SECTION 3 - SCIENTIFIC COMMITTEE

3.1
REPORT OF THE EIGHTEENTH MEETING OF THE NAMMCO SCIENTIFIC COMMITTEE

EXECUTIVE SUMMARY

The 18th meeting of Scientific Committee (SC) was held in Gjógv, Faroe Islands, 2-5 May 2011. The SC had reports from four NAMMCO SC Working Groups (WGs): The CS WG on Coastal seals (ANNEX 1), The AE WG on Abundance Estimates (ANNEX 2), the SP WG on Survey Planning (ANNEX 3), and the AS WG on Assessment of large whales (ANNEX 4). It had also the Report of the Joint NAMMCO/ICES Workshop on observation schemes for by-catch of mammals and birds (ANNEX 5).

THE ROLE OF MARINE MAMMALS IN THE ECOSYSTEM

Last year the SC recommended modelling of marine mammals in the ecosystem. It agreed that funding should be sought first from the Nordic Council Ministers, then from the European Union, and finally from Norwegian sources. Walløe and Butterworth were tasked as coordinators of a steering group that need no input from the SC, and will report back to the SC.

The March 2011 meeting of the steering group recommended

- that a project descriptions and budget be provided for all modelling approaches
- that the coordinators provide a short description and budget of the coordination component
- that data officers provide a document describing the data for ***Norway*** and ***Iceland***

Progress since March include

- the identification of a data officer for ***Iceland*** and the compilation of an overview document over the Icelandic data to be used for the modelling exercise,
- the possibility of funding by NordForsk was investigated with negative results
- the possibility of European funding was considered, but no suitable call was identified
- extra finances have been promised through the Nordic Council of Ministers for the continuation of the established network for writing project proposals.

The **SC noted** that Walløe would look for funding possibilities, that he had already started the process, and that he would continue after the IWC SC meeting in Tromsø, June 2011. The **SC reiterates** its determination to the project, and urges that financing bodies are identified and the application for funding is speedily compiled.

BY-CATCH OF MARINE MAMMALS

The ICES-NAMMCO workshop on by-catch monitoring reviewed indirect and direct by-catch monitoring, data collection, and fleet data needed for raising estimates to fleet level. A Guidelines manual on best practices in by-catch monitoring will likely be ready in June-July 2011 as an ICES Cooperative Research Report.

Two case studies were reported from NAMMCO countries. ***Iceland*** estimated harbour porpoise by-catch rates from research surveys in limited space and time, and compared these with results from a questionnaire survey and official logbook data. By-catch rates calculated from logbook data were considerably lower than those estimated by other methods (see 2010 SC Report).

In ***Norway***, starting in 2005, two fishing vessels were contracted in each of nine domestic fishery statistical areas to provide detailed statistics of effort, target species catch, and by-catch of non-target fish and marine mammals. Each vessel was visited regularly by scientist that stayed onboard on day trips. The first two years revealed frequent takes of three marine mammal species: the annual takes by the contracted vessels were in the low hundreds for harbour porpoise, and less than one hundred for harbour and grey seals. The collected data from contracted vessels in combination with landings statistics of target species from the same vessel category and gear types will enable extrapolated marine mammal by-catch totals in entire fisheries to be produced. These extrapolations will be made when data from the third year becomes available.

The **SC notes** that the Workshop was initiated upon a request from ***Norway*** to have their monitoring system evaluated. At its last meeting, the SC strongly recommended that Norway ensure completion of the by-catch evaluation, so the monitoring system could be presented and evaluated at the WS. However, this did not happen. Only some preliminary result of the Norwegian monitoring system was presented at the WS. The **SC strongly recommends** the completion of the analysis, in particular since "the annual takes by the 18 contracted vessels were in the low hundreds for harbour porpoise and less than one hundred for harbour and grey seals".

The **SC notes** that by-catch numbers could be high both in ***Norway*** and ***Iceland***. The **SC reiterates** that accurate estimates of total removals are essential for the assessment of all species and **strongly recommends** that Norway and Iceland provide estimates of by-catch in a timely manner. The SC also noted that a reliable abundance estimate of porpoises had been endorsed for Iceland but that such abundance estimate was still missing for Norway.

The **SC strongly encourages** ***Iceland***, ***Norway*** and the ***Faroes*** to proceed with the implementation and results analysis of their by-catch monitoring systems. The SC reiterates its recommendation to ***Greenland*** to investigate the degree to which by-catch is reported as catch. The SC informed that PINRO in the ***Russian Federation*** has plans to implement by-catch monitoring in the White Sea.

SEALS AND WALRUSES STOCKS - STATUS AND ADVICE TO THE COUNCIL

The **SC reiterated** its previous recommendation that all takes of all species should be reported, and it **strongly recommends** that reporting systems for all species with an allowed hunt should be in place for all areas. This is currently not the case for seals in ***Iceland***. The ***Faroes*** should ensure investigation on the efficiency of the reporting system implemented in March 2011.

Harp Seals

White Sea/Barents Sea

Pup production estimates are available from Russian aerial surveys carried out 20-23 March 2010. The estimate is 163,022 (SE=32,342), which is slightly higher than in 2009, higher than in 2008 and 2005, and less than in 2004 and 2000-2003.

An upcoming ICES/NAFO WG meeting on Harp and Hooded Seals will review the status and assess the catch potential of harp seals in the Northeast Atlantic. ICES consider the harp seal stock data rich, and to maintain this status, new data collections are being secured for the Barents Sea/White Sea stock by sampling onboard a commercial sealer in 2011.

Greenland Sea

Norway conducted aerial surveys to assess the pup production of hooded and harp seals in 2007, and the results are now implemented in management. Following the request from ICES concerning data rich populations, new surveys must be conducted in the Greenland Sea in 2012, with harp seals being the primary target.

Northwest Atlantic

In the order of a thousand harp seal pups have been observed in Southeast ***Greenland*** since 2007, and some pups have been spotted in Baffin Bay and Davis Strait. A joint effort with ***Norway*** is planned to locate untraditional pupping areas, but funding is still lacking. The **SC repeats its recommendation** to facilitate the funding and execution of the reconnaissance surveys.

R.2.1.11 *to evaluate how a projected increase in the total population of northwest Atlantic harp seals might affect the proportion of animals summering in Greenland*, has been forwarded to ICES by ***Greenland*** and it is on the agenda of the ICES-NAFO WG on harps and hoods meeting to be held in August 2011.

Hooded seals

Greenland Sea

A total of 151 hooded seals were taken by ***Norwegian*** scientists in 2010 to continue a time series that started in 1995 on the condition of hooded seals in the Greenland Sea.

Norway will conduct an aerial harp seal survey in 2012 where hooded seals will also be covered if possible. Hooded seals have been protected since 2007, and to assess the

effect of the protection, more than five years are needed because hooded seals mature at four to five years of age.

The upcoming ICES/NAFO WG meeting on Harp and Hooded Seals will review the status of hooded seals in the Greenland Sea.

Ringed seal

Satellite tracking of one animal in south ***Greenland*** showed local movements over eight months. 15 tags are planned to be deployed in the Melville Bay area in 2011, and some tags in northern Dove Bay (northeast Greenland) in 2012. Nine ringed seals were equipped with tags around Svalbard ***Norway*** in 2010 for data collection on animal movements, oceanographic parameters, and primary production, with further tags being deployed in 2011-2012.

Grey and harbour seal

In March 2011 the CS WG met to 1) review the ***Norwegian*** management plans for harbour and grey seals, 2) perform assessments in the NAMMCO areas and when possible in other North-Atlantic areas, and 3) develop a common management model for both species in the NAMMCO area.

Norway aims to ensure sustainable and viable populations of both species within their natural distribution. In practical management, however, the government must weigh the desire for the preservation of seal populations, against the desire to reduce the damage on fisheries and aquaculture in the coastal zone. The Ministry of Fisheries and Coastal Affairs has decided to stabilize the harbour seal population at a target level (TL) around 7,000 counted animals during moult. The grey seal population should be stabilized at a TL equal to 1,200 pups born annually. Hunting quotas are used to stabilize the populations at the TL, and measures should be designed to ensure the greatest impact in areas where there is documented significant damage to the fishing industry from seals.

Grey seals are managed within three management units (Northern, Central and Southern Norway) based on pupping time and genetics differences. Harbour seal are managed in administrative units following county borders. Small, unique and geographically isolated populations of harbour seals will not be exposed to hunting. Hunting quotas are set for five years periods, so that it will be possible to adjust the removals in relation to new population estimates, new knowledge about the damage to the fishing industry, new environmental threats, etc. The management plan suggests reduced hunting until populations are decreased to 0.5 TL (Table 1).

The WG expressed concerns that a reduction to 0.5 TL over a 5-year period would represent a significant decrease in numbers that might impair a speedy recovery of the population. It was noted that a reduction by 50% over three generation (*e.g.* 45 years for harbour seals) would place a population in the endangered category within the IUCN framework. The WG recommended setting the maximum reaction level up to 0.7 TL over a management action time of 5 years.

Population size (1+)	Regulations
Above TL	Exploitation between sustainable catch and 1.5 x sustainable catch
Equal to TL	Exploitation equal to sustainable catch
Below TL and 0.7 TL	Exploitation equal to 0.7 x sustainable catch
Between 0.7 TL and 0.5 TL	Exploitation equal to 0.5 x sustainable catch
Less than 0.5 TL	0-quota
Less than 0.5 TL and decreasing with 0-quota	Restrictions on disturbance at the breeding areas

Table 1. Exploitation levels and regulatory measures in the Norwegian management plan.

The CS WG agreed that a management model for harbour and grey seals should include the following steps:

- Management objectives should be set to secure populations at target levels.
- Identify management units based on population structure
- Surveys be designed to allow for the estimation of variance and the identification of trends
- Identifying the survey precision needed to meet management objectives.
- Management advice should be provided as total removals, including struck-and-lost, by-catch and hunting quotas.
- Initiate studies that identify the occurrence of impacts on fisheries and aquaculture, including sealworm burden in fish in relation to seal density, and will point out areas where the population size needs to be controlled.
- Include an evaluation of the management plan (at latest after 6 years)

The **SC notes** that further considerations are needed before a management model can be recommended as a general model for grey and harbour seals in all NAMMCO areas. In particular stocks of harbour and grey seals are not seen as being in conflict with fisheries and aquaculture in all countries, and therefore it could not generally be expected that common management objectives would be to secure populations at target levels. A more general management objective would be to secure populations at, or above, target levels.

While the identification of a survey precision needed to meet management objectives would be optimal, it is likely not realistic in most NAMMCO countries. An alternative route would be to compare target levels directly to the minimum counts available (or minimum counts corrected for animals not present). This might be more realistic and useful in the sense that imprecise minimum counts (using *e.g.* only one count instead of three) should be negatively biased and thus result in precautionary management. Hence, if the management objective is to ensure a population of at least the target level, it might be possible to obtain this with relatively imprecise, cheaper and irregular surveys. A more focused management objective that aims to maintain the stock very close to a target level would require more precise and expensive surveying.

The **SC notes** the lack of a biological reference point in the proposed management model and **recommends** that the management approach aim to assess the current status of a stock relative to a reference point with no removals. Finally, it noted that the feed-back approach in Table 1 provides a type of catch control algorithm and as such a recommended approach for providing management advice. However, the proposed algorithm has not been simulation tested and it would therefore be difficult to judge whether it may result in desirable or undesirable population dynamic behaviour. The **SC recommends** that such feed-back-models are simulation tested before they are applied. The **SC notes** that the testing of such a management procedure would require significant increase in workload, as for the development of general management procedures for large whales. If simulation testing is not possible it is essential that the stock is surveyed frequently during an initial period and that the management plan is re-evaluated on several occasions.

To proceed with the assessment and development of a general management model (**R.2.4.2/2.5.2**) for grey and harbour seals the **SC recommends**:

- Establishment and/or continuation of standardised and regular monitoring programmes for seal abundance in all countries, including the development of appropriate survey methods
- Securing catch records and associated data from hunted seals
- Quantification and standardisation of methods to estimate struck and lost and by-catch
- Population assessment of both species in ***Russia***
- Survey of harbour seals along the coast of ***Iceland***
- Studies to identify the population structure of ***Norwegian*** harbour seals
- Exploration of the south-eastern ***Greenland*** coast for the presence of harbour and grey seals
- Estimation of the stock identity, size, distribution and structure of the ***Faroese*** population of grey seals
- Completion of the ongoing genetic analyses of grey seal population structures for the north Atlantic including new samples from the ***Faroe Islands***

The SC furthermore **recommends**

- Development of common sampling protocols for all areas in the north Atlantic in preparation for epidemic disease outbreaks, including establishment of blood serum stores for seals sampled
- Compilation of a database of samples stored in the NAMMCO countries

Grey Seals

A model for ***Norwegian*** grey seals is based on total pup production in 2006-2008, catch statistics, estimated by-catch mortality, and age specific pregnancy rates from Canadian grey seals. Model runs indicate an increase in abundance of the total Norwegian population during the last 30-years, estimating 8,063 (95% CI: 7,627 to 8,549) animals (including pups) in 2010. Current catch levels will likely deplete the populations in Rogaland, reduce the population in Sør-Trøndelag, and increase the population in Nord-Trøndelag, Nordland, Troms, and Finnmark. The **SC notes** with

concern that the quota and the actual removals have greatly exceed the management advice since 2003.

A model for grey seals in ***Iceland***, based on the catch-at-age data, annual pregnancy rates and an assumed survival scheme, indicated that the stock declined from about 12,000 grey seals in 1990 to about 5,000 in 2002. Aerial pup production surveys in 2005, 2008 and 2009, showed an increasing trend, estimating abundance at 5,500 (95% CI: 4,158 to 6,990) animals in 2005 and 6,100 (95% CI: 4,578 to 7,630) in 2008-2009.

No management regime is implemented for grey seals in the ***Faroes***. Fish-farmers are the only seal hunters, and logbooks have been implemented from March 2011 onward, to provide reliable numbers of exploitation. Total removal, as indicated from a questionnaire study, was 226-273 grey seals in 2010. The **SC notes** the high removal in relation to an assumed population size of about 2000 seals, which give reason for strong concern about the status of the species in the Faroes. The **SC reiterates its recommendation** that a greater priority be given to assessing the population size in a timely manner.

Ten grey seals were satellite tracked in the ***Faroes*** in 2007/2008. The mean lifetime of the tags was 212 days, and seals were stationary on the Faroe Plateau, staying mainly close to land. Very few seals were tracked outside the 100 m depth contour, and no seal moved longer than 17 nautical miles from land. Contact was lost with pregnant females for coherent periods of 15 – 21 days, which indicates breeding in caves.

There had been no certain observations of grey seals in ***Greenland*** until an adult grey seal was photographed near the islands Qeqertat in August 2009. In 2010 a grey seal pup was tagged and tracked for 26 days in the Qeqertat area. The seal moved around the tagging area and a little northward along the east coast. A ban on hunting of grey seals in Greenland was implemented from 1 December 2010.

A joint ***Norwegian-Russian*** research programme plan to address questions related to abundance estimation, stock identity, spatial distribution, habitat use, feeding habits and conflicts with fisheries.

Harbour seal

No new assessment data for harbour seals in the NAMMCO countries were presented to the CS WG.

The **SC expresses great concerns** about the high catch levels of harbour seals in ***Norway*** during the last ten years, as well as the potentially high by-catch, and **recommends** that set quotas follow the scientific advice, and that new assessment of harbour seals are carried out as soon as possible.

Iceland has recently established a management goal that aims at maintaining the harbour seal at the 2006 level (about 12,000 harbour seals). Due to decreased catch

and by-catch, it is possible that the population has increased since 2006, but it is necessary to carry out surveys to verify this.

A total protection of harbour seals in ***Greenland*** was implemented from 1 December 2010. The harbour seal population size is unknown, but using catch statistics and back calculations, and assuming a 5% replacement yield, the present number in West- and South Greenland was suggested to be in the range of 340-440 harbour seals. The **SC recommends** the execution of abundance and distribution investigations in the southeast Greenland, where the status of harbour seals is unknown.

Genetic harbour seal samples from Svalbard, ***Iceland***, Southeast ***Greenland*** and Northern ***Norway*** showed that each of the four locations comprised a genetically distinct population, with a rather low effective population size and indications of a population bottleneck caused by a recent decline in population size (Andersen *et al*. 2011).

Recent genetic analyses have indicated a finer scale of population differentiation of north Atlantic harbour seals than the 300-500 km suggested in earlier studies. Four genetically differentiated populations have been identified in Denmark and Southern Scandinavia with distances of 100-200 km separating subpopulations. The **SC notes** that there are indications of the presence of further subdivisions within the current management units, and **recommends** further investigation of the appropriateness of the current management units.

An ongoing project on harbour seals in Svalbard ***Norway*** aim to estimate the population size from aerial surveys, study movement patterns and space use, and investigate the potential impact of Greenland sharks as predators on arctic seals.

Bearded seal

13 satellite tags have been deployed on pups in Svalbard ***Norway***, and prototype tags to test small scale movements will be tested in 2011. Satellite tracking of three adult males in southeast ***Greenland*** showed a high degree of site fidelity.

Six moorings are planned to be deployed in the Southern Baffin Bay ***Greenland*** in October 2011 to identify the seasonal presence and relative abundance of vociferous baleen whales and bearded seals.

The **SC notes** again that only a few studies have been initiated for this data-poor and exploited species, and **reiterates** its recommendation to renew efforts towards information on biology, abundance and stock status in the view of an assessment.

Walrus

The **SC notes** that the ***Greenland*** quota for 2011 has been reduced to the level advised, with no allowance for struck and loss for the Baffin Bay – Northwest Greenland area. It noted that an interview survey to learn about the current walrus catch and about the user´s experience regarding the effects of climate change on this species has been carried out. A preliminary analysis suggests that the hunters in

Qaanaq may not lose a significant number of animals, which may justify the absence of an allowance for struck and loss for that area.

An aerial survey was carried out in the North Water in May-June 2010, and walruses were tagged by the sea ice in the area to obtain correction factors for the survey. Further tagging of walruses in the area is planned.

The **SC recommends** the completion of the hunter survey study and a re-evaluation of the assessment for this stock when a new abundance estimate is finalised.

A walrus tagged in the ***Faroes*** in February 2010 swam to Svalbard ***Norway*** before satellite contact with the animal was lost.

Camera monitoring in Svalbard ***Norway*** is ongoing to investigate haulout dynamics and potential impact of tourism. An aerial survey is planned for Svalbard in autumn 2011.

In response to a new oil and gas extraction the Marine Mammal Council in the ***Russia Federation*** has established a group for the study of walrus in the Pechora Sea. An aerial survey will be conducted in August 2011, and the **SC recommends** that the Russian Federation permits the ***Norwegian*** and Russian scientists to conduct a tagging study in the area.

