survey, conducted in 2005, will provide abundance estimates for white-beaked and common dolphins in the North Sea, western Baltic and European inshore waters.

7.15.2 Update on progress

The Management Committee has asked the Scientific Committee to carry out assessments of these species, but to date insufficient information has been available on stock delineation, distribution, abundance and biological parameters to initiate the work. Last year the Committee concluded that such an assessment could probably be conducted by 2008 at the earliest.

The Committee was pleased to note that considerable progress has been made in the Faroes in describing the ecology and life history of white-sided dolphins, and that this information had been presented previously. Samples from by-catch in the 1990's have been collected in Iceland, and analyses may be completed by 2008. Biopsy samples have been collected by Norway, to be used in a large scale genetic study. The Committee recommended that samples from all jurisdictions be included in this study.

Less progress has been made in developing abundance estimates from the NASS series. Estimates are available from the aerial surveys around Iceland (Pike *et al.* 2007), and an estimate of common dolphin abundance is available from the Faroese survey in 1995 (Canadas *et al*. 2007). Methodological problems may preclude the development of reliable estimates from past ship surveys by Iceland, the Faroes and Norway. New estimates will soon become available from the SCANS II conducted in 2005. Dolphins are a target species of the TNASS, and the Committee recommended that the methods used be adapted to provide estimates for these species, to the extent that is feasible without compromising the survey for other species.

Satellite tagging of *Lagenorhynchus* has been attempted unsuccessfully by Norway, but was successful on one animal this year in Iceland. Further work on satellite tagging was encouraged, and it was noted in this respect that the Faroese drive hunts would provide an excellent opportunity to capture and tag animals.

7.15.3 Future work

There are tentative plans to continue satellite telemetry work in Iceland, and work may be attempted in the Faroes and Norway in the future.

The Committee concluded that while some progress had been made on the identified research priorities, there was still insufficient information on abundance, distribution,

stock delineation, life history and ecology to warrant an assessment at this time. This may become feasible once feeding, genetic and life history studies have been completed in Iceland, the Faroes and Norway, and when new abundance estimates become available from the TNASS, CODA and other sightings surveys. Such an assessment could probably be conducted by 2008 at the earliest.

7.16 Harbour porpoise

7.16.1 Update on the results of SCANS II

See 7.15.1. Preliminary estimates for harbour porpoise have already been produced, and final estimates will be available in 2007.

7.16.2 Update on progress since the last Working Group meeting in September 1999

The International Harbour Porpoise Symposium hosted by NAMMCO in September 1999 included presentations on genetics, satellite telemetry, demographic parameters, ecology, abundance and removals, many of which were compiled into a Volume 5 of NAMMCO Scientific Publications.

The most important identified need is clearly for estimates of abundance from all areas other than that covered by SCANS-II. There has been some progress in providing estimates of relative abundance from Icelandic aerial surveys (Pike *et al.* 2007), but these estimates are problematic for this species. Estimates have not been developed from past aerial surveys off West Greenland or NASS ship surveys, and it is considered unlikely that reliable estimates could be derived due to methodological and technical issues. Efforts to conduct inshore vessel surveys in Norwegian waters have not been successful.

Records of recent directed catch are available from Greenland, but there is no reliable estimate of by-catch from Iceland or Norway, although it may be considerable in these areas. Both Iceland and Norway have recently taken steps to improve this situation (see 9).

It was noted that three studies on the stock structure of harbour porpoises have been published since 1999 (Tolley *et al.* 2001, Duke 2003, Fontaine *et al.* 2005). These studies have revealed genetic substructure across the North Atlantic. Harbour porpoises off Iceland appear to be more related to populations in the western North Atlantic than to those off Norway. However there are also indications of a substructure within Icelandic waters.

Discussion

The Committee commended the efforts of Norway to establish a monitoring system that will provide estimates of by-catch for this species, but noted that the situation with regard to the Icelandic system had not improved since it was reviewed by the Committee in 2003. It also noted that the directed catch in Greenland was nearly 3,000 animals in 2004, and that this removal may not include struck and lost animals. In order to estimate the sustainability of the ongoing by-catch and directed catch in these areas, better estimates of the present removal levels of harbour porpoises in Iceland,

Norway and Greenland as well as estimates of absolute abundance for all areas, are required. Harbour porpoises will be a target species of the TNASS, so better estimates may come from that survey. However it is likely that additional efforts will be required for Greenland and Norway, as recent surveys are not adapted for this species and do not cover inshore areas. The establishment of sampling programmes in the Faroe Islands, to obtain samples for genetics, ecology and estimation of biological parameters, was also recommended.

7.16.3 Future work

The Committee considered that formal stock assessments for this species were warranted for Greenland, Iceland and Norway, but that there was insufficient information on abundance in all areas and removals in Iceland and Norway to conduct assessments at this time.

7.17 Other whale species

Blue Whales

The distribution and abundance of blue whales was assessed from ship surveys conducted in the Central and Northeast Atlantic in 1987, 1989, 1995 and 2001 (SC/14/21). Blue whales were most commonly sighted off western Iceland, and to a lesser extent northeast of Iceland. They were very rare or absent in the Northeast Atlantic. Sightings were combined over all surveys to estimate the detection function using standard line transect methodology, with the addition of a covariate to account for differences between surveys. Total abundance was highest in 1995 (979, 95% CI 137-2,542) and lowest in 1987 (222, 95% CI 115-440). Uncertainty in species identity had little effect on estimates of abundance. There was a significant positive trend in abundance northeast of Iceland and in the total survey area.

Discussion

The Committee welcomed this new information. Víkingsson noted that the first long distance photographic match had recently been made between a blue whale photographed in Iceland and again off West Africa.

Bowhead whales

SC/14/40 presented new information on the Spitsbergen stock of bowhead whales, which is believed to number in the tens. Systematic surveys for monitoring the Spitsbergen stock have never been conducted. The ice edge in the Fram Strait between Svalbard and Greenland as well as the ice edge north of Svalbard for bowhead whales was surveyed in April 2006, visually and acoustically, from the research vessel Lance. In total, there were 8 observation events that included 17-20 bowhead whales. All of the whales were detected visually. Age and sex of the animals were not determined, but no calves were seen. For the surveyed area, during April 2006 most of the bowhead whales within the western range of the Spitsbergen stock were concentrated in the area 80-81° N, 0-2° E. The location of the whales at this time of the year may be determined by the availability of food as well as the particular ocean current systems that keep this part of the Fram Strait free of ice. Currently, it is not known whether the observed bowhead whales in the Svalbard area are stragglers from the northwest Atlantic or survivors of the Spitsbergen stock.

Discussion
The Committee welcomed this new information on a stock that was thought to be nearly extirpated. In discussion it was noted that records of incidental sightings by whalers and others from Norway and the Russian Federation exist, and it was suggested that these should be compiled into a report that might give some impression of spatial and temporal distribution for the stock. Opportunistic observations in Northeast Greenland in recent years indicate that the occurrence of bowheads in this area has increased (Gilg and Born 2005).

Brydes whales
SC/14/22 documented the catch of one possible specimen of Bryde's whale (*Balaenoptera brydei*) on 19 March 1926 outside the Møre coast of Norway.

Norwegian catch series
SC/14/7 provided a summary of the catches by Norwegian pelagic whalers in the North Atlantic between 1917 and 1937. A total of 4,260 whales were taken, the majority of which were fin whales. A summary of Norwegian coastal catches between 1868 and 1986 was provided in SC/14/8. Both of these papers were updates of previous compilations that included some new information.

The Committee thanked Bloch for her efforts and noted that these corrected catch series will be of use for various assessments. All the material will be made available at the NAMMCO Secretariat.

8. NORTH ATLANTIC SIGHTINGS SURVEYS

8.1 NASS-2001 and earlier surveys
Pike informed the Committee that most outstanding analyses from the NASS series will be published in a future volume of NAMMCO Scientific Publications (See 11.1). However no analyses are presently underway for killer whales or dolphins. There is increased interest in accessing the NASS data from outside of the NAMMCO countries, and several enquiries have come this year. Pike anticipated that these data would be valuable and useful for many years to come.

8.2 Report of the Planning Committee for TNASS
First meeting
The first TNASS planning meeting was held 22 March in Reykjavík, with participation of Canada, Faroes, Greenland, Iceland and Norway, plus representatives from the SCANS-II and CODA projects and the IWC. The full report of the meeting is included as Annex 4.

The preliminary plans for 2007 were presented by all jurisdictions. Canada had contacted the USA about the survey, and the USA was now considering conducting surveys in 2007 instead of 2008 as planned, for coordinating with TNASS.

The methodological problems encountered in previous surveys were reviewed both for aerial surveys and shipboard surveys. They include but are not limited to the problem

of accommodating 'national' methodology for non 'national' target species, with in particular the lack of sighting/identification of these species and the problem of implementing the tracking method for target species as different as fin and minke whales for shipboard surveys.

The methodological advances from SCANS-II were reported**,** including the **s**uccessful improvements made in obtaining more accurate event timing, sighting angles and distance estimates. The 'circle-back' technique used in the aerial survey for estimating *g(0)* performed well but required considerable allocation of effort.

With regards to the coordination within TNASS and with other surveys, it was agreed that:

1. Coordinated surveys greatly enhanced the value of each individual survey by allowing synoptic estimates to be produced, thus providing the best value in terms of information for money spent. The opportunity for having a synoptic survey of the Northern Atlantic from coast to coast was absolutely unique and the output of the survey should be optimized as much as possible, in particular through a high level of coordination and the use of the newest standard survey techniques;
2. The survey would be made multi-species to the extent possible, without compromising data on national target species, and a common survey protocol would be developed to optimize data collection for target species from all jurisdictions;
3. The Norwegian survey would continue to follow its own protocol, but would make every reasonable effort to coordinate with TNASS;
4. The timing of the surveys should be coordinated and be the same as most previous NASS, *i.e*. late June and July;
5. The analysis of the survey data would also benefit from a more coordinated approach;
6. The possibility of placing dedicated cetacean observers on the Redfish and MAR-ECO surveys and the Russian surveys would be explored.

The possible funding possibilities were discussed, in particular considering thatTNASS had been accepted as a component of the IPY ESSAR umbrella project. NAMMCO could fund at least two planning and a post-cruise meetings. The area of greatest needs for extra funding were identified and it was agreed that joint funding proposals would be developed by NAMMCO.

A list of action items, related to survey planning and coordination, equipment and methodology and funding, was developed with individuals assigned to complete the tasks.

Second meeting

The second TNASS planning meeting was held 18-19 November in Reykjavík, with participation of Canada, the Faroes, Greenland, Iceland, Norway, Russia and the USA as well as representatives from the SCANS-II/CODA project and the IWC. The full report of the meeting is included as Annex 5.

Chairperson Geneviève Desportes reminded participants that the coordination within TNASS, as well as associated surveys, in terms of timing, coverage and methodologies, as was agreed in the previous meeting would represent an absolutely unique opportunity to obtain a synoptic coverage of the Northern North Atlantic, which would be much more valuable than the some of its parts and that flexibility was required to achieve coordination.

Available resources and preliminary plans by jurisdictions

Canada planned aerial surveys in three areas: Arctic (northern Labrador to northern Baffin Island), Newfoundland/Labrador (northern Labrador to the southern Grand Banks, funding in place), and Scotian Shelf/Gulf of St. Lawrence. Highest priority were species at risk such as harbour porpoise, blue and fin whales, and leatherback turtles.

The Faroes planned one shipboard survey with a coverage similar to 2001. Priority species were fin whales and pilot whales.

Greenland planned an aerial survey from Disco Bay to Cape Farwell with minke, fin, and humpback whales as priority species. Preferred timing was August-September, but it was perhaps possible to conduct another survey in July.

Iceland planned a survey similar to that of NASS-2001, with offshore areas being covered by vessels (two dedicated, one combined with Redfish survey) and nearshore areas by 'plane. Priority species were minke and fin whales, plus harbour porpoises for the aerial coastal survey.

Norway will continue its 'mosaic' survey with two vessels and minke whales as the target species. If permission from the Russian Federation is granted, the eastern Barents Sea will be surveyed. Otherwise areas previously surveyed in poor conditions will be re-surveyed. Two Norwegian vessels will also participate in a mackerel survey together with Russia in the Norwegian Sea in July.

The Russian Federation would have cetacean observers on their Redfish survey vessel and their mackerel survey vessel in the Norwegian sea in July.

The European CODA survey will have 3 ship months for surveying between south of the Faroese area to the Spanish/Portuguese border off the shelf edge, using double platforms as in SCANS-II. Target species were common dolphins, as well as sperm and beaked whales.

The USA will conduct an aerial and a vessel survey in parallel in August, in the Gulf of Maine, Bay of Fundy and perhaps the Scotian Shelf, south of the Canadian area, targeting all cetacean species.

Coordination issues

Although recognizing national priorities, the value of coordinated surveys, in terms of

timing, coverage and methodology, leading to synoptic distribution and abundance estimates was again stressed.

Timing

All components of the survey should ideally occur within the same time period and that this should be similar to previous NASS to maintain comparability in the time series. All previous NASS, except 1989, have been conducted in July.

The timing of the US survey in August was not ideal but was not flexible. Canada and USA agreed to coordinate the progression of their respective surveys such that they covered adjacent areas simultaneously.

The preferred timing of the Greenlandic survey was considered problematic, because the possible movements of whales between survey areas between July and September would make interpretation of the results difficult. September was preferred by Greenland because fog was generally less prevalent then than in July, and it was considered that the chances of a successful survey were much higher in September than in July. Nonetheless the Planning Committee considered that there would be added value in conducting the Greenlandic survey in July, in coordination with the other components of TNASS. It was therefore strongly recommended that a Greenlandic survey be attempted in July, as close as possible in time to areas to the west and east.

Coverage

It was agreed that all jurisdictions, including the USA and the CODA survey, would cooperate fully in maximizing the spatial coverage of TNASS and in making the border of their survey areas contiguous.

The Norwegian plan to survey the eastern Barents Sea was considered problematic as this area is not contiguous with the remainder of the survey area. The Planning Committee stressed that the opportunity to get synoptic coverage of a much larger area was not likely to arise again in the near future, and that this should be seen as valuable to the Norwegian management programme. It was also noted that the TNASS proposal had been endorsed by both NAMMCO Council and the IWC Scientific Committee. The Planning Committee therefore strongly recommended that Norway survey in an area contiguous to the main TNASS survey area in 2007. A preferred area would be that to the northeast of the Icelandic survey area, extending to the Norwegian coast (Fig. 1, Annex 5).

Coordination with “Opportunity” shipboard surveys.

Permission and funding has already been sought to place dedicated cetacean observers on the MAR-ECO (North Atlantic Ridge, one UK and one US vessel) and the Redfish surveys (area south and west of the Icelandic Area, one German and one Russian vessel). NAMMCO will follow up and seek permission to place observers on the North Sea Mackerel survey (1 Russian and 2 Norwegian vessels).

Funding

Integrated budget
A summary of the budget is provided in Table 2, Annex 5. The total project cost will be approximately 34 million DKK, of which 48% was confirmed at the time of the meeting.

External funding proposals
Four proposals have been sent out in 2006 for funding different common sub-projects with answers expected from mid-December to mid-January:

1) Nordic Council / Arctic programme (1,700 kDKK): coordination, planning, analysis, Russian participation and provision of external expertise
2) NORA (Nordisk Atlantsamarbejde; 830 kDKK): surveys from 'opportunistic' survey vessels in areas adjacent to the TNASS core area, incl. observer training, travel and salary, and data analysis
3) and 4) Beckett and JL Funds (2,110 kDKK): acoustic survey for sperm and beaked whales, including equipment and data analysis).

Survey Design
Survey design issues were discussed on the basis of a paper presenting strategies for creating good survey designs under various constraints (*e.g.* complex topography, limited effort, animal migration pattern). The Planning group endorsed the approach of using automated design using specialised software to create "design unbiased" designs.

Consideration was given on how to accommodate the coastal and cryptic harbour porpoise as a target species in the Icelandic and Greenlandic aerial surveys. The Planning Committee agreed that a secondary fjord stratum could be developed for Icelandic waters to be surveyed on a pilot/opportunistic basis, without substantially compromising the efficiency of the survey for minke whales.

A Working Group was established (with Pike as chair) for developing the optimal survey design for the survey as a whole and each specific block (including optimal block boundaries, effort distribution and track design). The Working Group should discuss stratification, allocation of effort by stratum and the design of survey transects after it is known how much survey effort each country can contribute to the overall survey.

Field methods
Dedicated ship surveys
There was considerable discussion about the most appropriate method(s) to use on the dedicated vessels, taking into account area, target species, analytical approaches, problems encountered on previous surveys, practical arrangements, cost, *etc*. It was agreed that the primary searching mode should be the BT mode (double platform with tracking) with high powered binoculars for the tracking platform. Tracking would be attempted for the target species. Under poor conditions (*e.g.* heavy swell, Beaufort 5 or more), tracking will cease and if searching continues it will be in one-way IO mode (independent observer). The detailed protocol will be developed by a Working Group on shipboard protocols comprising Desportes (chair), Gunnlaugsson, Hammond, Palka and

Víkingsson. That group will also consider aspects such as school size estimation, delayed closure, ice edge protocol, angle/distance experiment etc. The personnel requirements will be 8 observers
per vessel.

Opportunistic ship surveys
The Planning Committee agreed that to the extent possible, the methods, data collection procedures and equipment to be used by observers on vessels of opportunity should be the same as those for the primary platform on dedicated vessels.

Acoustic survey
The extent of the acoustic survey will depend on external funding. The Sea Mammal Research Unit is a partner in this work and will be responsible for ensuring that the appropriate equipment (and manuals) is present on the relevant vessels.

Dedicated aerial survey
A Working Group was designated (with Donovan as chair) for designing protocols for the aerial surveys. It was agreed that while data would be collected in such a way to enable a variety of analytical approaches to be used (*e.g.* cue counting, standard line transect), cue counting will be the primary method for obtaining abundance estimates for minke and fin whales.

Collection of ancillary data
The Working Group noted that the collection of appropriate effort, weather and behavioural data will be dealt with by the relevant sub-groups on protocols.

Biopsy and tagging
The Planning Group recommended vessels carry the equipment necessary so that biopsy and satellite tagging could be done on an opportunistic basis at the discretion of the cruise leaders subject to the shipboard protocol.

Observers
Experienced observers should be used on all surveys, including observers with experience with tracking for the shipboard survey and with harbour porpoises for aerial survey. Training is required for both ship and aerial observers, as well as those specifically responsible for the acoustic equipment.

Task to be completed
A list of to tasks to be completed was developed (see Annex 5).

Future meeting of the Planning Group
The next meeting should be held in March, after the sub-committees on design and protocol have completed their work (probably mostly email correspondence).

Discussion by the Committee
The Committee was very pleased to see that the planning for the TNASS was well underway. It was particularly encouraging that Canada, Greenland and the Russian

Federation were full participants, and that the USA was willing to work so closely with the TNASS to coordinate their surveys with it. The cooperation of the CODA survey was also acknowledged. The Committee hoped that all of the funding applications would be successful, as this would increase the coverage through the incorporation of "opportunity" vessels, enable the operation of passive acoustic survey on all ships, and improve the coordination of the survey and the dissemination of information to the public.

Noting that there were some outstanding issues regarding the timing of some components of the survey, the Committee agreed that, in principle, all surveys should ideally occur in the same time period, and that this should be similar to previous surveys to maintain comparability in the time series. However it was recognized that the national obligations of participants, in terms of maximizing the probability of obtaining a good abundance estimate for their area, also played a role here. The Committee recommended that participants make every effort to coordinate the timing of the surveys to the extent that was possible and that NAMMCO support this effort.

The Committee also agreed with the view of the Planning Committee that the survey areas of participants should be contiguous. In this regard it was noted that Norway presently plans to survey in the eastern Barents Sea in 2007, which is not contiguous with the TNASS area. The Committee recognized that Norway has a survey programme in place that is based on providing optimal estimates of minke whale abundance for use in the RMP, and that this was their first priority in scheduling surveys. Nevertheless the Committee recommended that Norway fully consider the added value that could be obtained by linking their survey directly with the TNASS, as it is a rare opportunity to obtain more extensive synoptic coverage linked to neighbouring areas in the North Atlantic. The Committee supported the specific recommendation of the Planning Committee in this respect.

The Committee supported all other recommendations by the Planning Committee, wished them and all participants every success in planning, coordinating and conducting the survey, and looked forward to receiving a report on the survey at their next meeting.

9. BY-CATCH OF MARINE MAMMALS

9.1 Update on progress

In 2004 the Scientific Committee carried out an evaluation of the data collection and estimation procedures used in the Icelandic by-catch monitoring programme (NAMMCO 2005). This programme relies on self-reporting through logbooks, and does not cover all Icelandic fisheries. The Scientific Committee concluded that the estimates of by-catch from the system were likely negatively biased, because of poor coverage and possible underreporting. The Committee made a number of recommendations to improve the estimation of by-catch in Icelandic fisheries and strongly recommended that other member countries establish by-catch reporting systems for their fisheries.

Olafsdóttir informed the Committee that while one recommendation, involving estimating the precision of by-catch estimates, had been addressed, the other more substantive recommendations had not. It remains the case that the programme still does not cover all inshore fisheries, particularly the lumpfish fishery which may have a high by-catch of seals and other species.

In 2005 Norway began a monitoring programme for inshore fisheries for cod and anglerfish, details of which are provided in Annex 1, Section 8. The programme relies on "index fishermen" selected and contracted to observe and report detailed statistics on effort, catch and by-catches. Preliminary estimates of by-catch will be presented to the Management Committee Working Group on By-catch at their next meeting. In addition to the two observed fisheries, there is known to be some by-catch in the commercial fisheries for lumpsucker and in recreational gillnet fisheries. The by-catch rates in these fisheries are presently unknown.

There has been no progress in estimating by-catch in Greenlandic and Faroese fisheries, although by-catch in the Faroes is likely low due to the absence of a gill net fishery in shallow waters.

Discussion

The Committee noted and commended the progress that had been made in instituting a programme for estimating by-catch in Norway, particularly in inshore fisheries. However it was also noted that there had been little progress in improving the system in Iceland, according to the recommendations provided in 2004, and no progress in Greenland or the Faroes. Noting that by-catch may constitute an appreciable proportion of the total removals of coastal seals, harbour porpoises and dolphins in some areas, the Committee strongly recommended that all member countries establish by-catch monitoring systems for their fisheries.

10. DATA AND ADMINISTRATION

10.1 Amendment to Rules of Procedure

In 2005 the Committee recommended that the *Rules of Procedure* should be amended to confirm that NAMMCO funds the attendance of invited experts to meetings of NAMMCO Scientific Working Groups, irrespective of their country of origin. This was not clear in the original version. The Council agreed that the usual practice, whereby NAMMCO may fund most experts to attend meetings, if required, should be continued, and amended the *Rules* accordingly.

11. PUBLICATIONS

11.1 NAMMCO Scientific Publications

Pike informed the Committee that Vol. 6, *Grey Seals in the North Atlantic and the Baltic*, edited by Haug, Hammill and Olafsdóttir, is nearly complete, and will be published early in 2007. It will contain 17 primary papers in addition to the Introduction and Preface. Volume 7 on the North Atlantic Sightings Surveys, was originally to be edited by Øien and Pike, however Øien resigned as editor in

September 2006 and Christina Lockyer has taken over as co-editor with Pike. Significant progress has been made this year, with the completion or near completion of several papers. The editors have set an absolute, no exceptions deadline for the receipt of papers. Therefore it is likely that the volume will be published in 2007, and contain as many as 19 papers.

The recent Working Group on Harbour Seals was positive to the idea of publishing a volume with the central theme of the status of harbour seals in the North Atlantic. Desportes and Bjørge were proposed as editors. A total of 28 working papers were presented at the meeting, so it is likely that there is ample material for a volume. The volume could not be published before 2008.

The Committee recommended that the proposed volume on harbour seals be supported, and that Desportes and Arne Bjørge be editors for the volume. It was also recommended that one or more additional editors be found, preferably at least one from the western Atlantic.

12. BUDGET

Pike presented the budget for 2006 which detailed the costs of all Scientific Committee activities throughout the year. These costs included specific travel funding provided to experts, meeting costs and work contracts. All costs were within budget, and the draft 2006 budget as presented was approved.

13. FUTURE WORK PLANS

13.1 Scientific Committee

It was decided that the next meeting will be held in Greenland in early October, at a place to be decided.

13.2 Working groups

The following working groups will hold meetings during 2007/8:

- TNASS Planning Group, March 2007
- TNASS Planning Group (post survey), October 2007
- Beluga/Narwhal, late 2007 or 2008
- Walrus Working Group, 2008
- Marine Mammal-Fisheries Interactions, possibly 2008 depending on progress
- Dolphins, 2008 depending on progress
- Grey Seals, 2008.

Other meetings may be held depending on requests received from the Council.

13.3 Other matters

The Secretariat took note of these scheduled meetings and also noted that there might be additional requests from the Council in 2006. These will be reflected in the preparation of the 2007 budget.

14. ANY OTHER BUSINESS

Zabavnikov presented the Progress Report for the Russian Federation, which detailed recent research activities on pinnipeds and cetaceans carried out by Knipovich Polar Research Institute of Marine Fisheries and Oceanography (PINRO) in 2005. Highlights of the Report included:

- annual dedicated multispectral aerial surveys in the White Sea, for assessment of harp seal pups numbers during the whelping period;
- coastal small vessel surveys along the Kola Peninsula, to study seal migration;
- joint Russian-Norwegian ecosystem surveys in the Barents Sea using 4 research vessels, 2 Russian and 2 Norwegian, to study seal and whale distribution and abundance during the summer;
- aerial surveys in the Barents Sea in July, to study seal and whale distribution and abundance in relation to other ecosystem components.

The Scientific Committee welcomed this presentation, and the Report from Canada.

The Committee encouraged the Russian Federation to report by-catch from fisheries in the Russan sector. A report on incidental sightings of bowhead whales from the Barents Sea and areas to the east would be useful in that it would complement observations of the species west of Svalbard (see 7.17)

15. MEETING CLOSURE

15.1 Acceptance of report

A draft version of the Report, containing all items that were agreed upon, was accepted on 23 November 2006. The final version was accepted by correspondence on 12 December 2006.

15.2 Closing remarks

The Chair thanked all Committee members and observers for their contribution to the meeting and especially for their extra work resulting from the extensive review carried out this year. She thanked the Rapporteur for his hard work and Sverrir Daniel Halldorssón and the NAMMCO Secretariat for taking care of the practical details.

She thanked the Icelandic delegation for arranging the meeting in such a wonderful venue and for arranging the social events.

On the behalf of the Scientific Committee, she expressed how the Committee was sad to see Daniel Pike leaving his job as Scientific Secretary and returning to Canada. She thanked Daniel for his hard work during the eight years he has served as scientific secretary and acknowledged his patience with the Committee. She thanked him especially for not just having been an extremely competent and efficient scientific secretary, but also for having involved himself deeply in the work of the Committee and having become a driving and inspiring force in its work. The Committee wished Daniel all the luck, recognition and satisfaction he deserves in his Canadian future.

Pike thanked the Committee and noted that, from the very first meeting, he had been treated with respect and as a full and valued member. He especially thanked the national delegations for placing their confidence in him by giving him the chance to carry out whale surveys and analyze data from the wonderful NASS series, noting that this had enriched his working life immensely. He wished the Committee continued success in their work.

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Species	Locality	Area	Study	Season	2006	2007	2008	2009	2011
Narwhal	Melville Bay	Northwest	Survey	August		**xxx**			
	Melville Bay	Northwest	Correction/SID	August/Sept	**xxx**	**xxx**			
	Inglefield Bredning	Northwest	Survey	August		**xxx**			
	Inglefield Bredning	Northwest	Correction/SID	August	**xxx**	**xxx**			
	Uummannaq	West	SID	November	**xxx**	**xxx**	**xxx**		
	Scoresbysund	East	Survey	August			**xxx**		
	Scoresbysund	East	Correction/SID	August			**xxx**	**xxx**	
	All	All	Demographic			**xxx**	**xxx**	**xxx**	
Narwhal/beluga/ walrus	West Greenland	West	Survey	March/April	**xxx**				**xxx**
	Smith Sund	Northwest	Survey	March/April				**xxx**	

Table 1. Research on narwhal, beluga and walrus planned by the Greenland Institute of Natural Resources. Correction – correction factors for diving animals for use with survey estimates; SID – stock identification

Appendix 1

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 ASCOBANS
   - 5.3 ICES
   - 5.4 Canada/Greenland Joint Commission on Conservation and Management of Narwhal and Beluga
6. Role of marine mammals in the marine ecosystem
   - 6.1 Working Group on Marine Mammals – Fisheries Interactions
     - 6.1.1 Report on the Bergen conference (September 2006)
     - 6.1.2 Update on progress since the last WG meeting in October 2004
     - 6.1.3 Future work
   - 6.2 Other matters
7. Marine mammal stocks - status and advice to the Council
   - 7.1 Harp seals
     - 7.1.1 Report of the ICES/NAFO WG (June 2006)
     - 7.1.2 Update on progress
     - 7.1.3 New requests and future work
   - 7.2 Hooded seals
     - 7.2.1 Report of the ICES/NAFO WG (June 2006)
     - 7.2.2 Update on progress
     - 7.2.3 Future work
   - 7.3 Ringed seal
     - 7.3.1 Update on progress since the last WG meeting in February 1996
     - 7.3.2 Future work
   - 7.4 Grey seals
     - 7.4.1 Update on progress since the last WG meeting in April 2003
     - 7.4.2 Future work
   - 7.5 Harbour seals
     - 7.5.1 Report of the Working Group (October 2006)
     - 7.5.2 Update on progress
     - 7.5.3 Future work
   - 7.6 Walrus
     - 7.6.1 Update on progress since the last WG meeting in January 2005
     - 7.6.2 New request

7.16.2 Update on progress since the last WG meeting in September 1999
7.16.3 Future work
7.17 Other
8. North Atlantic Sightings Surveys
8.1 NASS-2001 and earlier surveys
8.2 Report of the planning Working Group for TNASS
8.3 Using TNASS for promoting NAMMCO's work: propagation possibilities
9. By-catch of Marine Mammals
9.1 Update on progress
9.2 Other
10. Data and administration
10.1 Amendment to Rules of Procedure
11. Publications
11.1 NAMMCO Scientific Publications
11.2 Other publications
12. Budget
13. Future work plans
13.1 Scientific Committee
13.2 Working Groups
13.3 Other Matters
14. Any Other Business
15. Meeting closure
15.1 Acceptance of report
15.2 Closing remarks.

Appendix 2

LIST OF DOCUMENTS

Doc. No.	Title
SC/14/1	List of Participants.
SC/14/2	Provisional Annotated Agenda
SC/14/3	List of Documents.
SC/14/NPR-F	National Progress Report – Faroe Islands.
SC/14/NPR-G	National Progress Report – Greenland.
SC/14/NPR-I	National Progress Report – Iceland.
SC/14/NPR-N	National Progress Report – Norway.
SC/14/NPR-C	National Progress Report – Canada.
SC/14/NPR-R	National Progress Report – Russian Federation.
SC/14/4	Observers Report: 58th Meeting of the IWC Scientific Committee, St Kitts and Nevis.
SC/14/5	Observers Report: ASCOBANS 13th Advisory Committee Meeting, Tampere, Finland.
SC/14/6	Report from the 2006 activities in ICES.
SC/14/7	Bloch, D. 2006. Norwegian pelagic whaling in the North Atlantic and around Iceland, 1917-1937. NAMMCO SC/. 1-11.
SC/14/8	Bloch, D. 2006. Norwegian coastal whaling, 1868-1986. NAMMCO (unpublished report). 1-43.
SC/14/9	ICES/NAFO Working Group on Harp and Hooded Seals- Report 2006.
SC/14/10	Report of the Joint Meeting of the NAMMCO Working Group on North Atlantic Fin Whales and the IWC Scientific Committee.
SC/14/11	Heide-Jørgensen, M.P., Simon, M.J. and Laidre, K.L. Estimates of large whale abundance in Greenland waters from a ship-based survey in 2005.
SC/14/12	Heide-Jørgensen, M.P., Borchers, D.L., Witting, L., Simon, M.J., Laidre, K.L., Rosing-Asvid, A. and Pike, D.G. Summary of an aerial survey of large whales in West Greenland in 2005.
SC/14/13	Heide-Jørgensen, M.P., Borchers, D.L., Witting, L., Simon, M.J., Laidre, K.L., Rosing-Asvid, A. and Pike, D.G. Preliminary analyses of the 2005 aerial survey of large whale abundance in West Greenland.
SC/14/14	Report of the NAMMCO Working Group on Harbour Seals.
SC/14/15	Report of the NAMMCO Planning Committee for the Trans North Atlantic Sightings Survey, March 2006.
SC/14/16	Report of the NAMMCO Planning Committee for the Trans North Atlantic Sightings Survey, November 2006.
SC/14/17	Proposed amendment to the Rules of Procedure for the Scientific Committee.
SC/14/18	Draft Budget 2006.
SC/14/19	Summary of requests by NAMMCO Council to the Scientific Committee, and responses by the Scientific Committee.
SC/14/20	Status of *NAMMCO Scientific Publications.*

Doc. No.	Title
SC/14/21	Pike, D.G., Víkingsson, G.A., Gunnlaugsson, Th. and Øien, N. 2006. A note on the distribution and abundance of blue whales (*Balaenoptera musculus*) in the Central and Northeast North Atlantic.
SC/14/22	Bloch, D. and Allison, C. 2006. Bryde's whales (*Balaenoptera bryderi*) found in the Norwegian whaling statistics, 1926.
SC/14/23	Haug, T., Salberg, A.-B. and Øigård, T.A. Consequences of various catch options on harp seal stocks in the northeast Atlantic.
SC/14/24	Harp seals: Update on progress.
SC/14/25	Hooded seals: Update on progress.
SC/14/26	Ringed seals: Update on progress.
SC/14/27	Grey seals: Update on progress.
SC/14/28	Harbour seals: Update on progress.
SC/14/29	Walrus: Update on progress.
SC/14/30	Fin whales: Update on progress.
SC/14/31	Humpback whales: Update on progress.
SC/14/32	Minke whales: Update on progress.
SC/14/33	Narwhal: Update on progress.
SC/14/34	Beluga: Update on progress.
SC/14/35	Bottlenose whales: Update on progress.
SC/14/35	Killer whales: Update on progress.
SC/14/36	Pilot whales: Update on progress.
SC/14/37	Dolphins: Update on progress.
SC/14/38	Harbour porpoise: Update on progress.
SC/14/39	Skaug, H., Daníelsdóttir, A.K. and Víkingsson, G.A. Relatedness of North Atlantic fin whales.
SC/14/40	Wiig, Ø., Bachmann, L., Janik, V.M., Kovacs, K.M. and Lydersen, C. Spitzbergen bowhead whales revisited.
SC/14/41	Report of the *Ad Hoc* Working Group: Are fin whales in the Central North Atlantic appropriately listed in CITES Appendix I?
SC/14/1	List of Participants.
SC/14/2	Provisional Annotated Agenda (Draft).

BACKGROUND DOCUMENTS

Doc. No.	Agenda	Title
SC/14/O/1	7.1, 7.2	ICES/NAFO Working Group on Harp and Hooded Seals- Report 2005.
SC/14/O/2	7	ICES/NAFO Working Group on Marine Mammal Ecology- Report 2006.
SC/14/O/3	7.15, 7.16	SCANS-II: Small cetaceans in the European Atlantic and North Sea.

ANNEX 1

NAMMCO SCIENTIFIC COMMITTEE
WORKING GROUP ON HARBOUR SEALS

Copenhagen, 3-6 October 2006

1. OPENING REMARKS

Chair Genevieve Desportes welcomed the delegates (see Section 6.2) to the first meeting of the NAMMCO Scientific Committee Working Group on Harbour seals, which represents the first ever North Atlantic working group focusing on harbour seals. She noted that the Working Group had been formed in response to a request from the Council of NAMMCO:

Harbour seal abundance has fluctuated in the Northeast Atlantic in recent years due to local outbreaks of viral distemper. Usually these outbreaks have been followed by rapid recoveries, and harbour seal abundance may have increased in many areas. In some areas, harbour seals are harvested and/or taken incidentally by fisheries and aquaculture operations (e.g. Greenland, Norway and Iceland). They also have significant direct and indirect interactions with fisheries in many areas. For these reasons, the Scientific Committee is requested to:

- *Review and assess the status of harbour seals throughout the North Atlantic;*
- *Review and evaluate the applied survey methods;*
- *Assess stock delineation using available data on genetics, spatial and temporal distribution and other sources;*
- *review available information about harbour seal ecology;*
- *Identify interactions with fisheries and aquaculture.*

The Working Group had therefore been assembled with emphasis on expertise on the North Atlantic and adjoining seas, notably the North Sea and Baltic. As the main task of the Working Group was to assess the status of harbour seal stocks, a necessary first step would be to review the evidence for stock structure and identify putative stocks for assessment.

2. ADOPTION OF AGENDA

The Agenda (Appendix 1) was accepted with minor changes.

3. APPOINTMENT OF RAPPORTEUR(S)

Daniel Pike, Scientific Secretary of NAMMCO, was selected as Rapporteur for the meeting, with the help of other members as required.

4. REVIEW OF AVAILABLE DOCUMENTS AND REPORTS

A large number of Working Papers and background documents (Appendix 2) were available for the meeting, and it was agreed to discuss each one as it pertained to the agenda item being considered. It was noted that an ICES Working Group on Marine Mammal Ecology had recently reviewed survey methods for coastal seals, and the

Working Group agreed to review their Report under Agenda Item 6.

5. STOCK DELINEATION (GENETIC DATA, SPATIAL AND TEMPORAL DISTRIBUTION INCL. SATELLITE TAGGING DATA)

Genetic evidence

A review of the most comprehensive studies of the genetic population structure of the harbour seal in Northern Atlantic was provided in **HS/22** and is summarized in Table 1. To summarize the results of the table focussing on the different areas, the known genetic population structure based on information from neutral markers (mtDNA and a suite of nuclear microsatellites markers) in the North Sea and UK showed the following population structure (Fig. 1): Northern Ireland and Scotland, East England, and Wadden Sea.. The following sub-population structure was suggested for Scandinavia: East Limfjord, Skagerrak, Kattegat, West Baltic, Norwegian west coast. The East Baltic population appears to be separate from other areas. In the Central and Northwest Atlantic separate populations are suggested for Iceland, Churchill in Hudson Bay, Miquelon Island and Sable Island.

In discussion it was noted that certain aspects of the ecology and biology of harbour seals, such as breeding in discrete colonies with a high degree of philopatry, short breeding season, coastal distribution, lack of strong seasonal migrations and a relatively sedentary nature compared with most other Atlantic seals, would lead to the expectation of a complex stock structure (*i.e.* many small stocks rather than few large). Genetic stock structure might arise through a combination of isolation by distance, limited exchange of breeders between breeding colonies, and geographical gaps in suitable breeding and feeding habitat. While at one level the most obvious stock unit might be the breeding colony itself, this degree of disaggregation might not be useful in a conservation management context. The Working Group therefore agreed to use the best available evidence to describe broad scale stock structure, while understanding that a more detailed view might be preferable for some purposes.

The results of genetic analyses to date have revealed a rather low level of differentiation on a small scale but detectable differences over medium scales (200-400 km) when sampling has been adequate (*e.g.* Denmark and Sweden). However it was noted that most samples have come from animals killed in the PDV outbreaks, and these may or may not correspond to breeding stocks, depending when the samples were taken. Samples for genetic analysis should best be taken from animals on the breeding colonies, or at least from animals whose breeding colony is known.

It should be recognised that the levels of genetic differentiation detected depend on sample size, genetic markers used and population genetic statistical software applied. For example, analyses using the programme STRUCTURE (Pritchard *et al*. 2000) indicated that the most probable number of stocks in Danish waters was two, while pairwise comparisons of sampling locations indicated the existence of five putative stocks. Andersen indicated that analyses using STRUCTURE were in general less sensitive to small differences between stocks, and that pairwise comparisons revealed a finer structure.

Samples suitable for genetic analysis are available from several jurisdictions, and analytical programmes are being planned by all countries. These analyses could be more useful and revealing if some standardization of methodology and analyses was undertaken and recommendations for this are provided in Section 10.

Other evidence

Acoustic

Bjørgesæter *et al.* (2004) compared the vocalizations of male harbour seals during the breeding season at six colonies in Norway, Sweden and Scotland. Multivariate analyses revealed two broad geographical groups, but also significant differences in the vocal repertoires between all colonies. It was suggested that these differences might be explained by vocal divergence between groups due to strong site fidelity to specific breeding areas. This may further indicate sub-population structures at a fine geographical scale along the Norwegian coast. However the stability of vocal repertoires over time has not been studied.

Satellite tagging

Papers HS/8, 12, 13, 15, 16, 18, 21, 26 and 27 provided details of satellite tag applications in several areas of the North Atlantic. Results from these experiments have been generally consistent with the following features, relevant to stock delineation:

- harbour seals undertake relatively short excursions from their favoured haulout area, usually of less than 50 km, but this may vary greatly between haulouts;
- excursions vary between a few hours to up to 9 days, and this also differs between haulouts;
- there is little evidence of extensive seasonal migrations;
- harbour seals tend to return to the same haulout, but may make excursions to other haulouts;
- behaviour seems to vary between individual animals, with some consistently making longer excursions than others;
- there is little evidence of sexual differentiation in behaviour, except that females tend to stay close to the breeding colony during the breeding season;
- there may be variation in behaviour between age groups, with younger animals being more prone to longer excursions and exchange between areas.

The emerging picture suggests a relatively sedentary, coastal seal, faithful to specific breeding colonies and haulout areas, but with some exchange between areas.

Satellite tagging conducted in Denmark (HS/21) reveals movement patterns that are consistent with the stock structure suggested by genetics, in that animals tagged in a putative stock area tend to remain within that area. It was pointed out that most tag applications do not encompass the breeding season, and therefore may not reveal much about breeding stocks. Stocks might mix outside the breeding season but still be faithful to their respective breeding areas. In fact to provide strong evidence of a breeding population in a specific location, a tag application would have to endure at least two breeding seasons, and this has not yet been achieved. Nevertheless the lack of mixing between putative stock areas at all times of the year can be taken as confirmatory evidence of stock structure.

Photographic identification

HS/17 outlined a method using the unique pelage patterns of harbour seals to photo-identify individuals through computer-aided pattern recognition. The method was used to provide short and long term mark-recapture estimates of the numbers of animals using a haulout site. It was considered that the method could also be used over multi-year time periods to directly assess the degree of fidelity to breeding sites, and the degree of exchange between breeding sites. It also provides the potential for providing information on individual life history. The method, however, should be validated with known animals (for example seals in human care) to make sure that the unique pattern is conserved throughout the animal's life.

Branding techniques

In Sweden, long-term life history information is being collected via freeze-branding of pups. It provides additional continuous information on movements and site fidelity.

Contaminants

This could provide additional information on stock structure and foraging areas. This approach could be regarded as a supplement to genetics information.

Other

Harbour seals were exterminated in the Faroe Islands, probably through overhunting, by about 1850 (HS/4). They have not recolonized the islands and very few harbour seals have been seen or sampled in the Faroes since that time, despite an intensive bounty hunt (directed towards grey seals) in the 1960's. This suggests that the harbour seals of the Faroe Islands comprised a separate stock or stocks, as otherwise recolonization would be expected. Examination of preserved material from the Faroes might be useful in genetic analyses.

A similar situation exists in West Greenland, where harbour seals have been reduced to very low levels or extirpated from most areas of the coast over the past 50 years (**HS/5**). Little recolonization has been observed, although a potential source population survives in SW and SE Greenland. However hunting is still allowed in all areas.

Conclusions

The Working Group regarded the stock structure indicated in Table 1 and Fig. 1 to be preliminary as it is based mainly on limited genetic sampling, often from opportunistically collected samples taken from seasons and areas outside the breeding period and areas. Further sampling and integrated analytical methods will likely reveal structure on a smaller scale, as has already been seen in Danish / Swedish waters. The level of differentiation required will depend somewhat on the general objectives of the management programme. For example, a finer level of stock delineation will be desirable for objectives related to harvest management than for objectives related to conservation of viable populations on a large scale without harvest. Non-genetic methods, including acoustics and individual-based methods such as photography and branding, also hold promise for establishing stock boundaries at smaller scales. Recommendations for research related to stock delineation are given in Section 10.

6. REVIEW OF SURVEY METHODS

Aerial and vessel surveys

Survey methods for harbour seals were recently reviewed by ICES (2003). The standard methodology for estimating harbour seal population size is via fixed-wing, occasionally helicopter, aerial surveys of haulout sites during the pupping or moulting periods when a larger fraction of seals are hauled out. In areas where seals are cryptic, *e.g.* rocky shores, thermal imaging camera are sometimes used. The thermal imager can detect groups of seals at distances of over 3km. Similar methods are used in the USA (HS/27), Canada (HS/26), Iceland (HS/6), Ireland (HS/13), the UK (HS/14), Norway (HS/9), Denmark (HS/20), the Baltic (HS/12) and the Wadden Sea (HS/24). Daily survey counts are normally made 2 hours either side of low tide, particularly mid-day, when more animals are expected to be out of the water. These counts only provide an index of the total population, and other methods have been imployed to derive correction factors to convert the counts to estimates of total abundance (see below). Details of the survey methods are presented in the noted working papers and many published reports, and are beyond the scope of this report.

In HS/20 statistical power analyses were conducted to determine the number of surveys that should be conducted in a single year, and the inter-annual frequency of surveys, which would maximize the power to detect trends in the population. The analysis used a large dataset of aerial surveys conducted between 1979 and 2006 in Denmark, Sweden and southern Norway. The analyses showed that there is much more power gained by surveying every year rather than several surveys every other year. In addition, trying to reduce the variation between surveys will have a great effect in some areas. In this area, most power was gained by using a ”trimmed mean” of the highest two of three counts at a particular site, although using the highest count was almost as good. There was little advantage to surveying more than three times per year. It was recommended that surveys should be carried out every year in late August, with at least three surveys performed per year.

There was some discussion about the use of the trimmed mean rather than simply choosing the highest count. Not using the lowest count helps to eliminate the problem of artificially low counts resulting from disturbance. In some areas seals react to a prolonged period of bad weather by hauling out in greater than usual numbers after the weather improves. Therefore index counts can be abnormally high as well as abnormally low. The trimmed mean is therefore somewhat more robust in the detection of trends, although the difference between using it and the highest count was not great. It was noted that this may be specific for this area, and use of the highest count may be better in other areas. However, when the highest of several counts are used, they should be summed on a regional basis, to avoid multiple counting of seals that have moved between haulout sites. In cases where a predictive model for haulout proportion has been developed, a single survey, with associated covariates, should be adequate.

In Iceland harbour seals have been surveyed on an approximately triennial basis since 1980. HS/6 estimated trend in abundance from 1980 to 2006 using GLM on log

transformed counts. Seal numbers declined significantly 5% (SE 1%) yr^{-1} during this period, with a sharper decline initially. The influence of covariates; wind force, tide height, time to low tide and tidal status (spring or neap tides), on trend estimates was significant, demonstrating the need to include covariates in statistical analyses to estimate trends more accurately. More seals were observed during spring as opposed to neap tides; at low tide; and in light wind conditions (ca. 5 m. sec^{-1}) as opposed to stronger or weaker winds. There was also a significant interaction between haulout sites and tide height, indicating that the effect of tide height differed between sites. Seal counts were transformed to estimates under optimal survey conditions using these covariates, and these corrected counts were in all cases higher than the uncorrected counts. The trend in corrected counts was nearly the same as the trend in the uncorrected counts.

The Working Group noted that the approach of adjusting counts using environmental covariates was particularly valuable to optimise survey counts in cases where within-year replicate surveys were not available. However several survey years of data are required to do this. An alternative approach would be to conduct several within-year replicate surveys as described later. Catch of seals could also be included in the modelling to see if it influences the estimation of trends. However in this case it is suspected that a large proportion of the catch is probably by-catch, and no estimates of by-catch are available for this area.

Harbour seals were counted along the entire Norwegian coast at known moulting haulout sites in the period mid August to early September 2003-2006, and these surveys were described in HS/9. In 2003-2005, almost all known moulting areas were covered by aerial photographic surveys using a fixed-wing aircraft fitted with a gyro mounted Leica RC 30 camera. The surveys were flown at altitudes of approximately 800-900 ft, and at low tide (± 2 hours), and as far as possible in good weather conditions. In some sub-areas, two or three independent surveys were conducted. In addition, visual counts using binoculars from smaller boats and islands were carried out in the Lysefjord, Rogaland in 2003, in the Porsangerfjord, Finnmark in 2005, and along the western Skagerrak coast in 2006. The 2003-2006 surveys revealed a total minimum population of 6,668 harbour seals in Norwegian waters. Harbour seals were most abundant in the Nordland and Sør-Trøndelag counties with counts of approximately 2,500 and 1,500 harbour seals, respectively.

Similar methods are used in the Wadden Sea (HS/24), with multiple (5) digital photographic surveys conducted during breeding and moulting seasons. In France the three haul out sites are surveyed by aerial, boat or ground survey (HS/25).

Historical information on harbour seal population in the U.S. is lacking, and HS/27 summarizes recent counts conducted between 1981 to 2001 during the pupping season (late May to early June) along the coast of Maine. Counts were conducted using aerial photographic survey. In 2001, the daily counts were corrected based on the fraction of radio-tagged seals relocated (Gilbert *et al.* 2005).

Surveys of the estuarine haulout sites on the east coast of Britain were made using

aerial photography from a fixed-wing aircraft. On sandbanks, seals are relatively easily located and this method of survey is highly cost-effective. In Scotland and Ireland, seals hauling out on rocky or seaweed covered shores are well camouflaged and difficult to detect (HS/13 and HS/14). Surveys of these coastlines are by helicopter using a thermal imaging camera. The thermal imager can detect groups of seals at distances of over 3km. This technique enables rapid, thorough and synoptic surveying of complex coastlines.

In discussion it was noted that there had been advances in the technology of thermal imaging and the equipment was now much lighter, more compact and affordable. The method could easily be adapted to vertical imaging from a fixed-wing craft. Flying the entire coast is necessary in areas where the locations of haulouts are not well documented and/or if surveys are infrequent. Speciation of mixed groups of harbour and grey seals can be problematic in some cases. Thermal imaging is more effective for moulting rather than pupping surveys, and on cool and cloudy rather than warm and sunny days.

Recent surveys in Canada (HS/26) have been conducted using a helicopter to count hauled-out animals along the coast and around small islands in parts of the Gulf of St. Lawrence and the St Lawrence estuary at an altitude of 152.4 m, and a distance of 300 m offshore to minimize disturbance. In the estuary surveys were flown during June 1995, 1996, and 1997, and in August during 1994, 1995, 1996 and 1997 and in different parts of the Gulf during June 1996 and 2001 (Robillard *et al*. 2005). Changes in counts over time in sectors that were flown under similar conditions were examined at nine sites that were surveyed in June and in August. Counts at the breeding sites are preferred as there is less disturbance at this time of year and less admixture with grey seals.

Deriving correction factors for haulout surveys

HS/28 documented the harbour seal haul out behaviour in Vesterålen, Norway, during the annual moulting period in 2003 and 2004. The purpose of these studies was to obtain necessary data for estimation of a correction factor to account for unobserved animals in aerial photographic surveys and visual counts. The studies were carried out using VHF telemetric equipment (using VHF flipper tags). The data were processed using various time series analysis techniques. First, a smoothed estimate of the proportion of seals that haulout was obtained using thin-plate regression splines in a GAM framework. Furthermore, in order to get some deeper knowledge about the behaviour of the seal, a multiscale analysis tool was applied in order to visualize the haulout pattern at different time scales. The proportion of seals hauled out was at a maximum during peak sun elevation and near low tide. The results of the time series analysis show that the main proportion of the hauled-out seals was in the range of 0.2 – 0.5 of pups and subadults at low tide, and that the sea level predicts the proportion of seals better than the sun elevation. The results are in good agreement with previous studies.

In discussion it was noted that the age composition of the tagged sample was biased relative to the population, consisting mainly of subadults and pups. Haulout patterns

differ by age and sex, so the derived correction factors will be biased when applied to the entire haulout. Unfortunately the age and sex composition of the population is seldom available. However a very coarse classification (*e.g.* pups, subadults, adults) may be adequate for the estimation of the proportion hauled out. It was also uncertain how constant the estimated rates would be over time, and between sites. Some differences were noted between the 2 years of this study, although these may be attributable to operational factors. A careful selection of predictor variables that area applicable over a broad range of sites may make this type of modelling broadly applicable, but this should be tested. Long term studies using individual identification methods, such as freeze-branding and photo identification, will also be valuable for this purpose.

Similar work was described in HS/8, where haulout behaviour of the Svalbard harbour seals was studied from June to August 2000 using a combination of counts performed hourly during 12 or 24 hr sessions in addition to telemetric data from 37 VHF-tagged seals (Reder *et al.* 2003). The number of animals increased steadily throughout the summer reaching a peak during the moulting period in August. Season (date), time of day, tidal state and temperature all significantly influenced the number of seals hauled out. Haulout patterns varied by age and sex generally in accordance with the demands of lactation, mating and moult. Not surprisingly, the mother-pup pairs were closely associated during the nursing period, while the mothers left the haulout areas for periods of several days during the post lactation period. The haulout behaviour of adult males suggested that they adjusted their behaviour to follow female distribution and movement patterns during the breeding period. Most juveniles and adults of both sexes stayed ashore for prolonged periods during moulting, which took place first in juveniles, then in adult females and last in adult males. The basic haulout behaviour pattern of the Svalbard harbour seals are similar to what is found for this species at lower latitudes. The data collected in this study can form the basis for making correction factors for population size assessments based on surveys of hauled out animals.

Sharples *et al.* **(**HS/15**)** presented a method to estimate seasonal absolute abundance that corrects seal counts using information from satellite telemetry data. The method was applied to data collected in a study of harbour seals in St Andrews Bay, southeast Scotland. Counts at haulout sites were made monthly between January 2001 and July 2003. Twenty-five seals were caught between November 2001 and March 2003 and were tagged with Argos Satellite Relay Data Loggers (SRDLs). A total of 3,282 seal days of data were recorded, at an average of 131 days (se = 6.0 days), per individual. To estimate the proportion of time spent hauled out, time at sea on foraging trips was modelled separately from haulout behaviour close to haulout sites because of the different temporal scales and different factors affecting these processes. A generalized linear mixed model (GLMM) framework was developed to capture the longitudinal nature of the data and the repeated measures across individuals. Despite considerable seasonal variability in the number of seals counted at haulout sites, the model generated consistent estimates of absolute abundance, the mean being 807 (95 % CI: 614 to 1,125). These new seasonal estimates will be valuable in assessing interactions between seals and fish stocks in this area and in the development of conservation and

management plans for seals and other species in the Firth of Tay Special Area of Conservation (SAC). The methods provide a framework for estimating the seasonal abundance of populations of phocid species in many areas of the world. The use of satellite telemetry provides important additional information on population integrity and at-sea distribution and behaviour.

The Working Group welcomed this advance in methodology, noting that it would enable surveys conducted at times outside the breeding and moulting seasons to be corrected for the proportion of animals at sea, which varies greatly throughout the year. In discussion it was noted that, similar to the situation with HS/28, the age distribution of the tagged animals (all adults) was not consistent with the age distribution on the haulout. As there is variation in haulout behaviour with age, this may bias the estimation of the fraction hauled out. It was also noted that the application of this method to a complex coastal environment with many haulouts, as opposed to the simple self-contained system of St Andrews Bay, might prove to be challenging. The expense of putting out many satellite tags for each site might also prove a limitation on the broader application of this method.

HS/18 presented a study which used satellite transmitters deployed on 10 harbour seals in southwest Scotland and 14 in northwest Scotland to examine movements and haul out patterns. Two geographical scales of movement were apparent in different seasons. Generally seals made short trips to within 25 km of the haulout site, often (40% of the time) returning to the sites they had just left. Thus a degree of site-fidelity and coastal foraging was apparent. However some individuals occasionally undertook longer distance movements of over 100 km, indicating the presence of at least some mixing between regions. Around half of the trips lasted between 12 and 24 hours, with the longest recorded trip lasting over nine days (217 hours). The proportion of time harbour seals were hauled out varied spatially, temporarily and according to sex (daily means of between 11 and 27%). The mean haul out duration was five hours, with a maximum of over 24 hours.

Other methods

HS/19 presented a study in which the unique pelage patterns of harbour seals were used for photoidentification of individuals from their natural markings. Harbour seals in northwest Scotland were photographed each month between April and October 2005. Each seal was photographed several times from both sides and at different angles. Different pattern cells or combinations of pattern cells (ventral, flank, shoulder and side of head) were used for computerised selection of potential matching pairs and those pairs were then checked visually. There was monthly variation in population estimates, calculated using capture-recapture methods, with highest numbers of adult harbour seals in May. Around three times more individuals used the sampling area between April and October (268, CV = 0.04) than were observed in a single aerial count in August (83, CV = 0.15) or were estimated per month using capture-recapture methods (mean = 86, CV = 0.07). In September 4% of the seals that used the sampling area between April and October were seen hauled out elsewhere within a 30 km radius. With increasingly affordable camera equipment combined with digital technology, photo-identification techniques and capture-recapture methods provide

both a potential additional method for monitoring harbour seals and important management information for the conservation of the population.

The Working Group welcomed this paper and noted that it provided very precise estimates of the number of seals on a haulout over short periods and the number using the haulout over longer periods (months). It was noted however, that the factor of three quoted in the previous paragraph assumes a closed population which is unlikely to be the case. However the method is labour intensive, and approaching seals closely enough to obtain a photo of suitable quality is not possible in many areas.On the other hand, information on individual life histories can be obtained over time. As previously mentioned, the method should be validated with known animals to make sure than the unique pelage patterns are conserved throughtout the animal's life.

Survey methods used in all the jurisdictions represented at the meeting are summarized in Table 2. Recommendations to improve surveys are provided in Section 10.

7. SIZE AND STATUS OF HARBOUR SEAL POPULATIONS/STOCKS

7.1 Greenland

Skin purchase statistics and catch statistics on harbour seals in Greenland were analyzed in order to extract information about trends in harbour seal abundance and in geographical and seasonal distribution of the catches (**HS/5**). Harbour seals have been severely depleted all along the Greenland west coast. Hunting seems to have been an important factor for this depletion, but intensive fishery for Arctic char and the strong cooling along the west coast of Greenland during the 1970s, 1980s and 1990s might also have influenced the seals significantly. Unlike the rest of Greenland, catches have been increasing in the southernmost part of Greenland since the 1950s. A dozen hunters living close to the tip of Greenland take a large part of these catches. They have been asked about their hunt which they claim is mainly accidental when harbour seals come into their hunting area. They still see large numbers of harbour seals hauling out during fall (100+ individuals) and don't observe any negative trend in harbour seal numbers in their area.

The Working Group noted the conclusion of HS/5 that harbour seals had been extirpated or reduced to extremely low levels in all areas of West Greenland, except for a small area of extreme south and southeast Greenland. It is very likely that these reductions are due to a combination of unsustainable hunting and environmental changes. While the terms of reference for the Working Group did not call on it to provide management recommendations, it was concluded that only a total cessation of harbour seal hunting in all of West Greenland will provide any opportunity for recolonization of the area from the remnant population in the extreme south. It was noted that the hunting of harbour seals is allowed in all areas of Greenland except in a few locations.

The Working Group recommended a research programme focussing on the remnant southern population, beginning with the installation of stationary cameras at known

haulout sites to get some idea of the numbers of animals present. This should be followed by satellite tagging of a few individuals to determine movement patterns and the location of the breeding areas. Once the breeding areas are located, aerial surveys should be conducted. Noting the extreme nature of this conservation issue, the Working Group recommended that this research should be conducted as an urgent priority.

7.2 Iceland

Aerial surveys have been conducted in 1980, 1985, 1989, 1990, 1992, 1995, 1998, 2003 and 2006 (HS/6, see 6. for methodology) on the coast of Iceland. Counting in years 1980 and 2006 resulted in grand totals of the whole coast of 14,459 and 5,358 harbour seals, respectively. The counts adjusted for environmental conditions were 15,800 (95% CI 15,141 – 17,015) and 8,023 (95% CI 6,913 – 9,911), respectively. Harbour seal numbers declined significantly at 5% (SE 1%) yr^{-1} during this period. The influence of covariates; wind force, tide height, time to low tide and tidal status (spring or neap tides), on trend estimates was significant, demonstrating the need to include covariates in statistical analyses to estimate trends more accurately. The distribution of harbour seals was divided into 99 haulout sites and total number of seals on each site was investigated separately. There were significant interactions observed between haulout sites and tide height, indicating different effect of tide height on count of harbour seals on the sites. Declines were highest in Faxa Bay, Breidafjord and on the South coast of Iceland.

To derive a population size for the Icelandic harbour seals the adjusted counts must be corrected for the number of seals missed by observer and the proportion of hauled out seals during the surveys. The seals missed by observers were corrected by applying a conversion factor 1.05 (SE 0.02) derived using simultaneous ground counts, and a correction for the proportion hauled out of 1.6 (range 1.2 – 2.2), derived from literature values, was applied to turn corrected adjusted counts to population size for each survey year from the grand total of adjusted counts. These give estimates of about 26,000 (range 19,000 – 37,000) in 1980 and 14,000 (range 10,000 – 19,000) in 2006. However a correction specific to Icelandic seals is needed.

The Working Group was unable to interpret the substantial observed declines in abundance around Iceland without associated information on historic catch. Anecdotal information suggests that by-catch in the lumpfish fishery may be substantial, but there are no data on this. Some of the areas where most decline occurred (Western and Northwest Iceland) coincide with areas of high lumpfish fishing intensity, but others (southern Iceland) do not. However it was noted that the fishery occurs during the spring when the distribution of seals may be different than that surveyed. The Working Group recommended that, as an urgent priority, that a document be prepared summarizing all available information on abundance, distribution, historical catch, by-catch and ecology of harbour seals in Iceland, and that the Scientific Committee of NAMMCO conduct a formal assessment of the stock. In addition, better information on by-catch should be collected from all fisheries in which harbour seals are taken. Caution should be taken to avoid double reporting,

7.3 Faroes

The harbour seal was exterminated as a breeding species in Faroe Islands about 1850 (HS/4). From historical sources it is evident the harbour seal for centuries was a relatively numerous species in the islands, and that the main distribution grounds were sheltered fjord areas, where also breeding occurred, in May. Compared to the grey seal, another resident of Faroese coastal waters, with a more open water distribution, harbour seals were once more common, but their number seemed to decrease with increasing number of inhabitants and human activities. Seal hunting was introduced with the Norse settlement in the islands in the seven century, and this hunt finally lead to the extermination of the harbour seal. The islanders hunted seals with high intensity because they were very dependent on natural resources, living in an isolated island group where nature not always was in favour. Very few sightings of harbour seals have been documented in recent years, and no recolonization has taken place.

Noting that the lack of recolonization indicated that this was likely a separate stock, with little mixture with other stocks, the Working Group recommended that genetic samples from museum specimens be obtained and compared with other areas. If animals do begin to recolonize the islands, they should be protected from hunting and harassment and the event should be carefully monitored.

7.4 Norway

Svalbard

There is no complete estimate for the size of the population of harbour seals inhabiting Svalbard. A compilation of various opportunistic counts of animals hauled out on Prins Karls Forland from walking, boat, helicopter or snowmobile surveys over several years mainly in the 1980s concluded that the population size was at least 500-600 animals. There was no knowledge available on haulout behaviour of these harbour seals in relation to various environmental, diurnal or seasonal conditions at this time, so no correction was attempted to compensate for animals not hauled out during surveys during these various partial estimates. This knowledge is available now and will be integrated into future surveys for estimation of population size. However, it is clear from the number of seals directly counted in recent years that the population size of harbour seals in Svalbard is at least 1,000 animals.

Svalbard harbour seals are on the National Red List and thus are totally protected from hunting. There are no commercial fisheries in the area that could have negative impacts on this population in terms of competing for resources or interaction with fishing gear. These seals reside in an area that is rarely visited by humans and are thus very naive in their behaviour and are easy to approach compared with harbour seals from populations elsewhere. Due to their very limited distributional range they are considered vulnerable in relation to any stochastic event, such as an oil spill, a virus outbreak etc. The short life span of the harbour seals in this population (see: Lydersen and Kovacs 2005) warrants further investigations.

As no data on trends in abundance or historical harvests were available, the Working Group could not arrive at any firm conclusions about the status of this stock. The short life expectancy in this population warrants further investigation. The planned research

programme was supported.

Mainland Norway

The survey carried out in 2003-6 (described above, HS/9) resulted in a total count approximately 800 seals lower than the count obtained in a similar study carried out during moult in 1996-1999 (Bjørge *et al*. submitted). Both studies covered the same areas and used mainly the same type of aircraft, and the same camera. Increased hunt along the entire coast, incidental mortality in bottom-set nets, and the phocine distemper virus (PDV) epidemics in the Skagerrak region in 2002, could have contributed to the lower present estimate.

The harbour seal quotas are set annually by the Norwegian Ministry of Fisheries, based on the decisions of the national Marine Mammal Council. This Council is composed of representatives from the whaling and sealing industry, and their main objective is to provide management advice to Norwegian authorities in all questions regarding marine mammals. The scientifically recommended quotas for harbour seals provided by the Institute of Marine Research (IMR) to the Council have since 1997 and up till today generally been set at 5 % of the counted population (see *e.g*. Nilssen 2006). However, in the latest years the Norwegian management authorities have increased the recommended quotas by 20-30 %. In order to reduce the abundance of harbour seals along the Norwegian coast, the quotas were increased even more in 2003 by the Marine Mammal Council and the management authorities, now being set at 13 % of the total counted population, except for some small colonies. Also, a bounty was promised for each harbour seal documented taken in Troms and Finnmark. This management regime was extended also for the period 2004–2006, including a bounty paid in the entire area from Finnmark to Møre and Romsdal in 2006.

In the period 1997-2002, 26-93 % of the quotas recommended by the IMR were taken annually (total annual removals varying between 60 and 466 harbour seals). The increased quotas and bounty paid in 2003-2005 did not seem to effect catches in 2003 (457 seals taken), but increased the takes in 2004 and 2005 (549 and 614 seals, respectively). The latter was 107 % and 111 % of the IMR recommended quotas. The bounty paid, may also lead to an increase in the numbers of unreported killed seals (seals that sink), since the bounty is paid only for animals where the lower jaw and body measurements have been sampled.

In discussion the Working Group noted that the current harvest, when combined with likely levels of by-catch (see 8) and possible unreported levels of struck and lost, was probably not sustainable, even given a likely total population estimate of 10-13,000 animals (Bjørge *et al*. submitted). The decrease in the point count from 1996-99 to 2003-6 is in accord with this, although this change in relative abundance would probably not be significant if all sources of variance were incorporated. There is an urgent need for the estimation of region-specific corrections to translate the counts to total abundance, and it was recommended that the study reported in HS/28 (see 6) be repeated in other areas. Noting that by-catch was likely a major source of anthropogenic mortality for Norwegian harbour seals, the Working Group recommended that the present by-catch monitoring system be expanded to include

other fisheries likely to catch seals, including the lumpsucker and recreational gillnet fishery. Finally, documentation of the nature and magnitude of problematic interactions between seals and fisheries would be useful in designing mitigation measures.

7.5 United Kingdom

In the United Kingdom, harbour seals are mainly found in Scotland: in the Northern and Western Isles, in shallow estuaries on the east coast and along the west coast (HS/14). In England, most harbour seals are found in The Wash, in Lincolnshire and Norfolk, with only very small numbers along the south and west coast or in Wales. In Northern Ireland, harbour seals are found in the south, between Carlingford Lough and Belfast Lough. The greatest numbers of seals are found in Scotland, particularly in Shetland, Orkney, the Western Isles and the west coast of Scotland.

Most surveys are carried out by the Sea Mammal Research Unit (SMRU) using different forms of aerial survey and most surveying is in August, during the annual moult (see 6.). The Wash, in England, is normally surveyed twice annually using fixed-wing aircraft. Most of the Scottish coast is surveyed only once on an approximately 5-yearly cycle. Rocky shorelines (most of them!) are surveyed by helicopter using a thermal imaging camera. The sandy east coast estuaries (Firth of Tay and Moray Firth) are surveyed more frequently using a variety of techniques: from land, by fixed-wing aircraft or by helicopter using a thermal imaging camera. Since 1988, the University of Aberdeen has surveyed the Moray Firth repeatedly during the breeding season (June to July) and during the moult (August). SMRU conducted these surveys in 2006 and conducts additional surveys of these two areas during August.

Prior to surveys carried out in August 2006, harbour seal numbers around the UK were considered to be broadly stable, with some differences regionally. Numbers in the Scottish east coast estuaries appeared to have declined in recent years. In the Moray Firth, the decline was attributed to a bounty system which had been in operation for a number of years. There was no obvious explanation for the Firth of Tay. In The Wash, two outbreaks of phocine distemper virus (PDV) in 1988 and 2002 reduced the numbers of seals counted by 50% and 22% respectively. Elsewhere in Scotland there was no obvious variation in the numbers of seals counted during surveys.

In 2006, surveys of Shetland and Orkney showed considerably reduced counts from previous surveys. The reasons for the observed differences are not clear at present. In addition, numbers of harbour seals counted in The Wash have continued to decline since the 2002 PDV epizootic. This is in contrast to the situation following the 1988 outbreak, when numbers remained static for about three years before gradually increasing, and in marked contrast to populations in the south-eastern North Sea, which have shown marked increases following the 2002 PDV epizootic.

There is no organised harvest of harbour seals in the UK. A number of seals are shot under licence, issued by the Scottish Executive or by the Department of the

Environment, Food and Rural Affairs (DEFRA) to reduce predation on salmonids entering river systems. Seals may also be 'taken' at the few netting stations (fixed or sweep) that are scattered around the coast.

In discussion the Working Group could not determine a cause for the recent observed declines of harbour seals at Orkney, Shetland and around the Scottish North Sea coast. Possibilities included: shifts in the time of moulting; recruitment failure due to increased competition with other species, possibly because of a reduction in forage fish stocks; increased predation by sharks or killer whales; increased competition with grey seals for haulout space or other resources; an undetected disease outbreak; or a combination of all or some of these. It was noted that a negative association between trends in abundance in grey and harbour seal had been observed in other areas, including Sable Island, the Kattegat/Skaggerak and the Wadden Sea.

One possible approach would be to develop a modelling approach to determine what magnitude of changes would be required to produce the observed reductions in abundance, and it was recommended that this be pursued. Other recommendations included repeating the survey at the earliest possible opportunity; close monitoring of some colonies to determine if the peak time of moulting has changed; and monitoring of the age and sex distribution of some colonies.

7.6 Ireland

The estimate of 2,905 animals in the Republic of Ireland, when combined with a near identical survey of Northern Ireland in 2002 (Duck 2006), gives an All-Ireland minimum population of 4,153 harbour seals (HS/13, Cronin *et al.,* 2004). Although this estimate is more than three times the 1978 estimate (1,248) (Summers *et al*., 1980), the figures are not directly comparable due to different timing and survey techniques. The 1978 survey was carried out during the breeding season and did not cover the entire coastline of Ireland. The 2003 estimate should instead be considered as a more reliable baseline figure against which future estimates can be compared to assess population trends. The current status of the harbour seal in Ireland is therefore unknown.