CETACEANS STOCKS - STATUS AND ADVICE TO THE COUNCIL

The **SC reiterates** its previous recommendation that all takes of all species should be reported, and it **strongly recommends** that reporting systems for all species with an allowed hunt should be in place for all areas. This is currently not the case for small cetaceans in ***Iceland*** and harbour porpoise in the ***Faroes***.

Fin whale

2007 abundance estimates for all areas (Appendix 3), but ***Norway***, have now been provided to, reviewed and endorsed by the SC. The 2007 surveys as well as the mosaic Norwegian surveys are considered additive. A revised combined estimate for the North Atlantic can be calculated as soon as the revised estimates from the combined SCANS-II/CODA/Faroese analysis and the estimates for the latest Norwegian mosaic surveys and the SNESSA becomes available.

At the last NAMMCO meeting the *MCC recommended* that simulation trials required to check if catch levels for 60% tuning are sustainable in the long term should be carried out as soon as possible. Further studies should be carried out to help distinguish between alternative stock structure hypotheses, particularly in and around the area of proposed whaling, using several different approaches such as genetics, satellite telemetry and photo-identification.

Iceland reported that there are plans to rerun the trials for the 0.60 tuning level in 2011. The **SC considered** that it would be most appropriate to first review the results

from that process, and the acceptability of the RMP performance indicated, before deciding on possible further related analyses.

Extensive biological sampling was conducted by ***Iceland*** from all fin whales landed in 2010. This research includes age determination, maturity and fecundity, energetics, feeding ecology, parasitology and genetics. Laboratory analyses of all samples are completed. A DNA registry was initiated in 2010 to develop a tissue bank and a DNA database for all genetic samples.

Humpback whale

2007 abundance estimates for all areas (Appendix 3), but ***Norway***, have now been provided to, reviewed and endorsed by the SC.

The possibility for responsive movement to survey vessels remains a point to be investigated for the ***Icelandic-Faroese*** shipboard survey and the **SC recommends** further analyses.

At the last NAMMCO meeting *the MCC recommend* the running of detailed simulation testing of the AWMP-C procedure for ***Greenland***. The **SC notes** that the development and simulation testing of management procedures for humpback whales in West Greenland is ongoing in the IWC, and it **recommends** that NAMMCO relies on this work to avoid duplication.

For the first time since 1986, there was a quota for humpback whales in ***West Greenland***. All nine whales were caught. Catches were spread from Disko Bay to Cape Farewell. Measurements and biological samples were collected from one whale caught close to Nuuk. The **SC recommends** eye sampling for age determination as well photographic sampling the tail of caught whales.

Sei whale

NASS abundance estimates of sei whales exist for 1987, 1989 and 1995, and the SC have now reviewed and endorsed estimate for the 2001 and 2007 surveys (Appendix 3). The 2007 survey is considered the best recent estimates for the species in the area. The estimates are similar to previous estimates when constrained to overlapping areas, except for the 1995 estimate, which is higher.

The **SC reiterates** that with the exception of NASS-89, the NASS has not been ideal for estimating sei whale abundance, both because the area coverage is small and the time of the year for the surveys is not optimal for this species. If a better estimate is needed, surveys will have to extend farther to the south and/or be conducted later in the season. The **SC recommends** that it, as soon as possible, is decided whether sei whale is a target species for the nest surveys as this should affect either the timing and/or the areal coverage.

At the last NAMMCO meeting the *MCC recommended* that the SC assess the status of sei whales in West Greenland waters and the Central North Atlantic, and provide minimum estimates of sustainable yield (**R.3.5.3**). The **SC notes** that the RMP could

be applied using the existing data. The resulting catch limits would consequently be lower than the stock could sustain. A prerequisite for initial assessment work is the recalculation (including considerations of extrapolation) of abundance estimates for a comparable area and assessing the extent of negative bias for the reasons mentioned above. Advice based on an RMP approach would require an initial assessment and likely the development of implementation trials.

Minke whale

2007 abundance estimates for all areas (Appendix 3), but ***Norway***, have now been provided to, reviewed and endorsed by the SC.

Corrected total estimates for the 2007 and 2009 ***Icelandic*** aerial surveys have also been endorsed by the SC. The best available estimate of abundance for 2007 was 48% that for 2001. Abundance in 2009 remains the lowest yet seen in all areas, just 46% that observed in 2007 and 22% that estimated in 2001, the latter difference being significant. The **SC agrees** that the new evidence presented strengthened the conclusion that the observed decline in minke whale abundance was not a result of error in measuring distances or analytical problems. The inclusion of the 2008 survey demonstrates that minke whale abundance exhibits great fluctuations from year to year.

The **SC made several conclusions**:

- given the importance of cue rates to the present cue-counting approach, it would be timely to consider a full review of the available data;
- more data are required to estimate availability bias and its spatial and temporal variability. This could best be done through tagging studies using time-depth recording tags;
- the previous assumption that the most important component of the Central Atlantic stock is found within Icelandic coastal waters in summer is not valid every year. There can be considerable annual variation as shown by the 2007, 2008, and 2009 results;
- common minke whales absent from ***Icelandic*** coastal waters may have moved further north and/or east towards ***Greenland***, but preliminary results from the 2010 ***Norwegian*** surveys in the CM area will not explain the difference;
- areas close to East ***Greenland*** have not been well covered in recent years due to weather and ice conditions; these have been shown to have high densities in some previous surveys;
- consideration should be given to following the practical and analytical approach used in ***Greenland*** for aerial surveys for common minke and fin whales, recognising financial implications;
- the above points should be taken into account when planning for future surveys;
- spatial modelling approaches for all of the past surveys (separately and where possible combined) should be considered to see if these provide some information on key variables that might help explain the changes in distribution;

- while difficult to incorporate directly into spatial modelling, it would also be valuable to examine other time series of data *e.g.* prey species or proxies for prey species that may help to explain changes in distribution, including both annual variation and possible longer term future changes.

At the last NAMMCO meeting the *MCC recommended* a correction for *h*(0) and error in the 2007 and 2009 survey as soon as possible to adjust the management advice. The SC used the corrected estimates and the catch for 2010 of 60 minke whales, to update catch limit calculations resulting in sustainable annual catch limit of 229. The **SC concludes that annual removals of up to 229 minke whales from the CIC area are safe and precautionary**. As for the previous advice, this catch level can apply for the next five years (2011-2016) before a revision is needed.

The *MCC also recommended* calculating, as soon as possible, catch limits based on running the RMP on the Central North Atlantic medium area, with catch cascade allocation of catches to small areas. The **SC concludes** that, as a first step, decisions must be made on input parameters. Gunnlaugsson should work with Skaug to suggest abundance estimates to be used as input including considerations of additional variance if surveys from different years are combined.

Greenland has secured tissue samples from 117 individuals from the catch in 2010, and a tagging study in Disko Bay will continue through 2011 to obtain calibration factors for aerial surveys.

The **SC reiterates the recommendation** that all genetic samples in the NAMMCO area be analysed for kin comparisons in order to obtain a better understanding of stock structure.

Narwhal

R.3.4.12 *on the advice on sustainable takes of narwhal from the Kane Basin* is part of the ToR for the NAMMCO/JCNB JWG meeting scheduled for 12-18 February 2012.

An aerial survey in West ***Greenland*** is scheduled for the spring 2012. The primary targets will be narwhal and beluga, and the secondary target will include bowhead whale and walrus.

Beluga

R.3.4.13 *on a revision of the advice on the temporal and geographical restrictions on the takes of beluga from West Greenland* is part of the ToR for the NAMMCO/JCNB JWG meeting in 12-18 February 2012.

Bottlenose whale

The AE WG recommended at its last meeting, that T-NASS and CODA data be combined for a model based reanalysis. ***Faroese*** data will be included, and the **SC recommends** that the results be made available as soon as possible.

Killer whale

Killer whales from the ***Faroes*** have been resighted at the Shetland Islands and ***Iceland***. The Faroes plan to sample biopsies and continue photo-id work.

Pilot whale

A Conventional Distance Sampling abundance estimate for the ***Iceland-Faroes*** shipboard area was presented to and endorsed by the SC (Appendix 3). Hence, estimates for all areas (Appendix 3), but ***Norway***, have been provided to, reviewed and endorsed by the SC.

An index of relative abundance had been developed for the area common to all NASS surveys (Figure 1), with the aim of determining trends. Because trends inferred from the index areas may not be representative of overall trend, and because of possible changes in operational biases among the surveys, the **SC agrees** that no firm conclusions about trends in pilot whale abundance could be inferred. The **SC recommends** that future surveys must have a clear and carefully designed protocol for defining groups and estimating group sizes.

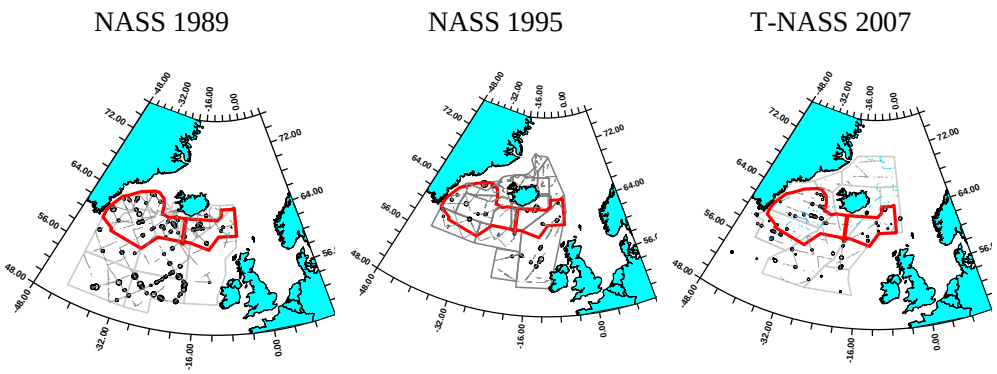

Figure 1. Areas covered by the surveys from 1989; 1995 and 2007. The red line delimits the common area for all three survey years.

The **SC notes** that the 1989 pilot whale estimate had long been used as a reference estimate for pilot whales in the North East Atlantic because it covered the widest geographical area. It **agrees** that the estimate is now too old as a reference point, and that the 2007 estimate of 128,093 (95% CI:75,682 to 216,802) for the ***Iceland/Faroese*** area was the best that is currently available noting that it applies to a considerably smaller area and a earlier time period than the 1989 estimate. It is not known how it relates to animals that may be available to the Faroese hunt. An abundance estimate from the combined CODA and Faroese data would soon become available, to supplement the estimate.

The AE and AS WGs noted with the difficulties it faced in providing estimates of abundance of pilot whales appropriate for management purposes given the absence of adequate information on movements and population structure. The primary concern remains the identification of the area over which the pilot whales harvested in the ***Faroes*** range, and the **SC recommends** in order of priority:

1. Tagging with the goal to tracking animals from as many schools as possible and if possible throughout the whole year.
2. That survey estimates from 1989, 1995 and 2007 are divided into comparable blocks so that recent estimates and trends can be investigated on a larger area than what has been done so far and for the areas close to the Faroese.
3. That a list of available abundance estimates for the area E and NE of the Faroes be compiled, and that the ***Faroese*** contact ***Norway*** and SCANS to investigate if other estimates can be developed from these areas, and that such estimates are developed.
4. That the area NE of the Faroes be taken into consideration when planning future surveys.
5. That, provided samples are available from more than just the Faroes, an appropriate group of genetic experts be contacted to discuss whether further genetic studies can help resolving stock structure issues.

The SC will monitor progress on the above tasks to decide when most appropriate to conduct an assessment, and noted that there might be sufficient information for an assessment in West ***Greenland***. The **SC recommends** that an assessment for this area is considered in relation to an assessment for the ***Faroes*** area.

The SC was informed that the ***Faroese*** catch monitoring recommended by the SC, which is needed for the definition of a long term monitoring programme, had not been implemented because of lack of funding. The **SC recommends** a timely implementation and underlines that *ad hoc* sampling would not fulfil the requirements of the recommendation.

White-beaked, white-sided and bottlenose dolphins

Abundance estimates are missing for dolphins in the ***Icelandic-Faroes*** area, the Icelandic coastal area and off ***Norway***. Endorsed estimates are given in Appendix 3. The **SC recommends** that the analysis of the Icelandic and Faroese shipboard survey data as well as the analysis of the last two Icelandic coastal aerial surveys be carried out as soon as possible.

Preliminary estimates of life history parameters for **white-sided dolphins** from the ***Faroes*** was provided to the SC. Updated information on diet reveals a domination of blue whiting irrespective of sampling year. Other primary prey species that contribute significantly to the diet in various years were Norway pout and whiting, and greater argentine and sand eels were notable in some years. Fish predated by white-sided dolphin are small, most frequently between 3 and 10 cm.

Seven **white-sided dolphins** were tracked for up to 15 days in the ***Faroese*** in 2009. This revealed a south-eastern movement of six animals, to the northern slope of the Faroe-Shetland Channel, while one animal moved north into the Norwegian Sea. One animal from the southern area was tracked to the area south of Lousy Bank. Dives down to 230 m was recorded.

The genetic diversity of **white-sided dolphins** from eight regions of the North Atlantic showed high haplotype and low nucleotide diversity, indicating an ancient bottleneck followed by range expansion. The genetics show a continuous population across the North Atlantic, with the exception being animals from the North Sea and eastern Scotland. These show some differentiation from the both the eastern and western North Atlantic.

The **SC notes** that data are still not sufficient for an assessment and reiterates the recommendation that the ***Faroese*** samples for diet and life history parameters from 350 **white-sided dolphins** be finalised.

Harbour porpoise
2007 abundance estimates for all areas (Appendix 3), but ***Norway***, have now been provided to, reviewed and endorsed by the SC, including an additional aerial estimate for the ***Faroese*** coastal area from 2009.

The **SC concluded** that the ***Icelandic*** survey had produced the best available estimate for this area, which is a large improvement relative to previous NASS surveys. Given the differences in survey methods between years, the trend analysis in previous studies is likely not applicable. To estimate trends, further surveys optimized for harbour porpoises are required.

Analysis of harbour porpoises caught in West ***Greenland*** in 2009 showed a better body condition and more varied diet than porpoises caught in 1988-1995. The **SC notes** that this could be due to a difference in the timing of the sampling.

Sperm whale
No abundance estimates are available from T-NASS.

The T-NASS acoustic data from ***Iceland*** have been analysed following a methodological course in November 2009 sponsored by NAMMCO. Subsequently a technical problem has been discovered with the data. This can be solved but a reprocessing of the data is required. The **SC recommends** that the reanalysis of the data is carried out and abundance estimate finalised, and it urges the ***Secretariat*** to find a suitable agreement with the Sea Mammal Research Unit (SMRU).

There has been no progress with the analysis of the ***Faroese*** acoustic data. The **SC urges** the Faroes to investigate whether there is the same technical problem with their data and to carry out the analyses in parallel with the Icelandic data.

Bowhead whale
Observations of bowhead whales around Svalbard ***Norway*** from 1940 to 2009 show an increase during the last decade (Wiig *et al.* 2010). This could be due both to an increase in the numbers of whales, or due to increased tourism and a dedicated reporting system. An acoustic study that will continue through 2012 had shown that bowheads are present in the Fram Strait (at about 79ºN, 5ºW) throughout the winter and generally during most of the year.

A satellite tracked bowhead whale from the Spitsbergen stock moved from the so-called northern whaling ground (at about 79-80°N) to the southern whaling ground (72-74°N) during summer and then back north again during winter. This is opposite of the general seasonal movement patterns for other bowhead stocks, but in accordance with reports from whalers in previous centuries.

Greenland reported that studies in Disko Bay will continue, and that acoustic monitoring in Baffin Bay will start in the fall 2011. Bowhead whales will be a secondary target specie of an aerial survey planned for spring 2012.

Risso's dolphin

The **SC notes** the catches in the ***Faroese*** of this protected species (three in 2009 and 21 in 2010).

Risso's dolphin has a worldwide distribution in tropical and temperate waters. They have never been observed in ***Faroes*** waters before 2009, when four individuals were observed at 62º23'N 07º51'W, less than 16 nm NNW off Mykines. A additional pod of 300 individuals was observed in the Northern islands in September and driven to shore to Klaksvík, with three animals killed and the others driven out to sea again. On april 2010 a pod of 21 animals was driven ashore on the Southern Island Hvalba. The 24 dolphins killed (8 males and 16 females) were examined and sampled. The **SC encourages** the completion and publication of this work, which add to the understanding of the species poorly known biology and ecology in the North Atlantic.

GENERAL MODELS FOR THE MANAGEMENT OF BALEEN WHALES

Noting that NAMMCO have endorsed an RMP-like approach for the management of baleen whales, the **SC recognizes** that the approach cannot in most cases be applied immediately to stocks of baleen whales in the NAMMCO area. Although considerable work has already been done by the SC of the IWC as part of RMP implementation for some stocks (North Atlantic minke and fin whales) further simulation testing is needed for the modifications recommended by NAMMCO (*e.g.* different tuning levels). As described in Table 3, for many species/stocks that have not been subject to the RMP implementation process, appreciably more work would be required before a RMP-like management procedure could be implemented.

Species/ area	NAMMCO			Approach under IWC	Comments (requirements for long-term management)
	Request from	Advice to	Approach used by		
Fin whales					
EGI	Yes	2011-2015	RMP, CLA 0.60 TL	RMP 0.72	ISTs for 0.6 required because of stock structure questions but yet to be completed
WG	No*			Interim	Implementation trials needed + MP development
NE Atlantic	Yes	No			Implementation trials needed to check RMP
Minke whales					
CN Atlantic	Yes	2011-2015	RMP, CLA 0.60 TL		ISTs for 0.6 not seen as a priority because stock structure questions are not major
NE Atlantic	No*			RMP 0.60 (Norwegian)	
WG	No*			Interim	Implementation trials needed + MP development
Humpback whales					
CN Atlantic	Yes	No			Implementation trials needed to check RMP
WG	Yes	2010-2015	Interim	Interim	Implementation trials needed + MP development
NE Atlantic	No				Implementation trials needed to check RMP
Sei whales					
CN Atlantic	Yes	No			Implementation (trials) needed to check RMP
WG	Yes	No			Implementation (trials) needed + MP development
NE Atlantic	No				

Bowhead whales					
WG	No*			Interim	Implementation trials needed for MP development

Table 3. List of assessment status by species and area (* management advice provided by the SC of the IWC). Interim as in Allison *et al* (2009), longer term approaches involving simulation trials and AWMP development occurs in IWC. EGI: East Greenland and Iceland; WG: West Greenland; CN Atlantic: Central North Atlantic; NE Atlantic: North East Atlantic. RMP: Revised Management Procedure; MP: Management Procedure; IST: Implementation Simulation Trials; CLA: Catch Limit Algorithm.