A number of dedicated marine mammal and fishery interaction observer programmes have operated in the waters around Ireland, mostly operating offshore and off the south coast. Of these, a small number of harbour seals (three) have been reported to have been entangled in gill (tangle) nets (BIM, unpublished data, Rogan, E. UCC, *pers comm*.). Strandings programmes have primarily focused on recovering small cetaceans for post-mortem examination. Only a small number of harbour seals (<5) have been examined, and in one of these, cause of death was reported to be
from entanglement in fishing gear (Rogan, E. UCC, *pers comm.).*

It is known that harbour seals in Ireland were affected by outbreaks of Phocine Distemper Virus (PDV) in 1988-89 and 2002 (CWSS 1991, CWSS 2002, Barrett *et al*. 2003). Yet, in spite of apparent local increases in seal deaths and changes in haulout counts at a few sites in western Ireland (Gilleran, J., NUIG, *pers. comm.*) and confirmed pathology from an animal found on the Aran Islands (Kennedy, S.,

DARDNI, *pers. comm.*), in the absence of consistent monitoring of regional haulout groups in the Republic and a reliable up-to-date population estimate, it was not clear if the disease caused a significant decline in population size in the Republic or indeed around the island of Ireland as a whole.

As there is no reliable information on past abundance or catches, the Working Group could arrive at no conclusion about the status of harbour seals around Ireland. The Working Group endorsed the recommendations for further research noted above and recommended that the monitoring be continued.

7.7 Southern Scandinavia

Skagerrak, Kattegat, Limfjord and southwestern Baltic

Southern Scandinavia is divided into seven geographically distinct sub-populations (Skagerrak (Area 1), central Kattegat (Area 2), southwestern Kattegat (Area 3), southwestern Baltic Sea (Area 4), central and western parts of Limfjorden (Areas 5 and 6) and the Danish part of the Wadden Sea (Area 7, see 5.). Systematic aerial surveys have been conducted annually or biannually in the Skagerrak, Kattegat and the Wadden Sea since 1979, in the Limfjorden since 1988 and in the western Baltic Sea since 1990.

Before the epidemic in 1988 the sub-populations of harbour seals increased with an annual growth rate between 11 and 16.9%. After the 1988-epidemic aerial surveys showed a decrease in the harbour seal population of 45-56%. After the epidemic all sub-populations increased with an annual growth rate between 1.8 and 15%. The second epidemic in 2002 resulted in population declines of 17-56% of the different sub-populations. After the second epidemic the sub-populations generally increased more rapidly with 2.1-20.5% annually except for one area that continued to decrease. The number of harbour seals counted in Area 1-6 in 2005 was 3,561, 4,829, 532, 549, 422 and 214, respectively. This gives a total for the combined area (1-6) of 10,107 seal in 2005, not corrected for seals in the water at the time of the surveys.

In discussion it was noted that, while records of by-catch are not available, mortality due to by-catch must have been low to allow the high population growth rates observed after the epizootics in 1988 and 2002. The seal populations here are recovering quickly (except for the Limfjord) after the last disease outbreak.

The Working Group supported the recommendations that the survey programme should be optimized for power to detect trends by surveying annually, at least three times per year. An intensive monitoring programme at Limfjord, including feeding studies and individual marking to obtain age structure and life history parameters, would also be useful as this is apparently a stressed population that may be food-limited.

Kalmarsund, Baltic Sea

The harbour seals in Kalmarsund are descendents of the seals that first colonised the Baltic after the last glaciation some 8,000 years ago. They are genetically distinct from adjacent populations in the Southern Baltic and the Kattegat, and occurrence of private

alleles and low genetic diversity suggest more or less complete isolation during much of its history. The population passed a severe bottle-neck in the 1970s, when only 50 animals were counted in the area, and when about 10-20 pups were born. Protective measures led to improved conditions and the population is currently increasing at 7.8% per year and counted numbers amounted to 530 in 2006. Also pup production has increased at a similar rate and 96 pups were counted in the area in 2006. The population is beginning to increase its range since seals older than pups are observed at the southern and eastern parts of Öland. However, only single pups are born at these newly colonised sites. The population is red-listed by IUCN and protected against hunting by national legislation

This population did not suffer any increased mortality during the 1988 and 2002 epizootics, although it is suspected that they had been exposed to the PDV. By-catches, mainly in fyke nets for eel, amounted to about 20 seals until 1998, but modification of traps resulted in substantial reduction of by-catches, and only single animals are now by-caught annually. The population is exposed to organochlorine pollution, which is suspected to have affected fertility rates after the 1960s. High prevalence of osteoporosis and bone lesions (alveolar exostosis) is evident in jaw bones.

The Working Group agreed with the conclusions of the authors that the stock in this area was recovering from near extirpation in the 1970's, but was still at a low level relative to the historic one. It seems likely that the population will continue to expand and perhaps occupy larger parts of its former habitat.

Report from the Baltic Marine Environmental Protection Commission (HELCOM)

In July of 2006 a new HELCOM Recommendation concerning protection of seals in the Baltic Sea area was adopted. The Recommendation defined five *Management Units* for Baltic Sea seal populations, and described a set of *General Management Principles* applicable to the whole Baltic Sea area, and advised National Management Plans to be developed based upon these principles. The general management principles identified the following three management objectives that link the seal populations to the Baltic Sea Ecosystem:

- *populations size (with the long-term objective to allow seal populations to recover towards carrying capacity levels);*
- *distribution (with the long-term objective to allow breeding seals to expand to suitable breeding distribution in all regions of the Baltic); and*
- *health status (with the long-term objective of attaining the health status that secures the continued existence of the populations).*

Specific Target, Limit and Precautionary approach Reference Levels form an integral part of these general management principles and objectives. With regard to population size the HELCOM Recommendation advised that:

- for all populations below the Limit Reference Level, no allowances for deliberate killing should be issued;
- for populations between the Limit Reference Level and the Precautionary Approach Level, licenses for anthropogenic removals can only be issued if a

significant positive long-term growth rate can be observed, and if licenses for anthropogenic removals are issued, special care has to be taken so that the positive long-term growth rate is not jeopardized;

- for populations between the Precautionary Approach and the Target Reference Levels, and for population above the Target Reference Level, licenses for anthropogenic removals can be issued provided that the long-term objectives of the General Management Principles are not compromised.

Finally the HELCOM Recommendation advised the establishment of a HELCOM seal expert working group to advice HELCOM parties in implementing the seal management as outlined in the Recommendation.

The NAMMCO working group on harbour seals endorsed the approach outlined in the HELCOM Recommendation. The working group noted that the general management principles and objectives described by HELCOM are applicable to harbour seal populations in some areas outside the Baltic Sea area. Therefore the NAMMCO working group *recommends* that the HELCOM recommendation be consulted when developing management plans for harbour seals in areas where no plans exist.

7.8 Wadden Sea

After a PDV-epizootic in 1988, the harbour seal population in the Wadden Sea recovered rapidly and the minimum population estimate was 21,000 in 2001. Another PDV outbreak occurred in 2002, and in 2003 the minimum population estimate was 10,817, only 47% of what was expected if no epizootic had occurred. Pup production (number of pups counted per total number counted) in 2003 - 2005 was higher than before the epizootic, and the stocks are increasing at a rapid rate. This can be explained by the skewed age and sex composition of the surviving population. The demographic structure will likely gradually return to a stable composition. Continuation of the close monitoring of the population will enable assessment of the recovery from its depleted size. The main conservation issues facing the stocks in this area are related to industrial activities, especially the establishment of wind farms and gravel extraction. Competitive interactions with fisheries, and by-catch are also concerns.

The Working Group agreed with the conclusion of the authors that the populations in this area were recovering rapidly from the recent disease outbreak in 2002, and that further recovery could be expected. It was recommended that the survey series be continued in this area, as it provides a valuable historical record of the development of the seal populations. The Working Group also supported the other research priorities identified for this area, focusing on foraging ecology (including diet composition and feeding grounds) to identify critical habitats for this species in the North Sea, and determining the level of threat posed by human activities, including recreational boating, establishment of wind farms and gravel extraction.

7.9 Southern North Sea – Channel

The most southern colonies of harbour seals in the Eastern Atlantic are located in France. Three major areas are utilized for breeding and hauling out: Baie du Mont

Saint Michel (BMSM), Baie des Veys (BV) and Baie de Somme (BS). The colonies are regularly monitored by different associations: Maison de la Baie du Mont Saint Michel in coopeartion with Oceanopolis, Groupe Mammalogique Normand, Picardie Nature and La Reserve Naturelle de Beauguillot (since the eighties for BS and the nineties for BMSM and BV). The main objective of this monitoring is to follow the development and breeding success of the populations, and to minimize disturbance by human activities. Different census methods are used, including land census, aerial census (BMSM and BV) and boat census (only BMSM). The three colonies have increased in size substantially since the mid-1990s. Each year, pregnant females, pups and post weaned seals are observed in the three colonies, indicating success in breeding. The largest colony is in the Baie de Somme with about 140 individuals counted in 2005, while 58 harbour seals where observed in BV and 41 in BMSM in 2006. A study report on human activities and possible disturbance (aircraft, walkers and mussel bed shifting) will be available at the end of 2006 for the BMSM. In 2006, the University of La Rochelle has also initiated a satellite tagging study at BMSM.

The Working Group noted that these are very small populations that are increasing in size. As such the monitoring of these groups was encouraged, possibly through detailed individual-based studies, which should be feasible for these small groups.

7.10 Eastern Canada

Harbour seals are found all along the Atlantic Canada coast from Cape Chidley in Labrador to the United Staters border, in the Gulf of St. Lawrence and St. Lawrence River Estuary. Animals also occur in Hudson Bay, and are reported from the southern Baffin Island coast. A small land–locked population, considered to form a separate sub-species (*Phoca vitulina mellonae*) occurs in Lac des loup-marins in northern Quebec. Unfortunately, no large-scale effort has been undertaken to evaluate harbour seal abundance in Atlantic Canada. Instead, available estimates result from regional studies that have addressed specific concerns. These studies have used different methods and methods have for various reasons changed during the studies.

Early estimates of abundance are available for Atlantic Canada, but these are based on responses to questionnaires from fisheries officers on the number of harbour seals they felt were present in their area. These surveys resulted in a very rough estimate of about 13,000 animals in Atlantic Canada. On Sable Island, count and tagging data are available for the number of pups (1970-2002), parturient females (1987-1996) and juveniles, adult males and females (1991-1998) (Boulva and McLaren 1979, Lucas and Stobo 2000, Bowen *et al*. 2003). Using the number of pups as an index of abundance, pup production numbered around 350 animals in the early 1970's. The number of pups increased beginning in 1978 reaching a maximum of just over 600 pups by 1989, then declined to around a dozen pups or less by 2002 (Bowen *et al.* 2003). A decline in the number of juveniles and adults did not occur immediately, but a decline was observed in these age classes as a result of the reduced number of pups moving into the older age classes. This decline appears to result from a combination of shark-inflicted mortality, on both pups and adult females and inter-specific competition with the much more abundant grey seal for food resources (Bowen *et al*. 2003).

Elsewhere, a series of coastal aerial surveys were flown over parts of the Bay of Fundy and southwestern Nova Scotia during 1985, 1986, 1987, 1991 and 1992 (Stobo and Fowler 1994). Total counts of hauled-out animals from these areas varied from 731 in 1985 to 3,534 in 1992. Although the authors concluded that the harbour seal population in this area was likely increasing, inter-annual differences in survey conditions and areas covered did not allow for this change to be quantified.

Helicopter surveys have also been flown to count hauled-out animals along the coast and around small islands in parts of the Gulf of St. Lawrence and the St Lawrence estuary. In the estuary, surveys were flown during June 1995, 1996, and 1997, and in August during 1994, 1995, 1996 and 1997 and in different parts of the Gulf during June 1996 and 2001 (Robillard *et al*. 2005). Changes in counts over time in sectors that were flown under similar conditions were examined at nine sites that were surveyed in June and in August. Although all slopes were positive, only one was significant, indicating numbers are likely stable or increasing slowly. Overall, the June surveys resulted in an average of 469 (SD=60, N=3) hauled-out animals, which is lower than a count of 621 (SD=41, N=3) hauled-out animals flown under similar conditions in August. Aerial surveys in the Gulf of St. Lawrence resulted in counts of 467 animals in 1996 and 423 animals in 2001 for a different area (Robillard *et al.* 2005).

In Newfoundland, Boulva and McLaren (1979) looked at harbour seal abundance and distribution by sending a questionnaire to local fisheries officers. Since then, as in other regions, there has been little attempt to examine harbour seal abundance. A few local boat or aerial surveys, and interviews with fishermen were completed during May-September 2001-2003 to obtain more information on harbour seals in the province (Sjare *et al*. 2005). Direct comparisons with the earlier study (Boulva and McLaren 1979) are not possible, but the impression is that the current distribution has changed little, that numbers at some haulout sites in the southern part of the province may have increased, while abundance at some haulout sites in the western, northern and northeastern part of the province have remained stable or may have declined (Sjare *et al*. 2005).

With the exception of Sable Island, where harbour seal abundance has declined since the 1970s, it is not possible to evaluate trend among harbour seals in Atlantic Canada. A comparison of current distribution, with that observed in the 1970s suggests that there has been little change since then (Boulva and McLaren 1979).

The Working Group was not able to evaluate the status of Canadian stocks of harbour seals because little historical information on abundance or catch is available, and there is no estimate of total abundance for the area. It was recommended that an area-wide estimate of abundance or relative abundance be obtained as soon as possible. The situation at Sable Island is of interest as this group has declined, perhaps due to competitive interactions with grey seals and/or predation by sharks. Therefore it was recommended that this group be closely monitored

7.11 Eastern US

Historical information on harbour seal population in U.S. is lacking. The first abundance estimate was made in the early 1970s (c. 5,000 seals). During the period 1981 to 2001, the uncorrected counts of seals during the pupping season along the coast of Maine increased from 10,543 to 38,014, an annual rate of 6.6 percent. The corrected 2001 abundance estimate was 99,340 harbour seals. Productivity in this population has increased since 1981 from 6.4% pups to 24.4%.

Since 1989, National Marine Fisheries Service fishery observers have documented harbour seal by-catch in several Atlantic coast fisheries, particularly those using anchored sink gillnets (Waring *et al*. 2006b). By-catch has been observed from Maine to western Long Island, and in all seasons north of Cape Cod. Most of the takes have occurred in the Gulf of Maine, Particularly off the Massachusetts coast, across all seasons. A total of 673 harbour seal takes were observed from 1989-2003, the latest data available. The estimated annual by-catch of harbour seals (CV in parenthesis) in northeast sink gillnet fisheries ranged from 370 (0.23) to 1470 (0.38), and the 2003 estimate was 542 (0.28). The length and age composition of sampled animals indicates that majority of the animals are juveniles.

The Working Group noted that harbour seals in this area have been increasing for the past 20 years, and that there is no indication that the population size has stabilized. Therefore it was considered that the populations in this area were recovering from past bounty hunting or mortality due to other sources. It was recommended that the survey series be continued. The area has recently been recolonized by grey seals, and it would be useful to monitor interactions between grey and harbour seals in situation with an expanding grey seal population, to determine if exclusion or competition is taking place. A recent increase in strandings (both live and dead) has been noted, and the reasons for this should be investigated.

The status of harbour seal stocks in all jurisdictions is summarized in Table 3.

8. INTERACTION WITH FISHERIES AND AQUACULTURE

By-catch of harbour seals occurs at some level in all areas but the magnitude of the problem is unknown in most areas. Table 3 provides information about by-catch monitoring programmes by jurisdiction.

Norway

A pilot study in Norway in 2004 revealed the possibility of high by-catches of marine mammals (grey and harbour seals and harbour porpoises) in three coastal gillnet fisheries. These were fisheries for cod, anglerfish and lumpsucker. Starting in October 2005 fisheries for cod and anglerfish (which had the highest fishing effort of the three) were monitored for by-catches of marine mammals. Two commercial fishing vessels (less than 15m total length) in each of 9 coastal fishery statistics areas were selected and contracted (the selection procedure was described in Bjørge *et al*. 2006b) to observe and report detailed statistics on effort, catch and by-catches. In cod fisheries (fisheries targeting cod using bottom-set gillnets of 80-100mm half mesh) about 920,000 kg of cod were landed from the observed operation from October 2005

through August 2006.Two harbour seals were caught during these observed fishing operations. The total landings of cod by vessels less than 15m total length operating similar nets during the same period were about 43.4 million kg indicating that the level of by-catches of harbour seals could be in the order of about 100 seals annually.

In the fisheries targeting anglerfish with large meshed gillnets (180 mm half mesh) about 120,000 kg anglerfish were landed from the observed trips from October 2005 through August 2006. Fifteen harbour seals were caught during these observed operations. In the entire gillnet fisheries for anglerfish about 2.7 million kg were landed during this period indicating a level of by-catch of harbour seals in the order of 350 seals annually.

These estimates of the approximate magnitudes of annual by-catches are based on a preliminary (and erroneous) assumption that within each fishery the by-catch rate is equal across all areas and months. When statistics from a full 12 month period become available the data from the observed fisheries will be subject to further analyses.

In addition to the two observed fisheries, a number of harbour seals are assumed to be taken in the commercial fisheries for lumpsucker and in recreational gillnet fisheries. The by-catch rates in these fisheries are presently unknown.

Most of the Norwegian commercial fish catches are landed by vessels larger than 15 m total length operating demersal trawl and purse seine in offshore areas (in the Barents, North and Norwegian seas). These fisheries are assumed to have relatively low levels of marine mammal by-catches (Bjørge *et al*. 2006b), and in particular of harbour seals which have a coastal distribution along the Norwegian coast (Bjørge *et al* 2002).

Taken together this information suggests that the by-catch of harbour seals in Norwegian waters is roughly equivalent to or greater than the directed catch.

Baltic

By-catch of harbour seals is most common along the Swedish west coast, mainly in coastal fisheries for salmon, eels, flatfish and cod. By-catch was estimated as 461 (95% CI 333 – 506) in 2001, but this was considered an underestimate as it did not include part-time and recreational fishers (Lunneryd *et al.* 2004). In the past there have been interactions with the trap fishery for eels, but gear modification has nearly eliminated the problem.

Scotland

In Scotland some seals are shot when they interfere with salmon aquaculture or wild salmon fisheries, but the numbers killed in this way are not known. There is also some by-catch but estimates were not available at the meeting.

USA

Annual by-catch of harbour seals in US waters is in the high hundreds (see 7.11). There has been some interaction between harbour seals and fish farms, but the shooting of seals is not permitted under US law. The siting of aquaculture operations

is important in minimizing interactions, as the magnitude of seal interactions is related to distance from haulout sites, and little interaction occurs at distances of greater than about 4 km (Nelson *et al.* 2006). Acoustic deterrents have been found to be ineffective in deterring seals.

Canada

Compared to harp, hooded and grey seals, harbour seals are thought to be only minor consumers in the Atlantic Canada ecosystem, owing to their low abundance (Hammill and Stenson 2000), but as outlined elsewhere, there is considerable uncertainty regarding harbour seal abundance in eastern Canadian waters. Harbour seals have been identified as problematic in salmon aquaculture operations in the Bay of Fundy, but this impact has not been quantified. Harbour seals have been implicated in catch losses and damage in small coastal fisheries for smelt (*Osmerus mordax*) and gaspereau (*Alosa pseudoharengus*), but these impacts have not been separated from the impacts of the larger grey seal (Cairns *et al*.2000). Harbour seals are also caught in fishing gear, primarily small trap nets deployed in coastal fisheries, but incidental catch levels have not been quantified.

Iceland

In Iceland seals are generally regarded as competitors by fishermen. Fishermen are also concerned by the impact of sealworm on the value of their catch, although this problem may be mainly related to grey seals. Seals are sometimes shot around fishing nets, aquaculture operations and in salmon rivers, but there are no good estimates of the numbers taken in this way. Seals are taken as by-catch in gillnet fisheries for cod and in the lumpfish fishery. There is a logbook programme in the former fishery but reporting is incomplete and unreliable. There is no monitoring programme for the lumpfish fishery and anecdotal reports indicate that by-catch in this fishery is likely substantial.

Denmark

In Denmark there have in the past been interactions with the coastal fyke net fishery, but gear modifications have been successful in reducing this problem. No estimates of by-catch were available to the meeting, but it was noted that there were no anecdotal reports of high seal by-catch in the area.

9. REVIEW OF AVAILABLE INFORMATION ON HARBOUR SEAL ECOLOGY (INCLUDING DATA FROM SATELLITE TAGGING)

Distribution and movements

Ecological insights gained from satellite tag applications were described in several working papers: HS/8, 16, 18, and 21

HS/8 reviewed a study by Gjertz *et al.* (2001) in which 14 animals at Svalbard were equipped with satellite transmitters during 1992-95. The study animals included subadult and adult animals of both sexes. The animals were tracked for 110.9±79.9 (SD) days (range 7-313 days). All but three of the harbour seals stayed in the Prins Karls Forland area and adjacent offshore waters during the entire tracking period. The

three animals that moved away (all subadult males) traveled south along the coast of Spitsbergen. One stayed in an offshore area out from Hornsund, while the two others moved further south, down to Bjørnøya (~74.5°N) and stayed in this general area for the rest of the tracking period. This study concluded that the majority of the harbour seals in Svalbard appear to be stationary and that their local distribution around Prins Karls Forland seems to be affected little by the presence of drifting sea ice. More satellite tagging is planned for this area.

HS/16 presented distributional information gained from satellite tags applied to 113 harbour seals, from November 2001 to 2006. A total of 12,154 days of harbour seal data have now been collected, an enormous wealth of information on populations throughout Britain, providing data on locations while at sea and on land, diving behaviour and haulout behaviour on land. This data set represents animals from all the major harbour seal populations in the western North Sea. In each study region harbour seals were making repetitive shorter distance foraging trips as well as more further ranging movements. There were marked differences in movements of animals tagged from different populations. For example animals in Orkney made relatively short foraging trips of 30 to 40 km, whereas animals to the south in the Wash made more distant foraging movements of up 120 km. Movement data received from the tags, combined with information on the number of animals counted during aerial surveys at haulouts have been used to predict at sea usage of the populations in question. Dense areas of usage were found to be as far as 90 km from haulouts, much further than previously thought for this species. Statistical models were constructed to determine predictors of foraging habitat with respect to environmental variables. Depth and distance from the haulout captured the greatest variability consistently in all sites with sediment type explaining less of the variation with regional differences.

HS/18 reported results from satellite transmitters deployed on 10 harbour seals in southwest Scotland and 14 in northwest Scotland to examine movements and haulout patterns. Two geographical scales of movement were apparent. Generally seals made short trips to within 25 km of the haulout site, often (40% of the time) returning to the sites they had just left. Thus a degree of site-fidelity and coastal foraging was apparent. However some individuals occasionally undertook longer distance movements of over 100 km, indicating the presence of at least some mixing between regions. Around half of the trips lasted between 12 and 24 hours, with the longest recorded trip lasting over nine days (217 hours). The proportion of time harbour seals were hauled out varied spatially, temporarily and according to sex (daily means of between 11 and 27%). The mean haul out duration was 5 hours, with a maximum of over 24 hours.

Data from satellite tracking of 45 harbour seals from three localities from the Danish part of the Wadden Sea, the Kattegat and the Western Baltic were presented in HS/21. The results showed no contact or exchange between these three areas. However, the 21 harbour seals tagged in the Danish Wadden Sea from 2002-2005 showed contact to other haulout sites in the Danish Wadden Sea as well as the German and Dutch Wadden Sea in decreasing order. Some very long distance foraging trips, in excess of 500 km, occurred, albeit rarely.

Tagging studies have so far been very limited in Canada and the USA (HS/27 and 28). Small scale VHF radio tagging has been conducted intermittently in Maine coastal waters, most recently in association with the 2001 abundance survey (Gilbert *et al.* 2005; Waring *et al.* 2006a). Most animals remained within 50 km of the tagging / release locations. Longer range movements of tagged animals (*i.e.*, Cape Cod to Maine ~250 km) were consistent with seasonal movements between wintering and pupping habitats.

Foraging ecology and diet

USA

Information on harbour seal prey species in US. Atlantic waters is principally derived from analyses of (a) faecal or "scat" samples collected at haulouts and (b) of stomachs of seals that had been incidentally caught in fishing gear (Payne and Selzer 1989, Ferland 1999, Williams 1999, Craddock and Polloni 2006, Slocum *et al.* 2005). Sandeels (*Ammodytes sp.*) are preferred in most areas, particularly in areas with sandy bottoms. Further north over rocky substrates a greater variety of prey are taken, including some species of commercial value. However there is little or no overlap in size between harbour seal prey and fish taken in commercial fisheries. Most studies have not corrected for differential erosion and retention of otoliths, and so may be biased.

Canada

HS/28 summarized recent diet data from Canada. Harbour seals consume a wide variety of prey. In an early sample made up of animals from the Bay of Fundy, Sable Island and southeastern Cape Breton Island, Herring (*Clupea harengus*), squid (*Illex illecebrosus*), flounder (*Pleuronectidae sp.s*), alewife (*Alosa psuedoharengus*), hake (*Merluccius sp.* and *Urophycis sp.*), smelt (*Osmerus mordax*) and mackerel (*Scomber scombrus*) accounted for 78% of the diet by percent occurrence. Atlantic cod (*Gadus morhua*), capelin (*Mallotus villosus*) and sand lance (sandeels) were also consumed, but each accounted for less than 3% of the diet (% occurrence) (Boulva and McLaren 1979). In a more recent study, involving animals collected in the Bay of Fundy, the Eastern shore of Nova Scotia and Cape Breton Island (Bowen and Harrison 1996), herring, squid, Atlantic cod, pollock (*Pollachius pollachius*) and hake accounted for 54% and 61% of the diet by % occurrence and % mass respectively. Alewife (*Alosa pseudoharengus*), flounder and capelin each accounted for less than 3% of the diet. In the St Lawrence Estuary, trophic relationships of harbour seals, harp seals (*Phoca groenlandica*), hooded seals (*Cystophora cristata*), grey seals (*Halichoerus grypus*) and beluga (*Delphinapterus leucas*) have been examined (Lesage *et al*. 2001). Limited diet information indicate that harbour seals in the estuary feed on capelin, sand lance (sandeels), herring, some sculpins (*Cottidae sp.*) and flatfish (Lesage *et al*. 2001).

Iceland

The main food species of harbour seals in Icelandic waters, ordered in percentage by weight, were cod, redfish (*Sebastes sp.*), sandeels, saithe (*Pollachius virens*), herring, catfish (*Anarhichas lupus*) and capelin (Hauksson and Bogason 1997). The most pronounced geographic difference in feeding was between common seals from the south coast and seals from the other coastal areas. Sandeel was the main prey item in

the south, but cod in the other areas. Given that sandeels appear to have decreased in abundance around Iceland recently, new data on diet is needed for this area.

Svalbard

Analyses using scats, stomach contents and fatty acids indicated that various species of fish dominated the diet (Andersen *et al.* 2004). Atlantic cod (*Gadus morhua*) was found to be the dominant prey in terms of biomass, while polar cod (*Boreogadus saida*) was the most frequently consumed prey item numerically. Hard-part diet analyses produced the same general picture suggested by the fatty acid composition of the blubber regarding the assessment of what the seals ate. The latter analyses also suggested that a systematic, selective process is involved when the dietary fatty acids are incorporated into the blubber.

Mainland Norway

Results from analyses of scat samples and stomach contents from harbour seals collected throughout the year in Vesterålen, north Norway, in 1990-1995, revealed a diet comprised mainly of saithe, both with respect to prey occurrence and biomass. Little variation occurred in the diet throughout the year, probably due to a large and stable abundance of saithe in the area. Also herring, cod, sandeel and various flatfishes occurred in the diet. The seals seemed to prefer small fish, and older seals appeared to have a more varied diet than the younger animals. In a captive study carried out at the Aquarium in Bergen, the recovery of otoliths was only 14.8% when harbour seals were fed whole fish. Recovery rates varied between species: 4.6, 47.7 and 46.6% of herring, haddock (*Melanogrammus aeglefinus*) and cod, respectively (Berg *et al.* 2002).

Scotland

The diet of harbour seals was studied for the population of harbour seals hauling-out in the area of St Andrews Bay, northeast Scotland. 852 faecal samples were collected over a six year period and analysed to investigate seasonal and annual variation in the diet (HS/17). Consumption estimates were corrected for differential retention and erosion of otoliths. Overall harbour seal diet was heavily dominated by sandeels and whiting. Ten prey species made up more than 95% of the total prey consumed by weight. There were significant seasonal trends in the consumption of sandeels, peaking in winter months when sandeels are dormant in the sand or spawning (94 percent by weight). Outside the winter months sandeels remained the dominant prey species although gadoids such as whiting (*Merlangius merlangus*), cod and haddock and flatfish such as dab (*Limanda limanda*), flounder (*Platichthys flesus*) and plaice (*Pleuronectes platessa*) were more prevalent. This pattern was found to be consistent across years. The diet of harbour seals hauling out within the Tay Estuary was found to be considerably different to those of harbour seals hauling out in the surrounding area. Diet in the winter was still dominated by sandeels but outside this period salmonids made up over 50% of the diet by weight in each season. Given the marked geographical variation in harbour seal diets it is clear that results from one area should not be extrapolated to seals in other areas.

Denmark

Comparative studies on the seasonal and regional variation in the diet of harbour seals and great cormorants were conducted in Limfjorden, a semi-closed water system in northwest Denmark (HS/23). To compare harbour seal diet from an open water system containing similar prey species, diet analysis from the western Baltic was included. During spring, seal diet was related to an increase in Atlantic herring, which entered Limfjorden to spawn (90% of the biomass consumed). During summer and autumn seals consumed a mixed diet. The diet of seals in western Baltic and cormorants in Limfjorden showed no marked seasonal trends. Only few commercial species were found to be included in seal and cormorant diet, and only Atlantic herring was during a limited time period taken by seals in sizes larger than the allowed minimum sizes in fishery.

A summary of diet studies from several jurisdictions is provided in Table 4.

10. RECOMMENDATIONS FOR RESEARCH

In addition to the recommendations relating to specific stocks under Section 7, the following general recommendations for research are provided.

Stock delineation

- Samples for genetic analysis are best obtained from the breeding sites;
- Samples should be taken from all animals that are handled for tagging or other purposes;
- Genetic studies should use a common set of markers, including those used in previous studies;
- In southern Scandinavia 15 microsatellite markers applied to a sample size of 30 individuals gives a resolution at the sub-structure level separating breeding colonies at a distance of 150 km. This should be considered as a minimum for future studies;
- Around 50 mg skin, blood or muscle samples should be collected, stored in a 2 ml saturated salt solution and 20% DMSO and frozen when possible;
- Museum specimens should be obtained for genetic analysis from areas where harbour seals are presently rare or absent, such as the Faroes and West Greenland;
- Further studies should be conducted to determine long term site fidelity of individuals to breeding and haulout sites;
- If finer scale stock divisions are required, individual-based methods, such as freeze-branding and photo-id, should be considered.

Surveys

- Define the target – total population or index of population size;
- Survey in either breeding or moulting season, or preferably both. Different segments of the population are surveyed at each of these times. Survey the entire area at intervals to be aware of new colonies or movement between colonies;
- Conduct multiple surveys, preferably three on different days within any season. Frequency of the surveys will be determined by the study objectives;
- Timing and duration of surveys should take into consideration environmental variables (*e.g.* tide, weather) as well as potential human disturbances;

- Possible changes in the timing of the moulting and pupping seasons should be taken into consideration in establishing the timing of surveys, and interpreting the results;
- Aerial surveys provide more accurate counts in most cases than counts conducted from land or by boat;
- Photography should be used to determine numbers in groups hauled out, especially large groups;
- Coordinate surveys to ensure that the entire survey/management area is covered within a short time frame;
- If estimating total population size from surveys, additional information on length of time ashore from telemetry or individual based studies is required.

Population studies

- Standard sampling of handled animals should include: photos, sex, mass, axillary girth, blubber depth at a specified body site, double flipper tag, blood, tissue sample for genetic analysis. If the animal is drugged, total length, incisor tooth, and blubber sample from the same body site should be collected;
- If possible, animals that are tagged should be freeze-branded for identification once the tag is shed.

Ecological/feeding

- Studies should be conducted in areas where they have not been done or have not been done recently;
- Conduct research on gut passage times, to determine the time period reflected in diet data from scat samples;
- Determine digestive coefficients and numerical correction factors specific for harbour seals to enable unbiased diet reconstruction from scat samples;
- More information on energy use by harbour seals is needed to translate diet data to consumption rates;
- Simultaneous feeding and fish resource surveys, to determine selectivity in relation to resource availability, are required;
- Research focussed on determining the reasons behind different population developments in areas that are geographically close together, such as Limfjord and other Danish waters.

11. OTHER BUSINESS

The Working Group agreed that the idea of producing a volume of NAMMCO Scientific Publications with the central theme of the status of harbour seals in the North Atlantic, should be pursued. This proposal will therefore be presented to the NAMMCO Scientific Committee at their next meeting.

12. ADOPTION OF REPORT

The main sections of the Report were adopted on 6 October 2006, and the final Report was adopted by correspondence on 8 November 2006.

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STOCK		EVIDENCE	REFERENCE
1	Sable Island	Genetic mt DNA	Stanley *et al*. (1996)
2	St Pierre & Miquelon	Genetic mt DNA	Stanley *et al*. (1996)
3	Greenland	Geographic isolation	
4	Iceland	Genetic DNA microsat;	Goodman (1998)
		Genetic mt DNA	Stanley *et al*. (1996)
		Geographic isolation	
5	N.Ireland/Scotland	Genetic DNA microsat.	Goodman (1998)
		Genetic mt DNA	Stanley *et al*. (1996)
6	South Norway	Genetic DNA microsat.	Goodman (1998)
7	East England	Genetic mt DNA	Stanley *et al*. (1996)
		Genetic DNA microsat.	Goodman (1998)
8	Wadden Sea	Genetic DNA microsat.	Goodman (1998)
9	East Baltic	Genetic DNA microsat.	Goodman (1998)
		Genetic mt DNA	Stanley *et al*. (1996)
10	Danish Wadden Sea	Genetic DNA microsat.	Olsen *et al.*(in prep)
11	Limfjord	Genetic DNA microsat.	Olsen *et al.*(in prep)
12	Skagerrak	Genetic DNA microsat.	Olsen *et al.*(in prep)
13	Kattegat	Genetic DNA microsat.	Olsen *et al.*(in prep)
14	West Baltic	Genetic DNA microsat.	Olsen *et al.*(in prep)
		Genetic mt DNA	Stanley *et al*. (1996)
15	Churchill	Genetic mt DNA	Stanley *et al*. (1996)
16	Svalbard	Geographic isolation	

Table 1. Stocks of harbour seals identified in the North Atlantic.

AREA	PLATFORM	METHOD	SEASON	PUP PROD	REPEATS	FREQ (yrs)	COV.	TOTAL POP.
Iceland	Aerial, fixed-wing.	Visual and photo	moult	N	≤3	3	All	N
Norway	Aerial, fixed-wing.	Visual and photo	moult	N	1-3	5	All	N
	Ground, boat							
UK Scotland	Aerial, fixed-wing and helo.	Visual, photo, infrared.	moult	N	1-5	5	Most	N
England	Aerial, fixed-wing and helo.	Photo	moult	N	1-2	1	Most	N
Eire	Aerial, helo. with ground counts.	Infrared	Moult	N	1	?	All	N
N Ireland	Aerial, helo. with ground counts.	Infrared	moult	N	1	?	All	N
E Baltic	Aerial, fixed-wing.	Visual and photo	moult	N	3	1	All	N
S Scandinavia	Aerial, fixed-wing.	Visual and photo	moult	N	3	1	All	Y

Wadden Sea	Aerial, fixed-wing.	Visual and photo	Breed and moult	Y	3	1	All	Y
La Manche, France	Land, boat	Visual	All	Y	NA	NA	All	N
E Canada	Aerial, helo.	Visual	breed	N	1	?	Most	N
E. USA	Aerial, fixed-wing	Visual and photo	breed	Y	1	3-5	All	Y

Table 2. Survey methods for harbour seals in use in various jurisdictions. Prod. - production; Freq. - frequency; Cov. - coverage; Pop. – population; NA - not available; helo. - helicopter.

STOCK / AREA	ABUNDANCE				TREND	CATCH		DISEASE	OTHER THREATS	STATUS	REF
	Est. (95% CI)	Year	Com-ponent	Cor-rections	Ann. % (yrs)	Est.	Yrs	Yrs, % decline			
Faroes	Sporadic sightings		Total			None			None	Extirpated	SC/14/HS/4
Greenland											
West	Very low.		Total			Unknown (low)			Fisheries, climate change	Strongly depleted	SC/14/HS/5
Southeast / Southwest	Unknown		Total			*ca* 50			None	Unknown	SC/14/HS/5
Norway											
Mainland	6668	2003-6	Haulout	None		540	Avg 2003-5	2002 -60 (SE Norway only)	By-catch	Likely declining. Present takes including by-catch likely exceed sustainable levels.	SC/14/HS/9
Svalbard	>1,000		Haulout	None		0		Unknown	None	Unknown, No concern	SC/14/HS/5

STOCK / AREA	ABUNDANCE				TREND	CATCH		DISEASE	OTHER THREATS	STATUS	REF
	Est. (95% CI)	Year	Com-ponent	Cor-rections	Ann. % (yrs)	Est.	Yrs	Yrs, % decline			
Iceland	8,023 (6,913-9,911)	2006	Haulout	Environmental covariates	-5 (1980-2006)	296	Avg. 2002-5		By-catch	Depleted, likely declining.	SC/14/HS/6
United Kingdom											
Scotland	23,500	2000-06	Haulout	None	Neg. Shetland, Orkney, E. Coast	100-150, some unreported.	Recent	1988, 2002 only affected certain areas, especially east coast of England and N Ireland in 1988	None	Uncertain, recent declines in some areas.	SC/14/HS/14
England	3,000										
N Ireland	1,250										
Ireland	2,905	2002, 2003	Haulout	None	Unknown	None		Unknown	By-catch, illegal shooting by fishermen	Unknown	Cronin *et al*. (2004)
S. Scand-inavia Baltic, Wadden Sea											

STOCK / AREA	ABUNDANCE				TREND	CATCH		DISEASE	OTHER THREATS	STATUS	REF
	Est. (95% CI)	Year	Com-ponent	Cor-rections	Ann. % (yrs)	Est.	Yrs	Yrs, % decline			
Skagerrak, Kattegat, Limfjord and southwest-ern Baltic	10,107	2005	Haulout	None	Limfjord -17.3 (2003-5) Others 2.1 - 25.3 (2003-5)	*ca* 20	Ann.	2002, 17-56%	By-catch	Recovering after epidemic in 2002, except Limfjord.	SC/14/HS/20
Kalmarsund Baltic Sea	490	2006	Haulout	None	7.8% (1990-2006)	None		No	by-catch	Depleted, increasing	SC/14/HS/12
Wadden Sea	10,817	2003	Haulout	None	12.7 (1989-2002) ca. 15 (2003-2005)	None		1988 -52% 2002 -50%	Industry, fisheries, disturbance	Recovering after epidemic in 2002.	SC/14/HS/24
North America											
Eastern Canada	Likely >5000	1985-1997	Haulout	None	Unknown	Unknown (low)		No known, but possible outbreak in 2006.	by-catch	Unknown, probably stable. Protected from hunting in Atlantic Canada.	

STOCK / AREA	ABUNDANCE				TREND	CATCH		DISEASE	OTHER THREATS	STATUS	REF
	Est. (95% CI)	Year	Com-ponent	Cor-rections	Ann. % (yrs)	Est.	Yrs	Yrs, % decline			
Eastern USA	99,340 (83,118 - 121,397) [23,722 pups]	2001	All	Fraction hauled out.	6.6% (1981 - 2001	None		Possible outbreak in 2006.	by-catch	Increasing or stable	SC/14/HS/27

Table 3. Summary of the status of harbour seal stocks in the North Atlantic.

JURISDICT-ION	MONITORING PROGRAMMES	EST.	OBSERVER EFFORT	COMMENTS
Greenland				
Iceland	Coastal gillnetters	2002	Mandatory logbook.	No observations of lumpfish fishery which probably accounts for most of by-catch.
Faroes	None			
Norway	Coastal gillnetters, observed	Oct-05	18 vessels <15 length out of approx. 5000 vessels <15m total length	Fishers contracted to observe and report detailed statistics on effort, catch and all by-catch. Programme constructed for monitoring by-catches of harbour and grey seals and harbour porpoise. Norwegian coastal waters.
	Offshore fleet, observed	Jan-04	A team of 8 observers on randomly selected vessels within area and season	Independent observers from the Directorate of Fisheries. Main purpose is to monitor catch of undersized target species and by-catch of non-target commercial species. From January 2004 these observers were instructed to report marine mammal by-catches. Norwegian EEZ.
	Offshore fleet, observed	Jan-05	10 vessels >15m length	Contracted observers instructed to observe and report detailed statistics on effort, catch and all by-catch. Supplemented with independent observers from IMR. The main purpose is to get age and size distribution of target species and detailed records of all by-catches. North, Norwegian and Barents Seas.
UK	Observer programme			
Ireland	Observer programme	1996	Occassional and random effort on gillnetters and trawlers	Contracted observers to monitor marine mammal by-catch in the Celtic Sea
Sweden	Interviews with fishermen	2002	Interview survey.	Skagerrak, Kattegat, Baltic. Lunneryd *et al*. (2004)
Denmark	Observer programme			Observer programme for harbour porpoises and other species in the Danish fishery. Managed by Danish Institute for Fisheries Research
East Canada	None			Occasional reporting from fisheries observers on incidental catch, not systematic, and not to species.

USA	Observer programme	2006	c. 5% observer coverage in northeast sink gillnet fishery; c. 2% observer coverage in mid-Atlantic coastal sink gillnet; and less than 1% coverage in bottom trawl fisheries	Marine mammals in general. Northeast US Atlantic coast and EEZ waters.

Table 4. By-catch monitoring programmes in the North Atlantic. Est. – Established.

POPULATION				METHOD					SOURCE
Country	**Area**	**Yrs.**	**Seasons**	**Method**	**No. of samples**	**Correction**		**weight/ frequency**	
						Dig. Coef.	***NCF***		
Scotland	St Andrews Bay	1998-2003	All	Scat	852	Yes, based on grey seals	Yes, based on grey seals	weight	SC/14/HS/17
Scotland	Firth of Tay	2000-2003	All	Scat	161	Yes, based on grey seals	Yes, based on grey seals	weight	SC/14/HS/17
Scotland	Moray Firth	1987-1988	All	Scat	407	no	no	frequency	Pierce *et al.* (1991)
Scotland	Moray Firth	1989 & 1992	All	Scat	1,129	no	No	weight	Tollit and Thompson (1996)
Scotland	Moray Firth, Summer Islse, Orkney, Isle of May	1988	All	Scat	570	no	No	frequency	Pierce *et al.* (1990)

POPULATION				METHOD					SOURCE
Country	**Area**	**Yrs.**	**Seasons**	**Method**	**No. of samples**	**Correction**		**weight/ frequency**	
						Dig. Coef.	***NCF***		
Scotland	Shetland	1994	Jul, Aug, Sep	Scat	200	yes	No		Brown and Pierce (1997)
Scotland	Shetland	1995-1996	All	Scat	733	yes	No	weight	Brown and Pierce (1998)
England	The Wash	1990-1992	All	Scat	708	yes	yes	weight	Hall *et al.* (1998)
Scotland	Inner Hebrides	1993-1994	Jun-Nov	Scat	238	yes	No	weight	Pierce and Santos (2003)
Norway	North Norway	1990-1995	All	Scat & Digestive tract	150	yes, based on a feeding experi-ment		Frequen-cy, numerical & weight	Berg *et al.* (2002)
Norway	Svalbard		All	fatty acid	22				Anderson *et al*. (2004)
Norway	Svalbard		All	Scat	117			weight	Anderson *et al*. (2004)

POPULATION				METHOD					SOURCE
Country	**Area**	**Yrs.**	**Seasons**	**Method**	**No. of samples**	**Correction**		**weight/ frequency**	
						Dig. Coef.	***NCF***		
Denmark	Limfjorden	1997 & 1998	All (except Dec-Feb)	Scat	106	no	No	weight	Andersen *et al*., submitted
Denmark	Southwest-ern Baltic	2001-2005	All (except Dec-Feb)	Scat & Digestive tract	26	no	No	weight	Andersen *et al.*, submitted
Sweden	Skagerrak	1977-1979 and 1987-1988	All	Scat	about 10,000 otoliths	yes		weight	Härkönen (1986); Härkönen (1987a,b); Härkönen & Heide-Jörg-ensen (1990)
Canada	Bay of Fundy, Sable Island and southeastern Cape Breton Island			Digestive tracts	352	no	No	frequency	Boulva and McLaren (1979)

POPULATION				METHOD					SOURCE
Country	**Area**	**Yrs.**	**Seasons**	**Method**	**No. of samples**	**Correction**		**weight/ frequency**	
						Dig. Coef.	***NCF***		
Canada	Bay of Fundy, the Eastern shore of Nova Scotia and Cape Breton Island			Digestive tracts	250	no	No	weight	Bowen and Harrison (1996)
USA	Cape Cod			Scat	Ferland: 174 (112 with re-mains); Payne & Selzer (234)				Ferland (1999); Payne and Selzer (1989)
USA	Gulf of Maine			Stomach	Williams: 75 (68 with remains; Craddock & Polloni (101)				Williams (1999); Craddock and Polloni (2006)

POPULATION				METHOD					SOURCE
Country	**Area**	**Yrs.**	**Seasons**	**Method**	**No. of samples**	**Correction**		**weight/ frequency**	
						Dig. Coef.	***NCF***		
USA	Maine			Stomach	3				Ferland (1999)
USA	New Jersey			Scat	??				Slocum *et al*. (2005)
USA	MA north shore			Stomach	2				Ferland (1999)
USA	New Hampshire			Stomach	17				Ferland (1999)
Iceland	Entire coast	1992-1993	All	Stomach	799 (493 with remains)	no	No	weight	Hauksson and Bogason (1997)

Table 5. Selected information on the diet of harbour seals in the North Atlantic. Dig. Coef. – Digestive Coefficient; NCF – Numerical Correction Factor.

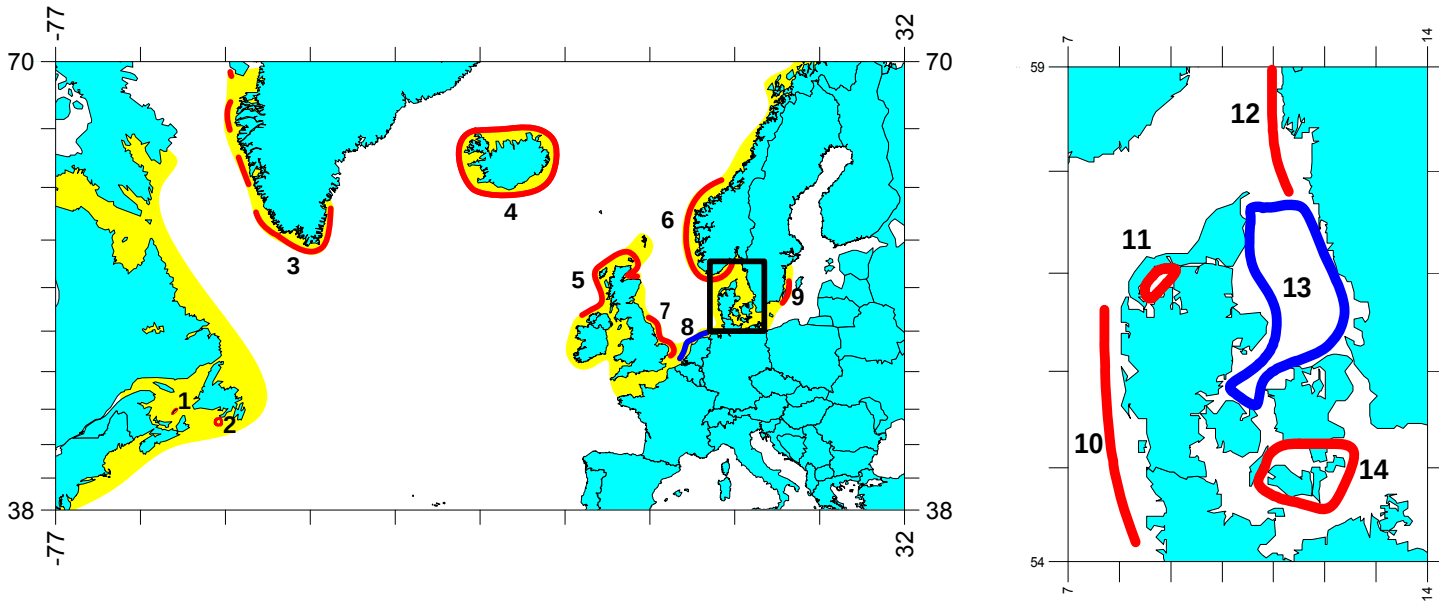

Fig. 1. Stocks of harbour seals identified in the North Atlantic, identified by the coloured strips. Approximate range is in yellow. 1. Sable Island; 2. St Pierre and Miquelon; 3. Greenland; 4. Iceland; 5. Northern Ireland/Scotland; 6. Southern Norway; 7. East England: 8. Wadden Sea; 9..East Baltic; 10. Danish Wadden Sea; 11. Limfjord; 12. Skagerrak; 13. Kattegat; 14. West Baltic. Not shown: Svalbard and Churchill in Hudson Bay, Canada.

Appendix 1

AGENDA

1. Opening remarks
2. Adoption of agenda
3. Appointment of rapporteur(s)
4. Review of available documents and reports
5. Stock delineation (genetic data, spatial and temporal distribution Including satellite tagging data)
6. Review of survey methods
7. Stock size and status of harbour seal populations/stocks
   - 7.1 Greenland
   - 7.2 Iceland
   - 7.3 Faroes
   - 7.4 Norway
   - 7.5 United kingdom
   - 7.6 Ireland
   - 7.7 Baltic Sea
   - 7.8 Wadden Sea
   - 7.9 Southern North Sea – Channel
   - 7.10 Eastern Canada
   - 7.11 Eastern US
8. Interaction with fisheries and aquaculture
   - 8.1 Geographical review
   - 8.2 Problem size
   - 8.3 Mitigation methods in use
9. Review of available information on harbour seal ecology (including data from satellite tagging)
10. Recommendations for research
11. Other business
12. Adoption of report.

Appendix 2

LIST OF DOCUMENTS

DOC

SC/14/HS/1	Draft List of Participants.
SC/14/HS/2	Draft Agenda.
SC/14/HS/3	Draft List of Documents.
SC/14/HS/4	Mikkelsen, B. Harbour seals in Faroe Islands.
SC/14/HS/5	Rosing-Asvid, A. Harbour seal catch history in Greenland.
SC/14/HS/6	Hauksson, E. Trend in abundance of Icelandic common seal *Phoca vitulina,* 1980-2003.
SC/14/HS/7	Hauksson, E. Growth and reproduction in the Icelandic common seal.
SC/14/HS/8	Lydersen, C. Status of the harbour seals in Svalbard.
SC/14/HS/9	Nilssen, K.T., Skavberg, N-E., Poltermann, M., Haug, T. and Henriksen, G. Status of harbour seals (*Phoca vitulina*) in Norway.
SC/14/HS/10	Bjørge, A. The HELCOM recommendation 27-28/2 on the conservation of seals in the Baltic Sea area. A modern ecosystem based management approach for Baltic seals.
SC/14/HS/12	Härkönen, T. Status of Baltic harbour seals.
SC/14/HS/13	Cronin, M. Status of harbour seals in the Republic of Ireland, including survey methods and current research on harbour seal ecology.
SC/14/HS/14	Duck, C. The number and distribution of harbour seals in the United Kingdom.
SC/14/HS/15	Sharples, RJ., MacKenzie, M.and Hammond, PS. Estimating the seasonal abundance of seal populations from counts and and telemetry data.
SC/14/HS/16	Sharples, RJ., Matthiopoulos, J. and Hammond, PS. Distribution and movements of harbour seals in the western North Sea: Shetland, Orkney, the Moray Firth, St Andrews Bay and the Wash.
SC/14/HS/17	Sharples, RJ, Arrizabalaga, B and Hammond, PS. Harbour seal diet in St Andrews Bay , Northeast Scotland, 1998-2003.
SC/14/HS/18	Cunningham, L., McConnell, B., Duck, C., Baxter, J., Lonergan, M and Boyd, I. Using satellite telemetry to determine harbour seal movements and haulout patterns.
SC/14/HS/19	Cunningham, L., Duck, C., Baxter, J. and Boyd, I. Using photo-identification and capture-recapture methods to monitor the conservation status of harbour seals.
SC/14/HS/20	Teilmann, J. *et al.* Optimising survey design in Scaninavian harbour seals: population trend as an ecological quality element.
SC/14/HS/21	Dietz, R. *et al.* Movements of harbour seals in Danish waters.
SC/14/HS/22	Andersen, L., Olsen, M.T., Teilmann, J. and Dietz, R. Status of genetic population structure of the harbor seal (*Phoca vitulina vitulina*) in the Northern Atlantic (**Presentation, no document**).
SC/14/HS/23	Andersen, S.M., Teilmann, J., Harders, P.B., Hansen, E.H. and Hjøllund, D. Diet of harbour seals (*Phoca vitulina vitulina*) and great cormorants (*Phalacrocorax carbo sinensis*) in Danish waters –

competition and interactions with the fishery.

SC/14/HS/24 Reijnders, P. Population development and status of harbour seals in the Wadden Sea.

SC/14/HS/25 Hassani, S. Status of the most southern European populations of harbour seals, in France and Belgium. (**Presentation, No document**).

SC/14/HS/26 Hammill, M. Status of harbour seals in Atlantic Canada.

SC/14/HS/27 Waring, G. Gilbert, J.R., Belden, D., Van Atten, A. and DiGiovanni Jr., R.A.A review of the status of harbour seals in the northeast USA.

SC/14/HS/28 Salberg, A-B., Øigård, T.A., Nilssen, K.T. and Haug, T.: Telemetric studies of harbour seal haulout behaviour in Vesterålen, Norway.

BACKGROUND DOCUMENTS

SC/14/HS/O1 Anonym. 2005. Outcome of the HELCOM/ICES/EU Seal Expert Workshop, Stockholm, Sweden, 6-8 September 2005. 23pp.

SC/14/HS/O2 Bjørgesæter, A., Ugland, K.I., and Bjørge, A. 2004. Geographic variation and acoustic structure of the underwater vocalization of harbor seal (*Phoca vitulina*) in Norway, Sweden and Scotland. *J. Acoust. Soc. Am*. 116(4): 2459-2468.

SC/14/HS/O3 Cunningham, L, Sharples, RJ and Hammond, PS 2004 Harbour seal diet in the UK. In SC/14/HS/O7.

SC/14/HS/O4 Hauksson, E. and Bogason,V. 1997. Comparative feeding of grey (*Halichoerus grypus*) and common seals (*Phoca vitulina*) in coastal waters of Iceland, with a note on the diet of hooded (*Crystophora cristata*) and harp seals (*Phoca groenlandica*). *J. Northwest Atl. Fish. Sci*. 22:125-135.

SC/14/HS/O5 NAMMCO. 1997. Report of the Scientific Committee working Group on Sealworm infection. In: *NAMMCO Annual Report 1997*. NAMMCO, Tromsø. Pp. 147-172.

SC/14/HS/O6 Ólafsdóttir, D. and Hauksson, E. 1997. Anisakid nematodes in the common seal (*Phoca vitulina* L.) in Icelandic waters. *Sarsia* 83:309-316

SC/14/HS/O7 SCOS. 2004. Scientific Advice on Matters Related to the Management of Seal Populations: 2004.

SC/14/HS/O8 SCOS. 2005. Scientific Advice on Matters Related to the Management of Seal Populations: 2005.

SC/14/HS/O9 Sharples, RJ, Cunningham, L and Hammond, PS 2005 Distribution and movements of harbour seals around the UK. In SC/14/HS/O8.

SC/14/HS/O10 Thompson D, Lonergan M and Duck C. 2005. Population dynamics of harbour seals *Phoca vitulina* in England: monitoring growth and catastrophic declines. *J. Applied Ecol.* 42 (4): 638-648.

SC/14/HS/O11 Gilbert, J.R., Waring, G.T., Wynne, K.M. and Guldager, N. 2005. Changes in abundance of harbour seals in Maine, 1981-2001. *Mar. Mamm. Sci.* 21:519-535.

SC/14/HS/O12 Waring, G.T., Gilbert, J.R, Loftin, J. and Cabana, N. 2006. Short-term movements of radio-tagged harbour seals in New England. *Northeast. Nat.*13:1-14.

SC/14/HS/O13 Skinner, J.P. 2006. Physical and behavioural development of nursing harbour seal (*Phoca vitulina*) pups in Maine. MSc. Thesis, University of Maine.

SC/14/HS/O14 Bjørge, A., Øien, N. and Fagerheim, K-A. Abundance of harbour seals, *Phoca vitulina*, in Norway based on aerial surveys and photographic documentation of hauled-out seals during the moulting season. *Mar. Mamm. Sci.*, Submitted.

SC/14/HS/O15 Nelson, M.L., Gilbert, J.R. and Boyle, K.J. 2006. The influence of siting and deterrence methods on seal predation at Atlantic salmon (*Salmo salar*) farms in Maine, 2001-2003. *Can. J. Fish. Aquat. Sci.* 63:1710-1721.

ANNEX 2

JOINT NAMMCO/IWC SCIENTIFIC WORKSHOP ON THE CATCH HISTORY, STOCK STRUCTURE AND ABUNDANCE OF NORTH ATLANTIC FIN WHALES

Reykjavík, Iceland, 23-26 March 2006

1 OPENING REMARKS

Johann Sígurjónsson, Director of the Marine Research Institute, welcomed participants (see Section 6.3) to the meeting. He noted that, despite the recent growth in industry and tourism, fisheries remained a very important part of the Icelandic economy and culture. Fin whales are the most abundant large whale species around Iceland, and therefore play an important role in the marine ecosystem. Iceland may in the future choose to resume hunting of fin whales, subject to international obligations. Therefore the outcome of these deliberations was of great importance, and he wished the participants a productive meeting.

Geneviève Desportes, Chair of the NAMMCO Scientific Committee, noted that the Scientific Committee of NAMMCO has carried out fin whale assessments on four previous occasions since 1999. The Committee operated on a general request to provide assessment advice for all North Atlantic stocks, but particularly for the East Greenland-Iceland (EGI), Norwegian and Faroese areas. Most recently, a working group of the Committee met in October 2005 to evaluate new information on stock identity, catch series, catch per unit effort (CPUE) and abundance, refine assessment models for the EGI area, and prepare for assessments of Norwegian and Faroese stocks.

Greg Donovan, Head of Science from the IWC Secretariat welcomed the participants on behalf of the IWC. He noted that this was the first such joint meeting between the Scientific Committees of NAMMCO and the IWC. Although the management procedures and approaches of the two organisations were somewhat different, he was delighted that it had proved possible to cooperate on common scientific issues, especially since many of the participants attended both IWC and NAMMCO meetings.

2 APPOINTMENT OF CHAIR AND RAPPORTEUR

Lars Walløe was selected as Chair, and Daniel Pike, Greg Donovan, Phil Hammond and Cherry Allison were appointed as rapporteurs for the meeting.

3 ADOPTION OF AGENDA

The agenda (Appendix 1) was adopted with minor changes. It was decided that the IWC and NAMMCO components of the Working Group would meet separately on the final day to address issues particular to their respective organisations.

4 REVIEW OF AVAILABLE DOCUMENTS AND REPORTS

Documents available for the meeting are detailed in Appendix 2. In addition some working papers from previous NAMMCO and IWC meetings, as well as published documents, were made available as needed.

5 STOCK STRUCTURE

The consideration of stock structure is of great importance to the understanding and interpretation of data on biological parameters, catch data and abundance, especially in a management context (irrespective of what that management context may be). For this reason it had been hoped to discuss stock structure at the start of the meeting. However, for practical and logistical reasons, especially related to the question of calibration and standardisation of work between different laboratories (in order to arrive at an agreed genetic dataset), it was not possible to do so. However, it was agreed that the report would maintain the order of the original agenda.

5.1 Genetic evidence

Authors' summaries

Daníelsdóttir presented paper SC/14/FW/5 – SC/M06/FW5 outlining the genetic analyses from nuclear and mitochondrial DNA data collected so far. The analyses were conducted at two hierarchical levels; a micro- and macro-geographical scale.

The micro-geographical study used 900 samples collected off Iceland during the period from 1981 to 1989. The genotype was determined in each of these samples at 9 nuclear microsatellite loci. Homogeneity tests revealed statistically significant levels of genetic heterogeneity among years as well as between seasons (spring, summer and autumn). However, the degree of genetic divergence among sample partitions was low (average $F_{ST} \sim 0.005$).

The data was also used to estimate of the number of panmictic populations (referred to as "clusters" in the employed software STRUCTURE by Pritchard *et al*. (2000)) contained in the Icelandic samples. The authors concluded that the most likely number of populations was two, when using the methodology outlined in Evanno *et al*. (2005).

The macro-geographical study was based upon the same 9 loci but the sample sizes were smaller; 59 from Iceland, 54 from Norway, 39 from Spain, 16 from West Greenland and 13 from eastern Canada. The macro-geographical analysis revealed statistically significant levels of genetic heterogeneity among the above sampling localities before applying sequential Bonferroni corrections, after which statistically significant levels of heterogeneity was detected only between eastern Canada and the remainder North Atlantic sampling localities. The average degree of genetic divergence between eastern Canada and the other North Atlantic localities was 0.0235 (estimated as Wright's F_{ST}), and 0.0022 among the remainder North Atlantic locales.

Mitochondrial control region DNA (mtDNA) sequences (285 base pairs) were also compared in the macro-geographical study for a total of 558 samples from the above described areas, in addition to new samples (19) from the Faroe Islands as well as those

described in Bérubé *et al*. (1998). The homogeneity test conducted using the mtDNA sequences confirmed earlier conclusions that the North Pacific as well as the Mediterranean Sea are distinct from the North Atlantic locales. In addition, significant levels of heterogeneity (*i.e*. P<0.05) were also observed among years within single areas, such as the Faroe Islands, West Greenland and Atlantic Spain. As was the case for the nuclear DNA analysis (the 9 microsatellite loci above), the overall level of genetic divergence among sampling locales in the North Atlantic was low (H_{ST} in the range of 0 to 0.06). The Faroe Island samples (which were not part of the microsatellite analysis described above) were "relatively" divergent from the other North Atlantic locales, although no assessment was conducted if this level of divergence was significantly higher (in a statistical sense) than that observed among the remaining North Atlantic locales. The authors used the method of Evanno *et al*. (2005) to estimate the number of breeding populations in the North Atlantic.

Palsbøll briefly presented the results of a preliminary analysis (using the six microsatellite loci employed by Bérubé *et al*. (1998)) considered as two data sets totalling 572 samples[1]. These were essentially the same as those employed in the macro-geographical analysis of mtDNA sequences. A total of 176 samples were analyzed at the Institute of Marine Research in Reykjavik and the remaining 369 at University of California Berkeley. Calibration of the data generated at the two different laboratories was conducted using 28 samples that had been analyzed in both laboratories. Of the 78 pair-wise homogeneity tests conducted, 18 P-values higher than 0.05 were obtained, indicating statistically significant levels of heterogeneity among most sample partitions. Significant levels of genetic heterogeneity were also observed among samples collected in different years within one area (*e.g*., Gulf of St. Lawrence, Iceland, Faroe Islands and Atlantic Spain). However, most estimates of genetic divergence were low (between 0 and 0.04) among the North Atlantic and Mediterranean Sea sampling locales. Excluding the comparisons that include the Sea of Cortez, the highest degree of genetic divergence was observed between samples collected in three different years off the Faroe Islands (F_{ST} estimated at 0.06 and 0.074). However, no assessment was conducted to ascertain if these levels of genetic divergence were significantly (in a statistic sense) larger than those observed among and within other North Atlantic sampling locales. No spatial trends (*e.g*., isolation by distance) were detected among the estimates of genetic divergence. However, the data may not provide sufficient statistical power to detect such correlations if the effect sizes are small.

Kitakado presented the results of a preliminary analysis using a new method aimed at estimating mixing proportions for stocks for North Atlantic fin whales under multiple

[1] A working paper (Daníelsdóttir, A.K., Bérubé, M., and Palsbøll, P.J. Levels of nuclear differentiation among North Atlantic sample areas from combined data set from the Institute of Marine Research (Iceland) and University of California Berkeley (USA)) was circulated but it was agreed that rather than include this as an Annex to the report, the authors would be encouraged to finalise the paper and submit it to the IWC and NAMMCO Scientific Committees when it is complete.

stock scenarios[2]. The same data were used as in SC/14/FW/5 – SC/M06/FW5 (1,023 individual's genotypes at 9 loci). The method is a likelihood version of his original method (SC/56-SD8) and it was first presented at the recent IWC Scientific Committee "Testing of Spatial Structure Models (TOSSM) Workshop (IWC, 2006a). The method is to estimate area-wise mixing proportions without assuming presence of baseline stocks. The integrated likelihood function with elimination of nuisance parameters was employed to estimate the mixing proportions, and then the maximum values under one-, two- and three-stock scenarios were compared to determine the likely number of stocks. Proportions of 70:30 and 72:27:1 were identified under the two- and three-stock hypotheses, respectively. A comparison of the results for the various scenarios by integrated likelihood indicated that one breeding stock was present in the whole feeding ground. Kitakado emphasised that the results of the model selection were only preliminary at this stage, because this new method must be subjected to more comprehensive testing (*e.g.* within the TOSSM framework). He also noted that to facilitate better understanding of spatial stock structure, he would undertake further investigation of area-wise mixing proportions using his method. It was noted that difficulties were found in reaching convergence in this particular analysis of the fin whale data.

Discussion

The Workshop welcomed the results of all these analyses, recognising the amount of work that they represented.

In the full discussion of the papers presented, a number of key factors emerged that require further work before a full understanding of the contribution of the genetic work to the elaboration of stock structure in the North Atlantic fin whales can be completed. These are described below. Given the importance of this in a management context to both the NAMMCO and IWC Scientific Committees, it was **agreed** that every effort should be made to complete this work before the next annual IWC Scientific Committee meeting in May 2006. It was also **agreed** that Donovan will send any resulting documents and working papers to the NAMMCO Secretariat for distribution to the NAMMCO Scientific Committee.

(1) Finalisation of the complete genetic dataset

As noted above, considerable effort has already been put into calibrating the work of the two major laboratories involved in analysing the samples. The Workshop **agreed** that it was essential that this work should be completed (including the investigation of error rates) as soon as possible so that a 'final' agreed genetic dataset can be used in statistical analyses of the data. It also noted that the most efficient way to achieve this was for the

[2] A Working Paper (Kitakado, T. and Daníelsdóttir, A.K. Brief report on preliminary estimation of mixing proportions under multiple-stock scenarios for North Atlantic fin whales using individuals multi-locus genotypes data.) was submitted but it was agreed that rather than include this as Annex to the report, the authors would be encouraged to finalise the paper and submit it to the IWC and NAMMCO Scientific Committees when it is complete

two key persons (Daníelsdóttir and Bérubé) to work together in either Reykjavik or Berkeley and it was hoped that funds could be found to allow this to take place.

(2) Better understanding of the assumptions and methods of new analytical techniques

It was clear from the discussions at the Workshop that before final conclusions can be reached concerning the implications of the genetic data for stock structure and management, more time was required to understand aspects of certain newer analytical methods presented at this meeting. While ideally, this should take place in the TOSSM framework, it was recognised that this will not be possible this year. It therefore **agreed** that Skaug, Kitakado and Butterworth, in consultation with Palsbøll, Danielsdóttir and Pastene, should examine more fully the methods and assumptions used, particularly with respect to the work of Evanno *et al*. (2005) and Kitakado (2004). It is advisable that this group should also be consulted if analyses using methods previously unconsidered by the IWC or NAMMCO Scientific Committees are to be presented in the future.

(3) Further investigation of the statistical power of genetic analyses and the estimation of confidence intervals

In several instances, there was considerable discussion over the interpretation of P-values when values of, say *Fst*, were very small. The Workshop agrees that this topic requires further investigation and discussion and referred the matter to the intersessional working group above. In particular it noted that it was important when presenting results of Fst values that confidence intervals be calculated (*e.g*. using bootstrapping). This should also be undertaken for previously published data (*e.g.* the allozyme data – Daníelsdóttir *et al*., 1992) where significant differences have been reported.

(4) Completion of preliminary analyses presented by Palsbøll and Kitakado (see authors' summaries section of 5.1 above)

5.2 Non-genetic evidence

It is recognized that a full elaboration of stock structure may best be achieved by a combination of information of a suite of techniques, both genetic and non-genetic (*e.g*. see Donovan, 1991). SC/14/FW/7–SC/M06/FW7 summarised the available data on stock structure of North Atlantic fin whales based on non-genetic methods. This included data from a wide range of methods including:

- Mark-recapture data;
- Satellite tagging;
- Morphometrics;
- Photo-identification;
- Acoustics;
- Biological parameters;
- Pollutant concentrations;
- Historical depletion patterns.

The Workshop also received summary maps of sightings information obtained from the NASS surveys (Víkingsson *et al*. in prep.). Although it is recognised that the discriminatory power of each of these methods individually is rather poor with respect to

providing conclusions on stock structure, the authors note that collectively they indicate a separation between fin whales summering in the western, central and eastern North Atlantic. There also appears to be a more or less isolated stock in the Mediterranean Sea, perhaps extending out to southern Portugal. The implications of these data for stock structure hypotheses are considered under Item 5.3.

5.3 Stock structure hypotheses

The Workshop noted the synthesis of possible stock structure hypotheses developed by Danielsdóttir *et al*. (in IWC 2006) and agreed that consideration of these would form a useful basis for its discussion of stock structure hypotheses, recognising that this was not intended to be limiting. On the basis of the analyses of Bérubé *et al*. (1998) it was agreed to treat the Mediterranean and adjacent waters as a separate stock and not consider it further here. However, it was recognised that this may need to be reconsidered after the completion of the genetic work identified above.

For the first stage of the discussions, it was agreed to focus on hypotheses presented with respect to the number of breeding stocks. Table 1 summarises the available genetic and non-genetic evidence in terms of its ability to discriminate among breeding stock hypotheses. The Workshop agreed not to specify whether it believed any hypothesis was the 'best' at this stage. It recognised that this level of discussion was more appropriate to the respective Scientific Committees as it was related to management objectives and procedures.

The Workshop then went on to consider the hypotheses with respect to feeding areas, using the schematic figures of Daníelsdóttir *et al*. (IWC 2005) as a guide. It is important to stress that the figures are schematic and the location of the 'breeding stocks' is not intended to suggest any specific geographical location. The Workshop agreed to consider each of the figures in turn and modify them where appropriate. The Workshop noted that in many cases the discriminatory evidence is weak. The results of these discussions are given in Fig. 1.

The Workshop agreed that pressures of time meant that it had not been possible to fully consider the need for possible further scenarios (*e.g*. incorporating possible north-south structure, alternative links and/or strength of links between breeding stocks and feeding areas, or finer structure within feeding areas). It also noted that the results of the suggested future genetic work (Item 5.1) may lead to changes in stock structure hypotheses. It was **agreed** that this could be revisited at the St Kitt's meeting (in an IWC context) and scientists wishing to make proposals were encouraged to be specific and to document their rationale. Any such proposals will also be circulated to the NAMMCO Secretariat.

6 BIOLOGICAL PARAMETERS

6.1 Review of available estimates

SC/14/FW/11–SC/M06/FW11 presented information on biological parameters estimated from whaling data of varying quality and precision for the following stock

management areas (Donovan 1991): EGI; British Isles – Spain and Portugal; West Norway and Faroe Islands; North Norway; and Eastern Canada (Newfoundland – Labrador plus Nova Scotia). Available parameters included age and length at sexual maturity, asymptotic length, length at age 5 yrs, age at recruitment, mortality rate, ovulation interval and proportion pregnant in the mature female catch. The most recent information is from the EGI area, although none is more recent than before 1990. No data are available from West Greenland. For at least two areas, EGI and British Isles, Spain and Portugal, trends over time in reproductive and age parameters are suggested. Of particular note is the apparent increasing age at sexual maturity in EGI area between 1967 and 1989 together with a decreasing size at age during the same period. During the late 1960s, the eastern Canadian areas had a higher age at sexual maturity than the EGI and British Isles, Spain and Portugal stocks. Sizes at both sexual maturity and at physical maturity were similar in these latter two stocks, while whales from the east Canadian areas were smaller. However there may be some methodological differences in these measures which confound comparisons.