Apart from the assessment part of this work, the **SC considers** it questionable if the SC is currently in a position where it can carry out this work. The question is not only related to time and the extra funding required, but also to the fact that setting up and running implementation trials is a very specialised work and it cannot be expected that it will be possible to hire external experts that have the time and to be able to do this at short notice. Should management procedure implementation be an essential part of NAMMCO SC work in the future, it might require that an expert is employed directly by NAMMCO.

The **SC notes** that a potential distinction in NAMMCO between different types of whaling operations is not a scientific decision. These operations range from Subsistence over Small-Type Local to Fully Commercial. The SC has no specific comment on the appropriate tuning level (trade-off between catch and resource risk) to apply for different types of fishery, and considers that the Council should determine both this level and whether it should differ amongst the different fishery types.

The **SC agrees** that if an RMP-like approach is to be employed the necessary abundance information should be derived with a maximum interval of 10 years. Further details, including potential phase-out rule, should be decided after more precise definition of the management approach.

The **SC did not** directly consider which management procedure or tuning should be adopted by NAMMCO. It did though **note** that the IWC CLA for the three original tuning levels (0.60; 0.66 and 0.72) and the two extra tuning of the Norwegian RMP-approach are all realistic candidates, and that the 0.60 tuning has currently been applied in the two cases where an RMP procedure has been applied within NAMMCO. New management procedures may have to be developed for the ***Greenlandic*** fisheries should long-term advice have to be given for these by NAMMCO.

The IWC and Norwegian CLA have been subject to a range of simulation trials considered sufficient to allow them to be implemented to recommend catch limits dependent on *i)* the resource to which they are applied being considered a single stock, and *ii)* the tuning level chosen for the procedure yielding trial results considered to offer acceptable trade-offs between catches and risks of unintended depletion. Each

implementation should be initiated with an assessment, including various levels of Implementation Simulation Trials. If discrepancies are evident between observations and model fits, either immediately or during implementation reviews held at regular intervals after a management procedure is first implemented, these further simulated trials should be carried out using models of the dynamics which are more consistent with the observations.

The **SC notes** that the conclusions and recommendations of the AS WG **complete** the exploration within NAMMCO of work that has been carried out so far by other organisations, in particular IWC. While re-iterating it's recommendations that and RMP-like approach would be the ideal way forward for management of baleen whales in NAMMCO, the **SC stresses** that further development of this subject will require a substantial increase in capacity in terms of time and funding for the SC in general and the secretariat in particular.

SURVEYS

The **SC notes** that the last distance estimation for each sighting has been used consistently in analyses of the ***Iceland/Faroese*** shipboard data. The standard practice for line-transect surveys is the use of the first distance estimation. The **SC established** a small group to investigate if this introduces a bias into abundance estimates.

The **SC reiterates** its recommendation that a primary publication on T-NASS be developed, in cooperation with CODA and SNESSA. The SC encourages a speedy publication, and agreed that an agreement with the Editor (Donovan) of the IWCs Journal of Cetacean Research and Management is the forum of choice, with Desportes designated as the NAMMCO coordinator.

Besides delegates from NAMMCO countries, the SP WG meeting had representatives from Canada, Russia, CODA, and France (including St. Pierre and Miquelon). The **SC concludes** that the interests of the NAMMCO countries as well as ***Canada***, and the ***Russian Federation*** would be best-served by mounting another international large synoptic survey, with a strong will to coordinate with other ongoing surveys in the area, especially the European CODA/SCANS and the USA SNESSA.

The nest survey year will depend on several factors. "Phase-out" under the RMP will begin in 2014 for ***Iceland*** if a survey is not conducted before. But Iceland is not legally bound to this rule. The last year of the current ***Norwegian*** survey cycle is 2013, and Norway will likely have most coordination flexibility in this year or in 2014. ***Greenland*** work on obtaining diving data for correction factors before the next survey, which is planned to take place no later than 2017. It is unlikely that Canada, CODA/SCANS can mount another survey before 2014. Taken together, it is unlikely that another international survey can be conducted before 2014.

The **SC recommends** a synoptic survey within the same year. This will make the survey comparable to the previous five NASS. The **SC recognises** that ***Norway*** is

bound to its mosaic survey cycle, and **recommends** that all effort be made to make the area surveyed by Norway contiguous to the core area.

Norway and ***Greenland*** have developed survey methodologies that are well suited for their purposes, while ***Iceland*** and the ***Faroese*** are still in the process of optimising their aerial and shipboard surveys. The general pattern of using aircraft for coastal areas and ships for offshore areas is expected to hold also for the next survey.

For shipboard surveys the **SC recommends** the use of double platforms to correct for biases. It also **recommends** that the advantages and disadvantages of different survey methods be compared in the context of the target species in the next ***Icelandic, Faroese*** and CODA shipboard surveys, and that a Shipboard Methodology Group recommend a methodology at the next meeting of the SP WG.

At least three aerial survey methodologies have been used in the NASS area and other variations are used elsewhere. The **SC recommends** that the advantages and disadvantages of the different methods be compared in the context of the target species in the next ***Icelandic*** and ***Canadian*** aerial surveys, and that an Aerial Methodology Group recommend a methodology at the next meeting of the SP WG.

The **SC recommends** that the information from previous NASS be developed into a spatial analysis, looking at spatial patterns of encounter rates and/or densities of target species before the next meeting of the SP WG. The resulting plots of high and low density areas should be used to optimize the area and stratification of the survey.

The **SC reiterates** its previous recommendation that the survey should be coordinated to the maximum extent possible, and at a minimum at the level of TNASS, while at the same time respecting that the different countries may have different priorities. Having a single point of contact during the planning process is crucial. The **SC recommends** that NAMMCO appoint an overall Survey Coordinator to drive the planning process and appointed Desportes as temporary coordinator. The task of the coordinator will include

- Fundraising for the coordination and outreach work, as well as general survey activities, and ideally also for analyses of non target species data or/and overall analyses.
- Coordination and support to common activities (*e.g.* common cruise leader and observer guidelines).
- Reporting to the SP WG, compilation of updates and progress for the NAMMCO website, as well as the public at large.

As with previous NASS, it is likely that the next survey will depend to a large extent on funding from participating national governments. There is, however, the possibility of external funding from industry in some areas and from inter-governmental and non-governmental organizations. It should also be noted that the inclusion of monitoring objectives related to climate change could create some funding opportunities.

The **SC recommends** that the next meeting of the SP WG is scheduled for January 2012. By that time the factors affecting the timing of the survey should be clarified.

WORK PROCEDURES IN THE SC

The **SC is pleased** that its new RoP allows up 6 members to the SC per Country, with only 3 members attending a SC meeting. **It notes**, however, that the current membership is reduced to only two members for ***Iceland*** and the ***Faroe Islands***, and that it is three members from ***Norway*** and ***Greenland***.

The intent of the increase in membership was to allow for an increase in the scientific expertise of the SC, as well as allowing for backup expertise when some members are unable to attend a meeting. The SC is required to cover not only scientific expertise for the more than twenty species of marine mammals in the North Atlantic, but also scientific expertise on surveys and abundance estimation, population modelling and statistics, as well as the particular opinions of the different countries on the different subjects.

The **SC welcomes** additional experts on cetacean surveys, modelling/statistical experts, and seal experts. Presence of such experts will ensure the quality of the advice that the SC can provide for Council. The **SC urges** the Council to act on the matter of nominating new SC members for all countries.

FUTURE WORK PLANS

The **SC recommends** the following WGs to meet before its next meeting, noting that other meetings may be held depending on new requests received from the Council:

Working Group for Planning Future Surveys. The SC suggests a new meeting of the SP WG in *January 9-13 2012* to continue coordinating the year of the survey and recommending survey methods. *Chair: Geneviève Desportes*

Narwhal and Beluga Joint Working Group. The SC recommends that a new JWG meeting be held on *February 12-18 2012* to update assessments and advice for beluga and narwhal. *Convenor: Mads Peter Heide-Jørgensen; Chair: Rod Hobbs.*

Working Group on Large Whale Assessment. Remaining items of on the agenda include fin whale simulation trials for the Central North Atlantic applying the 60% tuning of the RMP, and studies on the stock structure hypotheses for North Atlantic fin whales. It includes also a recommended catch calculation with catch cascading for minke whales in the Central North Atlantic medium area. A tele-conference meeting might be held if sufficient progress is made. *Convenor: Gísli Víkingsson; Chair: Lars Walløe.*

Narwhal and Beluga Age Estimation Workshop is planned as three separate sub-meetings: *i*) a symposium style workshop over two days immediately prior to the Society for Marine Mammalogy (SMM) conference in Tampa in late November 2011,

ii) a hands-on beluga tooth workshop of up to four days after the SMM conference, and *iii)* a hands-on narwhal tusk workshop over one or two days in Copenhagen immediately before the JWG meeting (13-17 February).

WG meetings recommended to be held later than the 2012 SC meeting include:

Harbour Porpoise Working Group
Noting the open **Request R.3.10.1** the SC recommends that assessments of harbour porpoise be carried out for all areas if possible. The MCC recommend that total removal estimates for all areas, and that abundance estimates from the 2007 survey in Iceland and the 2010 survey in the Faroe Islands are available before meeting. The SC recommends that the WG meeting be in the fall of 2012. *Chair: Bjarni Mikkelsen*

Grey and Harbour Seal Working Group
The SMC recommended in 2010 that the WG on coastal seals perform assessment for grey and harbour seals in all areas and develop a common management model for both species in all areas. A second meeting is needed to finalize assessments and to agree on a common management model for all areas. *Convenor: Tore Haug; Chair: Kjell Tormod Nilssen.*

Pilot Whale Working Group
The SC recommend that a pilot whale WG meeting be held to perform assessments and aim at providing advice on sustainable removals for pilot whales around the Faroes Islands and West Greenland, as relating to **R.3.8.1**, **R.3.8.2** and **R.3.8.5**. This meeting awaits progress on abundance estimates and stock structure from the Faroes.

FINAL COMMENTS

Thorvaldur Gunnlaugsson (Iceland) was elected as Vice Chair to the SC, and the next meeting will be in Greenland with a tentative timing for April 16-27, 2012.

MAIN REPORT

1. CHAIRMAN'S WELCOME AND OPENING REMARKS

The Scientific Committee (SC) Chair Lars Witting opened the 18th meeting of the NAMMCO SC. He welcomed all the NAMMCO participants (Address section 5.4) to the Gjáargardur Hotel in Gjógv as well as the observer from Japan and the Russian Federation. The SC Chair also expressed the SC's sympathy for Christina Lockyer who had to cancel her participation to the meeting at the last minute due to family reasons.

Witting briefly listed the SC Working Group meetings that were held during the time since the last SC meeting, and mentioned those which are scheduled for the immediate future.

2. ADOPTION OF AGENDA

The Draft Agenda (Appendix 1) was adopted with minor amendments.

3. APPOINTMENT OF RAPPORTEUR

Mario Acquarone (Scientific Secretary) was appointed Rapporteur with the help of the meeting participants as needed.

4. REVIEW OF AVAILABLE DOCUMENTS AND REPORTS

4.1 National Progress Reports

National Progress Reports for 2010 from the Faroes, Iceland and Norway were presented to the Committee. In addition the SC was pleased to receive progress reports from Canada, the Russian Federation and Japan. No report was received from Greenland at the meeting.

4.2 Working Group Reports and other documents

Working Group Reports (see also ANNEXES 1-5) and other documents available to the meeting are listed in Appendix 2.

5. COOPERATION WITH OTHER ORGANISATIONS

5.1 IWC

Acquarone reported that the 62nd meeting of the SC of the International Whaling Commission was held in Agadir, Morocco, 30 May -11 June 2010 and was chaired by Palka. Acquarone attended as observer for the NAMMCO SC. Lockyer figured as invited participant for the age estimation of southern hemisphere minke whales.

A report on the 18th Annual meeting of the NAMMCO Council was submitted by the nominated IWC observer Goodman and a report on the 16th meeting of the NAMMCO SC was submitted by Walløe.

Fourteen sub-committees (including Standing Working Groups, SWGs) were established. There were 28 national delegations numbering between one and 26 members, 56 invited participants and one local scientist. NAMMCO was one of five observer organisations present at the meeting.

A number of sessions for sub-committee deliberations was organised over the period, based on three concurrent sub-committee meetings for each of four work sessions per day. In addition this allowed for several *ad hoc* working groups to meet in the evenings.

Of particular relevance to NAMMCO the Environmental Modelling sub-committee was informed of the modelling exercise initiated by the NAMMCO SC under the Marine Mammal and Fisheries Interactions Working Group. An expression of interest from the subcommittee was recorded which will be followed by an invitation to report on progress on occasion of the next meeting of the IWC SC.

Discussions in the Aboriginal Whaling Management Procedures sub-committee included items relating to the estimation of the need for whale products by Greenland and on the efficiency of utilization for large whales The Revised Management Procedure sub-committee examined the estimates used for catch limit calculations in Northeast Atlantic minke whales in order to clarify which data are available for the calculations especially with regards to the area around Jan Mayen.

Acquarone was also invited by the chair of the Small Cetaceans sub-committee to report on the results of the activities of the Joint NAMMCO/JCNB Scientific Working Group on Narwhal and Beluga. In view of the interest by the IWC into a review of the status of monodontid populations Acquarone reminded the sub-committee that any effort dedicated to these two species in Canadian and Greenlandic waters would necessarily involve the same scientists already committed to the NAMMCO/JCNB Scientific Working Group, which possibly would lead to a duplication of the effort adding very little information.

The IWC SC was also informed of the details and the rationale behind the Proposed Consensus Decision to Improve the Conservation of Whales as a part of the process known as “the Future of the IWC” which would be discussed the following week by the Commission. Among the elements of this proposal were the elimination of whaling under special permits and the commitment by member countries to seek advice on catches only by the IWC.

During the meeting of the Commission, the member countries failed to reach an agreement and this proposal was not approved.

Following the annual meeting in Agadir the Scientific Secretary of NAMMCO had received a query from the SC of the IWC to widen the work of the next meeting of the NAMMCO/JCNB Scientific WG (see item 5.4) to encompass a global review of narwhal and beluga. The SC considered that, though scientifically feasible, this exercise would not improve the quality of its advice to Council.

5.2 ICES and NAFO

Haug reviewed the 2010 activities in ICES which have some relevance to the work in NAMMCO SC. This included work in the ICES Working Group on Marine Mammal Ecology (WGMME), the Study Group for By-catch of Protected Species (SGBYC), and the Joint NAMMCO/ICES Workshop on observation monitoring schemes for by-catch of mammals and birds (WKOSBOMB). The ICES Annual Science Conference (ASC) generally include sessions with marine mammals included as an integral part, occasionally also sessions entirely devoted to marine mammals.

Besides the above related activities which took place in 2010, the WGMME met in February 2011 in Germany. One of the standing Terms of Reference (ToR) for the WGMME is to "*Review and report on any new information on population sizes, population/stock structure and management frameworks for marine mammals*", work undertaken as part of the Memorandum of Understanding between the European Commission and ICES. Sinéad Murphy, chair of the WGMME, asked Desportes, as T-NASS coordinator, whether information on and results from T-NASS could be provided to the group. The T-NASS WG agreed to accommodate the request, although none of the members could attend the meeting. Desportes prepared a document for the ICES meeting including general information on T-NASS, abundance estimates already endorsed by NAMMCO as well as distribution maps (SC/18/O/07).

The SC sees the ICES WGMME as one of the most relevant forum for presenting the results of T-NASS and generally advertising for the NAMMCO activities. The SC recommends that all efforts be made in the future for presenting NAMMCO activities to this forum, when relevant, either by members of SC WG when possible, alternatively by the Secretariat.

5.3 JCNB

No new information was presented at this meeting. The next meeting of the NAMMCO SC Working Group on the population status of narwhal and beluga in the north Atlantic and the Canada/Greenland Joint Commission on conservation and management of narwhal and beluga Scientific Working Group is scheduled to take place in 12-18 February 2012, most likely in Copenhagen.

6. ROLE OF MARINE MAMMALS IN THE ECOSYSTEM

6.1 Update on modelling from *Acquarone*

The SC notes that the report of the March 2010 meeting listed the following suggestions:

- that a general and a detailed project descriptions be provided for all approaches
- that Walløe and Butterworth provide a short description of the coordination component
- that all approaches provide a budget
- that the coordination component also provide a budget
- that data officers provide a document describing the data for Norway and Iceland

- that Walløe and Butterworth were tasked to take charge of the overall coordination component with a definition of the role of coordinator especially for:
    - Liaison with Data Officers
    - Adjustment of the dynamic schedule for the meetings, deliverables and deadlines

Acquarone reported that since the last meeting of the MMFI WG 13-14 March 2010 progress consisted in:

- the identification of a data officer for Iceland and the compilation of an overview document over the Icelandic data to be used for the modelling exercise,
- the possibility of funding the project through NordForsk has been investigated with negative results
- the possibility of funding the project through European funding has been considered, though no suitable call has been identified
- extra finances have been promised through the Nordic Council of Ministers for the continuation of the already established network whose aim is the writing of the project proposal.

The SC also notes that Walløe would look for funding possibilities, that he had already started the process, and that he would continue after the IWC SC meeting in Tromsø in June 2011.

The SC reiterates its determination to proceed with this project. It urges the Chair and the coordination group to ensure that the application for funding of the project is speedily compiled and that financing bodies are identified as soon as possible.

6.2 Other updates

Haug reported that a high priority part of the planned Joint Norwegian-Russian Research Program on Harp Seal Ecology is to deploy satellite transmitters on harp seals in the White Sea. In 2007-2010 it was planned to do this in a joint Russian-Norwegian effort just after the moulting period (in late May), or, alternatively, in late March – early April if ice conditions turns out to be unfavourable in early May. Unfortunately, the Federal Technical Committee (FTC) has forbidden all satellite tagging using non-Russian tags in Russian waters in all years. The Russian colleagues in the Knipovich Polar Research Institute of Marine Fisheries and Oceanography (PINRO) will apply for permission to tag seals in the White Sea also in 2011. If permissions to tag are received, PINRO will be responsible for organizing the logistics required for a vessel-based live catch of seals in May 2011, while Institute of Marine Research (IMR) will be responsible for providing the satellite tags, including all necessary technical details, as well as experienced personnel and equipment for anaesthetising seals and tag deployment. The use of Russian tags will be considered if permission from FTC to use foreign tags will be denied.

As an alternative to the White Sea operation above, IMR conducted a boat based survey to the north-western Barents Sea 25 May – 12 June 2010. The purpose of the

cruise, which also included Russian participation, was to capture 15 harp seals on which to deploy satellite tags before release. However, it proved impossible to capture any seals as only few were observed. Also, very little ice was observed in the area, and the drift ice was spread out too much to allow for the planned live capture of seals. The lack of proper ice has most probably contributed to the very low number of seals in the area.