This compilation was welcomed. However the comparison of these parameters across stock areas is problematic because many of the studies were conducted in different time periods, and the magnitude of temporal changes in some parameters is as great as the differences seen between stock areas. In addition the studies were conducted by different workers and using somewhat differing methodologies. In some cases the uncertainty in the estimates is poorly documented or unavailable. For these reasons apparent variation in biological parameters across stock areas is considered a weak indicator of stock structure, unless well controlled studies coincident in time have been conducted.

6.2 Evidence for trends in estimates

Víkingsson presented a preliminary analysis of temporal trends in ovulation interval and age at maturity in whales sampled from the grounds west of Iceland between 1969 and 1989 (SC/14/FW/12–SC/M06/FW12). Previous studies (Konradsson *et al.* 1991, Lockyer 1981, 1986, 1987, Víkingsson 1990, 1995, Sigurjónsson 1992) have shown that such changes are correlated with the body condition of whales and food availability in this area. Estimates of age at maturity can be extended back to 1910 through studies of the transition phase of the ear plug. Trajectories in these parameters were compared to predicted abundance in the area from the model described in Section 9.1.1. The peaks and troughs in both time series appear roughly synchronous, although formal analyses of this relationship have not yet been carried out.

The Working Group agreed that a full analysis would require consideration of a number of factors including environmental conditions, food availability and other factors causing fluctuations in carrying capacity, in addition to changes in the abundance of fin whales.

6.3 Values for use in modelling (see Item 9.1.1)

The Working Group agreed that there was nothing in the review presented in SC/14/FW/11–SC/M06/FW11 to necessitate change to the parameter values used by both the IWC (IWC 1992) and NAMMCO (NAMMCO 2000, 2001, 2004, 2006)

Scientific Committees.

7 CATCH DATA

7.1 Available catch data, level of detail and level of disaggregation of data

Bloch presented SC/14/FW14–SC/M06/FW14 containing information on Norwegian pelagic catch operations by 18 companies between 1917 and 1937. The total number of whales taken was 4,147, which is known to be a minimum. Of these, 3,516 whales were known by species, where 72% were fin whales, 9% blue and 8% humpback whales.

From Jonsgård (1966) and daily reports from whalers and land stations it can be seen that the whalers were operating close to western Iceland from Reykjanes to Straumnes in the years 1931-1934 and 1937 in the months July-October.

A total of 775 whales was taken in Icelandic waters of which 672 or 87% were fin whales. The exact numbers exist for 1931, 1933 and 1937, while the 1932 catch was estimated assuming half the whales were taken in west Greenland and the other half outside west Iceland. The operating area was Faxafloi, west of Iceland in all years, except the Pioner expedition operating June-July 1933 which took 48 whales north of Iceland from Axarfjörður to Straumnes, the most northwestern point of Iceland.

Gunnlaugsson presented SC/14/FW13 – SC/M06/FW13 containing a new analysis of historical catch records from land stations in Iceland during the early whaling period 1883 to 1915, before whaling was banned in Iceland. Original catch records (some partial and some incomplete) were available for just over half the catches. Some graphical presentation of these data has been given in an earlier paper (Gunnlaugsson *et al.* 1989) but now all known catches are presented. The data are divided between the Westfjord and east coast regions, but stations operated on the east coast only during the years 1901-1913. In the previously published literature, the only complete data available were for grand totals by year for all stations combined. Published partial data by station and in some cases species composition were used to complement the data where the catch record data are missing. Some totals by station are still missing for the years 1893-1900 where the published totals have to be used, and for the Westfjord operation in the years 1901-1903 when the totals by station for the east coast were subtracted from the published totals to get totals for the west. The total fin whale catch was then prorated from the observed proportion of fin whales by year and region. The available sex-determined catch showed a ratio of 52% females and gives no indication of variation over time or space. The season was short in Iceland and concentrated in mid summer. Catch position records show that there was very little overlap in the range of the east and west operations, but the operational range expanded with time. Different CPUE series are derived. CpB as used in previous fin whale assessments is total catch of all species per boat-season by year and now split by region, FprB90 is fin catch per boat-season rectified for effort expended catching other species. CpBM is catch per boat month available only where the catch dates are known and the operation time is taken to be from the first to the last whale caught and alternately FpBM. The CpB series using catches of all species (implicitly assuming effort proportional to species composition) and FpB series with a constant correction per other species are considered to be opposite

extremes in an attempt to capture the signal of decline in these data.

The positions of the catches in SC/14/FW13–SC/M06/FW13 showed that many fin whales prior to 1915 appeared to be taken close to Icelandic coasts, especially on the East coast where whales are not often seen nowadays. It was suggested that a component of the stock was harvested, which may no longer exist, but the effect might be explained by a change in fin whale distribution.

Bloch then presented SC/14/FW15–SC/M06/FW15, which gave details of the catches of North Atlantic fin whales taken off Norway, the Faroes, Scotland, Ireland and Greenland, and SC/14/FW16-SC/M06/FW16, which showed CPUE data from the fin whale catch in the same area, 1901-1971. The CpBM was calculated from landstations in Ireland, Hebrides, Shetland, the Faroes, Norway coastal catch, and Norwegian pelagic catch for the period 1901-1971. The working season was estimated as the period from the first to the last day whales were taken that year. Often a whaler had worked for a few days and then again ½-2 months later in the same waters. In these cases, the number of weeks in work is noted for every whaler. The modern whaling was more or less based on fin whales as they were the most numerous species. The time used to shoot other species was removed from the total CpBM to obtain the fin-CpBM. The smaller and less fat sei whale was less desirable to whalers compared to larger and fatter species like blue and humpback whales. Sperm whales were taken in increasing numbers as the fin whale numbers decreased. One day was subtracted for catches of sei whales while two days each were subtracted for blue, humpback and sperm whales. Other species (right, bottlenose, pilot, minke and killer whales) were very few in number and were excluded from the calculations. Other factors that may have influenced CPUE, for example engine trouble, bad weather, the boat leaving to whale in another district, or the best gunners and captains leaving for the more profitable whaling in the Antarctic, were not considered in the calculations.

Previously (IWC 1992, NAMMCO 2000, 2004, 2006), 25% of the Faroese catch in the period 1916-39 was assumed to have been taken in the EGI area. The rationale for this assumption was questioned in view of the Faroese regulation requiring catches to be landed within 36 hours of killing, meaning that catches were taken within 40 nautical miles of the station. Allison explained that the decision had been taken following inspection of the Faroese catch positions from 1948-84, of which up to 25% appeared to have been taken to the West of the specified boundary between the EGI and West Norway-Faroe Islands areas (a line from 60°N, 17°W to 67°N 3°E).

Bloch noted that she had obtained position data for ~11,000 catches, of which about half are from the Faroes. Many of these position records are in the form of a bearing and distance from a specified point and need to be converted to latitude and longitude for mapping. Once this has been done, it may be possible to see migration routes through the year in the data. Plots of these catch data will be developed in the future. Gunnlaugsson agreed to supply Bloch with the programme he had used to convert bearing and distance data to latitude and longitude.

Donovan presented Aguilar's paper SC/14/FW1 – SC/M06/FW17, which gave a

comprehensive summary of fin whale catches around the Iberian peninsula. Catches were listed by year and by area (Straits of Gibraltar, Portugal and NW Spain), and included information on lost whales. The high loss rate by an operation in Portugal in 1945 was reported to be 43%. The group thanked Aguilar, in his absence, for his work.

It was noted that the crash in availability of fin whales near Gibraltar and Southern Portugal was not reflected in Spanish catches further north, which might be evidence that the southern whales are from a different stock, possibly from the Mediterranean.

Lawson presented SC/14/FW21–SC/M06/FW21 which provided information on the distribution of fin whale catches in Newfoundland and Labrador, Canada. Whaling was banned from 1972, but most stations had already closed by then, following the collapse of the stock in the mid 1960s. Plots were shown which showed the change in catch distribution over four time periods. It was suggested that the fishery continued over time by moving to different catch areas, until the stock collapsed. Lawson reported that he had found detailed catch and CPUE data from the 1969 season and is looking for further data. Lawson was thanked for his work. In answer to a question about the distribution of fin whales between Canada and West Greenland, Lawson reported that fin whales were seen right across the Davis Strait, but that the survey effort was low.

Reasons for the closure of North Atlantic whaling stations were discussed, including bankruptcy due of the scarcity of whales and/or general economic difficulties (*e.g.* in 1930). In the Icelandic east coast fishery the whales had become smaller and more difficult to find and the station closed on economic grounds before the Icelandic ban on whaling in 1915. It was recalled that that the reasons for the Icelandic ban included pressure from herring fishermen opposed to whaling, pollution from whaling stations as well as the need for rebuilding of the stocks for future use by Icelanders themselves (Tønnessen 1967, Einarsson 1987). However the profitability of the whaling had been reduced considerably and it can be argued that whaling would have ended anyway for commercial reasons (Tønnessen 1967). In Northern Norway, the whaling ban from 1905-15 was imposed following bad years in the cod and herring fisheries, and was not reopened until World War I when the meat was needed for food. Similarly whaling was banned in the Shetland Islands during the herring season (1905-08). It was also noted that in operations off the West coast of Norway the proportion of fin whales in the catch remained fairly constant until after World War II, after which sperm whaling took over. The fin whale catch was used for meat whereas the sperm whale was not eaten but used for other purposes.

Following these discussions it was agreed to refer discussions of CPUE data to a small group (see Item 7.2). It was also agreed that it would be useful to summarise the information available on fin whale catches in the North Atlantic. A small group was set up to prepare the data, but did not have time to complete the task during the course of the meeting. It was agreed that a table would be produced to list the catches by year and area showing the assumptions made and the extent of data available in each case including whether the number of whales had been estimated as a proportion of the known total catch, the extent information available on catch positions and the numbers

of struck and lost whales.

7.2 Catch per Unit Effort (CPUE) data

The purpose of attempting to develop CPUE series is to use the values as an index of abundance, either (a) of a 'stock' or (b) in a geographical area. If it can be used, the actual relationship with abundance must be determined. Use of such data has been common in both fisheries whaling management in the past and there is an extensive literature on the assumptions and potential difficulties of using such data in this regard (*e.g.* see IWC 1989).

What is it to be used for?

There are a number of questions and assumptions to consider before deciding whether a CPUE series can be used in a management context. In the context of this meeting, the first question to be asked is what is the series to be used for? The potential answers (not always mutually exclusive) include:

(1) as a direct index suitable for estimating trends in abundance of (a) a 'stock' or (b) a geographical area;
(2) as a direct index suitable for 'fitting' in an assessment model such as HITTER-FITTER (see Item 9.1.1 and SC/14/FW/23–SC/M06/FW23), or 'conditioning' in an IWC RMP Implementation process; and
(3) a crude qualitative measure of trend for use in evaluating the results of modelling exercises.

The suitability of a particular series (or not) depends on the potential use to which it is put.

Factors that can affect the suitability of an index

To be used as an index of abundance, it is important that the measurement of effort reflects searching effort for the target species – in this case the fin whale. There are a number of factors that can influence these two features that must be considered when determining whether an appropriate CPUE series can be developed. In the context of determining trends (or lack of trend) in an index of abundance, two aspects of such factors should be examined: trends and 'noise'; the former is more important than the latter.

Target species

In the simplest case, where a fishery takes only one species – then this is clearly the target species. Difficulties can arise in multi-species fisheries as is commonly the case for fin whaling. In some datasets it may be that it is possible to isolate a time period within a season when only fin whales are taken because they are either the only species present or the only species allowed to be caught. Provided certain information is available (*e.g.* knowledge of days when boats were at sea) this may be used to select a period when it is clear that fin whales were the sole target species.

However, in most cases, the situation is more complex with two or more species being taken at the same time. In such cases, there may be one or more 'preferred' species and the reasons for any preferences must be examined to see how this may affect the use of the series as an index of abundance of fin whales. For example, in the case of the early

Icelandic whaling series the order of preference of species at the start was blue whale (products), humpback whale (ease of capture, hence profits) and then fin whales (apparently wider, more even distribution). If an appropriate fin whale CPUE catch series is to be developed, then it must be for time periods when it can be assumed that the target species was the fin whale – inter-related factors that should be considered in this, include examination of:

- the proportion of fin whales in the catch (uncertainty in species composition should be taken into account as well as economic aspects relating to the preferred choice of the whalers – note that there may be situations where a species may still not be the target species even if it starts to account for a large portion of the catch);
- when the searching area can be considered to be determined by the expected distribution of the fin whale and not by the distribution of other preferred species (this relates to the above point and may have economic component);
- the temporal component of the composition of the catch within a season (*e.g.* it may be possible to restrict consideration to a subset of the longer season where the fin whale is the target species);
- differences in strategy amongst operations (*e.g.* whether all of the vessels have the same target species or whether different operations adopt different priorities, *i.e.*, the index may be appropriate for some vessels but not others).

If/once a decision is made on the basis of one or more of the above factors, sensitivity to the choice must be investigated.

Searching and related features

Even if it can be assumed that for a certain period or periods, the target species is the fin whale, there are a number of factors that must be considered before it can be decided whether a suitable index reflecting search time can be developed (both in terms of affecting the noise around a value and affecting conclusions regarding trends).

Methods need to be developed to try to reduce the 'handling time' (*i.e.* time not spent searching for the target species – in a full 'time budget model' this includes all activity from the moment the first animal is seen to the time searching begins again). This interacts with the considerations under target species above. In effect one should try to remove handling time for all species, including the target species. An example of this approach is given in SC/14/FW/13–SC/M06/FW13 and called FiBM -01, -02. This assumed a constant time per 'other' (i.e. non-fin) whale caught of one and two days respectively.

The Working Group requested that to the extent possible, such methods take into account *inter alia*:

- 'handling' time of target and other species;
- possible differences between operations (*e.g.* different species priorities during the same season or group of seasons);
- factors affecting searching strategy and decisions made at sea (*e.g.* cooperation among boats);
- changes in vessel efficiency over time (*e.g.* engines, experience etc.);
- changes in searching efficiency as a result of environmental factors (*e.g.* weather)

- the number of whales that can be brought back to land at one time by a vessel and the possible use of towing vessels.

A further complication can arise if there is no/little information on the length of the season, as is the case for the early Icelandic series. SC/14/FW/13–SC/M06/FW13 provided one way of considering this in its FprB90 index (season assumed 90 days in length with one day subtracted per other whale captured). The Working Group requested that this method be reconsidered to take into account inter alia:

- an assessment as to whether there may have been operational/environmental factors that may have increased the noise and more importantly affected trends in the index (*e.g*. caused different season lengths due to breakdowns, weather, etc.);
- possible alternative values to those assumed and the sensitivity to these.

The Working Group **recommends** that papers proposing CPUE series provide adequate documentation of the rationale behind any assumptions made and values chosen and consideration of alternative values and assumptions to capture uncertainty/possible bias. In particular, given discussions under Item 9, it **recommends** that priority be given to investigating whether appropriate CPUE series can be developed for the 'early' (pre-1915) Icelandic whaling operations and Faroese whaling after the 1st World War.

7.3 Possible under- or over-reporting, including struck and lost animals, ship strikes and by-catches

There was little information available on struck and lost rates. At the IWC fin whale meeting in 1991 (IWC 1992), a loss rate of 50% was assumed for catches up to and including 1915. Tønnesen (1967, p. 44) discussed struck and lost rates in the early operations: "There are those that believe that the numbers for the first 20-25 years from 1867 should be doubled and for the next 15-20 years increased by 50%". A reduction in the struck and lost rate after the learning period of 20-25 years appears reasonable, but the loss factor may have increased somewhat again at the turn of the century due to more catches being taken in off shore waters as well as long towing distances along the coast in later years. The group also noted the high loss rate of 43% by an operation in Portugal in 1945 owing to the poor quality of harpoon lines (SC/14/FW17–SC/M06/FW17, Tønnesen and Johnsen 1982, p.507)

No evidence was known to suggest that any significant numbers of fin whales are caught incidentally in the North Atlantic.

The group thanked Bloch, Gunnlaugsson and Allison for all their hard work on catch and CPUE data.

7.4 Development of catch series in relation to stock structure hypotheses, including alternative catch series to capture uncertainty if necessary.

It was agreed that there was sufficient uncertainty in the catches, in particular in years when the fin whale catch was estimated from the total catch and in years when the struck and lost rate was thought to be appreciable, to warrant development of alternative catch series. It was agreed that the information in the catch series will be used as a basis to develop a 'high' and a 'low' series containing the maximum and minimum catches.

8. ABUNDANCE ESTIMATES (RECENT)

8.1 Review of available estimates by area and year

8.1.1 Central and eastern North Atlantic

Pike introduced SC/14/FW/18-SC/M06/FW18, which presented spatially stratified abundance estimates for fin whales from the Icelandic and Faroese components of North Atlantic Sightings Surveys (NASS) conducted in 1987, 1989, 1995 and 2001. Of particular interest were areas considered useful in modelling, namely East Greenland, West Iceland, the remainder of the EGI area and surrounding areas (Fig. 2); these areas were defined as recommended by the NAMMCO Working Group in 2003 (NAMMCO 2004). The data were re-analysed using a standardized methodology to make the estimates internally consistent. As the stratification scheme has been different for each survey, post stratification was used to derive common areas for comparison between surveys. Total abundance estimates for each survey were mostly similar to previous published and unpublished estimates (Table 2). The exception was the 1989 survey, for which the new estimate was about 15% higher than the estimate presented by Buckland *et al.* (1993). This is likely due to minor differences in analytical methods and the spatial post-stratification. Estimates for the portion of the EGI area covered by the surveys ranged from a low of 4,657 (CV=0.161) in 1987 to 23,676 (CV=0.133) in 2001.

The analysis used AIC (Akaike's Information Criterion) to select the model for the detection function. There was little difference in AIC among models but the estimates of effective strip half width (*esw*) varied little among different models indicating a lack of model uncertainty. Nevertheless, to avoid variation in abundance estimates due to selection of different functional forms of the detection function because of slight variations in AIC, in future it might be appropriate to weight estimates of *esw* from competing models by AIC to obtain the most robust results.

Øien introduced SC/14/FW/25-SC/M06/FW25, a summary of previously presented estimates of fin whale abundance from the Norwegian surveys since 1988. Fin whale abundance was estimated by combining non-duplicate sightings from both platforms on the Norwegian surveys conducted in 1995 and later, assuming that $g(0)$=1. The survey in 1995 covered the whole northeast Atlantic synoptically and resulted in an estimate of abundance of 5,395 (CV=0.20) (Øien 2003). Over the period 1996-2001, a corresponding area was covered by partial surveys and a total estimate of 10,500 (CV=0.24) calculated (Øien 2004). This latter estimate included survey block NVS (to the north and east of Iceland) which contributed about 4,000 individuals to the estimate; this block was not covered in 1995. For the partial surveys in 1996-2001, additional variance reflecting any changes in distribution from year to year had not been included in the estimate of variance. The Workshop recommended that this be done using methods developed for minke whales.

8.1.2 Estimates of *g(0)* from Icelandic, Faroese and Norwegian surveys

Pike introduced SC/14/FW/19-SC/M06/FW19, an estimate of $g(0)$ for fin whales from the NASS-2001 surveys in Icelandic and Faroese waters. Previous abundance

estimates for fin whales from the Icelandic and Faroese NASS (Buckland *et al.* 1992, Gunnlaugsson *et al.* 2002, Víkingsson *et al.* 2006) have not been corrected for visible whales that are missed by observers (perception bias) or whales that are missed because they are diving while the vessel passes (availability bias). The paper provided an estimate of the probability of detection on the trackline (*g(0)*) for the primary platform and corrected estimates of abundance for the 2001 survey, the only one for which double platform methods were fully implemented, based on mark-recapture methodology available in DISTANCE 5. Models assuming full and point independence (Laake and Borchers 2004) were considered, and the latter type were selected based on minimization of AIC. Of the covariates considered, *g(0)* was dependent on perpendicular distance from the trackline, certainty of species identification (fin or probable fin) and Beaufort sea state. The mean value for *g(0)*, averaged over all covariates, was 0.812 for the primary platform. The total abundance in the survey area corrected for *g(0)* was 28,724 (CV=0.16), compared to 25,761 (CV=0.13) from the conventional analysis including non-duplicate sightings from both platforms. This indicates that *g(0)* for the combined platforms, which is not directly estimable because the platforms were not symmetrically independent, was about 0.9.

Øien presented SC/14/FW/20-SC/M06/FW20, an estimate of *g(0)* for fin whales from Norwegian surveys in 1995 and 1996-2001, which were conducted with a two-way independent double platform configuration. Abundance estimates presented earlier from these data have been based on combining non-duplicate data from these two platforms and assuming *g(0)*=1 for this configuration (see 8.1.1). Estimates of *g(0)* were calculated using the mark-recapture distance sampling module in DISTANCE 5. Assuming point independence, estimated *g(0)* for the combined platform ranged from 0.91-0.92 for 1995 and 0.93-0.94 for 1996-2001. For the single primary platform, corresponding values were 0.71 for 1995 and 0.74-0.75 for 1996-2001. The total abundances of fin whales calculated taking *g(0)* into account were very similar to those based on combining the platforms with non-duplicates.

The Working Group discussed whether the available abundance estimates should be corrected for *g(0)*. It noted that the primary purpose of the *g(0)* analyses had been to investigate the effect of using available double platform data for correcting abundance estimates and to use the results to inform the design of future surveys. Although there was no loss of precision in the corrected estimates for the Norwegian surveys, the CVs of the corrected estimates for the Icelandic/Faroese surveys were larger. The Workshop agreed that these analyses were useful in informing whether or not it would be necessary to implement double platform methods in future surveys but that it was preferable to use the uncorrected estimates at this time.

The Workshop **agreed** that for general purposes the best estimate of current abundance in the Central North Atlantic (including the Faroes) is 25,800 (CV=0.125) for the year 2001. The best estimate for the eastern North Atlantic is 4,100 (CV=0.210) from the 1996-2001 survey series. These estimates are based on the assumption that *g(0)*=1. It was noted that discussion of the use of abundance estimates for specific purposes (*e.g.* use in the IWC's RMP Implementation process) would occur in the respective scientific

committees.

8.1.3 West Greenland

Witting presented SC/14/FW/22-SC/M06/FW22 which reported on a ship-based line transect survey conducted in September 2005 for large whales off East and West Greenland. The survey platform primarily targeted capelin, *Mallotus villosus*, using acoustic methods and systematically covered the east and west coasts of Greenland from the coast to the shelf break. The surveyed area comprised 81,000 km^2 in East Greenland and 225,000 km^2 in West Greenland. A total of 194 sightings of 13 cetacean species were made and standard line transect methods were used to derive abundance estimates of the four most commonly encountered large cetaceans. The authors developed abundance estimates for East and West Greenland. Despite good conditions and considerable effort, few cetaceans were observed in the northernmost strata in West Greenland. This suggests that the southbound fall migration of large whales from Northwest Greenland may have started by the time the survey was initiated.

The Workshop discussed the possible implications of the survey design and the distribution of realized survey effort. In West Greenland, the square-pattern survey design provides approximately equal area coverage but the transect parallel to the coast should not be included in a standard line transect analysis (at least not in estimation of encounter rate). In the northern part of East Greenland, the zig-zag design is reasonable but the sole transect in the southeast area, along which most of the fin whales were seen, is parallel to the coast and thus not representative of the area surveyed. Realized survey effort was very patchy, being mostly close to the coast in some areas but offshore in other areas. These factors could all potentially cause bias when extrapolating estimated density to the whole study area. The Workshop noted that the estimated variances seemed low given the number and distribution of sightings. It was unclear what had been used as replicate transects in the calculation of variance.

The Workshop welcomed this presentation. It was recognized that the survey was designed for other purposes but encouraged the authors to attempt a reanalysis to try to account for some of the problems identified. Given the above problems the Workshop agreed that it could not accept the estimates presented in SC/14/FW/22-SC/M06/FW22. The Workshop noted that an aerial survey had been conducted at the same time but analyses of the data had not yet been completed. It looked forward to a revised presentation incorporating a reanalysis of the shipboard survey data and presentation of the aerial survey analysis. Confidence in the extrapolation aspects of the shipboard survey analysis arising from poor realized coverage of some regions might be enhanced by comparing with distribution patterns evident from previous surveys and the recent aerial survey.

8.1.4 Canada

Lawson presented SC/14/FW/25-SC/M06/FW25, which described aerial surveys for marine megafauna conducted off Newfoundland in mid Sept-Oct of 2002 and 2003.

Transects were flown at 204 km/hr and 152 m ASL (above sea level). The 11,123 km of effort were flown in a Cessna 337 Skymaster with two rear observers. The area under the aircraft out to ~16.6 m from the track line was not visible. The 106 transects were arranged in a parallel design, placed to cover most of the bathymetric gradient, from shore to at least 172 km, with many extending beyond 260 km. DISTANCE 5 was used to analyse the data. No fin whales were sighted on the west coast in 2002, although they have been sighted there subsequently. Twenty-nine fin whales were seen in 12 sighting events; most on the NE coast, with a single whale seen off the east coast and two off the south coast. Fin whales were sighted at perpendicular distances of 26-1,238 meters; other sightings were made at greater distances while off-effort. Five additional "large whale" sightings made at times and places near the fin whale sightings were assumed to be fin whales and incorporated into the data. Analyses yielded a density estimate of 0.006182 fin whales per km^2 (95% CI: 0.00257-0.01487). This equates to a point estimate of 1,103 fin whales (95% CI: 459-2,654) in the study area, uncorrected for *g(0)*. It is not appropriate to extrapolate this estimate to the entire Newfoundland stock area.

The Workshop welcomed this presentation, which was the first attempt to estimate the abundance of fin whales in this area. Comments were made about the low number of sightings and the lack of visibility directly under the aircraft. The Workshop agreed that it was not reasonable to extrapolate densities estimated from the survey to unsurveyed areas but looked forward to the presentation of results from future surveys.

8.2 Estimates of trends in abundance

Information on trends in abundance in the eastern North Atlantic from Norwegian surveys was available in SC/14/FW/25-SC/M06/FW25. Prior to 1995, large parts of the northeast Atlantic were covered in single-platform surveys in 1988 and 1989. To investigate trends in relative abundance, an area was defined which had been covered in all surveys ("kernel" area). Estimates of abundance from the primary platform data from double platform surveys from 1995 onwards and from the single platform data prior to 1995 were calculated. A non-significant increase of about 2% per year was found.

The Workshop noted that the "kernel" area was chosen to incorporate survey data common to all survey years rather than to incorporate a core area of distribution. It discussed how to interpret the estimate of trend from these data, given the observed variation in distribution from year to year. It agreed that, although the estimated trend provided information on the change in abundance in the "kernel" area, it was unknown whether this area provided information on trend in possible stocks.

Information on trends in abundance in the central North Atlantic from Icelandic and Faroese surveys was available from work in preparation by Vikingsson *et al.* – the results from which are reproduced in Appendix 5. Estimated abundance in the area west and southwest of Iceland increased at an annual rate of 10% (95% CL: 6% - 14%) between 1987 and 2001. This is the area where nearly all fin whaling has been conducted since 1915. Estimated abundance in the whole EGI area has increased at

3% (95% CL: -1% - 7%) per year, *i.e.* this rate of increase is not significant at the 5% level. It is possible that there have been increases in survey efficiency, *i.e. g(0)* may have been lower in the earlier years, but the Workshop agreed it was unlikely that this factor could fully explain the observed increases in abundance. The difference between the estimated rates of increase in the western area and the EGI area covered by these surveys indicates that some shift in the relative abundance of whales has occurred between 1987 and 2001.

9 ABUNDANCE ESTIMATES (PRE-EXPLOITATION)

9.1 Methods

9.1.1 Use of population models

SC/14/FW/23–SC/M06/FW23 reported a new assessment model of the EGI fin whale population, modeled as four sub-populations with movement between the following areas: East Greenland (area 1), West Iceland (area 2), East Iceland (area 3) and the Far East (area 4) (See Fig. 2). The model is sex- and age-structured, and is fitted to CPUE, sightings survey abundance split by area, and mark-recapture data using both maximum likelihood and Bayesian approaches. Movement parameters are not differentiated by sex since the inclusion of sex-specific movement parameters did not improve the AIC. For the base case assessment scenario, best fits to the data were obtained when the West Iceland and East Iceland sub-populations are effectively fully mixed, with an annual interchange with East Greenland of a few percent and virtually no interchange with the Far East region. For the base case and most sensitivity tests, the overall recruited population is increasing and above 80% (base case 84%) of pre-exploitation abundance (*K*), and sub-populations in all areas are above 70% (base case > 79%) of the individual *K* values; MSYR(1+) is estimated at 1.7%. Projections for annual catches of 0, 100, and 200 whales indicated that only the last would result in abundance decreases compared to current levels. Under catch levels of 200 whales there was less than a 12% probability that any of the 1+, recruited or mature female components of the total EGI population would fall below 60% of pre-exploitation levels within the next 30 years.

A minor discrepancy in the catch series used in the model was noted, in that 25% of catches landed in the Faroe Islands between 1916 and 1929 were assumed to come from West Iceland when they should have been applied to East Iceland. The validity of this assumption needs further consideration. However these catches were small and would have no effect on the general outcomes of the model.

Some of the predictions of the model did not coincide with our present understanding of fin whales in this area. Firstly, the model predicts a low rate of mixing between East Greenland and West Iceland, whereas Discovery marking and radio tagging experiments suggest higher rates of exchange over recent years. However it was pointed out that most markings applied in the East Greenland area were quite close to the borderline with West Iceland. Secondly, the model provided a poor fit to the trends in abundance estimates in Area 1 (East Greenland), an area for which sightings surveys have shown a large and significant increase in abundance since 1987. The

model predicted little increase in this area. However it was noted that the apparent increase in abundance might be exaggerated because of differences in bias between surveys and distributional shifts (see 8.2). Finally, the model suggested a high rate of mixing between West and East Iceland. This is contrary to the history of whaling in the area, which indicates that the West Iceland whales were depleted first, around the turn of the last century, after which whalers moved to East Iceland where the stocks were apparently much less depleted. This suggests that there was not a high rate of exchange between these areas. There were too few Discovery marks placed off East Iceland to be informative about this exchange rate.

Butterworth suggested that the inconsistencies suggested above might be partially due to distributional shifts, which were not accounted for in the model. Such shifts have been observed in the NASS series, for example in the area west of Iceland and around Norway. It was also suspected that these conflicting results may have been due to an overemphasis on the two early CPUE series in the model, because of low associated variances. These series are assumed to be linearly proportional to abundance, but there is considerable uncertainty about this (see 7.2) and it was considered that additional sensitivity runs, incorporating improved CPUE indices, indices entered with higher levels of variance and alternative assumptions about their relationship to abundance, would be of value. Furthermore, it was suggested that sensitivity runs incorporating two or more factors simultaneously would be useful, particularly runs combining combinations of alternative CPUE assumptions and choices of natural mortality.

The Working Group could not draw firm conclusions from this modelling exercise, but noted that the more complex models involving two or more spatial components, such as this model and that of Cunningham and Butterworth (2003), did fit the historical and modern CPUE and abundance data better than single homogeneous stock models. The model can be improved as the stock structure of fin whales in the area is clarified, particularly with regard to stock boundaries and mixing rates.

10 FUTURE WORK AND RESEARCH RECOMMENDATIONS

The Working Group reiterated research recommendations made in previous NAMMCO meetings (NAMMCO 2000, 2001, 2004, 2006 in press), and identified those most important to refine existing assessment and extend assessments to other areas:

Catch series

- Produce an agreed catch series, explicitly listing assumptions and estimates for each year and area (see item 7.1);
- Provide position data for as many catches as possible, including conversion of data expressed as a bearing and distance from a fixed point into a latitude and longitude;
- Produce alternative catch series incorporating different levels of struck and lost rates and varying other assumptions as necessary.

Stock structure

- Finalise the complete genetic dataset as documented under Item 5.1;
- Better understand assumptions and methods for new genetic analytical techniques and further investigate power of genetic analyses and estimation of confidence intervals as documented under Item 5.1;
- Completion of preliminary analyses presented under Item 5.1;
- Additional genetic sampling in all areas, but particularly in areas from which samples are few or lacking, such as East Greenland, northern and eastern Iceland, the Faroes, Norway, Canada and the USA;
- Inclusion of biopsy programmes in future sightings surveys should be considered;
- Use microsatellite analysis to determine if closely related individuals are present on different feeding grounds;
- Run duplicate analyses and inter-laboratory comparisons to estimate error rates in genetic typing;
- Satellite tagging to determine habitat use and migratory patterns once methodological/technical issues are addressed. If possible, a biopsy should be obtained from all tagged animals for genetic analysis and sex determination.

Abundance

- Incorporate additional variance into estimates from Norwegian mosaic surveys;
- Future surveys, such as the proposed Trans North Atlantic Sightings Survey (TNASS) in 2007, should cover as wide an area as feasible, including eastern Canada and West Greenland;
- New abundance estimates from the ship and aerial surveys carried out off Greenland in 2005 should be produced.

Assessment models

The following pertain to assessment models for the EGI, Faroes and Norwegian areas as relevant.

- Extend modelling to include neighbouring areas, including Norway, the Faroes and West Greenland;
- Incorporate agreed catch series using existing boundaries and conduct sensitivity analyses with alternate series;
- Incorporate improved CPUE series with appropriate variances, when they are completed, and conduct sensitivity analyses with alternate series;
- Conduct sensitivity analyses using alternative CPUE series and levels of mortality simultaneously;
- Analyze correlation of predicted abundance with observed trends in biological parameters;
- Ascertain why the present model estimates a high mixing rate between West and East Iceland.

Other

- If new catches are taken, samples should be taken if possible both within and outside the traditional whaling grounds. The material should be investigated to get an updated view of age structure and sex distribution on and outside the whaling grounds, and biological parameters such as age at sexual maturity and fecundity;

- Compile information on incidental sightings, marking with Discovery tags, satellite tagging tracks, biopsy samples and age determinations of some samples for areas where this has not already been done.

11. MANAGEMENT RECOMMENDATIONS (NAMMCO only)

Allison, Donovan and Hammond did not take part in deliberations under this item.

11.1 EGI

The Working Group found no reason to change its advice provided in 2005 (NAMMCO in press), that projections under constant catch levels suggest that West Iceland (termed the "inshore substock" in earlier analyses) will maintain its present abundance (which is above MSY level) under an annual catch of about 150 whales. It is important to note that this result is based upon the assumption that catches are confined to West Iceland, *i.e.* to the grounds from which fin whales have been taken traditionally. If catches were spread more widely, so that other stock components were also harvested, the level of possible overall sustainable annual catch would be higher than 150 whales.

11.2 North Norway

The Working Group is not yet in a position to provide management advice for this area. Once the work identified for this area under item 10. has been done, assessments can be carried out for this area. However, given the rather low abundance estimates (<2,000) and the high historical harvest in the area, it can be expected that the stock will be found to be depleted relative to past levels.

11.3 West Norway-Faroes

No new assessments were considered for this area. The Working Group reiterated the advice provided in 2005 (NAMMCO in press), that uncertainties about stock identity are so great as to preclude carrying out a reliable assessment of the status of fin whales in Faroese waters. The Working Group therefore reiterated the recommendations made in 2000 (NAMMCO 2001) to carry out a research programme to elucidate the stock structure of fin whales in this area, and their relationships to other areas. Once this is done, it may be necessary to obtain clearer guidance on the management objectives for harvesting from what is likely to be a recovering stock before specific advice can be given. It was recognized that genetic analyses are proceeding that may clarify the stock structure in this and other areas. Extraction of CPUE data for this region has been undertaken and its analysis may inform on the status of fin whales in this area.

12 OTHER BUSINESS

It was agreed that future work on fin whales, including meeting documents, working papers and reports, would be exchanged between the IWC and NAMMCO Scientific Committees.