During the Norwegian summer surveys to the northern Barents Sea, very large numbers of harp seals had been observed along the ice edge and 20-30 nautical miles south of this. Preliminary results from analyses of faeces and gastrointestinal tracts (collected in 1996, 1997 and 2004-2006) indicate that the summer consumption to a large extent was dominated by krill, polar cod also contributed importantly. All sampling were performed in a period with low capelin abundance.

To obtain a more integrated picture of the summer diet, fatty acids was studied in 57 harp seals and 16 potential prey species collected simultaneously in the area in May-June 2006 (Grahl-Nielsen *et al*. 2011). The fatty acid composition had been determined in the inner and outer sections of the seal blubber and in the potential prey. A weak predator-prey relationship, with respect to fatty acid composition in the inner blubber and the prey, suggests that the fatty acid composition in the inner layer is mainly determined by the metabolism rather than the fatty acid composition of the diet. Using fatty acid composition as an estimator of prey use in harp seals appears unreliable for quantitative purposes, but attempts are also being made to assess whether the method can be used to characterize the diet of minke whales. Thus, blubber profiles were collected, and stomach contents were inspected in whales taken in the Norwegian commercial hunt in 2009-2011, and analyses are in progress.

7. BY-CATCH OF MARINE MAMMALS

7.1 Updates

ICES-NAMMCO workshop on by-catch monitoring

The Workshop (WS) was the result of an initiative from NAMMCO who had expressed a wish to improve fishery by-catch monitoring among its Member States. Recognising that this is an area where the International Council for the Exploration of the Sea holds some expertise, a joint workshop was agreed with the aim of developing guidelines describing best practice for conducting marine mammal and seabird by-catch monitoring. The co-chair of the workshop from NAMMCO was Droplaug Olafsdottir.

Desportes presented the report of the Workshop (ANNEX 5). The Workshop reviewed indirect and direct means of monitoring by catch, data collection and management as well as related fleet data needed for raising observed by-catch rate to fleet level and raising procedures. They also looked at cooperation with the industry and outreach. Only the parts directly relevant to the SC are further developed below.

Ideally by-catch monitoring is addressed through direct on board observer schemes, but these can be expensive to implement, particularly in the early exploratory phase

when by-catch levels are not known and costly sampling effort may be focused in inappropriate areas. A number of other less direct approaches that can be used to obtain some initial information about possible by-catch levels were reviewed.

Two examples were reported from NAMMCO countries. In Iceland where preliminary estimates of porpoise by-catch rates from research surveys in a limited time and area were compared with results from a questionnaire survey and with official logbook data. In this case, by-catch rates calculated from logbook data were considerably lower than those estimated using other methods (More details can be found in the 2010 Annual Report of the NAMMCO SC).

In Norway, starting in 2005, 2 fishing vessels were contracted in each of 9 domestic fishery statistical areas to provide detailed statistics of effort, target species catch, by-catch of all non-target fish and marine mammals. The value of the contract was a significant proportion of the annual revenue of the contracted vessels. Each of the vessels was visited regularly by scientific staff, and they stay onboard on day trips. Any discrepancy between statistics of trips with and without scientific staff on board will result in cancellation of the contract. The first 2 years of monitoring revealed frequent takes of 3 marine mammal species: the annual takes by the contracted vessels were in the low hundreds for harbour porpoise, and less than one hundred for harbour and grey seals. The collected data from contracted vessels in combination with landings statistics of target species from the same vessel category and gear types will enable extrapolated marine mammal by-catch totals in entire fisheries to be produced. Extrapolation to the entire fisheries will be made when data from the third year of monitoring becomes available.

The WS discussed how fishing effort data can be used to plan and stratify sampling at sea, and how it can be used to raise observed by-catch rates to the fishery or fleet level. Problems with the reliability of effort data were described and discussed. Some of the statistical methods for raising by-catch estimates were also reviewed. It was stressed that there is not a single preferred way to determine overall total by-catch for a fishery, and that generally caution is required because sampling levels tend to be low and by-catches of protected species are generally rare events. It was also noted that total by-catch estimates are highly dependent on the multiplying factor, and that a detailed knowledge of the fishery is important to obtain the most reliable estimates.

The WS agreed that a detailed manual or set of guidelines on best practice for conducting marine mammal and seabird by-catch monitoring would be drawn up and, with the prior agreement of the Advisory Committee (ACOM), would be submitted to ICES for publication under its Co-operative Research Report Series. (The SC was informed that this document was due for July).

Acquarone reported that according to the Workshop Chair the Guidelines manual on best practices in by-catch monitoring will likely be ready in June-July 2011 with the aim of publishing this as a ICES Cooperative Research Report. The SC is looking forward to the publication and distribution of this manual.

The SC noted that the Workshop was initiated upon a request from Norway to have their monitoring system evaluated. At its last meeting, the SC strongly recommended that Norway ensure completion of the by-catch evaluation, so the monitoring system could be presented and evaluated at the Workshop. However, this did not happen. Only some preliminary result of the Norwegian monitoring system was presented at the Workshop. The SC regretted this and strongly recommends the completion of the analysis, in particular in the view –that "the annual takes by the 18 contracted vessels were in the low hundreds for harbour porpoise and less than one hundred for harbour and grey seals" – and the fact that there are no abundance estimates for porpoises in Norwegian waters.

The SC also noted that by-catch numbers could be high both in Norway and Iceland, based on preliminary information presented to the Workshop and the SC last year. The SC reiterates that accurate estimates of total removals are essential for the assessment of all species and strongly recommends that Norway and Iceland provide estimates of by-catch in a timely manner. The SC also noted that a reliable abundance estimate of porpoises had been endorsed by the SC for Iceland but that such abundance estimate was still missing for Norway.

Marine Mammals by-catch monitoring

Iceland and Norway
There was nothing new compared to the situation reported to the Workshop.

Faroes
The electronic logbook system has been developed and includes an obligatory column for reporting by-catch. Its implementation has been delayed until 2012.

The SC strongly encourages Iceland, Norway and the Faroes to proceed with the implementation and results analysis of the by-catch monitoring system. It is aware of the new staff situation in Iceland and hopes that this would only have little consequence on the progress of the monitoring and its reporting.

The SC reiterates its recommendation to Greenland to investigate the degree to which by-catch is reported as catch.

7.2 Future work
The SC was informed that PINRO in Russia has plans to implement by-catch monitoring in the White Sea.

8. SEALS AND WALRUSES STOCKS - STATUS AND ADVICE TO THE COUNCIL

The SC reiterated its previous recommendation that all takes of all species should be reported (direct catches, struck and loss, by catches, and other human caused mortality), and it strongly recommends that reporting systems for all species with an allowed hunt should be in place for all areas, which is currently not the case for seals

in Iceland. The Faroes should ensure investigation on the efficiency of the reporting system implemented in March 2011 for grey seals.

8.1 Harp Seals

8.1.1 Update

Haug and Zabavnikov informed that pup production estimates based on data collected during traditional Russian multispectral aerial survey (infrared and digital imageries) carried out 20-23 March 2010 are now available. Before, during and short time after the survey, traditional ice condition monitoring was carried out using available internet sources. Reconnaissance flights were conducted in the entire White Sea area on March 8 and 14. Few active whelping was observed on 8 March, while an increasing numbers was observed on 14 March. Thus, it was assumed that the starting date of the multispectral aerial survey (20 March) was convenient to get pup production numbers data near the peak of pupping. The ice conditions in 2010 were considerably better for harp seal whelping than in 2008 and 2009, and closer to the situation observed in 2002-2003 when the most recent maximum of total pup production were recorded. The highest pup production density was recorded in the south-eastern part of the "Basin" in the White Sea, close to the border with the Dvinsky Gulf. In other areas of the White Sea densities were similar or much lower, and in adjacent south-eastern areas of the Barents Sea (Cheshskaya Bay and outside it) only very scattered adults with pups were observed. The total pup production estimate is 163,022 (SE=32,342). This value is slightly higher than in 2009, and higher than in 2008 and 2005, but less than observed in 2004 and 2000-2003.

Biological parameters are important in the population models used to assess status and catch potential in harp and hooded seals. For data rich assessment, ICES require that such data are updated every 5 year. Most recent data for the Barents Sea/White Sea stock of harp seals is from 2006. For the Greenland Sea harp seal stock, new data were collected during the commercial hunt on the moulting grounds in 2009 on reproductive rates to supplement material collected in 2000-2008. ICES now consider both harp seal stocks to be data rich. In order to maintain this status, new data collections are being secured for the Barents Sea/White Sea stock by sampling onboard a commercial sealer in 2011.

Request R.2.1.11 to evaluate how a projected increase in the total population of northwest Atlantic harp seals might affect the proportion of animals summering in Greenland, has been forwarded to ICES by Greenland and it is on the agenda of the ICES-NAFO WG on harps and hoods meeting to be held in August 2011.

Lydersen reported from a study of ageing techniques on harp seals comparing the use of teeth, aspartic acid racemisation (AAR) and telomere sequence analyses. AAR showed great potential while telomeres were considered as not useful (Garde *et al*. 2010). More material from known aged animals would be preferred to fine-tune the AAR method.

8.1.2 Future work

Norway conducted aerial surveys to assess pup production for populations of both hooded and harp seals in the Greenland Sea in 2007. Haug reported that the results are now published and implemented in the management of both species. Following the request from ICES concerning data rich populations, new surveys must be conducted in the Greenland Sea in 2012. Harp seals will be the primary target species because it is still being hunted.

Haug reported that the upcoming ICES/NAFO WG meeting on Harp and Hooded Seals will review the status and assess the catch potential of harp seals in the Northeast Atlantic.

Rosing-Asvid reported that since 2007 a relative large number harp seal pups, in the order of a thousand, were sighted close to the southeast Greenland coast. Also some pups were spotted in Baffin Bay and Davis Strait. A joint effort with Norway is planned in order to identify the location of untraditional pupping areas, but funding is still lacking. The SC repeated its recommendation to facilitate the funding and execution of the reconnaissance surveys.

8.2 Hooded seals

8.2.1 Update

Haug reported that for the Greenland Sea stock of hooded seals, data on fertility rate and maturity are from 1956-1994. Updated information was, therefore, required. In 2007-2008, material for a broader project including both assessment of reproduction, contaminant loads and general health status of Greenland Sea hooded seals were collected from 85 animals. To supplement these samples, a dedicated survey was conducted in the Greenland Sea in July 2010. A total of 151 hooded seals were taken for scientific sampling during the cruise. All new material from Greenland Sea hooded seals are now being analyzed and compared with available historical material.

8.2.2 Future work

Norway will conduct new aerial surveys in the Greenland Sea in 2012. Harp seals will be the prime target species since this population is still hunted. If possible, however, also hooded seals will be surveyed. Hooded seals have been protected since 2007. To assess the effect of protection on the pup production, more than 5 years are needed due to the usually 4-5 years age at maturity observed in hooded seals.

Haug reported that the upcoming ICES/NAFO WG meeting on Harp and Hooded Seals will also review the status of Greenland Sea hooded seals.

8.3 Ringed seal

8.3.1 Update

Labansen *et al*. (2011) examined the diet of ringed seals from coastal and offshore areas of Northeast Greenland. Similar to earlier results, this study suggests that the ringed seal is a generalist that exploits prey based on availability, with a few key species dominating the diet in an area at least on a seasonal basis.

Rosing-Asvid reported that he attached a satellite tag to one animal in south Greenland and that this instrument has been working for 8 months revealing animal movements of a very local character.

Lydersen reported from a new study in Svalbard on ice dependency of ringed seals outside the breeding season. In 2010 nine ringed seals were equipped with newly developed tags that collect data on oceanographic parameters and primary production as well as animal movements. Further deployments will be made in 2011-2012.

8.3.2 Future work

In Greenland 15 satellite tags will be deployed in the Melville Bay area in 2011 and some tags are to be deployed in northern Dove Bay (northeast Greenland) during 2012.

8.4 Grey seal

8.4.1 Working Group (WG) Report

Haug presented the report (ANNEX 1) from the first meeting of the NAMMCO SC Working Group on Coastal seals which was held during 14-18 March 2011 in Copenhagen. In attendance were 11 scientists representing Norway, Iceland, Greenland, Faroe Islands, Denmark and Sweden. As terms of reference the WG was to: 1) Review the Norwegian management plans for harbour and grey seals, 2) Perform assessments for harbour and grey seals in the NAMMCO areas and when possible in other North-Atlantic areas, and 3) Develop a common management model for both species in the NAMMCO areas.

Management plans for harbour and grey seals in Norway

The governmental goal is to ensure sustainable and viable populations of harbour and grey seals within their natural distribution areas. In practical management, however, the government must weigh the desire for the preservation of seal populations, against the desire to reduce the damage on fisheries and aquaculture in the coastal zone. The Ministry of Fisheries and Coastal Affairs has decided to stabilize the harbour seal population at a target level (TL) equivalent to that about 7,000 counted animals during moult. The grey seal population should be stabilized at a TL equal to 1,200 pups born annually. Hunting quotas are used to stabilize the populations at the TL. Population-regulating measures should be designed to ensure that they have the greatest impact in areas where there is documented significant damage to the fishing industry caused by seals.

Grey seals are managed within three management units (Northern, Central and Southern Norway) based on pupping time and genetics differences. Harbour seal are managed in administrative units following county borders. Small, unique and geographically isolated populations of harbour seals will not be exposed to hunting. Hunting quotas are set for five years periods, so that it will be possible to adjust the removals in relation to new population estimates, new knowledge about the damage to the fishing industry, new environmental threats, etc. The management plan suggests reduced hunting until populations are decreased to 0.5 TL (Table 1).

Population size (1+)	**Regulations**
Above TL	Exploitation between sustainable catch and 1.5 x sustainable catch
Equal to TL	Exploitation equal to sustainable catch
Below TL and 0.7 TL	Exploitation equal to 0.7 x sustainable catch
Between 0.7 TL and 0.5 TL	Exploitation equal to 0.5 x sustainable catch
Less than 0.5 TL	0-quota
Less than 0.5 TL and decreasing with 0-quota	Restrictions on disturbance at the breeding areas

Table 1. Exploitation levels and regulatory measures in the Norwegian management plan.

The WG expressed concerns about the management reactions to decreasing population sizes. In particular a reduction to 0.5 TL over a 5-year period would represent such a significant decrease in numbers that might impair a speedy recovery of the population. Furthermore, it was noted that a reduction of a population by 50% over three generation (*e.g.* 45 years for harbour seals) would place a population in the endangered category within the IUCN framework. The WG recommended setting the maximum reaction level up to 0.7 TL over a management action time of five years. The WG also recommend that:

- The division in the present management units are investigated against scientific evidence (*e.g.* genetics)
- That in particular harbour seal management units be defined based on genetics and other appropriate methods (*e.g.* telemetry and tagging)
- Surveys be designed to allow for the estimation of variance and the identification of trends
- The frequency of counts should be intensified if negative trends are detected
- Removals should be allocated based on TL specified for each individual management units
- "Sustainable catches" should be explored for harbour seals and should be clearly defined for both species
- The effects of age and sex of removals should be explored

Common management model for harbour and grey seals

Härkönen reported on the development following the HELCOM/ICES/EU Seal Expert Workshop (Stockholm, 6-8 September 2005) which proposed a set of General Management Principles for seal management applicable to the whole Baltic Sea area. These general management principles were designed to allow for National Management Plans to be developed based upon sub-regional and national aspects. The results from the Stockholm workshop and the review of Norwegian management plans formed the background for the WG's discussion on a common management model for harbour and grey seals.

The WG agreed that a management model for harbour and grey seals should at least include the following steps:

- Management objectives should be set in such a way to secure populations at target levels.
- Identify management units based on population structure taking into consideration population size, location, distribution and dispersal.
- Assess population trends within each management unit. Regular surveys have to be made and designed in such a way that their precision can be estimated (see the Report).
- Identifying the survey precision needed to meet management objectives.
- Management advice should be provided as total removals which include struck-and-lost, by-catch and hunting quotas.
- Initiate studies that identify the occurrence of impacts on fisheries and aquaculture, including sealworm burden in fish in relation to seal density, and will point out areas where the population size needs to be controlled.
- Include an evaluation of the management plan (at latest after 6 years)

The SC noted that further considerations are needed before a management model can be recommended as a general model for grey and harbour seals in all NAMMCO areas. In particular the SC noted that stocks of harbour and grey seals are not seen as being in conflict with fisheries and aquaculture in all countries, and therefore it could not generally be expected that common management objectives would be to secure populations at target levels. Also it may not be possible to reduce a stock to a target level by quota allocation as quotas might not be taken, indicating that a more general management objective would be to secure populations at, or above, target levels. While the identification of a survey precision needed to meet management objectives would be optimal, it is likely not realistic in most NAMMCO countries. An alternative route would be to compare target levels directly to the minimum counts available (or minimum counts corrected for animals not present). This might be more realistic and useful in the sense that imprecise minimum counts (using *e.g.* only one count instead of three) should be negatively biased and thus result in precautionary management. Hence, if the management objective was only to ensure a population of at least the target level, it might be possible to obtain this with relatively imprecise, cheaper and irregular surveys. A more focused management objective that aims to maintain the stock very close to a target level would instead require more precise and expensive surveying.

The SC also noted the lack of a biological reference point in the proposed management model and recommends that the management approach aim to assess the current status of a stock relative to a reference point with no removals. Finally, it noted that the feed-back approach outlined in Table is a type of catch control algorithm and as such a recommended approach for providing management advice. However, the proposed algorithm has not been simulation tested and it would therefore be difficult to judge whether it may result in desirable or undesirable population dynamic behaviour. The SC recommends that such feed-back-models are simulation tested before they are applied. The SC noted that the testing of such a management procedure would require significant increase in workload, as for the development of general management procedures for large whales (see item 10). If

simulation testing is not possible it is essential that the stock is surveyed frequently during an initial period and that the management plan is re-evaluated on several occasions.

Status of grey seals in the NAMMCO area

In reviewing the status of grey seals in the NAMMCO area, the SC noted that a model had been developed for estimation of total population size for Norwegian grey seals and projection of future population trajectories under various catch options. The model includes total pup production estimates in 2006-2008, estimated by-catch mortality rates and catch statistics, while age specific pregnancy rates were derived from a large study on Canadian grey seals. Model runs indicated an increase in abundance of the total Norwegian grey seal population during the last 30-years, estimating a total of 8,063 (95% CI: 7,627 to 8,549) animals (including pups) in 2010. Current catch level will likely result in a depletion of the populations in Rogaland, a reduction of the population size in Sør-Trøndelag, and an increase in the population size in Nord-Trøndelag, Nordland, Troms, and Finnmark. The SC noted with concern that the quota and the actual removals have greatly exceed the management advice since 2003.