13 ADOPTION OF REPORT

A draft version of the Report was adopted by consensus on 26 March. The first joint meeting between the NAMMCO and IWC Scientific Committees was considered successful, efficient and productive. The Chair thanked the rapporteurs and the staff of the Marine Research Institute for their hard work during the meeting. The Chair was thanked for his efficient management of the meeting.

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Breeding stocks	**1 (complete mixing)**	**1 (isolation by distance)**	**2**	**3**	**4**	**5+**
DNA nuclear*	I?	C	C	C	I?	I?
DNA mitochondrial	NI	NI	NI	NI	NI	NI
Allozyme*	I?	C	C	C	C	NI
Morphology	I?	C	C	NI	NI	NI
Biological parameters	C	C	C	NI	NI	NI
Mark-recapture	NI	NI	NI	NI	NI	NI
Telemetry	NI	NI	NI	NI	NI	NI
CPUE (depletion pattern)	NI	NI	NI	NI	NI	NI
Sightings	NI		NI	NI	NI	NI

Table 1. Available genetic and non-genetic evidence in terms of its ability to discriminate among breeding stock hypotheses. Options – compatible (C), incompatible (I), perhaps incompatible, requires further work (I?), provides no information (NI) *Requires further consideration and possible reanalysis of data (see Item 5.1)

SURVEY	REGION	N	CV
1988	EG	5,024	0.228
1988	WI	3,452	0.259
1988	EI+FE	6,856	0.427
1988	OUT	675	0.284
1988	EGI-TOT[1]	15,332	0.216
1988	TOT	16,007	0.205
1995	EG	8,412	0.294
1995	WI	6,800	0.231
1995	EI+FE	4,145	0.442
1995	EI+FE[2]	5,053	0.368
1995	OUT	1,594	0.285
1995	EGI-TOT	19,357	0.22
1995	EGI-TOT[2]	20,265	0.211
1995	TOTAL	20,951	0.213
1995	TOTAL[2]	21,859	0.205
2001	EG	11,706	0.195
2001	WI	6,565	0.195
2001	EI+FE	5,405	0.292
2001	OUT	2,085	0.282
2001	EGI-TOT	23,676	0.133
2001	TOTAL	25,761	0.125

Table 2. Regional abundance estimates from Icelandic and Faroese North Atlantic Sightings Surveys. Areas are as defined in Fig. 2.
[1]Includes Norwegian estimate for Jan Mayen area from 1987 (IWC 1990, p. 141);
[2]Includes Norwegian blocks NVN and JMC from 1995 (Øien 2003).

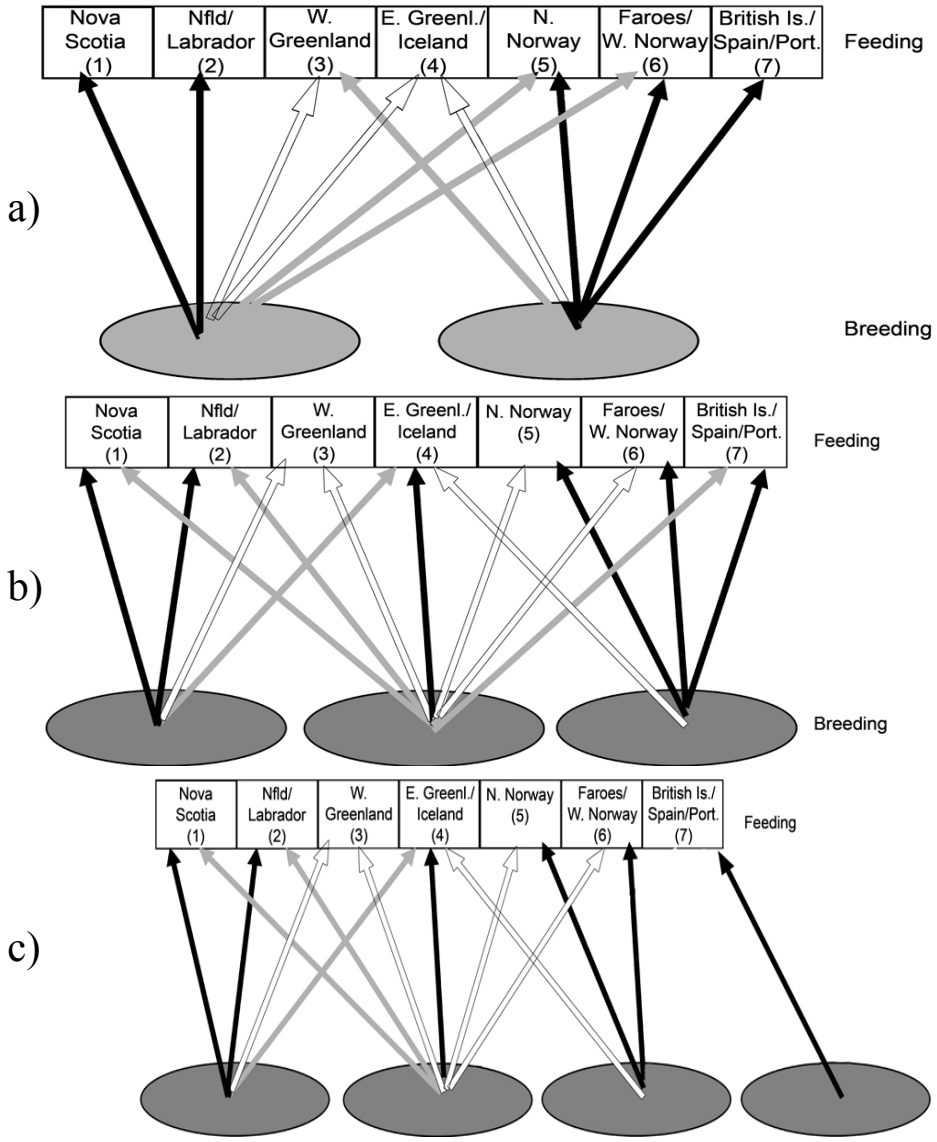

Fig. 1. Feeding – breeding stock scenarios for North Atlantic fin whales, showing scenarios for 7 feeding stocks and a) 2, b) 3 and c) 4 breeding stocks. Arrow colours indicate the strength of the evidence supporting the link: black – strong; grey – weak; white – very weak.

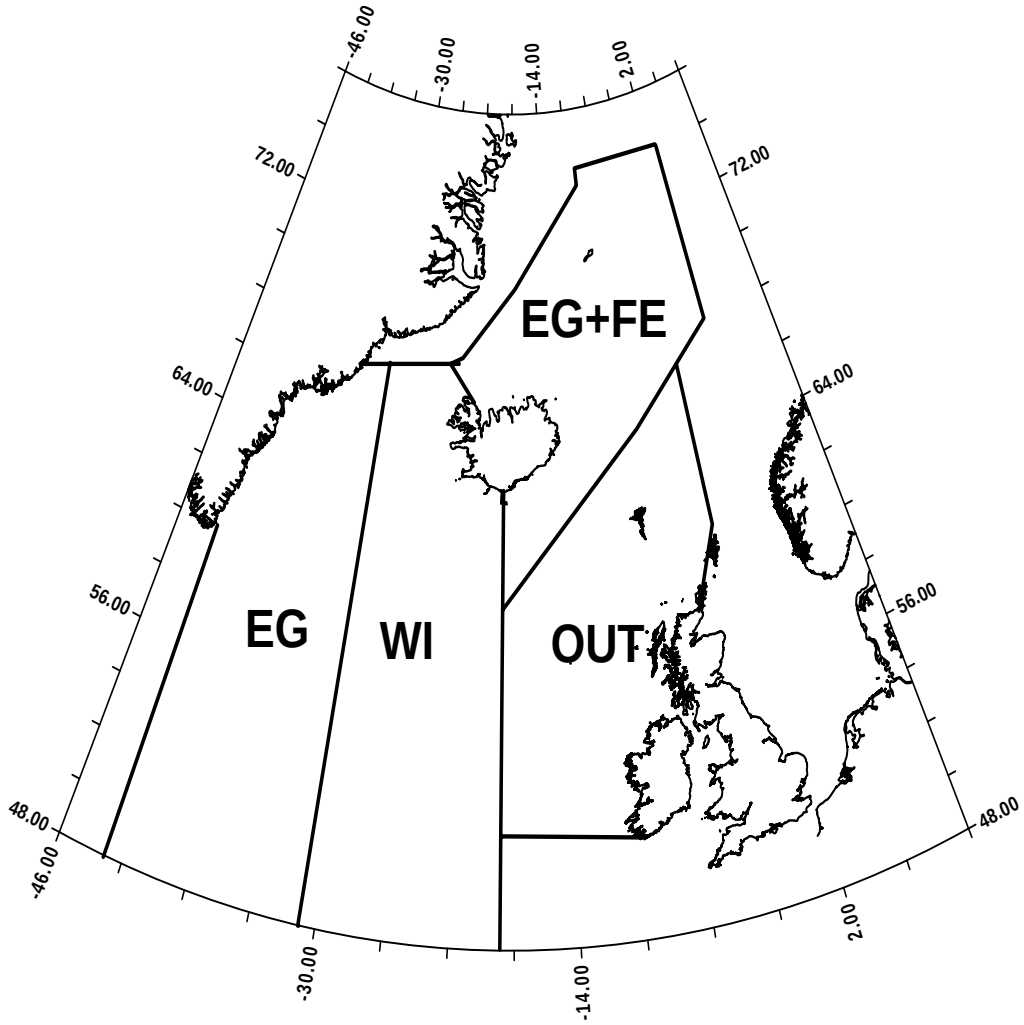

Fig. 2. Approximate boundaries of sub-population areas used in the assessment model for the EGI stock (see Item 9.1.1). EG – East Greenland (area 1); WI – West Iceland (area 2); EI + FE – East Iceland and Far East (areas 3+4); OUT – outside of EGA area (not used).

|Appendix 1

AGENDA

1 Opening remarks
2 Appointment of chair and rapporteur
3 Adoption of agenda
4 Review of available documents and reports
5 Stock structure
  5.1 Genetic evidence
  5.2 Non-genetic evidence
  5.3 Stock structure hypotheses
  5.4 Mixing rates
6 Biological parameters
  6.1 Review of available estimates
  6.2 Evidence for trends in estimates
  6.3 Values for use in modelling (see Item 9.1.1)
7 Catch data
  7.1 Available catch data, level of detail and level of disaggregation of data
  7.2 Limitations of data
    7.2.1 Known missing or unreported data
  7.3 Possible under- or over-reporting, including struck-and-lost animals, ship strikes and by-catches
  7.4 Development of catch series in relation to stock structure hypotheses, including alternative series to capture uncertainty, if necessary
8 Abundance estimates (recent)
  8.1 Review of available estimates by area and year
  8.2 Estimates of trends in abundance
  8.3 Development of abundance estimates in relation to stock structure hypotheses
9 Abundance estimates (pre-exploitation)
  9.1 Methods
    9.1.1 Use of population models
    9.1.2 Use of genetic models
  9.2 Results of modelling exercises and their implications for the adequacy of the models, stock structure hypotheses, catch histories etc.
  9.3 Estimates of initial abundance in relation to stock structure hypotheses
10 Future work and research recommendations
11 Management recommendations (NAMMCO only)
12 Preparations for pre-implementation assessment (IWC only)
13 Other business
14 Adoption of report.

Appendix 2

LIST OF DOCUMENTS

Document No.

SC/14/FW/1	List of participants.
SC/14/FW/2	Draft annotated agenda.
SC/14/FW/3	Draft list of documents.
SC/14/FW/4 – SC/M06/FW4	Pastene, L.A. and Kitakado, T. Thoughts on stock structure analysis/hypotheses of North Atlantic fin whales based on the experiences of North Pacific common minke and Bryde's whales RMP implementations.
SC/14/FW/5 – SC/M06/FW5	Daníelsdóttir, A.K., Bérubé, M., Palsbøll, P.J., Stefánsson, M.O., Thorgilsson, B., Jorunsdóttir, Th.D., Ragnarsdóttir, A., Árnason, A., Gunnlaugsson, Th., Ólafsdóttir, D., Øien, N., Witting, L., Pampoulie, C. and Víkingsson, G.A. Genetic stock delineation of fin whales.
SC/14/FW/7 – SC/M06/FW7	Víkingsson, G.A. and Gunnlaugsson, Th. Stock structure of fin whales (*Balaenoptera physalus*) in the North Atlantic – indications from non-genetic data.
SC/14/FW/8 – SC/M06/FW8	Mikkelsen, B., Bloch, D. and Heide-Jørgensen, M.P. Movements of two fin whales (*Balaenoptera physalus*) tracked by satellite telemetry in Faroe Islands in 2001.
SC/14/FW/11 – SC/M06/FW11	Lockyer, C. A review of the biological parameters of fin whales: focus on the North Atlantic.
SC/14/FW/12 – SC/M06/FW12	Víkingsson, G.A. Trends in biological parameters for the EGI stock.
SC/14/FW/13 – SC/M06/FW13	Sigurjónsson, J. and Gunnlaugsson, Th. Revised catch series and CPUE for fin whales taken from the early modern whaling land stations in Iceland
SC/14/FW/14 – SC/M06/FW14	Bloch, D. Norwegian coastal and pelagic whaling, 1917-1986.
SC/14/FW/15 – SC/M06/FW15	Bloch, D. and Allison, C. The North Atlantic catch of fin whales, 1894-1984, taken by Norway, the Faroes, Shetland, the Hebrides, Ireland and Greenland.
SC/14/FW/16 – SC/M06/FW16	Bloch, D. and Allison, C. Whale catches in the North Atlantic 1894-1984, taken by Norway, the Faroes, Shetland, the Hebrides, Ireland and Greenland.
SC/14/FW/17 – SC/M06/FW17	Aguilar, A.: Catches of fin whales around the Iberian Peninsula: Statistics and sources.
SC/14/FW/18 – SC/M06/FW18	Pike, D.G. and Gunnlaugsson, Th. Regional estimates of density and abundance of fin whales (*Balaenoptera physalus*) from

Document No.

	Icelandic and Faroese North Atlantic Sightings Surveys.
SC/14/FW/19 – SC/M06/FW19	Pike, D.G., Gunnlaugsson, Th. and Víkingsson, G.A. An estimate of *g(0)* for the NASS-2001 survey for fin whales (*Balaenoptera physalus*) in Icelandic and Faroese waters.
SC/14/FW/20 – SC/M06/FW20	Øien, N. and Bøthun, G. Estimates of *g(0)* for fin whales in Norwegian double platform surveys, 1995 and 1996-2001.
SC/14/FW/21 – SC/M06/FW21	Lawson, J. Preliminary information on distribution and abundance of fin whales in Newfoundland and Labrador, Canada.
SC/14/FW/22 – SC/M06/FW22	Heide-Jørgensen, M.P., Simon, M.J. and Laidre, K.L. Estimates of large whale abundance in Greenland waters from a ship-based survey in 2005
SC/14/FW/23 – SC/M06/FW23	Branch, T.A. and Butterworth, D.S. Assessment of the East Greenland / Iceland fin whale population using a four-substock model.
SC/14/FW/24 – SC/M06/FW24	Bérubé, M., Bloch, D., Mikkelsen, B., Heide-Jørgensen, M.P. and Palsbøll, P.J. Stock-identity of Faroe Island fin whale biopsies.
SC/14/FW/25 – SC/M06/FW25	Øien, N. Abundance estimates for fin whales from Norwegian surveys.

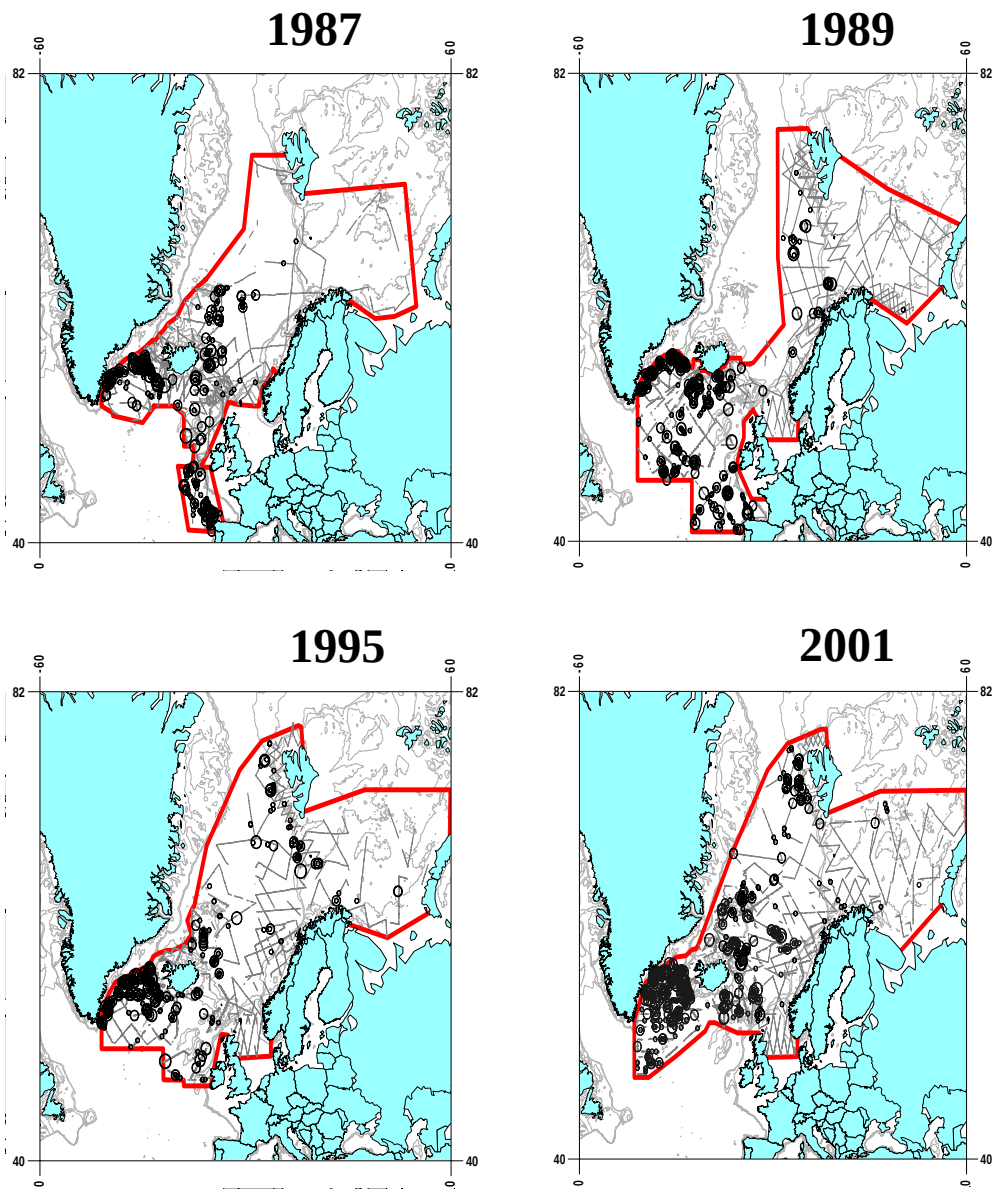

Fig. 1. Realised survey effort and sightings of fin whales in NASS ship surveys, 1987 to 2001. Symbol size is proportional to group size from 1 to 4+. The Norwegian sector of the 2001 survey was surveyed from 1996-2001.

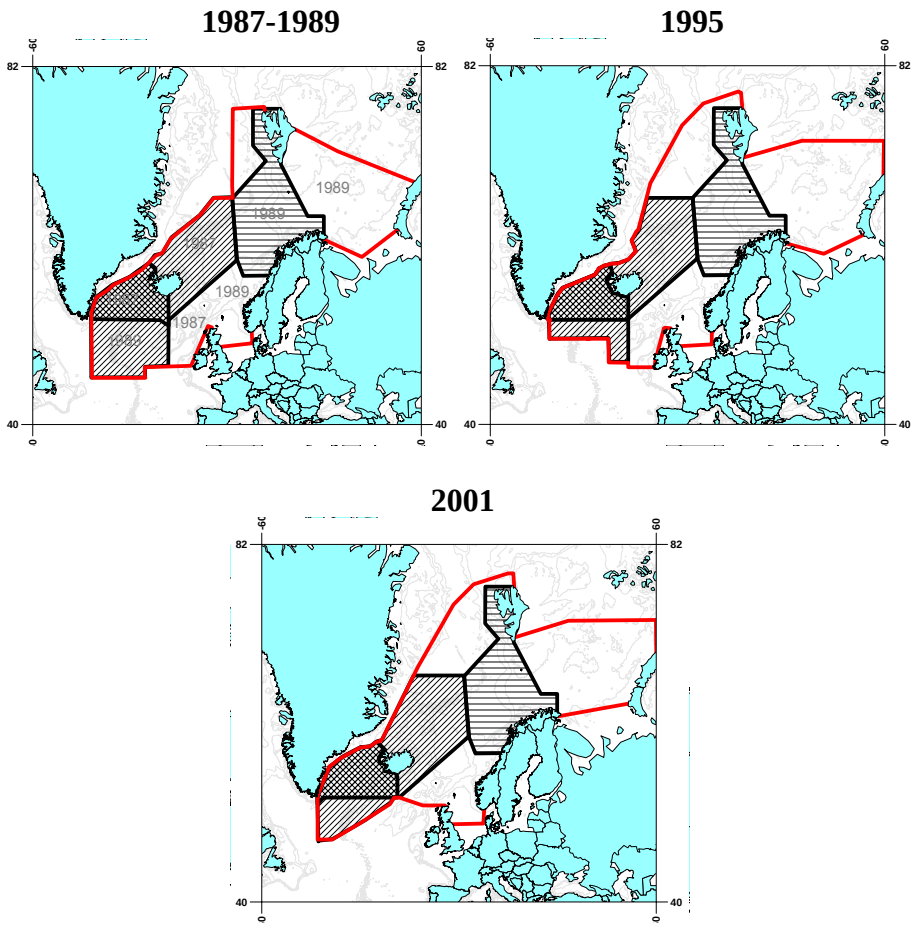

Fig. 2. Regions used in examining trends in fin whale abundance. Survey year is indicated for the 1987-1989 compilation. The Norwegian sector of the 2001 survey was surveyed in the period 1996-2001. Cross hatched – WEST; Diagonally hatched – EGI; Horizontally hatched – NORWAY; TOTAL outlined in red.

YEAR	REGION	N	CV	L	R	COMMENTS
1987	WEST	3,607	0.18	2,537	5,132	
1989	WEST	6,006	0.25	3,468	10,401	
1995	WEST	13,726	0.23	8,667	21,740	
2001	WEST	14,021	0.18	9,550	20,586	
GROWTH RATE		0.10		0.06	0.14	
1988	EGI	15,237	0.22	9,990	23,239	Includes components of 1987 and 1989 surveys.
1995	EGI	20,262	0.21	13,464	30,492	Norwegian – Øien (2003)
2001	EGI	23,676	0.13	18,024	31,101	
GROWTH RATE		0.03		-0.01	0.07	
1988	NOR	1,242	0.38	512	3,009	Øien and Bøthun (2005)
1989	NOR	1,106	0.43	464	2,637	Øien and Bøthun (2005)
1995	NOR	1,806	0.51	576	5,668	Øien and Bøthun (2005)
1998	NOR	1,723	1.09	201	14,734	Øien and Bøthun (2005)
GROWTH RATE		0.05		-0.13	0.26	
1988	TOTAL	17,482	0.19	11,981	25,508	Includes components of 1987 and 1989 surveys.
1995	TOTAL	26,343	0.17	18,754	37,004	Norwegian – Øien (2003)
2001	TOTAL	29,891	0.11	24,040	37,167	Norwegian – Øien (2004)
GROWTH RATE		0.04		0.01	0.08	

Table 1. Estimates of abundance by region for NASS shipboard surveys after post-stratification. N – abundance; CV – coefficient of variation; L, R – lower and upper 95% confidence intervals. Regions are shown in Fig. 2.

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ANNEX 3

AD HOC WORKING GROUP

ARE FIN WHALES IN THE CENTRAL NORTH ATLANTIC APPROPRIATELY LISTED IN CITES (Convention on International Trade in Endangered Species) APPENDIX I?

1. CHAIRMAN'S WELCOME AND OPENING REMARKS

Lars Witting (Greenland) was appointed as chair. He welcomed all participants, especially those invited from outside NAMMCO (see Section 6.4)

The chair summarised the terms of reference for the meeting. At the recent July 2006 CITES Animals Committee meeting, it had been decided to undertake periodic reviews of species listed on the CITES Appendices, and the North Atlantic central stock of fin whales had been nominated for review with Iceland agreeing to undertake this before the next CITES Animals Committee meeting. The chair noted that the North Atlantic central stock of fin whales was interpreted at that CITES meeting to refer to the East Greenland Iceland (EGI) area. The purpose of the Working Group meeting was to examine the validity of the stock's current CITES listing under Appendix I with reference to the specific listing criteria adopted by CITES.

2. ADOPTION OF AGENDA

The agenda was adopted with some minor changes, and is given in Appendix 1.

3. APPOINTMENT OF RAPPORTEUR

Christina Lockyer from the NAMMCO Secretariat was appointed as rapporteur.

4. REVIEW OF AVAILABLE DOCUMENTS AND REPORTS

A total of 9 documents (see Appendix 2) was available to the meeting.

5. BACKGROUND

Vikíngsson presented SC/14/CITES/4, and gave some background on the reason for the Working Group meeting. At the 22nd meeting of the Animals Committee of CITES in Lima (Peru), 7-13 July 2006 under "Periodic review of animal species included in the CITES Appendices", it had been agreed to include the central stock of North Atlantic fin whales *Balaenoptera physalus* in this review. Iceland volunteered to evaluate this species before the next meeting of the Animals Committee. The main purpose of the periodic review mechanism is to evaluate whether a species is appropriately listed in a CITES Appendix. Fin whales are presently listed in Appendix I which applies to "species that are the most endangered among CITES-listed animals and plants. They are threatened with extinction and CITES generally prohibits commercial international trade in specimens of these species".

The 13th Conference of the Parties to CITES (CoP13) held in 2004 agreed to Resolution Conf. 9.24 (Rev.) concerning criteria for listings on the different CITES Appendices**.** The resolution states that when considering proposals to amend Appendices I and II "the views, if any, of intergovernmental bodies with competence for the management of the species concerned should be taken into account". Although the periodic review by the Animals Committee is not a formal proposal to transfer species from one Appendix to another, the same criteria and working methods apply. Consultations with range states are also part of the periodic review process. NAMMCO is one obvious choice as an intergovernmental body to consult according to these guidelines because of its recent assessments of North Atlantic fin whales, its role in coordinating the series of North Atlantic Sightings Surveys (NASS), and the fact that NAMMCO includes all the range states for the East Greenland – Iceland stock of fin whales as defined in the IWC schedule.

The next CITES Animals Committee review meeting is scheduled for February 2008. The NAMMCO Council has requested the NAMMCO Scientific Committee to undertake a review of the appropriateness of the current CITES listing of this fin whale stock.

6. STOCK STRUCTURE

The Working Group first discussed the precise interpretation of the term "central stock of North Atlantic fin whales" used by the CITES Animals Committee, and whether or not this was to be interpreted as the geographic region specified in the IWC Schedule for the EGI stock.

The Working Group was guided in its discussions by SC/14/CITES/5 which provided the CITES criteria for listing of species, and especially by Annex 3 on split-listing and Annex 5 on population structure and definition. These were considered to confirm that the EGI fin whale stock, as defined in the IWC Schedule, is an appropriate unit for split-listing amongst other fin whale stocks.

The Working Group agreed to confine its discussions to the geographical area relating to the EGI stock without special reference to adjacent stocks, recognizing that questions of movement/dispersion and inter-breeding between stocks, as considered in the IWC's RMP implementation process, might potentially influence the conclusions.

7. COMPATIBILITY WITH APPENDIX I LISTING

7.1 CITES Criterion A

"A species is considered to be threatened with extinction if it meets, or is likely to meet, ***at least one*** *of the following criteria.*
A. The wild population is small, and is characterized by ***at least one*** *of the following:*
i) an observed, inferred or projected decline in the number of individuals or the area and quality of habitat; or
ii) each sub-population being very small; or
iii) a majority of individuals being concentrated geographically during one or more

life-history phases; or
iv) large short-term fluctuations in population size; or
v) a high vulnerability to either intrinsic or extrinsic factors."

The term "small wild population" is rather loosely defined in the CITES Criteria (CITES Conf.9.24 (Rev.CoP13) Annex 5), understandably as the judgment of "small" is taxon specific. However, a figure of 5,000 individuals is mentioned as an appropriate guideline for low-productivity species and a corresponding figure of 500 for a very small sub-population.

The Working Group referred to SC/14/CITES/4 and its summary presentation on this matter, which detailed evidence for population distribution, dispersion and abundance from mark-recapture, and catch per unit effort (CPUE) from the Icelandic whale fishery (Rørvik *et al*. 1976, Rørvik 1981, Sigurjónsson and Gunnlaugsson 1984, 1985a). There have been four fin whale surveys in the region. NASS surveys in 1987 and 1989 (Sigurjónsson *et al*. 1989, 1991, Joyce *et al*. 1990) covered the area from Spain to West Greenland (Sanpera and Jover 1989, Larsen *et al.* 1989, Hiby *et al*. 1989, Gunnlaugsson and Sigurjónsson 1990, Buckland and Cattanach 1992, Buckland *et al*. 1992a, 1992b, 1993, Øien 1989, 1991, Schweder *et al*. 1997). Estimates of abundance from NASS surveys conducted in 1995 and 2001 by Iceland and the Faroe Islands (Sigurjónsson *et al.* 1996, Desportes, *et al.* 1996, 2002, Víkingsson e*t al.* 2002, NAMMCO, 1998, 2002) are also available.

Based on the NASS surveys, a joint NAMMCO-IWC scientific workshop on the catch history, stock structure and abundance of North Atlantic fin whales held in Reykjavík in March 2006 agreed to the following abundance survey estimates for the EGI stock, which were noted to have been increasing steadily (extract from Table 2, Doc. 6):

SURVEY	***N***	**95% Confidence intervals**
1987+1989	15,332	9,990 – 23,239
1995	19,537	13,464 – 30,492
2001	23,676	18,024 – 31,101

The Working Group concluded that fin whales in the central North Atlantic are clearly abundant and cannot be considered a "small population" from the perspective of present absolute abundance. The Working Group also noted that, except for minke whales, the fin whale is the most abundant baleen whale in the North Atlantic (SC/14/CITES/6).

Given this conclusion, the Working Group agreed that it was unnecessary to consider the additional sub-criteria listed under Criterion A.

7.2 CITES criterion B

"The wild population has a restricted area of distribution and is characterized by ***at least one*** *of the following:*

i) fragmentation or occurrence at very few locations; or
ii) large fluctuations in the area of distribution or the number of sub-populations; or
iii) a high vulnerability to either intrinsic or extrinsic factors; or
iv) an observed, inferred or projected decrease in any one of the following:
- *the area of distribution; or*
- *the area of habitat; or*
- *the number of sub-populations; or*
- *the number of individuals; or*
- *the quality of habitat; or*
- *the recruitment."*

The Working Group noted that there was no evidence that current fin whale distribution in the central North Atlantic has contracted appreciably from that before whaling commenced. In recent surveys the animals were found widely within the EGI area indicating no restriction in distribution (see Fig. 1, Appendix 5, Annex 2). It was noted that abundance west of Iceland was reduced in the early 20th century, but had since recovered.

The Working Group accordingly concluded that fin whales are widespread in the central North Atlantic, and agreed that there was no need for further discussion on the additional sub-criteria under criterion B.

7.3 CITES criterion C

"*A marked decline in the population size in the wild, which has been* ***either****:*
i) observed as ongoing or as having occurred in the past (but with a potential to resume); or
ii) inferred or projected on the basis of any one of the following:
– a decrease in area of habitat; or
– a decrease in quality of habitat; or
– levels or patterns of exploitation; or
– a high vulnerability to either intrinsic or extrinsic factors; or
– decreasing recruitment."

The footnote on exploited aquatic species, of CITES Conf.9.24 (Rev.CoP13) Annex 5, states: "in general, historical extent of decline should be the primary criterion for consideration of listing in Appendix I", with the guideline on the extent-of-decline for a low productivity species being a current depletion of 15-20% of the abundance prior to exploitation.

Annex 5 also specifies that: "A recent rate-of-decline is important only if it is still occurring, or may resume, and is projected to lead to the species reaching the applicable point for that species in the Appendix-I extent-of-decline guidelines within approximately a 10-year period. Otherwise the overall extent-of-decline is what is important." Furthermore, it excludes listing as a result of a scientifically based harvesting programmeme that reduces the population to a planned level, not detrimental to its survival.

The abundance estimates of the EGI fin whales stock show that the stock is currently increasing. The most recent assessment of the EGI fin whale stock is that by Branch and Butterworth (MS 2006). This analysis treats the stock as four sub-populations with movement between them, and takes account of all available catch, abundance index (CPUE and sightings surveys) and mark-recapture data within a sex- and age-structured population dynamics model framework.

A large number of assumptions were made in this assessment. The estimated present population size as a fraction of that before exploitation commenced range from 75% - 95% (see Table 12 of Branch and Butterworth (MS 2006), where these results are given in terms of the component of the population of a size large enough to be considered for commercial harvest, *i.e.* the "recruited" population). The Working Group concluded that the EGI fin whale stock does not meet the listing criterion related to the historical extent of decline.

A decline may resume given renewed harvesting. However, projections based on population models similar to that referenced above show that the EGI stock is expected to remain above its MSY level given a constant annual catch of 150 whales for the next 20 years (NAMMCO 2004, 2006, 2007 in prep.). Hence under future catches below that level, the CITES decline criterion would not be met.

Some further considerations are presented in Appendix 3.

7.4 Overall conclusion

The primary issue before the Working Group was whether the EGI stock of fin whales qualified for listing under Appendix I in terms of the biological criteria specified by CITES.

During the last 20 years considerable efforts have been made in monitoring the EGI population of fin whales. Abundance estimates of between 15,000 (1988) and 24,000 (2001) that have been agreed in the Scientific Committees of both NAMMCO and the IWC, together with catch history data, show the EGI stock to be above MSY level, with a high probability of being above 70% of its pre-exploitation level. There are no indications of any recent decrease in distribution or abundance. On the contrary the population has been increasing in size over the last two decades. The Working Group therefore concluded that the fin whale population in the region of the Central North Atlantic (the EGI stock) does not meet any of the biological criteria for listing under CITES Appendix I (threatened with extinction).

Some additional points were raised during discussion in relation to SC/14/CITES/5 p.2, point f) concerning the transfer of CITES Appendix I listed species to Appendix II (see Annex 4. Precautionary measures. A. 2 b) and c)). If the EGI fin whale stock is to be recommended for transfer from Appendix I to II, reassurance is needed that any catch quota will be reviewed periodically in relation to stock status and that there will be periodic surveys to provide information on distribution and abundance (ref. Annex 4, C.1 and 2). NAMMCO regularly monitors this stock of fin whales, and Iceland as a member of both IWC and NAMMCO is required to report all catches. It is recognized

however, that consumptive utilisation in one area may affect abundance in an adjacent area and this matter remains to be addressed by the IWC as part of the RMP implementation process and by NAMMCO.

8. OTHER MATTERS

8.1 Process-related issues

The Working Group considered only the EGI stock. It noted that questions on movement/dispersion and inter-breeding between stocks, as are being addressed in the IWC RMP implementation process, could increase the number of range states (from only those that border the geographical area of the EGI stock) that would need to be consulted by Iceland during the review process.

8.2 CITES template for changing status

The Working Group reviewed the CITES template for proposals to amend Appendices in Annex 6 of SC/14/CITES/5. All items listed in this Annex 6 template were considered and commented upon where relevant below.

Item 5. Threats – regarding exploitation, current catch quotas set by Iceland are less than the 150 whales per annum estimated to be sustainable in the medium term (see earlier under item 6.3 in this report).

Item 8. Species management – 8.1 and 8.2 – Iceland follows recommendations of NAMMCO, which conducts regular reviews of population status. However, member countries can set their own quotas and management goals. Nevertheless, Iceland will be reporting all catches and also maintaining genetic registers of all whales caught to address potential compliance concerns.