A population model for grey seals in Iceland, based on the catch-at-age data, estimates of annual pregnancy rate and an assumed survival scheme, indicated that the stock declined from about 12,000 grey seals in 1990 to about 5,000 in 2002. Aerial pup production surveys in 2005, 2008 and 2009, showed an increasing trend, estimating abundance at 5,500 (95% CI: 4,158 to 6,990) animals in 2005 and 6,100 (95% CI: 4,578 to 7,630) in 2008-2009.

No management regime is implemented on grey seals in the Faroes and present population size is unknown. Today, fish-farmers are the only seal hunters in the islands. Hunting logbooks have been implemented from March 2011 onward, which intend to provide reliable numbers of exploitation level in the future. Total removal, as indicated from a questionnaire study, was 226-273 grey seals in 2010. The SC noted the high removal levels in relation to the assumed population size of about 2000 seals, which give reason for strong concern about the status of the species in the Faroes. The SC reiterated strongly its recommendation that a greater priority be given to assessing the size of the population, and that in a timely manner.

Distribution and migration of grey seals in the Faroes were investigated by deploying satellite tags on 10 seals during June 2007 and May-August 2008. The satellite tags had a lifetime from 123 days to 286 days (mean 212 days). The seals were stationary on the Faroe Plateau, mainly staying close to the islands. Very few of the seals were tracked outside the 100 m depth contour. No seal moved longer distances from land than 17 nautical miles or for a longer period than three days. Three pregnant females were tagged. Contact was lost with the females for coherent periods of 15 – 21 days, because they were sheltered from contact when at the breeding locations, which indicates that breeding occurs in caves.

There had been no certain observations of grey seals in Greenland until an adult grey seal was photographed near the islands Qeqertat in August 2009. In 2010 (also in the

Qeqertat area), a grey seal pup was tagged (Argos tag) and tracked for 26 days, in which the seal moved around in the tagging area and a little northward along the Greenland east coast.

A ban on hunting of grey seals in Greenland was implemented 1 December 2010.

8.4.2 Future work

The WG emphasized the need to get a more clear and quantitative picture of the magnitude of conflicts between grey and harbour seals and fisheries and fish farming, and suggested further exploration of the ecological role of the two seal species in coastal ecosystems, their impact on fish catches, gear and fish farms, and the distribution and impact of sealworm on fisheries. The SC endorsed these recommendations.

Furthermore, in order to proceed with the assessment and development of a general management model (**R.2.4.2/2.5.2**) for grey and harbour seals the SC recommends:

- Establishment and/or continuation of standardised and regular monitoring programmes for seal abundance in all countries, including the development of appropriate survey methods, to obtain compatible results in time series
- Securing catch records and associated data from hunted seals
- Quantification and standardisation of methods to estimate struck and lost and by-catch
- Population assessment of both species in Russia
- Survey of harbour seals along the coast of Iceland
- Studies to identify the population structure of Norwegian harbour seals
- Exploration of the south-eastern Greenland coast for the presence of both harbour and grey seals
- Estimation of the stock identity, size, distribution and structure of the Faroese population of grey seals
- Completion of the ongoing genetic analyses of grey seal population structures for the north Atlantic including new samples from the Faroe Islands

The SC furthermore recommends

- Development of common sampling protocols for all areas in the north Atlantic in preparation for epidemic disease outbreaks, including establishment of blood serum stores for seals sampled
- Compilation of a database of samples stored in the NAMMCO countries

Haug and Zabavnikov informed the SC of the plans of a joint Norwegian-Russian research programme. The programme will address questions related to abundance estimation, stock identity, spatial distribution and habitat use, and feeding habits and conflicts with fisheries.

8.5 Harbour seal

8.5.1 Working Group (WG) Report

Status of harbour seals in the NAMMCO area

No new assessment data of harbour seals in the NAMMCO countries were presented to the WG on Coastal Seals (ANNEX 1).

The SC expresses great concerns about the high catch levels of harbour seals in Norway during the last ten years, as well as the potentially high by-catch, and recommends that set quotas follow the scientific advice, and that new assessment of harbour seals are carried out as soon as possible.

The Icelandic government has recently established a management goal for the harbour seals in Icelandic waters that aims at maintaining the population at the 2006 level (about 12,000 harbour seals). Due to decreased catch and by-catch, it is possible that the harbour seal population has increased since 2006. It is, however, necessary to carry out surveys to verify the status of the population.

A total protection of harbour seals in Greenland was implemented from 1 December 2010. The harbour seal population size is uncertain, but using catch statistics and back calculations, and assuming a 5% replacement yield, the present number in West- and South Greenland was suggested to be in the range of 340-440 harbour seals. The SC recommends the execution of abundance and distribution investigations in the southeast Greenland, where the harbour seal status is unknown.

Recent genetic analyses have indicated a finer scale of population differentiation of north Atlantic harbour seals than the 300-500 km suggested in earlier studies. Thus four genetically differentiated populations have been identified in Denmark and Southern Scandinavia with distances of 100-200 km separating subpopulations. The SC noted that there are indications of the presence of further subdivisions within the current management units, and therefore recommend further investigation of the appropriateness of the current management units.

8.5.2 Other updates

A newly published genetic study (Andersen *et al*. 2011) where samples from harbour seals from Svalbard was compared with samples from Iceland, Southeast Greenland and Northern Norway showed that each of these four locations comprised a genetically distinct population, had a rather low effective population size and showed an indication of having experienced a bottleneck resulting from a recent population decline.

Lydersen reported from an ongoing project on harbour seals in Svalbard. The main aims were to estimate the population size from aerial surveys, study movement patterns and space use via deployment of satellite transmitters (N=60), and investigate the potential impact of Greenland sharks as predators on arctic seals.

8.6 Bearded seal

8.6.1 Update

Lydersen reported that 13 satellite tags have been deployed on pups in Svalbard and that data are presently being analysed.

Rosing-Asvid reported that the satellite tagging of 3 adult males in southeast Greenland showed a high degree of site fidelity.

8.6.2 Future work

Prototypes (CTD-GPS) tags to test small scale movements will be tested during summer 2011 in Svalbard.

Greenland informed that there is funding granted to the Greenland Institute of Natural Resources (GINR) for deploying an array of six moorings with underwater sound recording equipment in the Southern Baffin Bay, in collaboration with the University of Washington. The aim is to identify the seasonal presence and relative abundance of vociferous baleen whales and bearded seals. It is expected that the equipment will be deployed in October 2011 and retrieved one year later.

The SC noted again that only a few studies have been initiated for this data-poor and exploited species. It reiterates its recommendation to renew efforts towards information on biology, abundance and stock status in the view of an assessment.

8.7 Walrus

8.7.1 Update

Greenland: The SC noted that the quota for 2011 has been reduced to the level of the advice with no allowance for struck and loss for the Baffin Bay – Northwest Greenland area. It also noted that an interview survey to learn about the current walrus catch and about the user´s experience regarding the effects of climate change on this species has been carried out. A preliminary analysis of these data suggests that the hunters in Qaanaq may not lose a significant number of animals, which would justify the absence of an allowance for struck and loss for that area.

An aerial survey was carried out in the North Water in May-June 2010, and walruses were tagged by the sea ice in the area to obtain correction factors for the survey. Tagging was done in close collaboration with local hunters.

The SC recommends the completion of the hunter survey study and a re-evaluation of the assessment for this stock when a new abundance estimate is finalised.

A walrus was satellite-tagged in the Faroes 21 February 2010 and swam to Svalbard before contact was lost with the animal.

Lydersen presented a new paper on fatty acids (FA) and walruses from Svalbard (Skoglund *et al*. 2010). The FA composition of the potential prey organisms was different from that of the blubber of the walruses, though more similar to the inner blubber than to the outer blubber or dermis. FA composition of the outer blubber and dermis were significantly correlated with age. Correlation between fatty acids in the dermis and age is currently being further explored on other seal species as a means of ageing seals and walruses.

Lydersen also informed that a fixed camera monitoring of the haulouts, to investigate haulout dynamics and the potential impact of tourism, is still ongoing.

In Russia the Marine Mammal Council has established in 2010 a special group for the study of walrus in the Pechora Sea as a response to new oil and gas extraction.

8.7.2 Future work

An aerial survey for walruses in the Pechora Sea will be conducted in August 2011. This is a co-operation between the State Research and Design Institute for Fishing Fleet (Giprorybflot), in St. Petersburg (RUS) and the Norwegian Polar Institute. There will also be an aerial survey for walruses in Svalbard for the autumn 2011.

In Greenland researchers will continue a tagging study in the Qaanaaq area.

The SC recommends that Russian Federation permits the Norwegian and Russian scientists to conduct the tagging study in the Pechora Sea.

9. CETACEANS STOCKS - STATUS AND ADVICE TO THE COUNCIL

The SC reiterated its previous recommendation that all takes of all species should be reported (direct catches, struck and loss, by catches, and other human caused mortality), and it strongly recommends that reporting systems for all species with an allowed hunt should be in place for all areas, which is currently not the case for small cetaceans in Iceland and harbour porpoise in the Faroes.

Desportes and Víkingsson presented under every species the relevant items of the reports of the Working Group on Abundance Estimates (ANNEX 2) and the Working Group on Large Whale Assessment respectively (ANNEX 4).

9.1 Fin whale

9.1.1 Working Group (WG) reports

The issues remaining from the Quebec meeting of the Abundance Estimation (AE) WG regarding the Greenlandic analyses were solved. Estimates for all areas, but Norway, have now been provided to, reviewed and endorsed by the AE WG and subsequently the SC. The area specific endorsed estimates are reported in Appendix 3.

A reanalysis had been undertaken of the combined SCANS-II, CODA and Faroese T-NASS data. In the CODA analysis for fin whales, no evidence of responsive movement (attraction) had been found and a point (trackline) independence model could be used in the MRDS analysis, which led to larger estimates of abundance but details were not available to the meeting.

The surveys from 2007 as well as the mosaic Norwegian surveys were considered additive. A revised combined estimate for the North Atlantic can be calculated as soon as the revised estimates from the combined SCANS-II/CODA/Faroese analysis and the estimates for the latest Norwegian mosaic surveys and the 2007 SNESSA will become available.

The Management Committee for Cetaceans (MCC) recommended that simulation trials required to check if catch levels for 60% tuning are sustainable in the long term should be carried out as soon as possible. Further studies should be carried out to help distinguish between alternative stock structure hypotheses, particularly in and around the area of proposed whaling, using several different approaches such as genetics, satellite telemetry and photo-identification.

In 2010 the SC had provided a short term (for the next 5-year period) management advice. In order to provide a longer-term advice the SC recommended, *inter alia*, that the RMP Implementation Simulation Trials (ISTs) for North Atlantic fin whales be rerun for a 0.60 tuning level of the RMP CLA, and that some further investigation related to stock structure Hypothesis IV (IWC 2009), which underlies some of those trials and whose plausibility is under question, be conducted.

Iceland reported that there are plans to rerun the trials for the 0.60 tuning level in 2011. The SC considered that it would be most appropriate to first review the results from that process, and the acceptability of the RMP performance indicated, before deciding on possible further related analyses

A DNA registry research programme was initiated in the MRI in 2010. This research programme includes the development of a tissue bank in which all genetic samples collected from whales (commercial hunting, stranding and biopsy) will be registered with a unique ID number, and a DNA database in which all samples genotyped with genetic markers will be recorded. The database as well as the tissue bank should be completed by the end of 2011.

The SC endorses the conclusions recommendations of the WG reports.

9.1.2 Other updates

Before the 2011 European Cetacean Society ECS Conference a workshop was held on Mediterranean fin whales. Víkingsson participated and reported that apparently there are 2 stocks of this species in the Mediterranean and that the individuals of the westernmost of these show regular migration into the north Atlantic

Simon *et al.* (2010) show that fin whales are vocally active in the Davis Strait from July until the arrival of sea ice in December, suggesting that mating activities may take place in West Greenland.

Extensive biological sampling was conducted by MRI staff from all fin whales landed at the whaling station in Hvalfjörður in 2010. This research includes among others age determination, maturity and fecundity, energetics, feeding ecology, parasitology and genetics. Laboratory analyses of all fin whales (n=142) and all collected foetus samples (n=17) from the commercial hunt in 2010 is completed. Fifteen microsatellite genetic markers were screened, mtDNA sequenced and a sex marker analysed for all samples.

9.1.3 Future work

Greenland reported that acoustic devices moored in the South Baffin Bay, Davis Strait, aimed at investigating the ice-related behaviour of fin and bowhead whales and bearded seals, will be deployed in October 2011 and will continue operation through 2012.

Norway reported that acoustic devices aimed at bowhead and other baleen whales, moored in the Fram Strait are going to continue operation through 2011.

9.2 Humpback whale

9.2.1 Working Group (WG) report

Greenland informed that they would not provide estimates for their shipboard survey, because this would be of a lesser quality that that of the aerial survey. Estimates for all areas, but Norway, have now been provided to, reviewed and endorsed by the AE WG group and subsequently the SC. Estimates are reported in Appendix 3.

The possibility for responsive movement to survey vessels remains a point to be investigated for the Icelandic-Faroese shipboard survey and the SC endorsed the recommendation reiterated by the AE WG for further analyses of this issue (see Appendix 4).

At the last NAMMCO meeting the MCC recommend the running of detailed simulation testing of the AWMP-C procedure, including a change of the procedure to apply a time-series of abundance to provide management advice for a 5-year period. The SC noted that the development and simulation testing of management procedures for humpback whales in West Greenland is ongoing in the IWC, and it recommends that NAMMCO relies on this work in order to avoid duplication.

9.2.2 Other updates

A photo identification study of humpback whales around Nuuk in Greenland had 274 sightings of 52 individual whales between 2007 and 2010, with the 10 most observed whales accounting for 65% of the sightings. With relatively few individuals providing most of the sightings, there is the potential for a local conflict between the hunting and whale watching in the area. Assuming that the probability of catching an individual whale reflects the relative presence of the individual in the area, it was estimated that an annual removal of one individual would reduce the sighting rate by 28 to 46% over the next ten years, while the sighting rate would be reduced by 43 to 74% with an annual take of two individuals. In 2010 one whale was caught in the area. The municipality of Sermersooq has arranged meetings between tour operators and whale hunters, the hunters agreed to carry on board their vessels identification photographs of the most frequently seen humpback whales, and if possible to avoid taking those individuals.

Greenland: For the first time since 1986, there was a quota for humpback whales in West Greenland. All 9 whales were caught. Catches were spread from Disko Bay to Cape Farewell. Measurements and biological samples were collected from one whale caught close to Nuuk. The SC recommends eye sampling for age determination. It also

recommends getting a picture of the tail of caught whales for individual identification and calibration of age determination using individuals with known age.

9.2.3 Future work

Greenland communicated that in 2011, biological samples from the catches will be collected to the extent allowed by funding and logistics.

9.3 Sei whale

9.3.1 Working Group (WG) reports

Previous estimates of sei whale from NASS exist for 1987, 1989 and 1995. The AE WG and subsequently the SC have now reviewed and endorsed estimate for the 2001 and 2007 surveys (Appendix 3). Both an uncorrected and a fully corrected estimate have been accepted for the 2001 survey, while an uncorrected estimate have been accepted for the 2007 survey, the latest being considered as the best recent estimates of abundance available for this species in the area. These estimates are similar to previous ones when constrained to overlapping areas, except for the 1995 estimate which is higher.

The SC reiterated that with the exception of NASS-89, the NASS has not been ideal for estimating the abundance of this species, both because the area coverage is small and the time of the year for the surveys is not optimal for this species. If a better estimate of sei whale abundance was needed, surveys will have to extend farther to the south and/or be conducted later in the season than has been the norm for NASS. For the planning of the next NASS surveys, the SC recommend that it, as soon as possible, is decided whether sei whale is a target species because this should affect either the timing and/or the areal coverage of the survey.

At the last NAMMCO meeting the Management Committee for Cetaceans recommended that the SC assess the status of sei whales in West Greenland waters and the Central North Atlantic, and provide minimum estimates of sustainable yield (**R.3.5.3**). The SC noted that the RMP could be applied using the existing data. The resulting catch limits would consequently be lower than the stock could sustain. A prerequisite for initial assessment work is the recalculation (including considerations of extrapolation) of abundance estimates for a comparable area and assessing the extent of negative bias for the reasons mentioned above. Advice based on an RMP approach would require an initial assessment and likely the development of implementation trials.

9.3.2 Other updates

Acoustic monitoring by GINR and the University of Washington showed that sei whales are vocally active in the Davis Strait during August and September. Laidre *et al*. (2010) identified areas of high density of large whales, including sei whales, in West Greenland. Five out of six sei whales tagged in the Azores in 2008 and 2009 migrated to waters off South Greenland (University of the Azores, http://www.portulano.org/wkit/index.html).

9.4 Minke whale

9.4.1 Working Group (WG) reports

A CDS (*Conventional Distance Sampling*) estimate for the Icelandic-Faroese shipboard survey had been endorsed by the AS WG and the SC in 2010 (Appendix 3).

A correction factor (MRDS) has been endorsed for the Icelandic aerial surveys of 2007 and 2009 and the corrected total estimates for both surveys have been endorsed by the AE WG and subsequently SC (Appendix 3). The best available estimate of abundance for 2007 was 48% that for 2001. Abundance in 2009 remains the lowest yet seen in all areas, just 46% that observed in 2007 and 22% that estimated in 2001, the latter difference being significant.

The 2009 survey in the Icelandic coastal area was carried out primarily because the abundance of minke whales estimated from the 2007 survey was substantially lower than in earlier surveys (24% of that estimated for 2001) and results from a partial survey carried out in 2008 suggested that the 2007 results might be anomalous. However the uncorrected estimate for the 2009 survey was only 55% of the 2007 uncorrected estimate.

In order to examine whether this could be due to methodological (*e.g.*, error in measuring distances) or analytical problems, an extended analysis of the common minke whale data was undertaken. It incorporated results from a partial survey conducted in 2008 and extending the index of abundance based on line-transect density until 2001 to include later surveys. This index allowed inclusion of surveys conducted in 1986 and 1995 for which that data collected are not suitable for cue counting analysis. The trend in line-transect density of minke whales was very similar to that for the available corrected estimates. Density was stable or increasing in most strata from 1986 to 2001. There was a sharp decline in 2007, with density in the survey area being only 26-28% of that from the 2001 survey. Density in block 1 recovered to earlier levels in 2008, only to decline sharply again in 2009. The AE WG and the SC agreed that the new evidence presented strengthened the conclusion that the observed decline in minke whale abundance was not a result of error in measuring distances or analytical problems and the inclusion of the 2008 survey results did demonstrate that minke whale abundance exhibits great fluctuations from year to year.