9. FUTURE WORK

The CITES review process and its timing were discussed. The Working Group reports to the NAMMCO Scientific Committee, which reports to the NAMMCO Council. The extent and the manner in which the implications of the stock structure hypotheses illustrated in SC/14/CITES/6, Fig. 1 could be taken into account in reporting to the CITES Animals Committee in February 2008, would need to be reviewed after the 2007 IWC Scientific Committee meeting in the light of progress and decisions made there concerning the RMP implementation for North Atlantic fin whales. After that meeting, further inter-sessional work on fin whales may need to be planned. The early availability of preliminary results from the TNASS could be advantageous.

Iceland will need to monitor progress on this matter and perhaps request further help from NAMMCO should the IWC North Atlantic fin whale RMP implementation schedule be delayed.

10. ADOPTION OF REPORT

The meeting adopted the report on Tuesday 21 November.

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Appendix 1 - **AGENDA**

1. Chair's welcome and opening remarks
2. Adoption of agenda
3. Appointment of rapporteur
4. Review of available documents and reports
5. Background
6. Stock structure
7. Compatibility with Appendix I listing
   7.1 CITES criterion a
   7.2 CITES criterion b
   7.3 CITES criterion c
7.4 Overall conclusion
8. Other matters
   8.1 Process-related issues
   8.2 CITES template for changing status
9. Future work
10. Adoption of report

Appendix 2 - **LIST OF DOCUMENTS**

Doc. No.	Title
SC/14/CITES/1	List of participants.
SC/14/CITES/2	Draft Agenda.
SC/14/CITES/3	List of Documents.
SC/14/CITES/4	Review of the status of the the central stock of North Atlantic fin whale *Balaenoptera physalus* with respect to the CITES criteria
SC/14/CITES/5	CITES Criteria for amendment of Appendices I and II.
SC/14/CITES/6	Report of the Joint Meeting of the NAMMCO Working Group on North Atlantic Fin Whales and the IWC Scientific Committee.
SC/14/CITES/7	Report of the 58th Meeting of the IWC Scientific Committee. Annex D. Report of the Sub-Committee on the Revised Management Procedure.
SC/14/CITES/8	Distribution and abundance of fin whales (Balaenoptera physalus) in the northeast and central Atlantic as inferred from the North Atlantic sightings surveys 1987-2001.
SC/14/CITES/9	Regional estimates of density and abundance of fin whales (Balaenoptera physalus) from Icelandic and Faroese North Atlantic sightings surveys (SC/14/FW/18 – SC/M06/FW18).

Appendix 3

6.3 CITES CRITERION C

Population Modelling

There are some aspects of the results of the modelling exercise by Branch and Butterworth (MS 2006) that are perhaps not entirely satisfactory:

- The model estimates a high level of movement between east and west Iceland, but there are no corroborating mark-recapture data;
- Survey estimates of abundance for east Greenland indicate an appreciably higher rate of population increase in that area than does the model;
- The point estimate (though not the lower 95% confidence bound) from the most recent survey estimate of abundance is larger than the population model estimate for pre-exploitation numbers.

However, given the low number of marks placed off east Iceland, and the relatively high variance of the abundance estimates, the population model is not statistically inconsistent with these data.

Nevertheless the possibility of an increase in the equilibrium abundance in the absence of exploitation over recent decades compared to the past cannot be excluded. For example, fin whales may have taken (temporary) advantage of the extra food available as a result of the harvest-induced reductions in blue and humpback whale numbers. Such a possibility would not, however, change the conclusion of the main text that the EGI fin whale stock does not meet the decline criterion for Appendix I listing.

Genetics

Genetic analyses (Roman and Palumbi 2003) have provided a basis to argue that the North Atlantic fin whale population is appreciably more depleted than suggested by population models such as those referenced in the main text. This follows because these genetic calculations suggest much higher estimates of pre-exploitation abundance than indicated by population modelling. It should be noted, however, that such genetic analyses relate to historic levels of abundance on an evolutionary time scale. Furthermore, in response to a presentation of these genetic analyses by one of their authors, the IWC Scientific Committee concluded that the Roman and Palumbi estimates had "considerably more uncertainty than reported and cannot be considered reliable estimates of immediate pre-whaling size" (IWC, 2005). These analyses are therefore not considered informative as regards the application of the CITES decline criterion to the EGI fin whale stock.

ANNEX 4

PLANNING COMMITTEE
FOR THE
TRANS NORTH ATLANTIC SIGHTINGS SURVEY (TNASS)
Reykjavík, 22 March 2006

1. PRELIMINARY PLANS FOR 2007 BY JURISDICTION

Canada

Preliminary plans are for an aerial survey out to the approximate limit of the continental shelf, divided into three sections: Arctic (northern Labrador to northern Baffin Island), Newfoundland/Labrador (northern Labrador to the southern Grand Banks), and Scotian Shelf/Gulf of St. Lawrence. At present funding is in place for the Newfoundland/Labrador survey, probable for at least part of the Arctic survey, and uncertain for the Scotian Shelf/Gulf survey. The northward extent of the Arctic survey is also uncertain and will depend to some extent on coordination with Greenland. In particular Canada is interested in working with Greenland to ensure that Baffin Bay is surveyed from coast to coast, as far north as feasible.

There are at present no plans to carry out ship surveys, however surveys will be coordinated with American ship surveys insofar as possible. These may be uncertain because of recent budget cutbacks in the USA, although there is recent information that suggests the US will be conducting some cetacean survey activity in 2007 (perhaps with their new NOAA research vessel).

There is very little recent information on the distribution and abundance of cetaceans in Canadian waters, so all species are of interest. Harbour porpoise, blue and fin whales, and leatherback turtles are “species at risk” in Canada and therefore of highest priority.

Greenland

Plans for Greenland are as yet very uncertain, and will depend to some extent on whether surveys carried out in 2005 are successful in producing acceptable abundance estimates for minke and fin whales. Priority species would be minke, fin, and humpback whales, and narwhal north of Melville Bay. Previous surveys have indicated that baleen whales are uncommon north of Disko Bay during the summer and fall, so this will have to be a consideration in the design and in coordination with Canada. Funding is not yet in place for any survey activities. Witting noted that he would be discussing the possibility of using Coast Guard vessels as survey platforms.

Iceland

At present it is expected that the Icelandic coverage will be similar to that of NASS-2001. Offshore areas will be covered by ship and nearshore areas will be covered by aerial survey as in previous years. Target species will be minke and fin whales, and there will be a greater emphasis on getting viable estimates of harbour porpoises from the aerial survey.

As in 2001 the southwest area will be surveyed by combining platforms with an ongoing redfish survey. Russian and German vessels will also be involved and it may be possible to extend the coverage of the survey by putting cetacean observers on these vessels. There will also be a capelin and environmental research survey in the Greenland Sea north of Iceland in 2007, and it may be possible to co-platform with this survey as well. However this may be logistically difficult because of space limitations, frequent stops for hydrological sampling and vessel allocation issues. It is therefore likely that at least one dedicated cetacean sightings vessel will be required.

Faroes

At present the Faroes plans to carry out a vessel survey with coverage similar to that of 2001. The area will be designed to adjoin the CODA area if that survey takes place. Funding will be both external (from the oil industry?) and from the Faroese government. Target species will be fin whales and small whales such as pilot whales. It was noted in this respect that NASS coverage and timing has not been appropriate for obtaining a good estimate of pilot whale abundance since the 1989 survey.

Norway

Norway will be continuing its "mosaic" surveys in 2007, which will be the final year of a 6-year series. This means that areas that were not covered well in the previous 5 years will be re-done in 2007. Candidate areas are the area west of Svalbard, which could connect to the Icelandic sector, and the area west of Lofoten. This will depend to some extent on whether or not Russian authorities grant access to the eastern Barents Sea this year.

Methods will be the same as in previous surveys, and the target species is the minke whale. Two vessels will be used for a period of 5 weeks.

Russian Federation

Information on preliminary plans for surveys by the Russian Federation was received after the meeting:

- continue marine mammal aerial and research vessel surveys as part of annual mackerel feeding research in the Norwegian Sea during June-August;
- continue marine mammal aerial and research vessel surveys as part of annual joint Russian/Norwegian ecosystem surveys in the Barents Sea during August-September;
- carry out marine mammal research vessel surveys as part of International Redfish Research in the Irminger Sea during May-June;
- carry out marine mammal surveys onboard research aircraft and vessels in the Barents Sea during special research for oil and gas companies in the spring-autumn seasons;
- undertake marine mammal observation during special research onboard Russian fisheries vessels (if possible).

The volume of research and work will be dependent on funding which is uncertain as yet.

Other
Hammond informed the group that there was no word as yet on funding for the CODA project.[3]

The MAR-ECO project will continue in 2007 with a 4 week cruise by the *Bigelow*. The possibilities for coordination will be investigated.

2. REVIEW OF METHODOLOGICAL PROBLEMS ENCOUNTERED IN PREVIOUS SURVEYS

Aerial surveys
Canada
Recent surveys, the first in many years, have been conducted using standard single-platform aerial survey techniques from a Cessna 227 Super Skymaster, flown at 500 feet and ~100 knots. These surveys used two rear observers at bubble window positions, and a forward navigator/sighting recorder in the co-pilot position (off effort). Experimental surveys were conducted from a Canadian Armed Forces P-130 Aurora reconnaissance aircraft in March 2005 and 2006. Problems encountered for the Skymaster surveys included:

1. Low number of sightings of some species (*e.g.* fin and minke). This may mean that densities are relatively low and a high amount of effort will be required to get good abundance estimates.
2. Surveys cannot go far offshore (*e.g.*, approximately ≤120 n.mi.) because of operational safety concerns.
3. Small size of plane precludes full double platform methods. "Circle-back" method was not used so there is no estimation of *g(0)*.

It was noted that the *g(0)* issue could be addressed by using cue counting methods for some species (minke, fin, and perhaps blue whales), using circle-back procedures, using partial double platforms as in Icelandic surveys, and/or using literature values from similar surveys such as SCANS-II and NMFS.

The Aurora is a large 4-engined plane with two sets of bubble windows (plus other windows), making independent double platforms a possibility. The aircraft has significant range (longest flight to date has been 17 hours; usually 8-12 hours), high flight manoeuvrability, and room for up to 21 people.The main issue is the high flying speed, which at ~190 knots is more than twice as fast as that normally used in such surveys. The implications of this need to be addressed.

Greenland
For Greenlandic surveys the main problem has been weather conditions, especially the prevalence of fog, during the summer. Aerial surveys have been found to be somewhat more efficient than ship surveys because they can take better advantage of short weather windows and are less expensive than ships to maintain in an "idle" mode during bad weather periods. Recent surveys have been conducted in September when fog is usually less prevalent.

[3] The project did not receive EU funding. Other avenues are being explored.

Aerial digital photographic surveys were conducted in 2003 and 2004, but resulted in fewer than expected identified whales on the photographs. The reasons for this are unclear, but it was considered unwise at this point to rely on photography as a primary method before further experimental work is carried out. Witting noted that recent improvements and price decreases in camera equipment and in data storage might make digital photography a valuable secondary source of information, for species identification, confirmation of group size estimates and photogrametry. Witting agreed to look into the technical and cost aspects of this.

Iceland

Pike presented some recommendations for future aerial surveys that had been noted in a previous working paper (SC/10/AE/12). In general cue counting was considered an appropriate method for minke whales, and the data could be analyzed as a line transect for other species. A double platform, at least on one side of the plane, was necessary for determining perception bias and distance measurement error. The current monitoring system and software was somewhat cumbersome in that a laptop was required for each observer, but performed well. Special methods would be required to get better estimates of dolphin group size, if this is considered a priority.

Better estimates of harbour porpoise abundance are required for Iceland. It was considered that cue counting could work with this species, as they generally occur as singles and exhibit rather simple behaviour. Surfacing rate data are available for some areas, but not Iceland. However it was considered that experienced harbour porpoise observers would be required to get good estimates for this species, regardless of the methodology used. One possibility would be to use observers from SCANS-II, and apply the same correction factor for *g(0)* derived for that survey. This would require that the survey be flown at 600 ft, rather than 750 ft as used in previous surveys.

Russia

Russian surveys have been conducted using either a twin engine An-26 (named "Arktika) or L-410 aircraft. The aircraft have equipment including GPS and computer systems, infrared (IR) system (IR-radiometer and IR-scanner), digital photo- and video cameras and also systems for sea surface and subsurface layer temperature remote sensing. Few technical or methodological difficulties have been noted, but observation quality is of course dependent on weather conditions.

Ship surveys

The following issues were identified and discussed:

1. Species identification of non-target species. This is particularly a problem for the Norwegian surveys, which are dedicated to minke whales and operate in passing mode. For other areas it is a problem for dolphins and small whales, and large whales at distance. Greater use of "big-eye" or 7x50 binoculars could be made from one of the platforms or the bridge deck for species identification.
   Also observer experience is an important factor.
2. Implementation of Buckland-Turnock (B-T) tracking methodology was not very successful in 2001. Few tracks of target species were made. It was considered that the combination of large (fin) and small (minke) whales as target species

made tracking problematic. Also tracking was found to be possible only under very good weather conditions (Beaufort 3 or less), while the vessels maintained effort up to Beaufort 5. The double platform methodology did produce data suitable for estimating *g(0)* for fin whales, but probably not for minke whales. Insufficient tracks were obtained to estimate responsive movement, which may be important for minke whales. It was agreed that a double platform method was essential for smaller whales such as minkes, but less important for large whales. One possibility would be to stratify the survey such that full implementation of the B-T methodology is given higher priority in strata where high densities of minke whales are expected. This was considered feasible for the Icelandic survey area where the distribution of minke whales is predictable. The methodology could also change dependent on weather conditions, with B-T used only under optimal conditions. These options would have to be specified in the survey plan and protocol.

3. The angle and distance data for small whales, especially minkes, from Icelandic and Faroese surveys, exhibited features that made analysis problematic. These features included heaping at small angles and distances, and a secondary peak in sightings at medium distances. The reasons for this are unclear but are likely related to the combination of small and large whales as target species, and possibly to the use of binoculars on the primary platform. Suggestions for alleviating this problem included better angle and distance measurement techniques (see 4), the stratification scheme described above, and better observer training.
4. Problems with school size estimation, particularly for pilot whales and dolphins. If these species are considered a priority, special protocols will have to be developed. It was noted that such a protocol for pilot whales was implemented in the 1995 survey. The use of video cameras to record schools may also help, but again special protocols for their use would have to be developed.

4. METHODOLOGICAL ADVANCES FROM SCANS-II

Hammond and Desportes provided some information on new equipment and techniques used in SCANS-II. For ship surveys:

1. "Big-eyes". These were used on the tracker platforms but their contribution in terms of successful trackings is not yet known. Some sightings picked up by the tracker platform were too far away and out of range of the primary platform.
2. Acoustics. The system functioned well on all vessels. It required very little time to set up, deploy and retrieve, and virtually no maintenance underway. The success of the system in terms of monitoring abundance has yet to be proved. It will be used in CODA, with the emphasis on dolphins, sperm and beaked whales. The cost of a system is moderate (about 7 K £) and the data will probably become more valuable as analyses are refined.
3. Photographic estimation of distance, using video. This functioned well in most cases. The estimates are assumed to be more accurate than visual estimates. However it is still necessary to estimate distances in the normal way as video cannot be used for every sighting, particularly when conditions are rough.
4. Photographic angle measurement. This system functioned very well and is

highly recommended.

In the aerial surveys, the "circle-back" technique apparently functioned well and will result in useable estimates of *g(0)* although these have not been finished yet. The technique requires practice by the pilot and crew, and a considerable allocation of effort to generate enough data for useable estimates.

5. COORDINATION WITHIN TNASS AND WITH OTHER SURVEYS

It was agreed by all participants that coordinated surveys greatly enhanced the value of each individual survey by allowing synoptic estimates to be produced, thus providing the best value in terms of information for money spent. The opportunity for having a synoptic survey of the Northern Atlantic from coast to coast was absolutely unique and the output of the survey should be optimized as much as possible through a high level of coordination, use of the newest standard survey techniques, and use of alternative techniques to collect data not usually collected.

While recognizing that each jurisdiction has species of greatest interest, it was agreed that the survey would be made multi-species to the extent possible, without compromising data on target species. A common survey protocol will be developed to optimize data collection for target species from all jurisdictions, and each jurisdiction will make efforts to collect good data on the target species of other jurisdictions.

Given the experience from previous surveys, it seems obvious that the analysis of survey data would also benefit from a more coordinated approach. It was agreed that this would be a topic for discussion at future planning meetings.

It was agreed that the timing of the surveys should be coordinated and be the same as most previous NASS, *i.e*. late June and July.

It was agreed that the recruitment and training of observers should be coordinated. It may also be possible to coordinate with CODA in these areas, but this remains uncertain at present.

It was agreed that a joint survey design will be developed at a future planning meeting. In addition a common survey protocol, applicable to both aerial and ship surveys, will be developed and used. It was recognized however that the Norwegian survey will continue to follow its own protocol, but will make every reasonable effort to coordinate with TNASS.

6. FUNDING

A joint funding proposal to the Nordic Council of Ministers (NC) was developed by Desportes and Pike and submitted in December 2005. Unfortunately it was rejected, but has been retained by the NC for possible funding through other programmes. Desportes will follow up this proposal with people familiar with the NC system. TNASS has been accepted as a component of the ESSAR project for the International

Polar year. There is no funding attached to this acceptance, but it may enhance proposals for funding to other agencies.

It was agreed that the greatest needs for extra funding were for:
1. Extension of the Greenlandic and Canadian surveys so that they adjoin;
2. Possible placement of cetacean observers on ancillary surveys, such as Russian and German redfish surveys;
3. Purchase of new equipment, such as Big Eye binoculars, video cameras, distance measuring systems, and acoustic arrays;
4. Coordinated observer training.

An immediate need is to develop a full budget for the project, including costs of permanent staff involved, for use in funding proposals. All agreed to provide this information to Desportes as soon as possible.

Pike informed the group that NAMMCO would fund two planning meetings (other than this one), in 2006 and 2007, and a follow-up meeting in 2008. In addition some funding will be provided this year for project coordination. An application for additional funding for observer training, project management and contract analyses has been submitted. It was considered certain that some extra funds will be forthcoming, but the exact amount will not be known until 2007.

It was agreed that members would research opportunities for funding and convey these to Desportes, who would lead in developing joint funding proposals. Oil companies carrying out exploration in the survey area were considered an immediate possibility.

7. OTHER ISSUES

It may be feasible to conduct other activities, such as biopsy sampling, photography for individual recognition studies, and deployment of satellite tags during the survey, either from survey vessels or small boats deployed from them. However any such activities would have costs in terms of personnel and possibly lost survey effort, so their priority would have to be assessed in terms of these costs. Biopsy sampling was the most likely activity, and may be useful for genetic stock delineation particularly of fin whales. The group requested that the NAMMCO Scientific Committee recommend whether or not biopsy sampling or other ancillary activities were of sufficient priority that they should be attempted during the survey.

8. ACTION ITEMS

NO.	ITEM	WHO?	WHEN? (m.yr)
Survey Planning and Coordination			
1.	Provide budget information to Desportes.	Lawson, Witting, Víkingsson, Mikkelsen.	05.06

NO.	ITEM	WHO?	WHEN? (m.yr)
2.	Contact MAR-ECO project to discuss coordination.	Mikkelsen.	05.06
3.	Make contact regarding possibility of placing cetacean observers on Russian/German redfish survey vessels.	Víkingsson, Desportes, Zabavnikov.	05.06
4	Make contacts regarding possibility of conducting cetacean observations during annual Russian/Norwegian feeding mackerel research in the Norwegian Sea and annual Russian/Norwegian ecosystem surveys (with using aircraft and vessels).	Zabavnikov, Øien.	04.07
5.	Get information on the Canadian offshore survey activities.	Lawson.	05.06
6.	Apply for permits to enter territorial waters.	Víkingsson, Mikkelsen, Øien.	01.07
Equipment/Methodology			
7.	Assess implications of a start/stop survey design as used on co-platform surveys.	Planning Group.	11.06
8.	Assess implications of high flying speed in aerial surveys (Aurora platform).	Planning Group.	11.06
9.	Provide technical specifications and costs of video and angle measurement systems used on SCANS-II.	Desportes, Pike, Hammond.	09.06
10.	Provide technical specifications and costs of acoustic monitoring system used on SCANS-II.	Desportes, Pike, Hammond.	09.06
11.	Provide technical specifications and costs of digital photography system for aerial survey.	Witting, Zabavnikov.	05.06
12.	Provide technical specifications and costs of sea surface temperature sensing equipment for aerial survey.	Lawson, Zabavnikov.	05.06
13.	Address potential copywrite issues re. use of *Hval* software.	Gunnlaugsson.	05.06
14.	Look at 2001 data to determine number of successful trackings by species.	Gunnlaugsson, Pike.	11.06
15.	Look at SCANS-II and SOWER data to determine relative success of "big-eye" vs 7x50 binoculars for tracking.	Hammond, Donovan.	11.06
16.	Estimate *g(0)* for minke whales and other species from 2001 NASS data.	Pike, Gunnlaugsson, Øien.	11.06
Funding			
17.	Provide information to Desportes on potential funding sources for a joint	All.	06.06

NO.	ITEM	WHO?	WHEN? (m.yr)
	proposal.		
18.	Follow up funding proposal to NC.	Desportes, Pike.	06.06
19.	Develop new proposals as appropriate.	Desportes, Pike.	Ongoing
20.	Develop project description for ESSAR-IPY.	Desportes, Pike.	05.06

9. NEXT MEETING

It was agreed that the next planning meeting will be arranged by NAMMCO in November 2006.

10. MISCELLANEOUS INFORMATION

Lawson informed the group that DFO (Department of Fisheries and Oceans) has four pairs of "big-eye" binoculars, at least two of which could potentially be available for loan to TNASS partners. In addition they had recently purchased equipment to remotely sense sea surface temperature from an airplane, and Lawson agreed to supply technical specifications for this.

ANNEX 5

PLANNING COMMITTEE FOR THE TRANS NORTH ATLANTIC SIGHTINGS SURVEY

Reykjavik, 18-19 November, 2006

1. CHAIRMAN'S WELCOME AND OPENING REMARKS

Chair Genevieve Desportes welcomed delegates (see Annual Report Section 6.5) to the second planning meeting for the Trans North Atlantic Sightings Survey. She reminded delegates that it had been concluded at the first planning meeting that the full participation of Canada and Greenland, as well as Iceland, the Faroes and Norway, and coordination with surveys off Western Europe (CODA) and the Eastern USA, meant that the TNASS presented a perhaps unique opportunity to obtain very broad and synoptic coverage of the northern North Atlantic. By fully coordinating the national components of TNASS, in terms of timing, target species, coverage, stratification, methodologies, survey protocols and observer training, the results of the TNASS could be much more valuable than the sum of its parts. Therefore some flexibility on these matters will be required to make an integrated TNASS a reality.

2. ADOPTION OF AGENDA

The Draft Agenda (Appendix 1) was adopted with minor changes.

3. APPOINTMENT OF RAPPORTEURS

Daniel Pike, Scientific Secretary of NAMMCO, agreed to coordinate the production of the Report, with the assistance of other members as required. Documents available to the meeting are listed in Appendix 2.

4. OVERVIEW OF AVAILABLE RESOURCES BY JURISDICTION

A summary of the survey platforms and effort available to TNASS by jurisdiction is provided in Table 1, and a map of the survey area is provided in Fig. 1.

4.1 Canada

The Canadian components of TNASS will extend from the Canadian eastern Arctic to the southern Scotian Shelf. The surveys are divided into four initiatives: 1) Canadian Eastern Arctic IPY Survey, 2) Canadian Grand Banks IG Survey, 3) Gulf of St. Lawrence, and 4) Scotian Shelf, (Figure 1). The northward extent of the Arctic survey is uncertain and will depend on coordination with Greenland. The surveys will be carried out using a DeHavilland Twin Otter high-winged survey aircraft as the main platform. A Lockheed CP-140A Arcturus reconnaissance aircraft may be used in offshore areas, particularly Davis Strait between Canada and SW Greenland, but the availability of this platform is as yet unconfirmed. Virtually all cetacean species in the area, as well as sea turtles, basking sharks and sunfish, will be target species of the

survey, but most emphasis will be placed on species that are considered to be endangered or threatened in the area. A standardized methodology for aerial surveys has been developed over several years in this area.

4.2 Greenland

The main survey off West Greenland will extend from just north of Disko Bay south to Cape Farewell. It will probably use the same stratification and survey design as was used in 2005. Target species will be minke, fin and humpback whales, but all cetaceans encountered will be registered. Either a Partenavia or a Twin Otter will be used as a survey platform. Another survey, focusing on narwhal, will be carried out in Inglefield Bredning and Melville Bay in August, but the two surveys will not be connected. The preferred timing for the southern survey is August-September as fog is less prevalent then than earlier in the summer. However it may be possible to do two surveys, one in July and one in September. In addition the Coast Guard has been approached to provide ship time for some offshore work, but it seems unlikely that this will be provided. Standard cue counting methods, as used in earlier surveys, will be used in the main survey, while the narwhal survey will use double platform line transect methods.

4.3 Iceland

The Icelandic component of TNASS will be broadly similar to that carried out in 2001. The target species will be minke and fin whales (primary) and humpback whales and harbour porpoises (secondary). Aerial survey, using a Partenavia with bubble windows, will be used to cover the inshore out to the edge of the continental shelf. Offshore areas will be covered using three survey vessels. The western part of the area, between Iceland and Greenland, will be surveyed by a vessel participating in an International Redfish Survey, a co-platforming arrangement that functioned well in 2001. The northern and eastern parts will be surveyed by two dedicated cetacean survey vessels. The boundaries of the survey area will be established in cooperation with other TNASS partners.

4.4 Faroes

The Faroese contribution to TNASS will be similar to 2001, with one vessel being chartered for about one month. Target species of the survey will be pilot and fin whales, and white-sided dolphins. The boundaries of the survey block will be determined with regard to the Icelandic and Norwegian components, and to the CODA survey.

4.5 Norway

Norway will be continuing its “mosaic” surveys in 2007, which will be the final year of a 6-year series. The target species is the minke whale. To date the eastern Barents Sea has not been covered and it is hoped that this can be done in 2007; this will, however, require permission from Russian authorities to enter territorial waters. If permission is not granted, the survey area will be selected based on a preliminary analysis that will determine the area not already surveyed or areas surveyed in poor sighting conditions. Some consideration will also be given to coordination with the T-NASS. Two vessels will be used for a period of four weeks centred in July.

4.6 Russian Federation

The Russian Federation, in cooperation with Norway, will continue a series of "ecosystem" surveys, using both ships and an aerial platform. The surveys will be carried out in two areas: the Norwegian sea in July, and the Barents Sea in August/September. The Norwegian Sea survey will use one Russian vessel and two Norwegian vessels. The Russian vessel will carry a single marine mammal observer, and will also be carrying out acoustic fish surveys and trawl surveys. Presently data are not collected in a way that would allow estimation of marine mammal density. The aerial survey will utilize a specialized twin engined airplane which carries four observers who collect sightings of marine mammals, birds, fish and other data. It is conducted as a strip survey with the strip half-width equivalent to the altitude of the plane. The Barents Sea survey will be carried out using similar effort and methods, but here the Norwegian vessel also carries dedicated marine mammal observers.

4.7 CODA

The original proposal to the EU LIFE Nature programme was to cover all European Atlantic waters from the shelf edge (the offshore limit of SCANS-II in 2005) out to the 200 nm fishing limit of UK, Ireland, France, Spain and Portugal. When the proposal was rejected by the EU LIFE programme, almost all other supporting institutions agreed in principle to go forward with a reduced project with the same objectives. The partners and co-financiers are in Spain: Institute of Oceanography (IEO), Azti-Tecnalia, and Spanish Cetacean Society (SEC); in France: University of La Rochelle and the Ministry of Defence (Navy); in Ireland: University College Cork, Department of Environment (Duchas), Sea Fisheries Board (BIM); and in the UK: University of St Andrews, Joint Nature Conservation Committee, Department for Trade and Industry (new co-financier), Department for Environment (DEFRA). Duchas and DEFRA have yet to confirm but an answer is expected from DEFRA within a few days; if this is positive CODA will definitely go ahead.

The survey area is planned to be from the Spanish/Portuguese border in the south to a common boundary with the Faroes survey block in the north, and from the shelf edge to as far as resources allow offshore. The survey will be in the month of July 2007. There will be three ship months: two weeks on the *Cornide* and two weeks on the *Investigador* in Spanish waters and Bay of Biscay; one month on a French navy vessel in the central area; and one month on a charter ship in the northern area.

The target species will be the common dolphin and deep diving whale species (sperm/beaked whales). SCANS-II double platform visual methods will be used for all species encountered. Towed acoustics will be focussed on sperm/beaked whales and delphinids.

4.8 USA

The primary objective of surveys carried out off the US eastern seaboard is to estimate abundance for as many cetaceans as the data allow. These data will be used in species-specific stock assessments, primarily to determine whether human induced mortality is of concern. All cetacean species are targeted, however the species with high levels of fishery by-catch (harbour porpoises, common dolphins, white-sided dolphins, pilot

whales, and all turtles) or species that are endangered (humpback, fin, and sei whales) are of highest interest. A single ship and a Twin Otter plane will be used in the survey, which will be conducted in August. In addition to the visual survey, the ship will also use passive acoustic methods. In general the plane will survey inshore while the ship will survey offshore, but there will be overlap between the two to allow comparison of density estimates. The northern boundary of the survey area will be determined in cooperation with Canada.

5. COORDINATION ISSUES

In discussing issues of coordination, it was noted that all participants are making large investments of money, time and effort in their surveys. All participants see the value of coordination to the extent that is feasible, because a fully coordinated survey will produce results that will be more reliable and valuable for all parties.

5.1 Timing

In principle it was agreed that all surveys should ideally occur in the same time period, and that this should be similar to previous surveys to maintain comparability in the time series. The preferred timing for all participants was advanced as follows:

Norway:	July (no flexibility);
Faroes:	July
Iceland:	Late June/July
Greenland:	August/September
Canada:	Scotian Shelf: August (to coordinate with USA)
	Grand Banks: July/August
	Northern areas: July or August;
USA:	August (no flexibility)
CODA:	July (no flexibility)
Russia:	Norwegian Sea: July
	Barents Sea: August/September

It was explained that August/September was preferred by Greenland because fog was generally less prevalent then than in July, and it was considered that the chances of a successful survey were much higher in September than in July. However it was noted that previous surveys (prior to 2005) had been conducted in July, although several of these had been unsuccessful. Greenland noted that it may be possible to attempt two surveys, one in July and one in September, but this will depend on the level of funding received.

There was considerable discussion over the timing of the Greenlandic survey for fin and minke whales. It was noted that although some successful surveys had been carried out in July, several had not been successful due to poor weather, especially fog and/or high winds. September was preferred by Greenland because fog was generally less prevalent then than in July, and it was considered that the chances of a successful survey were significantly higher in September than in July (a successful survey was conducted in September in 2005). Greenland noted that it may be possible to attempt two surveys, one in July and one in September, but this will depend on extra funding.

From the perspective of TNASS, the value of components being as synoptic as possible was stressed. It was noted that a major value of synoptic surveys is that it reduces difficulties of interpretation of abundance estimates due to migration. Although the migration pattern of minke and fin whales is poorly understood, it will be difficult to rule out the possibility of animals sighted in July to the east of Greenland being counted in a September survey off West Greenland; most members of the Working Group agreed that the possibility for animals seen off the USA/southern Canada in August being seen in July off West Greenland seems more unlikely.

The Working Group noted that there is a risk that a July survey off West Greenland may not result in an abundance estimate; it recognised that from a Greenlandic perspective, the highest priority was to obtain an abundance estimate for management purposes – and that the chances of obtaining such estimates generally are higher in August/September than in July owing to widespread fog early in the summer. However, the Working Group also noted that there is no guarantee that a September survey will result in an estimate and that the interpretational problem in the context of the overall TNASS survey will certainly be greater for a September survey. The latest too has management implications since the area covered by the Greenland survey is not believed to cover the complete range of either the fin or the common minke whale populations.

Given this, the Working Group agreed that from a TNASS perspective, an early abundance estimate from West Greenland that is timed in with the other surveys is clearly preferable. It **strongly recommends** that a three-week survey be undertaken off West Greenland in July perhaps into early August, and that this survey be coordinated with the northern portion of the Canadian aerial surveys. It also **recommends** that Canada coordinate the southern portion of its surveys with the USA surveys being undertaken in August.

The Greenlandic scientists commented that a survey in July is unlikely to be prioritised by Greenland unless the chances of obtaining abundance estimates are significantly enhanced, e.g., by additional funding that allows for surveys to be undertaken in both July and September. If Greenland gives priority to a survey in September 2007, the Working Group **strongly recommends** that Greenland, supported by the other NAMMCO countries, includes considerable survey effort also in July 2007.

5.2 Coverage

A general overview of planned coverage is provided in Figure 1. The northern extent of the Canadian coverage will be adjusted to match that of Greenland, and the released survey effort will be applied to Hudson Strait and to areas farther south. Coverage of central Davis Strait is dependent on the availability of the Arcturus survey platform.

Given that the funding of several components of the TNASS is as yet uncertain, it was not possible to plan the coverage of the TNASS in detail. It was agreed in principle that jurisdictions would cooperate fully in establishing the borders of their survey areas to be contiguous and to maximize the spatial coverage of TNASS. This task will be assigned to the Survey Design Subcommittee (See 7.1).

The western edge of the Icelandic survey area is limited by the ice edge off East Greenland. While it was recognized that several species of cetaceans, possibly including minke whales, may occur within the ice pack, it was not considered feasible to survey within the pack ice.

The Planning Committee noted that Norway presently plans to survey in the eastern Barents Sea, an area that is not contiguous with the TNASS area. While recognizing that the Norwegian survey plan is based on providing optimal estimates of minke whale abundance for use in the RMP, the Planning Committee stressed that the opportunity to get synoptic coverage of a much larger area was not likely to arise again in the near future, and that this should be seen as valuable to the Norwegian management programme. It was also noted that the TNASS proposal had been endorsed by both NAMMCO Council and the IWC Scientific Committee. The Planning Committee therefore **strongly recommended** that Norway survey in an area contiguous to the main TNASS survey area in 2007. A preferred area would be that to the northeast of the Icelandic survey area, extending to the Norwegian coast (See Fig. 1).

5.3 Coordination with associated surveys

5.3.1 CODA

It was agreed that TNASS will cooperate closely with CODA in establishing contiguous survey boundaries.

5.3.2 USA

It was agreed that TNASS (primarily the Canadian component) will cooperate with the US survey as closely as possible.

5.4 Coordination with "Opportunity" ship board surveys

5.4.1 MAR-ECO

Research will be conducted along the North Atlantic Ridge under the MAR-ECO project by an American and a British vessel in July 2007. Permission to place cetacean observers aboard these vessels, subject to funding (see 6.2.2) has already been sought. The American vessel will carry a single cetacean observer, whose activities will be as compatible to the TNASS protocol as possible. As these are multi-purpose surveys that will include periodic trawling, it was uncertain whether or not an acoustic array could be accommodated by the vessels. This has also been requested, subject to funding, but a response has not yet been received.

5.4.2 ICES Redfish

In addition to an Icelandic vessel which will be a co-platform for the cetacean survey, Russian and German vessels will participate in an International Redfish Survey, coordinated by ICES, in 2007. These vessels will survey an area to the south and west of the main Icelandic survey area (see Fig. 1). Permission to place cetacean observers and acoustic arrays on these vessels (subject to funding) has already been requested, and a decision on this is pending. If granted, it would constitute a substantial addition to the main TNASS survey area.

5.4.3 Russian/Norwegian surveys in the Norwegian Sea

The planned Russian surveys are described under 5.4. It was clarified that the observers aboard the Russian vessels do not presently use standard line transect methods, but it was considered that a TNASS protocol for "opportunity" vessels could be adopted. Norwegian vessels also conduct fish surveys in the same area and time period, and it was agreed to investigate the possibilities of placing observers onboard. The aerial survey uses a strip transect methodology, cruising at no more than 300 km/hr at an altitude of 200 m with two teams of independent observers. The methodology is described in Anon (2005). This will be evaluated in terms of the potential value of this survey effort to TNASS.