The SC made several conclusions besides the general recommendation listed in Appendix 4:

- given the importance of cue rates to the present cue-counting approach, it would be timely to consider a full review of the available data as it is some time since this was last done – this should also examine the issue of possible changing cue rates and the implications of this for trend analyses;
- more data are required to estimate availability bias and its spatial and temporal variability. This could best be done through tagging studies using time-depth recording tags;
- the previous assumption that the most important component of the Central Atlantic stock is found within Icelandic coastal waters in summer is not valid

every year. There can be considerable annual variation as shown by the 2007, 2008, and 2009 results;

- although it had been suggested that the common minke whales absent from Icelandic coastal waters may have moved further north and/or east towards Greenland, preliminary results from Norwegian surveys in the CM area suggest that the 2010 numbers from this area will not explain the difference;
- areas close to East Greenland have not been well covered in recent years due *inter alia* to poor weather and varying ice conditions; these have been shown to have high densities in some previous surveys;
- consideration should be given to following the practical and analytical approach used in Greenland for aerial surveys for common minke and fin whales, recognising the financial implications;
- the above points should be taken into account when planning for future surveys;
- spatial modelling approaches for all of the past surveys (separately and where possible combined) should be considered to see if these provide some information on key variables that might help explain the changes in distribution;
- while difficult to incorporate directly into spatial modelling, it would also be valuable to examine other time series of data *e.g.* prey species or proxies for prey species that may help to explain changes in distribution, including both annual variation and possible longer term future changes.

Greenland informed that they would not provide estimates for their shipboard survey, because this would be of a lesser quality that that of the aerial survey. Estimates for 2007 for all areas, but Norway have now been provided to, reviewed and endorsed by the AE WG and subsequently the SC. In addition an estimate for the 2009 Icelandic coastal survey was also endorsed. Endorsed estimates are reported in Table 3.

At the last NAMMCO meeting the MCC noted that the advice given on minke whale should be valid for 5 years unless the SC considers that there are sufficient reasons for an earlier revision of the advice and the expense of surveys.

The MCC recommended a correction for $h(0)$ and error in the 2007 and 2009 survey as soon as possible and adjust the management advice in accordance with this estimate. The AS WG used these corrected abundance estimates and the catch for 2010 of 60 minke whales, to update catch limit calculations resulting in sustainable annual catch limit of 229. In accordance with this, the SC concluded that annual removals of up to 229 minke whales from the CIC area are safe and precautionary. As for the previous advice, this catch level can apply for the next five years (2011-2016) before a revision is needed.

The MCC also recommended calculating, as soon as possible, catch limits based on running the RMP on the Central North Atlantic medium area, with catch cascade allocation of catches to small areas. The AS WG and the SC concluded that, as a first step in this process, decisions must be made on input parameters before the calculations are performed. The exercise has been initiated by the IWC in 2010 using

a series of input parameters that NAMMCO could consider. In order to advance on this subject the SC recommend that Gunnlaugsson work with Skaug, in particular to suggest abundance estimates to be used as input including considerations of additional variance if surveys from different years are combined.

9.4.2 Other updates

Zabavnikov informed that during the last (August-September 2010) Norwegian-Russian ecosystem survey in the Barents Sea, the numbers of encounters with whales, particularly minke whales, had increased substantially as compared with similar surveys in previous years (2003-2009). Haug referred from a paper (Skern-Mauritzen *et al*. 2011), based on data from the ecosystem surveys, and dealing with baleen whale associations with prey in the Barents Sea. Here it was concluded that the three baleen whales studied (minke, fin and humpback) predominantly occupied a narrow, northern area that had high densities of krill, amphipods and polar cod along the northern range of the capelin distribution. Only a small proportion of the minke and fin whales occurred in the southern areas where herring was abundant. Herring was therefore not an important prey species in the Barents Sea in this season. Ecosystem-scale associations, which were determined by spatial associations between species distributions averaged across years, indicated that krill was the predominant prey species in this period which also was characterized with low capelin abundance in the area. Given the observed substantial reductions in zooplankton in the Norwegian Sea in the most recent decade, a shift in whale distribution from the Norwegian Sea to the Barents Sea cannot be ruled out, and may contribute to an explanation of the increased whale encounters in the northern Barents Sea where also the abundance of capelin has increased recently. Capelin is known to be important for minke, fin and humpback whales.

Haug also reported from work with the Norwegian minke whale DNA register: which was established in 1997. The register was designed primarily as a control system to detect any attempts at illegal trade of products derived from other stocks of minke whale, or other whale species, under cover of the legal Norwegian harvest originating from the Northeast Atlantic. The register consists of individual genetic profiles from a total of 7751 whales landed in the period 1997-2010. In addition to its primary objective as a control organ, the register has been used for other scientific purposes including population genetics and species and hybrid identification. As shown in SC/18/O/12, presented by Haug, the latter became particularly relevant when minke whales from the southern hemisphere were detected in the Norwegian hunt. The Antarctic minke whale (*Balaenoptera bonaerensis*), and the common minke whale found in the North Atlantic (*Balaenoptera acutorostrata acutorostrata*), usually undertake synchronized seasonal migrations to feeding areas at their respective poles during spring, and to the tropics in the autumn where they overwinter. Differences in the timing of seasons between hemispheres prevent these species from mixing. However, after detection in the DNA register and based upon further analysis of mitochondrial and microsatellite DNA profiles, the observation of a single *B. bonaerensis* in 1996, and a hybrid with maternal contribution from *B. bonaerensis* in 2007, was documented in the Norwegian catches in the Arctic Northeast Atlantic. Paternal contribution to the latter was not conclusively resolved. This is the first

documentation of *B. bonaerensis* north of the tropics, and, the first documentation of hybridization between minke whale species.

Lydersen informed about a study where the minke whale registry was used to identify blubber found in Greenland shark stomachs as being offal from the Norwegian minke whale hunt.

Ugarte reported that the tagging study in Disko Bay will continue through 2011 aiming at obtaining calibration factors for aerial surveys. Furthermore the GINR has secured tissue samples from 117 individuals from the catch in 2010.

In Iceland genetic samples in the minke whale tissue bank are currently being analysed.

The SC reiterates the recommendation that all genetic samples in the NAMMCO area be analysed for kin comparisons in order to obtain a better understanding of stock structure.

9.4.3 Future work

The Greenlandic tagging programme to provide correction factors for aerial surveys will continue through 2011.

9.5 Narwhal

9.5.1 Update

Request 3.4.12 on the advice on sustainable takes of narwhal from the Kane Basin is part of the ToR for the Joint NAMMCO and JCNB SC Working Group on the status of narwhal and beluga in the north Atlantic (JWG), scheduled for 12-18 February 2012.

9.5.2 Future work

Acquarone reported that the Steering Group (Christina Lockyer, Rob Stewart, Aleta Hohn and Rod Hobbs) appointed by the JWG on beluga and narwhal to look into the planning of age workshop(s) has come to more settled plans. This has been a very long process. Presently the possibilities are as follows:

1. Symposium style workshop – 2-days immediately prior to the Society for Marine Mammalogy (SMM) conference in Tampa in late November 2011. Up to 25 presentations are planned on the conference on a wide variety of age methods in different species. These may provide the basis for a NAMMCO publication on age estimation focusing on monodontids and marine mammals but including relevant methods in other species. There will be a core of invited people who should be prepared to contribute a paper, but the workshop will be widely announced, and hopefully will attract many who might also attend the biennial conference, and also have something to contribute. Some funding is available to help support attendance of those invited and who do not have their own funding. For general attendance, a registration fee will be charged.

2. Hands-on beluga tooth Growth-Layer Groups (GLG) workshop – up to 4-day workshop after the SMM conference – perhaps starting 4 December, in Beaufort, N. Carolina at the NOAA Pivers Island laboratory. Again, specialists will be invited to attend and bring tooth material and photographs for comparison of GLG patterns from different regions and stocks. The outcome will be guidelines on tooth preparation, GLG interpretation and standardization of reading methods. It is expected a maximum of 20 here.

3. Hands-on narwhal age workshop – 1-2 days in Copenhagen, Denmark – possibly 10-11 February 2012 – immediately before the JWG meeting (12-18 February). The reason for delaying this and holding it in Copenhagen is because of severe restrictions on movement of narwhal tusks to other locations outside of Denmark (CITES permits and also freight), and also because the work in progress currently will likely be fully completed by that time. It is anticipated that several of the participants will be attending the JWG anyway, and many others attending the JWG but not especially involved with age work, may also find the chance to see the material, informative. Hopefully, there will be something to report back to the JWG.

An aerial survey in West Greenland is scheduled for the spring 2012. The primary targets will be narwhal and beluga, and the secondary targets include bowhead whale and walrus.

9.6 Beluga

9.6.1 Update

Request 3.4.13 on a revision of the advice on the temporal and geographical restrictions on the takes of beluga from west Greenland is part of the ToR for the NAMMCO/JCNB JWG meeting in 12-18 February 2012.

Lydersen informed on the genetics of beluga from samples from Svalbard, the White Sea and West Greenland (O'Corry-Crowe *et al.* 2010). Genetic heterogeneity was observed between Svalbard and West Greenland that reveals limited gene flow over ecological time scales. Differentiation was also recorded between Atlantic belugas and two previously studied populations in the North Pacific, the Beaufort Sea and Gulf of Alaska. However, Bayesian cluster analysis of the nDNA data identified two population clusters that did not correspond to the respective ocean basins, as predicted, but to: (1) Arctic (Svalbard-White Sea-Greenland-Beaufort Sea), and (2) Subarctic (Gulf of Alaska) regions. Similarly, the deepest phylogeographic signal was between the Arctic populations and the Gulf of Alaska. Fitting an isolation-with-migration model yielded genetic abundance estimates that match census estimates, and revealed that Svalbard and the Beaufort Sea likely diverged 7,600 - 35,400 yr ago but have experienced recurrent periods with gene flow since then, most likely via the Russian Arctic during subsequent warm periods.

9.7 Bottlenose whale

9.7.1 Working Group (WG) report

Because of the paucity of the sightings, the AE WG recommended at its last meeting, that the T-NASS shipboard data be combined with the CODA data and incorporated in the model based reanalysis of the SCANSII/CODA data which was planned for this species. This combined analysis was not supported by NAMMCO. However, the data of the Faroese block (13 sightings) will be included in the re-analysis. The AE WG and the SC **recommended** that the results of this analysis be made available as soon as possible.

9.8 Killer whale

9.8.1 Update

As mentioned in SC/18/NPR–F, killer whales from the Faroes have been resighted by the Shetland Islands and Iceland.

Lydersen reported on a killer whale sighting of at least 3 animals at approximately 80°N 1°W in March 2010. This is one of the northernmost recorded sightings of this species.

9.8.2 Future work

The Faroe Islands plan to sample biopsies and continue photo-id work.

9.9 Pilot whale

9.9.1 Working Group (WG) reports

Abundance estimates

A Conventional Distance Sampling (*CDS*) estimate for the Iceland-Faroes shipboard area was presented to and endorsed by the AE WG and the SC (Appendix 3).

The revised model-based estimates (*DSM*) were very imprecise, with extreme upper confidence intervals. The AE WG and the SC concluded that the model-based analysis did not provide estimates of abundance superior to CDS estimates for use in assessments, probably because there were an insufficient number of sightings and/or the environmental covariates did not explain much of the spatial variance. The CDS estimate was preferred for assessment.

Index of relative abundance

Following the successive recommendations of the NAMMCO SC, an index of relative abundance had been developed (CDS approach with post stratification) and applied to the area that was common to all surveys, with the aim of determining trends in abundance over the 20 year period of the NASS. A comparative analysis of group size through the NASS survey had also been carried out. The area was subdivided in a western and eastern area. No firm conclusions about trends in pilot whale abundance in the areas could be drawn, partly because:

a) the index area comprised only a small portion particularly of the larger surveys (see Figure 1 below) as well as a small portion of the summer range of the species. Changes in distribution would therefore influence the estimated abundance.

NASS 1989 NASS 1995 T-NASS 2007

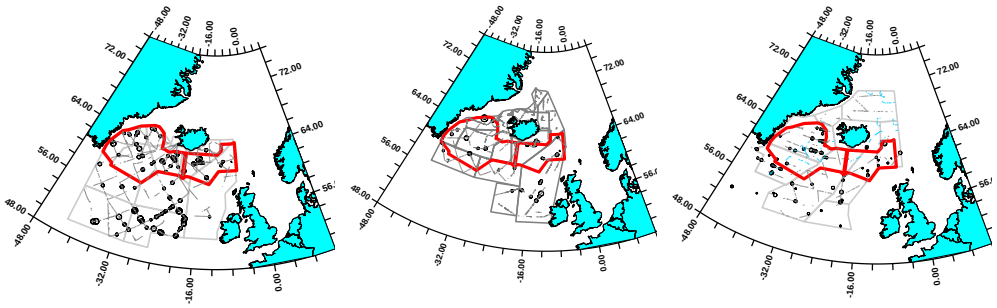

Figure 1. Areas covered by the surveys from 1989; 1995 and 2007. The red line delimits the common area for all three survey years.

b) what has being defined as a pilot whale "group" appears to have changed over time, and this might also influence the estimated abundances, especially for the early surveys.

The AE WG and the SC concluded that these surveys may not be the best approach to surveying pilot whales as this species is highly clumped in distribution. Further, since the index area is a small subset of this species' entire range, and the proportion of the total number of pilot whales within the index area likely varies from year to year, trends inferred from the index areas alone may not be representative of overall abundance trends. Because of this and possible changes in operational biases among the surveys, the SC agreed that no firm conclusions about trends in pilot whale abundance could be inferred from this work.

The SC recommends that future surveys must have a clear and carefully designed protocol for defining groups and estimating group sizes, as these are particularly important issues for this species.

Estimates for all areas, but Norway, have been provided to, reviewed and endorsed by the AE WG and subsequently the SC (Appendix 3 for estimates and Appendix 4 for remaining recommendations).

The AE WG and the SC noted that the 1989 pilot whale estimate had long been used as a 'reference' estimate for pilot whales in the North East Atlantic because it covered the widest geographical area. They agreed that this estimate was too old to be considered a current reference abundance estimate. When no reliable information on trends in abundance of North Atlantic pilot whales was available, they agreed that the estimate of 128,093 (95% CI:75,682 to 216,802) for the Iceland/Faroese survey area was the best that is currently available, noting that it applies to a considerably smaller area and a earlier time period than the 1989 estimate. It is not known either how it relates to animals that may be available to the Faroese hunt. An abundance estimate from the combined CODA and Faroese data would soon become available, which would supplement this estimate.

The AE WG noted with concern the difficulties it faced in providing estimates of abundance of pilot whales appropriate for management purposes given the absence of adequate information on *inter alia* movements and population structure, and an agreed assessment and management procedure. It drew this matter to the attention of the SC, and recommended that it should be addressed by the Assessment Group as a matter of urgency, noting that:

a) a timely research focus on a better understanding of stock structure and movements was essential as this will allow a more focussed survey area in the future, ideally for the next NASS, that relates directly to the provision of management advice;
b) in this regard it was not possible to obtain robust abundance estimates for the entire North Atlantic. At least initially, a management regime that does not require population abundance estimates and is robust to stock uncertainty should be developed;
c) the Assessment Group may also consider attempting to estimate the population size that would be required for the present Faroese hunt to be sustainable for comparison with available abundance estimates.

The AS WG shared the concerns of the AE WG regarding the difficulties it faced in providing estimates of abundance of pilot whales appropriate for management purposes given the absence of adequate information on inter alia movements and population structure, and an agreed assessment and management procedure (noting that the IWC management procedures apply only to baleen whales).

The primary concern remains the identification of the area over which the pilot whales harvested in the Faroes range. Tagging appears to offer the best prospects here.

A difficulty with identifying a minimum abundance for which the current harvest can be considered sustainable (as suggested in the AE WG report) is the absence of precise population trend information which would allow MSYR estimate. The best that could likely be done at this stage is to calculate a number corresponding to a minimum realistic value for MSYR (perhaps 1% of the total abundance).

In result the AS WG recommends (in order of priority):

1. That tagging be given the highest priority with the goal to track animals from as many schools as possible and if possible throughout the whole year.
2. That survey estimates from 1989, 1995 and 2007 (including CODA), *i.e.*, only from the three widest surveys, are divided into comparable blocks so that recent estimates and trends can be investigated on a larger area than what has been done so far and for the areas close to the Faroese.
3. That a list of available abundance estimates for the area E and NE of the Faroes be compiled, and that the Faroese contact Norway and SCANS to investigate if other estimates can be developed from these areas, and that such estimates are developed.
4. That the area NE of the Faroes be taken into consideration when planning future surveys.

5. That, provided samples are available from more than just the Faroes, an appropriate group of genetic experts be contacted to discuss whether further genetic studies can help resolving stock structure issues.

The SC endorses the recommendations from the AS WG and will monitor progress on the above tasks to decide when most appropriate to attempt to conduct an assessment.

The SC also notes that there might be sufficient information for an assessment in west Greenland and recommends that an assessment for this area is considered in relation to an assessment for the Faroes area.

9.9.2 Other updates

The SC was informed that the monitoring of the catch recommended by the SC over a 3-year period, which is needed for the definition of a long term monitoring programme, had not been implemented because of lack of funding. The SC recommended the timely implementation of this and underlined that the *ad hoc* sampling of the catch performed so far would not fulfil the requirements of the recommendation.

The SC reiterated its recommendation that the tagging data from 2004 be fully analysed and published in a timely fashion because they are of the highest relevance for an assessment of pilot whales.

9.9.3 Future work

SC recommends the Faroes to:

- Prioritise and increase the tagging effort
- Analyse data from surveys in the Norwegian area
- Perform new trend analysis from old surveys limited to the three largest surveys
- Collect samples from a broad area and analyse them for genetic comparison.

9.10 White-beaked, white-sided and bottlenose dolphins

9.10.1 Working Group (WG) report

Estimates are still missing for several species in several areas, the Icelandic-Faroes area, the Icelandic coastal area and off Norway (Appendix 4). The estimates already endorsed are given in Appendix 3.

The AE WG and subsequently the SC **strongly recommended** that the analysis of the Icelandic and Faroese shipboard survey data as well as the analysis of the last two Icelandic coastal aerial surveys be carried out as soon as possible.

9.10.2 Other updates

Mikkelsen gave a presentation on the latest progress of the study on the biology and ecology of white-sided dolphins from the Faroe Islands. Preliminary estimates of life history parameters (Table 2) show that minimum age at maturation for females is 4-5 years and that fifty percent are mature at age 7. For males this occurs at age 5. Length at sexual maturity is for females 240 cm and for males 269 cm, while weight at sexual

maturity is 110 kg and 125 kg, respectively. Asymptotic length and weight was for females 216.96 ± 1.30 cm and 140.67 ± 2.91 kg, while for males these parameters were 253.73 ± 3.65 cm and 197.65 ± 6.13 kg, respectively. The sex ratio goes from 17%, at young ages, up to 32% in favour of more males in the population. Pregnant and simultaneously pregnant and lactating females were missing and maturing animals (age's 4-8 and length groups 140-160 cm) were under-represented in the samples.

Update information on the diet, as reconstructed from hard prey remains in stomachs, reveals a domination of blue whiting (*Micromesistius poutassou*), occurring in 90-100% of the stomachs and contributing 36-99% by number and 45-97% by weight of prey consumed, irrespective of sampling year. Other primary prey species contributing significantly to the diet in various years were Norway pout (*Trisopterus esmarkii*) (up to 58% by number) and whiting (*Merlangius merlangus*) (up to 39% by weight). Greater argentine (*Argentina silus*) and sand eels (*Ammodytes sp.*) were notable in the diet some years. The fish predated by white-sided dolphin was of small size, mainly from 3 cm to 21 cm reconstructed length, but most frequently less than 10 cm; thus mostly 0-group and juvenile fish.

Life history	**Females**	**Males**
Maximum age (yr)	27	21
Minimum age at sexual maturity (yr)	5	5
Maturity ogive – age (length/weight) (yr)	7.34 (200/115)	5.01 (216/115)
Maximum length (cm)	240	269
Length at sexual maturity (cm)	190	205
Weight at sexual maturity (kg)	110	125
Asymptotic length (cm)	216.96 ± 1.30	253.73 ± 3.65
Asymptotic weight (kg)	140.67 ± 2.91	197.65 ± 6.13
Sex ratio (age 0)	1	1.32 (1.17)

Table 2. Life history of white-sided dolphins. Preliminary results of a study on the biology and ecology of white-sided dolphins from the Faroe Islands.

Tracking studies, with seven white-sided dolphins tagged in 2009 and tracked for up to 15 days, revealed a south-eastern movement of six animals, to the northern slope of the Faroe-Shetland Channel, while one animal moved north in to the Norwegian Sea. One animal from the southern area was tracked to the area south of Lousy Bank, when the tag failed. Dives down to 230 m was recorded.

The genetic diversity and population structure of white-sided dolphins, using both mitochondrial and microsatellite markers, and based on samples from eight geographic regions, including 50 samples from the Faroes, was explored. The analyses showed high haplotypic diversity but low nucleotide diversity, thus congruent with an ancient bottleneck followed by an expansion in range in most of the populations. The study finds that the population is continuous across the North Atlantic. However, the exception was animals from the North Sea and eastern Scotland, showing some degree of differentiation from the other populations in both the eastern and western North Atlantic

The SC thanks Mikkelsen for this presentation and recommends publication of these results.

9.10.3 Future work

The SC notes that the data on life history for any of the three species are still not sufficient for an assessment and reiterates its recommendation that the Faroese samples for diet and life history parameters from 350 white-sided dolphins be finalised and at the same time that an abundance estimate from the 2007 survey be attempted.

9.11 Harbour porpoise

9.11.1 Working Group (WG) report

Estimates for all areas, but Norway, have now been provided to, reviewed and endorsed by the AE WG and subsequently the SC, including an estimate for the Faroese coastal area from an aerial survey carried out in 2009 (see Appendix 3 for estimates per area).

The AE WG and the SC concluded that the Icelandic survey had produced the best available estimate for harbour porpoises in this area, and is a large improvement relative to previous NASS surveys for this species and area. They felt that, given the differences in survey methods used in 2007 (specialist porpoise observers, lower altitude) and the known extreme differences between observers evident for this species, the trend analysis contained in previous studies was probably not applicable. In order to estimate trends in abundance in these waters further surveys optimized for harbour porpoises are therefore required.

9.11.2 Other updates

Analysis of harbour porpoises caught in West Greenland in 2009 showed a better body condition and more varied diet than porpoises caught in 1988-1995. The SC noted that could be due to a difference in the timing of the sampling.

9.11.3 Future work

The Faroes communicated that they will continue the tagging programme.

Greenland reported that they will use the recent data on abundance, age structure and catch history to attempt an assessment.

9.12 Sperm whale

9.12.1 Working Group (WG) report

No abundance estimates are available from T-NASS yet (See Appendices 3 and 4).

The T-NASS acoustic data from Iceland have been analysed following a methodological course held in Iceland in November 2009 sponsored by NAMMCO. Subsequently a technical problem has been discovered with the data. It can be solved but a new, lengthy, reprocessing of the data is required (a minimum of 1 person-week per vessel). Considering both i) the interest in the potential abundance estimates, and ii) the investment already made in acquiring the acoustic data *(e.g.* the equipment), holding the course and performing the first analysis.

There has been no progress with the analysis of the Faroese data, which were not brought to the course mentioned above. The AE WG and the SC urges the Faroes to investigate whether there is the same technical problem with their data and to carry out the analyses of these data in parallel with the Icelandic data.

9.12.2 Future work

The AE WG and the SC recommends that the analysis of the acoustic data be carried out again and the abundance estimate finalised. It urges the NAMMCO Secretariat to find a suitable agreement with René Swift at the Sea Mammal Research Unit (SMRU), so the analysis can be redone in a timely manner. According to the René Swift at SMRU, the acoustic data can be treated and information on sightings can be extracted from the existing recordings, and that the reanalysis would likely take one week per vessel. Acquarone will investigate the possibility to proceed in case funding is allocated to the task.

9.13 Bowhead whale

9.13.1 Update

Lydersen reported on a new publication on observation of bowhead whales in Svalbard during the period of 1940-2009 (Wiig *et al.* 2010). There has been an increase in observations during the last decade, which could be due to an increase in numbers of whales, but also just an effect of increased tourism (more observers) and a dedicated reporting system. In addition he reported from an acoustic recording device that was attached to a Fram Strait mooring (at about 79ºN, 5ºW) which shows that bowhead whale(s) are present in this area throughout the winter and generally during most of the year. Also many other marine mammals, like blue and fin whales, various odontocetes and bearded seals were recorded by this device. In addition Lydersen reported on a successful satellite tag deployment on a bowhead whale from the Spitsbergen stock, where the whale moved from the so-called northern whaling ground (at about 79-80°N) to the southern whaling ground (72-74°N) during summer and then back north again during winter. This is opposite of the general seasonal movement patterns for other bowhead stocks, but in great accordance with what was reported by the old whalers in previous centuries for animals from the Spitsbergen stock

9.13.2 Future work

Greenland reported that the studies in Disko Bay will continue, acoustic monitoring in Baffin Bay will start in the fall 2011, and bowhead whales will be a secondary target of an aerial survey planned for spring 2012.

Norway reported that the acoustic devices moored in the Fram Strait aimed at recording bowhead and other baleen whale calls are going to continue operation through 2011.

9.14 Risso's dolphin

The SC notes the catches in the Faroese of this protected species as from the NPRs; 3 in 2009 and 21 in 2010.

Desportes reported on the sampling from these catches of Risso's dolphins (SC/18/10). Risso's dolphin has a worldwide distribution in tropical and temperate waters. They have never been observed in Faroes waters before 2009, sightings from Unst, the northernmost of the Shetland Islands, representing the furthest north observation in the eastern Atlantic. In August 2009 four individuals was observed at 62º23'N 07º51'W, less than 16 nm NNW off the Faroese islands of Mykines. A pod of 300 individuals was observed in the Northern islands and driven to shore to Klaksvík on September 2009, with 3 animals being killed and the others driven out at sea again. On april 2010 (Southern Island, Hvalba) a pod of 21 animals was driven ashore. The 24 dolphins killed (8 males and 16 females) were examined and sampled by the staff of the Natural History Museum. Results on life history and diet were reported.

The observations in the Faroese EEZ zone, especially the one north of 62ºN represent a northwards extension of the known range of Risso's Dolphin. Within the last years other more southern species of whales and fish have been observed around the Faroes, Shetland and north-western Scotland. The occurrence off the Faroes of Risso's dolphins in September 2009 and April 2010 confirms this tendency, parallel to the increasing temperature described for the North Atlantic waters since 1975.

The SC encourages the completion and publication of the work presented, which add to the understanding of the species poorly known biology and ecology in the North Atlantic.

10. GENERAL MODELS FOR MANAGEMENT FOR BALEEN WHALES

10.1 Working Group (WG) Report

The SC reviewed the report (ANNEX 4) from the Working Group on Assessments (AS WG). In the absence of Walløe, Chair of the WG, Víkingsson, Convenor of the WG, presented the report from the WG meeting.

As an introduction, a historical overview of management procedures for cetaceans was given with an emphasis on the development within the IWC during the last 4 decades. This development resulted in the adoption of management procedures by the IWC; the Revised Management Procedure (RMP) and Aboriginal Whaling Management

Procedures (AWMP) for the Bering-Chukchi-Beaufort Seas Stock of bowhead whales and East Pacific gray whales.

During discussion the working group agreed on the high value of the process of developing the RMP and AWMP and especially of the concept of feedback control mechanisms based on abundance, catch history and a population model. It also agreed that these principles are valuable and worth carrying over into any NAMMCO management procedure.

Generic procedures or species or stock specific procedures?

Noting that NAMMCO had endorsed the recommendation by the SC to adopt an RMP-like approach, the SC recognized that this approach cannot in most cases be applied immediately to stocks of baleen whales in the NAMMCO area. Although considerable work has already been done by the SC of the IWC as a part of RMP implementation for some stocks (North Atlantic minke and fin whales) further simulation testing is needed for the modifications recommended by NAMMCO (*e.g.* different tuning levels). For many species/stocks, *i.e.* those that have not been subject to the RMP implementation process, appreciably more work would be required before a RMP-like management procedure could be implemented. In order to provide an overview of the work needed for each species and stock, the Working Group tabulated the status for the baleen whales in the NAMMCO area in this regard (Table 3).

Apart from the assessment part of this work, the SC considered it questionable if the SC was currently in a position where it can carry out this work. The question is not only related to time and the extra funding required, but also to the fact that the setting up and running implementation trials is a very specialised work and it cannot be expected that it will be possible to hire external experts that have the time and to be able to do this at short notice. Should management procedure implementation be an essential part of NAMMCO SC work in the future, it might require that an expert is employed directly by NAMMCO.

Distinction between types of whaling operations (commercial versus aboriginal or some other distinction)?

The SC noted that a potential distinction in NAMMCO between different types of whaling operations is not a scientific decision. These operations range from Subsistence over Small-Type Local to Fully Commercial. The SC has no specific comment on the appropriate tuning level (trade-off between catch and resource risk) to apply for different types of fishery, and considers that the Council should determine both this level and whether it should differ amongst the different fishery types.

Abundance information needed and how should it be obtained?

The SC agreed that if an RMP-like approach is to be employed the necessary abundance information should be derived with a maximum interval of 10 years Further details, including potential phase-out rule, should be decided after more precise definition of the management approach.

Species/ area	NAMMCO			Approach under IWC	Comments (requirements for long-term management)
	Request from	Advice to	Approach used by		
Fin whales					
EGI	Yes	2011-2015	RMP, CLA 0.60 TL	RMP 0.72	ISTs for 0.6 required because of stock structure questions but yet to be completed
WG	No*			Interim	Implementation trials needed + MP development
NE Atlantic	Yes	No			Implementation trials needed to check RMP
Minke whales					
CN Atlantic	Yes	2011-2015	RMP, CLA 0.60 TL		ISTs for 0.6 not seen as a priority because stock structure questions are not major
NE Atlantic	No*			RMP 0.60 (Norwegian)	
WG	No*			Interim	Implementation trials needed + MP development
Humpback whales					
CN Atlantic	Yes	No			Implementation trials needed to check RMP
WG	Yes	2010-2015	Interim	Interim	Implementation trials needed + MP development
NE Atlantic	No				Implementation trials needed to check RMP
Sei whales					
CN Atlantic	Yes	No			Implementation (trials) needed to check RMP
WG	Yes	No			Implementation (trials) needed + MP development
NE Atlantic	No				

Bowhead whales					
WG	No*			Interim	Implementation trials needed for MP development

Table 3. List of assessment status by species and area (* management advice provided by the SC of the IWC). Interim as in Allison *et al.* (2009), longer term approaches involving simulation trials and AWMP development occurs in IWC. EGI: East Greenland and Iceland; WG: West Greenland; CN Atlantic: Central North Atlantic; NE Atlantic: North East Atlantic. RMP: Revised Management Procedure; MP: Management Procedure; IST: Implementation Simulation Trials; CLA: Catch Limit Algorithm.

How much stock structure information is needed, and how should it be used?

Recent assessments have generally identified stock structure issues as a major source of uncertainty. The SC agreed that the need for stock structure information from a variety of sources should be considered on a case by case basis.

What kind of Catch Limit Algorithm(s) should be adopted for the NAMMCO management procedure(s)?

The AS WG and the SC did not directly consider which management procedure or tuning should be adopted by NAMMCO. It did though note that the IWC CLA for the three original tuning levels (0.60; 0.66 and 0.72) and the two extra tuning of the Norwegian RMP-approach are all realistic candidates, that the 0.60 tuning has currently been applied in the two cases where an RMP procedure has been applied within NAMMCO. New management procedures may have to be developed for the Greenlandic fisheries should long-term advice have to be given for these by NAMMCO.

How much simulation testing should potential management procedures be put through before they can be accepted?

The IWC's CLA and the Norwegian CLA have been subject to a range of simulation trials considered sufficient to allow them to be implemented to recommend catch limits dependent on:

- The resource to which they are applied being considered a single stock, and
- The tuning level chosen for the procedure yielding trial results considered to offer acceptable trade-offs between catches and risks of unintended depletion.

Each implementation should be initiated with an assessment, including various levels of Implementation Simulation Trials. If discrepancies are evident between observations and model fits, either immediately or during implementation reviews held at regular intervals after a management procedure is first implemented, these further simulated trials should be carried out using models of the dynamics which are more consistent with the observations.

Discussion by the Scientific Committee
The SC adopted the conclusions and recommendations of the AS WG. Furthermore, the SC notes that this completes the exploration within NAMMCO of work that has been carried out so far by other organisations, here in particular the IWC. While re-iterating its recommendations that and RMP-like approach would be the ideal way forward for management of large baleen whales in NAMMCO, the SC stressed that further development of this subject will require a substantial increase in capacity in terms of time and funding for the SC in general and the secretariat in particular.

11. SURVEYS

Desportes, the Convenor of the Abundance Estimation WG, presented SC/18/06 (ANNEX 2) for Pike, the external Chair of the AE WG.

11.1 T-NASS

Appendix 3 summarises the best abundance estimates from T-NASS (2007) that have been endorsed by the SC for use in assessment. Appendix 4 provides a summary of recommended analyses for estimates that have not yet been completed. Remaining work includes the completion of abundance estimates for dolphins, bottlenose and sperm whales for the Faroese and Icelandic areas, large whales and dolphins from the Norwegian mosaic surveys, correction of estimates from Canadian aerial surveys for availability bias, and resolution of some methodological issues. The SC u**rges** members to complete these tasks as soon as feasible and to submit papers for publication in peer-reviewed journals, and preferably in a coordinated way – see below for details.

T-NASS/CODA model based analysis
At its last meeting the SC recommended an integrated model-based analysis of CODA and T-NASS data for some species. Funding for the T-NASS part could not be found through NAMMCO and the project was carried out only with the CODA and Faroese data. The SC reiterates that the proposed study represented a cost-effective means of obtaining a better understanding of the distributions and relative densities of the species, particularly in light of the great resources involved in collecting the data.

Methodological Issue
The SC notes that the last distance estimation for each sighting has been used consistently in analyses of the Iceland/Faroese shipboard data. The standard practice for line transect surveys, however, is the use of the first distance estimation. The SC strongly recommends that the issue is investigated to determine whether the practice introduces a bias into the estimates of abundance. It further recommends that Gunlaugsson takes an active lead in this investigation.

Publication of survey results
The SC reiterates its recommendation that a primary publication on T-NASS be developed, in cooperation with CODA and SNESSA. The SC encourages a speedy publication, and agreed that an agreement with the Editor (Donovan) the IWCs Journal of Cetacean Research and Management is the forum of choice, with Desportes

designated as the NAMMCO coordinator. The AE WG has developed a list of papers to be included.

T-NASS on the NAMMCO website

Noting that the T-NASS section on the NAMMCO web site has not been updated since 2007, the SC recommends an update that includes distribution maps as well as agreed abundance estimates. This section on the web site can be used of all NAMMCO partners to demonstrate the results and cooperative effort of T-NASS, and as such it might have funding implications for future surveys in some jurisdictions.

11.2 Planning of future surveys

Desportes, chair of the WG on Survey Planning, presented the report (ANNEX 4 (SC/18/07)) from the first planning meeting. Besides delegates from NAMMCO countries, the WG meeting had representatives from Canada, Russia, CODA, France and St. Pierre and Miquelon, as well as experts in surveys.

The jurisdictions interest in and purpose for conducting surveys were reviewed, and the target species and required information are summarised in Table 4.

The USA conducts some survey activity annually off its eastern seaboard, primarily to satisfy requirements under the Marine Mammal Protection Act. There was some flexibility in the system to coordinate survey activities with a larger international effort, as was done in 2007. In any event Canada would be coordinating their surveys with those of the USA in order to achieve a more complete synoptic coverage of the area.

The SC was informed of the initiative of the French Marine Protected Area Agency and their general interest for cooperation, and of the interest of St. Pierre et Miquelon, already cooperating with DFO, to be included in a future large synoptic survey.

The SC concludes that the interests of the NAMMCO countries as well as Canada, and the Russian Federation, combined with the common desire of following trends in distribution and abundance for ecosystem monitoring, would be best-served by mounting another international large synoptic survey, with a strong will to continue to coordinate with other ongoing surveys in the area, especially the European effort CODA/SCANS and the US SNESSA.

The year of the next survey will depend on several factors. “Phase-out” under the RMP will begin in 2014 for Iceland if a survey is not conducted before. But Iceland is not legally bound to this rule. The last year of the current Norwegian survey cycle is 2013, and Norway will likely have most coordination flexibility in this year or in 2014. Greenland work on obtaining diving data for correction factors before the next survey, which is planned to take place no later than 2017. It is unlikely that Canada, CODA/SCANS can mount another survey before 2014. Taken together, it is unlikely that another international survey can be conducted before 2014.

JURISDICTION	TARGETS	INFORMATION	FREQUENCY /Timing
Iceland	Primary: minke, fin	Absolute abundance	Every 6 years (IWC RMP)
	Secondary: sei, harbour porpoise	Abundance and trends	No requirements
Faroes	Pilot	Absolute or relative abundance according to management needs (not yet defined)	Not yet defined.
Norway	Minke	Absolute abundance	Every 6 years (IWC RMP)
Greenland	Primary: Minke, fin, humpback Secondary: harbour porpoise and dolphins.	Absolute abundance	At least every 10 years (IWCAWMP). Wait for new diving data; before 2017.
Canada	All, priority to SARA listed spp.	Absolute abundance, distribution	No requirements (requirement from SARA)
Russia	All	Relative abundance, distribution	No requirements
CODA/SCANS European effort	All	Absolute abundance	Decadal (European Habitat Directive)
All	All	Trends in distribution and abundance, for ecosystem monitoring.	No requirements.