5.4.4 Russian survey in the Barents Sea

See Item 5.4.3. It was considered that this survey was of less interest to TNASS because of the difference in timing.

5.4.5 IPY-ESSAR

The TNASS has been accepted as a component project of the Ecosystem Studies of Subarctic and Arctic Regions (ESSAR) project for the International Polar Year (IPY). ESSAR involves many projects covering physical and chemical oceanography as well as ecological studies at various trophic levels. To date the actual cross coordination of these components within ESSAR has been limited, but the Planning Committee considered that this presented an opportunity that should be more closely investigated. Pike agreed to lead coordination in this area.

5.4.6 Other

Iceland will be carrying out an ecosystem survey in the Greenland Sea in August 2007, which will involve oceanographic and fish surveys. There will be bird observers on board who will also record observations of cetaceans, but there is no room for additional observers on this vessel. However because of its timing it is of limited concern to TNASS.

6. FUNDING

6.1 Integrated budget

An integrated budget for TNASS has been prepared and used in several funding applications, and a summary of this is provided in Table 2. Total cost of the project is projected at approximately 34 million DK, of which about 15 million is confirmed at this time. Base funding from the Greenlandic, Norwegian and Faroese governments is confirmed, and there is a firm funding commitment from the Icelandic government. NAMMCO has also allocated special funds for TNASS for 2007. Funding for the Grand Banks portion of the Canadian programme has been confirmed, and it is expected that funding for the Arctic portion, from the Canadian IPY programme, will be confirmed in January. Funding for the Scotian Shelf and Gulf components is less certain and confirmation may not be available until spring 2007.

In a "worst case" funding scenario, it is likely that surveys could be conducted in an area similar to that surveyed in 2001, as well as West Greenland and the Grand Banks

region of Canada. In addition, the associated CODA, MAR-ECO, ICES Redfish and US surveys will likely go ahead irrespective of TNASS. Coordination and public outreach activities would proceed at a lower level than presently planned, and would be funded primarily by NAMMCO and national governments. In such a scenario the analyses planned for 2007/8 would proceed more slowly, mainly under national funding, and would therefore be less integrated in nature.

6.2 External funding proposals

6.2.1 Nordic Council

An application for funding was sent to the Nordic Council in the second quarter of 2006 and initially rejected. A revised application totalling 1.7 million DKK over two years (07/8) has been submitted to support activities related to survey coordination, planning and post-survey meetings, cooperative analytical work, including provision of external expertise, support for Russian observers and dissemination of information to the public. A response to this application is expected by mid January 2007.

6.2.2 NORA

A total of 830,000 DKK (730 in 2007 and 100 in 2008) has been sought from the Nordisk Atlantsamarbejde to fund "Sub-project 1", the operation of "platform of opportunity" surveys in areas adjacent to the main TNASS survey area. This will cover costs related to placing two observers on each of four ships, including wages, equipment, travel, data preparation and analysis. While the main targets of this application were the MAR-ECO and International Redfish Surveys, there may be other opportunities, such as the Norwegian mackerel survey, if these prove unfeasible. A response to this application is expected by mid December 2006.

6.2.3 Beckett Fund and JL Fund

Similar funding requests totaling 2,110 kDKK have been submitted to these Danish private funds, to support "Sub-project 2", the passive acoustic survey. The main cost is the equipment since the observers from the visual survey will deploy, monitor and operate the acoustic equipment. A secondary cost is related to the data preparation and analysis (which is very time consuming), as well as the reporting of the results, projected to take 12 months for two persons. The budget is presently based on equipping 12 vessels, 6 TNASS vessels and 6 vessels from three fishery surveys. A response to this request is expected in December 2006. It was noted that timing was critical here as the equipment will have to be ordered by the end of January if it is to be completed on time. Consideration should also be given to the prioritization of this equipment should partial funding be received.

6.2.4 What next?

As the main work of drafting funding proposals for these activities has been completed, it would be relatively easy to submit them to other potential supporters, including possibly industry. Members were requested to seek out external funding opportunities using any contacts they might have. However it was noted that it may be too late to seek funding from most sources for a project in summer 2007.

7. SURVEY DESIGN

7.1 Survey design issues

General

SC/14/TNASS/16 discussed strategies for creating good designs given the constraints inherent in many shipboard surveys of cetaceans: severely limited ship time and complex topography. Good survey design is essential for obtaining reliable results using standard (design based) analytical methods. Even for more complex (model based) analytical methods, a good survey design is very helpful. While it is difficult to optimise a survey design for multi-species surveys in which different species have very different distributions, there are some general rules of thumb for deciding what constitutes good survey design. A 'good' design is one (a) that employs randomization in laying out transects; (b) that is stratified if density of target species is known to vary on a large scale; (c) where each location within a stratum has an equal probability of being surveyed (equal coverage probability); (d) that produces at least 10-20 transects per stratum; (e) that, given the previous points, gives maximum efficiency per unit effort – for example by minimizing time spent travelling between survey lines (off-effort time). The use of computer software, such as the programme Distance, to create designs and compare their properties using simulation, was advocated, and an example of survey design, a multi-species survey of cetaceans in coastal British Columbia, Canada was presented. The design uses an equally spaced zig-zag configuration of transects in more open strata combined with sub-stratification to minimize off-effort time. In the highly convex inshore stratum, a systematic cluster sampling algorithm was used. Within the selected clusters a systematic parallel line layout to ensure equal coverage probability in the long, narrow fjords was developed.

The Planning Committee endorsed the approach of using automated design within DISTANCE to develop "design unbiased" track layouts for all strata. The level of coverage within each stratum will depend on the expected density of target species and the level of funding available. In many cases the latter is not yet known so design cannot proceed as yet. One confounding factor includes the need for the survey 'design axis' (the long axis used to orient the transects) to address issues of migrating animals, such that the survey does not progress only in the same direction as the direction of animal migration. A Working Group on shipboard survey design was established to develop appropriate designs for each block, after decisions have been made about funding, permits, survey effort to be allocated, and survey boundaries. The Working Group will also investigate the possibility of changing the design of the redfish survey with regard to the point above. Membership is Pike (Chair), Donovan, Hammond, Lawson, Mikkelsen, Palka, Simon, Víkingsson, Williams and Øien.

Harbour porpoise

The harbour porpoise is a target species for Iceland, and probably should be for Greenland, considering that there is a substantial directed harvest in Greenland and substantial by-catch in Iceland. In 2005, the NAMMCO Scientific Committee noted that estimates of abundance of harbour porpoises were required for these and other areas (NAMMCO 2006). Harbour porpoises probably have a more inshore distribution than minke whales in these areas, and may occur within the fjords. Therefore, if the harbour porpoise is to be a target species, some change in survey design may be required for both areas. Consideration should be given to allocating more effort to

inshore areas, especially fjords. While this may cost more flying time, it may not increase the total duration of the survey. Fjords could be surveyed on days when conditions farther offshore were unsuitable, utilizing time that would otherwise be spent on standby. A possible approach is to maintain the existing design for Iceland, and develop a "secondary" design concentrating effort in fjords and areas where harbour porpoise density is expected to be high. The secondary transects could be flown on an opportunistic basis. The same could be done for Greenland, but there, the fjord areas are so extensive that a great amount of extra effort would be required to cover them adequately. An alternate approach would be to fly only a few fjords on an experimental basis, or adopt the approach using "Primary Sampling Units" outlined in SC/14/TNASS/16.

The Planning Committee agreed that a secondary fjord stratum should be developed for Iceland waters to be surveyed on a pilot/opportunistic basis, without substantially compromising the efficiency of the survey for minke whales.

7.2 Approaches to stratification

It was noted that the Working Group on shipboard survey design should examine information from previous surveys (especially NASS) to assess whether the proposed survey design blocks (SC/14/TNASS/14, Figure 1) are appropriately drawn. It was agreed that the Working Group should discuss stratification, allocation of effort by stratum and the design of survey transects (Items 7.3-7.5) after it is known how much survey effort each country can contribute to the overall survey.

8. FIELD METHODS

8.1 Dedicated ship surveys

8.1.1 Review of SCANS-II and US methods

Hammond summarised the data collection methods used on the SCANS-II surveys in 2005. Surveys were in standard BT mode on all seven vessels. On the primary platform, there were two observers searching with the naked eye. Angles were recorded from angle boards and each observer had a measuring stick for estimating radial distance. On the tracker platform there were four scientists: two observers (one searching with "big-eye" binoculars, the other with pole-mounted 7×50s), a duplicate identifier and a data recorder, who was in contact with the observers on the primary platform. Distance was measured via a video camera mounted on the "big-eyes". Angle was measured via a webcam attached to the underside of the "big-eyes", taking images of lines on the deck. Each observer on each platform had a sighting/resighting button that when pressed relayed a time stamp to the data collection computer and started the audio recordings. On the tracker platform, the button also started the video camera and webcam. Details of the equipment and protocols are given in the SCANS-II shipboard observer handbook.

The equipment and protocol generally worked very well. The webcam gave excellent angle data and video estimates of distance were obtained for between 40-50% of sightings. The electronics generally worked well but some cables had to be replaced during the survey.

Palka described the methods used in the US North Atlantic surveys. US surveys use two symmetrical sighting teams, with each team comprising 4 people of whom 3 were on-effort at a time. Of the three people, two used high powered binoculars, while one person surveyed by eye and recorded the data from all three team members. Duplicate sightings were determined after the survey using information on the timing of the sighting, position relative to the ship, and swim direction. To more easily determine which sightings were duplicates, observers were encouraged to record more than one location of each sighting, particularly for those sightings that were far from the ship and/or changed swim directions. More details of the data collection methods can be found in Palka (2006). To account for reactive movements, possible heterogeneities and *g(0)*, methods described in Palka and Hammond (2001) were used to determine if there was evidence of responsive movement and if so, to correct the estimates. If there was no evidence of responsive movements then the data were analyzed using the direct duplicate with covariate method (Palka 2005a).

8.1.2 Survey mode

There was considerable discussion about the most appropriate method(s) to use on the dedicated vessels. Dedicated vessels included the Icelandic redfish vessel as well as the two Icelandic vessels and the Faroese vessel. Factors taken into account in the discussion included area, target species, analytical approaches, problems encountered on previous surveys, practical arrangements, cost etc. In conclusion, it was agreed that all vessels would follow the same survey mode and use the same equipment and protocols to the extent possible; there is less flexibility on the redfish survey.

It was agreed that the primary searching mode should be BT mode with high powered binoculars (choice of "big-eyes" or "little-eyes" would be left to the sub-group identified below) for the tracking platform. For the target species, where possible, tracking would be attempted until the animals were estimated to come abeam. Under poor conditions (*e.g.* heavy swell, Beaufort 5 or more), tracking will cease and if searching continues it will be in one-way IO mode. The detailed protocol will be developed by a sub-group on shipboard protocols comprising Desportes, Gunnlaugsson, Hammond, Palka and Víkingsson. That group will also consider aspects such as school size estimation, delayed closure, how to revise the survey design in response to the ice edge etc. The personnel requirements will be for 8 observers per vessel. The choice of observers is discussed under Item 9.

8.1.3 Data collection procedures

It was agreed that the data collection procedures followed on SCANS-II will be used. This includes:

- Webcam for the tracking platform to record angles (and investigation of an electronic system for the primary platform);
- Video measurement of distance for the tracking platform;
- Electronic data entry.

Practical aspects of this are considered further under Item 8.1.5.

8.1.4 Calibration experiments

The need for angle/distance experiments for the primary observers was agreed. Details

will be determined by the sub-group on shipboard protocols. For the trackers, visual distance estimates will be calibrated using a factor based on a comparison of the video distance measurement and reticule readings.

8.1.5 Equipment

Equipment needs are dictated by the decisions taken above with respect to protocols. It was agreed that given the relative complexity of the system, it is essential to contract out the acquiring and installation of the equipment, as well as training, to experienced personnel. It is important to carry spares (especially of cables) and consideration should be given to the use of Toughbook computers (www.panasonic.com). Questions of training are discussed further below under Item 9.2.1.

8.2 Opportunistic ship surveys

8.2.1 Advances in monitoring methods from SCANS-II

Hammond summarised the work being undertaken in the SCANS-II project related to using relative abundance data to monitor changes in abundance that will be used to help inform recommendations for best practice in monitoring cetacean populations in the periods between major absolute abundance surveys such as SCANS and NASS. This focussed on acoustic data and visual data collected by seabird observers both of which have monitoring potential if used on ships of opportunity.

Each of the seven SCANS-II survey ships towed hydrophones 200m behind the vessel that recorded high frequency clicks and lower frequency whistles. Acoustic data were stored digitally on computers running programmes Logger, RainbowClick and Whistle. Analysis identified harbour porpoise clicks and estimated perpendicular distance for tracks of clicks so that acoustic detection rates could be calculated. Information of ship noise was also collected and correlated with detection rate.

Each ship (except one) carried one or more seabird observers who also collected cetacean data independently, which were used to calculate harbour porpoise detection rates.

Acoustic and seabird observer detection rates will be regressed on BT estimates of absolute abundance; the variability accounted for by the relationship is a measure of how well each method is able to reflect true abundance. This variability can be incorporated into a power calculation to determine the relative power of each method to detect a trend in abundance of a given size over a given period. Information on the cost of each method will then give an indication of the relative cost to achieve a given power to detect a given trend. This comparison will be helpful when recommendations are considered.

8.2.2 Survey mode, data collection procedures, calibration experiments and equipment

The Planning Committee agreed that to the extent possible, the methods, data collection procedures and equipment to be used by observers on vessels of opportunity should be the same as those for the primary platform on dedicated vessels. It was agreed that wherever possible, at least two observers are present; if a choice has to be made between

one observer on two vessels and two observers on one vessel the latter is to be preferred. A protocol will be determined by the sub-group on shipboard protocols; recognising that this may need to be tailored to the particular conditions related to each vessel. Desportes agreed to liaise with the proponents of the platform of opportunity surveys on this issue.

8.3 Acoustic survey

8.3.1 State of the art

Methods to collect, identify and analyse harbour porpoise and sperm whale echolocation clicks are well advanced. For harbour porpoises, detection rate and distance of click trains from the trackline can be estimated as described under Item 8.2.1. For sperm whales, there are methods to estimate absolute abundance (Leaper *et al.* 1992). Methods of analysis for other species are less well advanced. There is ongoing work on bottlenose whale clicks (*e.g.* Hooker and Whitehead 2002). Methods to analyse delphinid whistles are less well advanced. There are plans to use SCANS-II visual and acoustic data to investigate methods to distinguish among whistles from different dolphin species. Whistles are produced in a behavioural context and the relationship between vocalisation rate and abundance is unknown.

8.3.2 Equipment and data collection

The Planning Committee noted that there is a funding request in for the acoustic programme. SMRU is a partner in this work and will be responsible for ensuring that the appropriate equipment (and manuals) is present on at least the dedicated TNASS vessels (apart from Norwegian vessels that may operate in Russian waters, because of permit problems). Even if the funding request is not granted, it is anticipated that the Faroese vessel will deploy acoustic equipment. The CODA vessels will all deploy acoustic equipment. Iceland will investigate the possibility of buying acoustic equipment if the funding request fails.

8.4 Dedicated cetacean aerial surveys

8.4.1 Review of previous methods used

Hammond summarised the aerial survey methods used on the SCANS-II survey. In 1994, the SCANS aerial surveys used two aircraft flying in tandem and a probabilistic method was used to account for animals missed on the trackline in the estimation of effective strip half width (*esw*) for the harbour porpoise. On SCANS-II in 2005, a modified ‘circle back’ or ‘racetrack’ method was used, in which a single aircraft circles back and resurveys a section of track line following a sighting. Robust estimation of *esw* requires a sufficient number of circles to be flown; the number depends on the detection probability of the species. For harbour porpoises, which have a low detection probability, the desired number of circles was determined by simulation to be about 60 (check) and 90 were achieved by the three aircraft.

Circles were not flown for species other than harbour porpoise. Information on availability bias from other sources was used to correct minke whale and bottlenose dolphin estimates. For common dolphin, striped dolphin and white-beaked dolphin, an availability bias correction from striped dolphin data was used. Estimates for species other than harbour porpoise were not corrected for perception bias but this was considered not to be large for dolphins.

In US waters, aerial surveys are flown in a Twin Otter with two large bubble windows and a belly window at 600 feet at 110 knots. Five scientists were employed: two searched through the bubble windows, one searched through a belly window, the fourth was a data recorder and the fifth was at rest. The racetrack data collection method and the VOR data entry programme developed by Hiby (1999) was used. In addition, GPS and sea surface temperature data were collected. Two external key pads were also connected to the data entry programme, where the keyboards were held by the bubble window observers and when a sighting passed perpendicular to the observer, a key on the external keyboard was depressed which then automatically recorded the time and side the observer was on. One difference from the traditional racetrack method was that the circling back procedure was used for any species that was found in a group of 5 animals or less and not seen again within 30 seconds of the time of the sighting that initiated the circle-back. This has allowed an estimation of *g(0)* for species groups, i.e., harbour porpoises, dolphins, and whales (Palka 2005b). In addition, the VOR programmes have been used to determine duplicate sightings and the direct duplicate with covariate method was used to estimate *g(0)* and abundance (Palka 2005b).

In both Iceland and Greenland, the predominant approach has been to use cue-counting for minke and fin whales. The protocol has evolved over the years but is based on that originally described in Donovan and Gunnlaugsson (1989). SC/10/AE/12 and SC/14/TNASS/O/3 provide a critique and some suggestions for improvements for the aerial surveys.

8.4.2 Survey mode, data collection procedures and equipment

It was agreed that a sub-group on aerial survey protocols would be established (comprising, Donovan, Pike, Witting, Palka, Lawson, Simon) the remit of which is to include data collection methods and equipment. It was agreed that the while data would be collected in such a way to enable a variety of analytical approaches to be used (e.g. cue counting, and standard line transect, and, if possible 'racetrack',), cue counting will be the primary method for obtaining abundance estimates for minke and fin whales.

Given the priority to be accorded to obtaining abundance estimates for harbour porpoises off Iceland, it was agreed that the available information be evaluated by the sub-group to determine whether it will be possible to obtain suitably precise estimates of minke whale abundance if the survey is flown at 600 feet. This is the optimum height for harbour porpoise surveys and one that will best allow use of SCANS-II estimates of animals missed on the trackline, in the likely event that employing the racetrack method in Iceland may result in the loss of too much effort. The relatively high density of minke whales in Icelandic waters means that precise estimates of abundance can be expected from surveys flown at 600 ft. The very low densities expected of minke and fin whales off West Greenland preclude flying at 600 feet as this will compromise the ability to obtain an abundance estimate. Hammond and Donovan will consult with Hiby and Borchers about the possibility of using cue counting for harbour porpoises (and investigate whether it is possible to use data from SCANS and SCANS-II to evaluate this).

Issues relating to choice of observers are dealt with under Item 9.

8.5 Collection of ancillary data

The Planning Committee noted that the collection of appropriate effort, weather and behavioural data will be dealt with by the relevant sub-groups on protocols. It therefore limited its discussion to additional environmental data that might be collected without compromising survey effort. It agreed that all of the dedicated planes should be equipped with temperature probes (as already used on the US and Canadian planes); these cost CAN$2,200 and automatically record sea surface temperature at 300 millisecond intervals.

Considerable environmental data are collected remotely from the Russian ecosystem programme planes. The practicality of installing any such equipment on the dedicated planes will be evaluated by the sub-group on aerial survey protocols after receiving additional information to be provided by Zabavnikov.

The possibility of installing high resolution digital video or still cameras to record a narrow strip directly under the planes was considered. It has the possibility of providing information on animals missed on the trackline and may be additionally valuable for harbour porpoise studies in West Greenland where the survey height will not be optimum for visual observers to see harbour porpoises. The Planning Committee agreed that this showed some promise but noted that it was not necessary for abundance estimates to be obtained from the aerial surveys. Before making any recommendation for installation of such cameras, it agreed that it would be necessary to test the efficacy of the approach by appropriate experiment. However, it also noted that this does not preclude countries voluntarily installing such equipment should they so wish.

8.6 Biopsy and tagging

The Planning Committee noted that at present there were no plans to carry out telemetry work from any of the vessels, although such plans may be developed. It recommended that each vessel with appropriate expertise carry equipment such that opportunistic biopsy and/or photo-identification work could be undertaken at the Cruise Leader's discretion such that the visual survey component was not compromised. The Cruise Leader would be aided in such decisions by countries providing advice on the origin of existing biopsy samples for each species and where data gaps may exist that had potential management significance with respect to stock structure.

9. OBSERVERS

9.1 Selection

Aerial surveys

If possible experienced observers should be used on all surveys. This is particularly important for Greenland as sightings are relatively rare so there is no opportunity for in-flight training. For Iceland, it was also considered important to have at least one observer who was experienced with harbour porpoise surveys. It was also recommended that a "relief" observer be employed for each survey. This observer could step in in case of illness, and otherwise transcribe data from the surveys in a timely manner. This was considered very important in order to provide timely feedback to the observers to correct any problems that might arise.

Greenland will aim to select observers with experience from previous minke whale surveys and to conduct training in Iceland if necessary. Some experienced observers are available in Iceland, and every effort will be made to obtain the services of an experienced harbour porpoise observer for the survey. Canada and the USA have a core group of experienced observers and these will be used in their surveys.

Ship surveys

Given that equipment, survey modes and protocols will be similar to those used on SCANS-II, it was recommended that at least one observer experienced with SCANS tracking methods be employed on all vessels. Otherwise observers will be selected separately by each jurisdiction.

9.2 Training

9.2.1 Shipboard

It was considered unlikely that funds would be found to conduct a full shipboard training survey. Training of cruise leaders will be conducted at a meeting in advance of the survey. It was recommended to allocate some time for each vessel at the beginning of the survey to conduct onboard training. Training will be conducted by the cruise leader in cooperation with the experienced tracker, subject to the common survey protocol, which will be provided well in advance of the survey. Øien volunteered to assemble a training DVD illustrating survey equipment, techniques and common sighting situations.

9.2.2 Aerial

Both ground and in-flight training is required for aerial observers, even as a refresher for experienced observers. Given that high densities of minke whales are generally found in Faxafloi Bay close to Reykjavik, this is a particularly convenient place to conduct in-flight training. A minimum of 5 hours of plane time should be allocated to training.

9.2.3 Acoustic

As in SCANS-II, one observer will be responsible for the deployment and operation of the acoustic array on each vessel. This was considered a relatively easy task, although some training is required. Provision for this training will be decided upon once funding for the acoustic survey is certain.

10. TASKS TO BE COMPLETED

	What	Who	When
1	Develop survey design, including stratification, effort allocation and transects.	Design WG	1 Mar 2007
2	Shipboard survey protocol, including for opportunistic ships.	Ship Protocol WG	1 Mar 2007
3	Aerial survey protocol.	Aerial Protocol WG	1 Mar 2007
4	Assess suitability of Russian aerial survey effort for inclusion in TNASS.	Aerial protocol WG	Jan 2007

5	Consult with experts re. the possibility of using cue counting for harbour porpoises and investigate whether it is possible to use data from SCANS and SCANS-II to evaluate this.	Donovan/ Hammond	Jan 2007
6	Provide information on specifications of equipment used in Russian aerial surveys.	Zabavnikov	Dec 2006
7	Follow up requests for placement of cetacean observers to MAR-ECO and ICES-Redfish Surveys.	Desportes/Pike	Dec 2006
8	Investigate possibility of placing observers aboard Russian and Norwegian fishery survey vessels, Norwegian Sea in July.	Zabavnikov/Øien/ Pike/Desportes	Dec 2006
9	Coordination with IPY-ESSAR.	Pike	Ongoing
10	Order acoustic equipment (subject to funding).	Desportes/Gillespie	1 January 07

11. DISSEMINATION OF RESULTS/PUBLIC RELATIONS

Funding for the establishment of a website and production of publicity materials has been applied for from the Nordic Council. If successful, an independent web site will be established, and all partners will contribute material. This site will also be reciprocally linked to the CODA and US sites.

12. NEXT MEETING

Most decisions about funding for the TNASS will be available by the end of January 2007, except for Canada for which information may not be available until April. It was considered feasible for the working groups to finish their work on survey design and survey protocols by the beginning of March. Therefore the next meeting of the Planning Committee will be held in March 2007.

13. ADOPTION OF REPORT

A draft version of the Report, containing all important items agreed upon, was accepted on 19 November 2006. The Chair thanked all members for contributing to what had been a very productive meeting, and noted that a great deal of progress had been made in planning the TNASS and linking it to associated surveys. She considered it very encouraging that a group of nations and jurisdictions with often different political outlooks was able to work cooperatively to plan and execute a project dedicated to the common objective of cetacean conservation. She also thanked the Rapporteurs for their hard labours and the Marine Research Institute for hosting the meeting. The Planning Committee thanked Desportes for her efficient chairing of the meeting.

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JURIS-DICTION Main survey	PLATFORM	DAYS	IND. PLAT-FORM	CRUISING SPEED (knots)	RANGE (hrs or days)	ALTI-TUDE	WIND-OWS (Pairs)	PLATFORM HEIGHT (m) 1	2	OBS.
Canada	Twin Otter 300	52	2	105	5 hrs	600	1			2
	Lockheed Arcturus	3	2	170	10 hrs	750t	3			6+
Greenland	Partenavia or Twin Otter		2	90	5-8 hrs	750	1			3
Iceland	Partenavia	20	2	90	8 hrs	600	1			3
	ship 1	30	2	10						8
	ship 2	30	2	10						8
	ship 3	30	2	10						8
Faroes	Ship 1	28	2	10				10.5	12	8
Norway	Ship 1	28	2	10						8
	Ship 2	28	2	10						8

Associated surveys										
USA	Twin Otter	30	1	100	5 hrs	600	1+belly			3
	R/V Bigelow	30	2					11.4	15	8
CODA	Cornide	14	2							8
	Investigador	14	2							8
	Ship 3	28	2							8
	Ship 4	28	2							8
Russia	Antonov-26	115 hrs	2	<186		650	2			4
Norwegian Sea										
	Ship 1		1							1

Table 1. Survey platforms and effort available to the TNASS and associated survey

Planning Committee for TNASS

Fund	Sent	Specific project	Ext. Part	Applied for 2,007	Applied for 2,008	Applied for Total	Answer	Granted 2,007	Granted 2,008	Granted Total
NAMMCO	Mar-06			260,000	110,000	**370,000**	mar-06/07	260,000		**260,000**
NAMMCO / NMR-Arctic	30/08/2006	Coordination incl. analysis, Russia, extl expertise, awareness campaign		973,000	712,000	**1,685,000**	19/01/2006			
NAMMCO / NORA	24/10/2006	1) Opportunistic surveys		730,000	100,000	**830,000**	mid 12/06			
NAMMCO / Beckett-Fonden	01/11/2006	2) T-NASS Acoustic	SMRU	1,680,000	430,000	**2,110,000**	mid 12/06			
NAMMCO / JL Fondet	07/11/2006	2) T-NASS Acoustic	SMRU	1,680,000	430,000	**2,110,000**	mid 12/06			
NAMMCO Total						**4,625,000**				
Faroese national		Faroese survey				**2,200,000**	Nov-06			**1,350,000**
Faroese oil		Faroese survey				**550,000**	Nov-06			**555,000**
Iceland national		Icelandic survey		6,363,000		**6,363,000**				
Norway national		Norwegian survey		4,620,000		**4,620,000**		4,620,000		**4,620,000**
Greenland national		Greenlandic survey		1,500,000		**1,500,000**				
Canada IPY		Can. Eastern arctic IPY		2,090,000	168,000	**2,258,000**				
Canada diverse		Can. Grand Bank		1,777,000		**1,777,000**		1,777,000		**1,777,000**
Canada diverse		Can. Gulf of St. Lawrence		1,704,000		**1,704,000**				
Canada diverse		Can. Scotian Shelf		1,777,000		**1,777,000**				
Russian Fed.										

Table 2. An overview of funding for TNASS, as of November 2006.

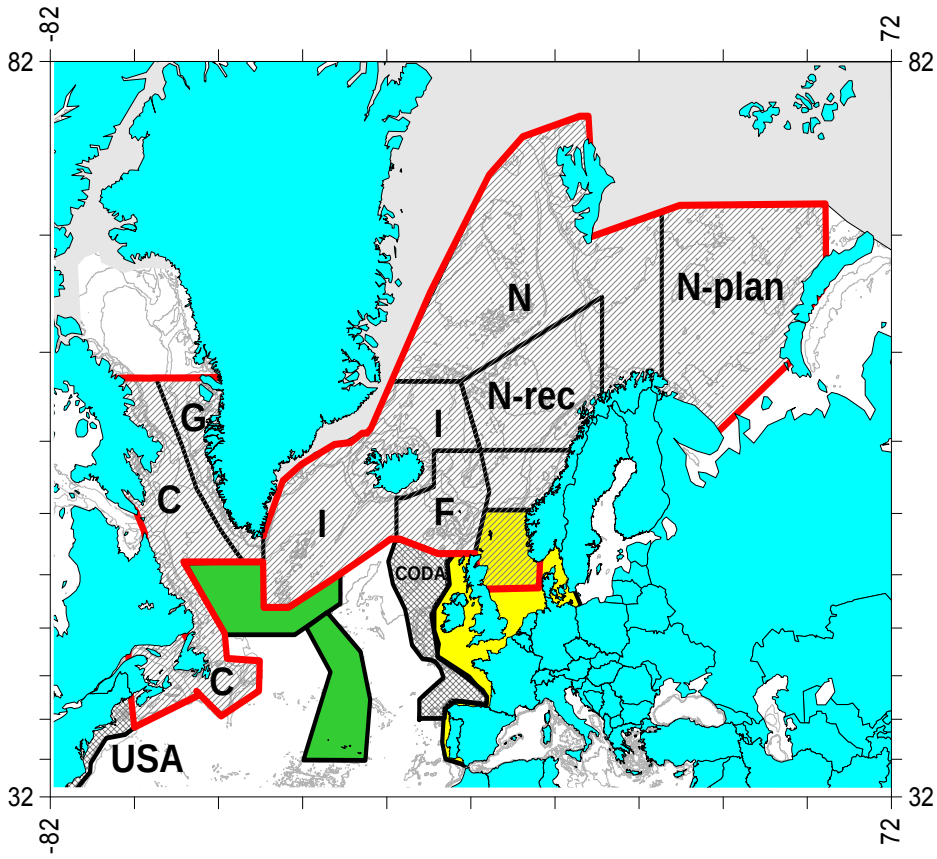

Fig. 1. TNASS and associated survey areas. The TNASS area is outlined in red, and includes the survey areas of Canada (C), Greenland (G), Iceland (I), the Faroes (F) and Norway (N). The Norwegian area is surveyed over a 6-year period, and the area planned to be surveyed in 2007 is shown as N-plan. The area recommended to be surveyed in 2007 is shown as N-rec. The yellow area was covered by SCANS-II in 2005, and the shaded area is the approximate southern extent of pack ice in the summer. Associated surveys are the American Eastern Seaboard and CODA surveys. The approximate areas of the ancillary ICES Redfish and MAR-ECO surveys are green.

Appendix 1

AGENDA

1. Chair's welcome and opening remarks
2. Adoption of agenda
3. Appointment of rapporteurs
4. Overview of available resources by jurisdiction
   - 4.1 Canada
   - 4.2 Greenland
   - 4.3 Iceland
   - 4.4 Faroes
   - 4.5 Norway
   - 4.6 Russian Federation
   - 4.7 CODA
   - 4.8 USA
5. Coordination issues
   - 5.1 Timing
   - 5.2 Coverage
   - 5.3 Coordination with associated surveys
     - 5.3.1 CODA
     - 5.3.2 USA
     - 5.3.3 Other
   - 5.4 Coordination with "Opportunity" shipboard surveys
     - 5.4.1 MAR-ECO
     - 5.4.2 ICES Redfish
     - 5.4.3 Russian survey in Norwegian sea (06-07)
     - 5.4.4 Russian survey in Barents Sea (08-09)
     - 5.4.5 IPY-ESSAR
6. Funding
   - 6.1 Integrated budget
   - 6.2 External funding proposals
     - 6.2.1 Nordic Council
     - 6.2.2 NORA
     - 6.2.3 Beckett Fund
     - 6.2.4 JL Fund
     - 6.2.5 What next
7. Survey design
   - 7.1 Survey design issues
   - 7.2 Approaches to stratification
   - 7.3 Rough stratification
   - 7.4 Allocation of effort by stratum
   - 7.5 Specifications for transects
8. Field Methodology
   - 8.1 Dedicated ship
     - 8.1.1 Advances in survey methods from SCANS-II
     - 8.1.2 Survey modes
     - 8.1.3 Data collection procedures

8.1.4 Calibration experiments
8.1.5 Equipment
8.2 Opportunity ship
8.2.1 Advances in monitoring methods from SCANS-II
8.2.2 Survey modes
8.2.3 Data collection procedures
8.2.4 Calibration experiments
8.2.5 Equipment
8.3 Acoustic survey
8.3.1 Status of the art (what information can be obtained from which species)
8.3.2 Equipment and data collection
8.4 Aerial
8.4.1 Survey modes
8.4.2 Data collection procedures
8.4.3 Calibration experiments
8.4.4 Equipment
8.5 Collection of behavioural and ancillary data
8.6 Biopsy and tagging studies
8.7 Other matters
9 Cruise Leaders and Observers
9.1 Selection
9.2 Training
9.2.1 Visual
9.2.2 Aerial
9.2.3 Acoustic
10. Dissemination of results/public relations
11. Tasks to be completed
12. Next meeting
13. Adoption of report.

Appendix 2

LIST OF DOCUMENTS

Doc. No.	Title
SC/14/TNASS/1	List of Participants.
SC/14/TNASS/2	Draft Agenda.
SC/14/TNASS/3	List of Documents.
SC/14/TNASS/4	Proposed contribution to TNASS: Canada.
SC/14/TNASS/5	Proposed contribution to TNASS: Greenland.
SC/14/TNASS/6	Proposed contribution to TNASS: Iceland.
SC/14/TNASS/7	Proposed contribution to TNASS: Faroes.
SC/14/TNASS/8	Proposed contribution to TNASS: Norway.
SC/14/TNASS/9	Proposed contribution to TNASS: Russian Federation.
SC/14/TNASS/10	Preliminary survey plan: CODA.
SC/14/TNASS/11	Preliminary survey plan: USA.
SC/14/TNASS/12	Overview over TNASS funding applications.
SC/14/TNASS/13	TNASS Budget.
SC/14/TNASS/14	Subproject 1: Extending TNASS: Collection of data from non-dedicated survey ships.
SC/14/TNASS/15	Subproject 2: TNASS acoustic.
SC/14/TNASS/16	Thomas, L., Sandilands, D. and Williams, R. Designing line transect surveys for complex survey regions.
SC/14/TNASS/17	Pike, D.G. Some recommendations for future aerial surveys off Iceland and Greenland.

BACKGROUND DOCUMENTS

Doc. No.	Title
SC/14/TNASS/O/1	Gunnlaugsson, Th., Halldórsson, S.D., Ólafsdóttir, D. and Víkingsson, G.A. NASS 2001 Icelandic shipboard survey report (SC/10/AE/10).
SC/14/TNASS/O/2	Desportes, G. *et al.* An evaluation of the methodology used in the NASS-2001 Faroese ship survey. (SC/10/AE/11).
SC/14/TNASS/O/3	Pike, D.G., and Víkingsson, G.A. The NASS-2001 Icelandic aerial survey: Introduction and evaluation. (SC/10/AE/12).
SC/14/TNASS/O/4	Report of the NAMMCO Scientific Committee Working Group on Abundance Estimates, March 2002.
SC/14/TNASS/O/5	Report of the Trans North Atlantic Sightings Survey, First Planning Meeting, March 2006.
SC/14/TNASS/O/6	Williams, R., Hedley, S.L. & Hammond, P.S., 2006. Modelling distribution and abundance of Antarctic baleen whales using ships of opportunity. *Ecology and Society* **11**(1): 1. [Online - URL: http://www.ecologyandsociety.org/vol11/iss1/art1/.]