Table 4. Target species and required information for each jurisdiction.

Lessons learned

The history of NASS shows how participation, survey extent, stratification, effort, design, and methodology have evolved over 20 years and 5 surveys. The stratification and shape of the survey area has changed so that the "common" area covered by all or most surveys amounts to only 40 to 60% of the total area covered.

A lack of correlation between effort intensity and fin whale density in several surveys suggests that stratification has not been optimal for this and probably also other target species. Transect design resulted in acceptable coverage in most years but some examples of inadequate design and/or survey execution were illustrated. Field methodologies have also changed, primarily with the move to double platforms by all participants after 1995. These changes limit the comparability of the estimates and make it challenging to estimate valid trends in density and abundance for some species.

Overall strategy

Synoptic vs. mosaic surveys

The mosaic surveys conducted by Norway have been effective in producing estimates of minke whale abundance acceptable for use in the RMP. A mosaic survey programme has practical advantages in that some survey activity is conducted every year, but is not as effective in describing large scale trends in distribution and abundance, primarily because the overall estimates cannot be ascribed to any one year. The SC recommends a synoptic survey **(**within the same year). This will make the survey comparable to the previous five NASS. The SC recognises that Norway is bound to its mosaic survey cycle, and recommends that all effort be made to make the area surveyed by Norway contiguous to the core area.

The SC agreed that the seasonal timing of the surveys should, ideally, coincide with the peak period of occupancy by the target species of the survey area. It also realises that the optimal seasonal survey period may not be the same for all countries. It was recognized that the seasonal distribution of whales may have changed over the past 20 years due to climate change or other factors. The SC recommends that any new information on the seasonal occurrence of cetaceans in the survey area be assembled and brought to the next planning meeting.

Best methodologies

Norway and Greenland have developed survey methodologies that are well suited for their purposes, while Iceland and the Faroese are still in the process of optimising their aerial and shipboard surveys.

The general pattern of using aircraft for coastal areas and ships for offshore areas is expected to hold also for the next survey. However, the possibility of using larger, faster aircrafts to survey offshore areas is being investigated by Canada and Iceland.

Shipboard survey

The SC recommends the use of a double platform surveys because it provide important data with which to correct biases. While these biases tended to be more important for smaller, cryptic species such as minke whales than for larger species such as fin whales, analyses have demonstrated that they exist even for the latter.

There had been problems with the implementation of the BT double platform configuration in both 2001 and 2007 in the Icelandic, Faroese and CODA shipboard surveys. Other double platform methodologies, such as the I/O used by Norway, and the BT with post-survey duplicate identification as used in SNESSA, are available. The SC recommends that the advantages and disadvantages of these approaches should be compared in the context of the target species mix and other circumstances expected in the next Icelandic and Faroese shipboard surveys, as well as CODA. The SC recommends that Desportes be tasked with preparing a document describing and comparing the various approaches available, and that a Shipboard Methodology Group under Desportes uses this documentation to recommend a methodology at the next meeting of the SP WG.

Aerial survey

At least three aerial survey methodologies have been used in the NASS area (cue counting, double platform I/O, and single platform with "circle back") and other variations are used elsewhere. There is an increasing use of technology such as video, still, and infra-red photography, and even drone aircraft. The SC recommends that the advantages and disadvantages of the different methods be compared in the context of the target species mix and other circumstances expected in the next Icelandic and Canadian aerial surveys. The SC recommends that Pike be tasked with preparing a document comparing the available approaches, and that an Aerial Methodology Group under Pike uses this documentation to recommend a methodology at the next meeting of the SP WG.

Spatial extent and stratification

The SC agreed that the information from previous NASS should be utilized to plan the next survey so that it can be optimized to meet its objectives in a cost effective way. The SC recommends the development of a spatial analysis, looking at spatial patterns of encounter rates and/or densities of target species before the next meeting of the SP WG. The resulting plots of high and low density areas should be used to optimize the area to be covered, the stratification of the survey, and the specific methodology to be used in each strata to obtain the best possible estimates.

It was noted that the distribution of some species (*e.g.*, fin, minke, and humpback whales) has changed over the course of the NASS and it is possible that the present core survey area may not be optimal in the future. If so a choice might have to be made between inter-survey comparability and the optimization for target species.

Survey planning and coordination

Coordination of international surveys can range from the loose association of national survey efforts characteristic of some NASS, to the tight central coordination of the CODA and SCANS surveys. The SC reiterated its previous recommendation that the survey should be coordinated to the maximum extent possible, and at a minimum at the level of TNASS, while at the same time respecting that the different countries may have different priorities.

The SC considered it important to continue the planning process given the commitment of participants to mounting a survey, even if the actual timing is unclear at this moment. Equipment and software must in some cases be designed and built, and ordered well in advance to avoid problems with late delivery and the lack of familiarity with equipment that have sometimes been experienced in past NASS surveys and particularly in the 2007 Faroese, Icelandic and Greenlandic shipboard surveys.

It is recognized that having a single point of contact during the planning process is crucial. The SC recommends that NAMMCO appoint an overall Survey Coordinator to drive the planning process and appointed Desportes as temporary coordinator. The task of the coordinator will include

- Fundraising for the coordination and outreach work, as well as general survey activities, and ideally also for analyses of non target species data or/and overall analyses.
- Coordination and support to common activities (*e.g.* common cruise leader and observer guidelines).
- Reporting to the SP WG, compilation of updates and progress for the NAMMCO website, as well as the public at large.

Foreseeable resources and possibilities for external funding

The WG considered it likely that, as with previous NASS, the next survey will depend to a large extent on funding from participating national governments. There is, however, the possibility of external funding from industry in some areas and from inter-governmental and non-governmental organizations. It should also be noted that the inclusion of monitoring objectives related to climate change could create some funding opportunities.

Planning Schedule

The SC recommends that the next meeting of the SP WG is scheduled for January 2012. By that time the factors affecting the timing of the survey should be clarified. The SC recommends that the following be completed before, and considered during, the next SP WG meeting

- Spatial analysis of all previous NASS for use in survey planning.
- Information on the seasonal occurrence of cetaceans in all survey areas
- A document describing advantages and disadvantages of different ship survey methodologies
- A document describing advantages and disadvantages of different aerial survey methodologies

12. NAMMCO SCIENTIFIC PUBLICATIONS

Acquarone presented the latest volume in the NAMMCO Scientific Publication Series: "Harbour Seals in the North Atlantic and the Baltic" and gave an account and an evaluation of the progress. He then continued by presenting the progress and future plans regarding the volume on walrus (SC/18/21 and SC/18/22).

The SC noted that most if not all the volumes in the NSP series originated from a WG meeting. With the intention of reducing the time between such a WG meeting and the publication of a potential volume, the SC suggests that the WG Chair/Convenor, in concert with the Secretariat, prepares the process by calling for contributions to the volume, from both WG participants and other potential contributors, to be submitted by the time the WG meeting is held.

13. DATABASES ON ABUNDANCE AND CATCHES

13.1 Abundance

Acquarone informed that there has been no progress made by the email group established at the NAMMCO SC17 due to priority conflict. The SC reiterates its interest in an abundance database holding all endorsed estimates and urges the email group (Acquarone, (Chair), Heide-Jørgensen, Øien, Gunnlaugsson, Mikkelsen and Witting) to proceed on the matter according to the guidelines set at NAMMCO SC17.

The SC reiterated that they considered it crucial to have a centralized database to protect the integrity of all NASS survey dataset and to facilitate its use by interested researchers, in the view of the experience gained. In addition a record of the original survey documentation should be assembled and maintained. One possible solution, of submitting the physical data to the IWC database, seems to be the optimal preservation method that would avoid the duplication of work. Countries are urged to submit survey data for all species to the IWC. The NAMMCO Secretariat should contact IWC to obtain access clearance for NAMMCO to these data.

13.2 Catches

Acquarone reported that little progress has been made on this item. Limited research has resulted in localising some of the data at the Secretariat. The process was put on stand-by due to more urgent matters. The SC encourages the email group (Acquarone (Chair), Ugarte, Haug and Mikkelsen as well as a member from Iceland to replace Ólafsdóttir) to proceed with the establishment a catch database at NAMMCO for all species and all areas. The SC noted again that the intent of the database was not to provide catch data for assessments, but only to hold catch histories (including by catch) for all species and areas. It also noted that the catch histories of the proposed Stock Status lists on the NAMMCO homepage (item 17.2) might be all that is needed for this database.

14. WORK PROCEDURES IN THE SCIENTIFIC COMMITTEE

14.1 Update on members to Scientific Committee

The **SC is pleased** that its new Rules of Procedure allows up 6 members to the SC per Country, with only 3 members attending a SC meeting. **It notes**, however, that the current membership is reduced to only two members for ***Iceland*** and the ***Faroe Islands***, and that it is three members from ***Norway*** and ***Greenland***.

The intent of the increase in membership was to allow for an increase in the scientific expertise of the SC, as well as allowing for backup expertise when some members are unable to attend a meeting. The SC is required to cover not only scientific expertise for the more than twenty species of marine mammals in the North Atlantic, but also scientific expertise on surveys and abundance estimation, population modelling and statistics, as well as the particular opinions of the different countries on the different subjects.

The **SC welcomes** additional experts on cetacean surveys, modelling/statistical experts, and seal experts. Presence of such experts will ensure the quality of the advice that the SC can provide for Council. The **SC urges** the Council to act on the matter of nominating new SC members for all countries.

14.2 Invited experts for WGs

According to the existing Rules of Procedure (RoP) for the SC, nomination of experts to participate in meetings of the Committee as *ex officio* non-voting members is subject to the approval of the Council no later than 30 days before the start of the meeting in question.

The approval process is time consuming and has on several occasions been difficult to follow. While it may be argued that this is due to bad planning and timing, the reality is that the time from Council requests of WGs to WG meetings often is short considering an expert invitation process that involves:

1) contacting all experts informally to see if they are interested and have time;
2) assembling the list of expected experts (time often defined by the last response);
3) getting approval of the list from Council, and then;
4) contacting experts with formal invitations.

Here it should be remembered that most of the involved people are quite busy with other duties so that any one of the above steps is likely to be somewhat delayed relative to the preferred timing. Furthermore, last minute changes may occur if some experts suddenly cannot come, or others find out that they unexpectedly can participate. While such changes don't fit well into a formal approval process, last minute additions of invited experts can surely be beneficial for the scientific process.

For the reasons above the SC would appreciate a more flexible process that does not involve any formal approval of experts from Council. It is suggested that the SC RoP be changed so that invited experts no longer have to be approved by Council. The Council will still be informed on invited experts prior to WGs, and the Council will still have to approve the budget of the SC, including sub-budgets on WGs with expected number of expert to be paid for by NAMMCO. The following changes to the RoP are suggested.

II Membership: Point 5.

Current version: The Scientific Committee may, on an *ad hoc* basis and subject to the approval of the Council, nominate experts to participate in meetings of the Committee as ex officio non-voting members. Any such nomination of experts must reach the Secretary of NAMMCO no later than 30 days before the start of the meeting in question.

Proposed new version: The Scientific Committee may, on an *ad hoc* basis, nominate experts to participate in meetings of the Committee as *ex officio* non-voting members. Any such nomination of experts must reach the Secretary of NAMMCO no later than 30 days before the start of the meeting in question.

IV. Organisation: Point 3.

Current version: The Scientific Committee decides the terms of reference of the Working Groups, their provisional agenda, membership, Chairmen and dates of meetings, and makes proposals to the Council on invitation of external experts or observers.

Proposed new version: The Scientific Committee decides the terms of reference of the Working Groups, their provisional agenda, membership, Chairmen and dates of meetings, and informs the Council on invitation of external experts or observers.

14.3 Recommendation to the Secretariat

The SC establishes a small WG (Scientific and General Secretary, SC Chair) for clarifying the working areas of the Scientific Secretary, including the expected assistance to the SC at WG meetings and the annual meeting.

The SC encourages the advanced submission of material on update on species to the Secretariat in order to facilitate the running of the annual meeting.

15. FUTURE WORK PLANS

15.1 Review of Active Request

The SC considered that all relevant requests were covered by the meeting.

15.2 Scientific Committee

The SC recognised that teleconference meetings are a valuable alternative to face-to-face meetings in case of urgent or minor matters. However it was unanimous in considering face-to-face meetings both more productive and manageable considering the size and scope of the present agendas.

The next meeting will be organized by Greenland and the timing is tentatively set in the period 16-27 April 2012.

15.3 Working groups

The SC recommends that the following Working Groups meet before its next meeting, noting that other meetings may be held depending on new requests received from the Council:

Working Group for Planning Future Surveys

In 2010 the MCC recommend beginning the preparation/planning for the next T-NASS surveys. In light of recent changes in distribution of some cetacean species the MCC recommended that consideration should be given to extending survey areas. Terms of reference should be to coordinate the year of the surveys, the time of year, and methods. The SC suggests a new meeting of the planning WG in *January 9-13/1 - 2012. Chair: Geneviève Desportes.*

Narwhal and Beluga Joint Working Group

The SC recommends that a new JWG meeting be held on *February 12-18, 2012* to update assessments and advice for beluga and narwhal. Apart from updating the

advice on takes of beluga in West Greenland, and narwhals in West and East Greenland, the ToR include two new requests:

R 3.4.12 – 2010: The Scientific Committee is requested to provide advice on sustainable takes of narwhal from the Kane Basin in spring, summer and fall.

R 3.4.13 – 2010: Noting the conclusions of the Scientific Committee, and in view of recent dynamic changes in the environment, the Council requests the Scientific Committee to reconsider its advice on the temporal and geographical restrictions on the takes of beluga from West Greenland within the framework of the NAMMCO/JCNB Joint Scientific Working Group.

The location is likely to be Copenhagen. *Convenor: Mads Peter Heide-Jørgensen; Chair: Rod Hobbs.*

Harbour Porpoise Working Group

Noting the open request R.3.10.1 the SC recommends that assessments of harbour porpoise be carried out for all areas if possible. The MCC recommend that total removal estimates for all areas, and that abundance estimates from the 2007 survey in Iceland and the 2010 survey in the Faroe Islands are available before meeting. The SC recommends that the WG meeting be either held in Marts 2012 prior to the next SC meeting or in the fall of 2012 after the next SC meeting. *Chair: Bjarni Mikkelsen*

Working Group on Large Whale Assessment

Remaining items of on the agenda for this WG include fin whale simulation trials for the Central North Atlantic applying the 60% tuning of the RMP, as well as further studies on the stock structure hypotheses for North Atlantic fin whales. It includes also a recommended catch calculation with catch cascading for minke whales in the Central North Atlantic medium area. It is suggested that a tele-conference WG meeting might be held within the coming year, if sufficient progress is made. *Convenor: Gísli Víkingsson; Chair: Lars Walløe.*

WG meetings recommended to be held later than the 2012 SC meeting include:

Grey and Harbour Seal Working Group

The SMC recommended in 2010 that the WG on coastal seals perform assessment for grey and harbour seals in all areas and develop a common management model for both species in all areas. A second meeting is needed in order to finalize assessments and to agree on a common management model for all areas. *Convenor: Tore Haug; Chair: Kjell Tormod Nilssen.*

Pilot Whale Working Group

The SC recommend that a pilot whale WG meeting be held to perform assessments and aim at providing advice on sustainable removals for pilot whales around the Faroes Islands and West Greenland, as relating to **R.3.8.1, R.3.8.2** and **R.3.8.5**. This meeting awaits progress on abundance estimates and stock structure from the Faroes (see recommendations under agenda item 9.9).

16. BUDGET

16.1 Spending in 2010/11

Acquarone presented the budget and the spending to date for 2010 (SC/18/11) which detailed the actual and foreseen costs of all SC activities throughout the year. These costs included specific travel funding provided to experts and work contracts. All costs were well within budget.

16.2 Budget for 2011/12

The SC drafted and approved a budget proposal for the year 2012.

17. ANY OTHER BUSINESS

17.1 Species/stock lists – update on work

Desportes showed the suggested template for the NAMMCO Stock Status List web site which presently includes fin and minke whales.

The SC gave positive comments and feedback and encourages the continuation of the project. It specifically noted that the site fulfils in particular the needs for divulgation of the T-NASS results as recommended by the AE WG and the SC. Furthermore the site will allow the presentation of catch data according to the recommendations of the SC. The SC notes that the stock status files available to the public on the present NAMMCO web site have not been updated since 2002 in spite of the availability of newer abundance estimates and assessments in the mean time.

17.2 US ESA listing of Arctic ringed seal

Acquarone reported that as a response to the initiation of the process of listing ringed seals in the US Marine Mammal Protection Act. NAMMCO, in a letter sent to the relevant US authority, has offered scientific assistance in the assessment of this species. He also reported that no response has been received to the letter.

17.3 Election of officers

Thorvaldur Gunnlaugsson (Iceland) was elected as Vice Chair to the SC.

18. MEETING CLOSURE

18.1 Acceptance of report

A draft version of the report containing the items that were agreed upon was accepted on most items of the report was approved on 5 May 2011 and the final complete version was approved by correspondence on 22 July 2011.

18.2 Closing remarks.

The Chair thanked all convened SC members, regretting the incompleteness of some delegations, and the observers for their contributions to the meeting. He thanked the Rapporteur for his hard work, Mikkelsen for arranging the meeting at such a pleasant location and the weather gods for the magnificent and unusual uninterrupted sunshine.

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Appendix 1

AGENDA

1. CHAIRMAN'S WELCOME AND OPENING REMARKS

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    - 4.2 Working Group Reports
    - 4.3 Other reports and documents

5. COOPERATION WITH OTHER ORGANISATIONS
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    - 5.2 ICES & NAFO
    - 5.3 JCNB

6. ROLE OF MARINE MAMMALS IN THE MARINE ECOSYSTEM
    - 6.1 Update on modelling
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7. BY CATCH OF MARINE MAMMALS
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Appendix 2

LIST OF DOCUMENTS

Doc.No.	**Title**
SC/18/01	List of Participants
SC/18/02	Provisional Annotated Agenda
SC/18/03	List of Documents
SC/18/NPR-F	National Progress Report – Faroe Islands
SC/18/NPR-G	*National Progress Report – Greenland*
SC/18/NPR-I	National Progress Report – Iceland
SC/18/NPR-N	National Progress Report – Norway
SC/18/NPR-C	National Progress Report – Canada
SC/18/NPR-J	National Progress Report – Japan
SC/18/NPR-R	National Progress Report – Russian Federation
SC/18/04	Observer's report: 62nd meeting of the IWC Scientific Committee
SC/18/05	Report of the Joint NAMMCO/ICES Workshop on observation schemes for bycatch of mammals and birds (WKOSBOMB) 28 June-1 July 2010 ICES, Denmark DRAFT
SC/18/06	Report of the NAMMCO Working Group on Abundance Estimates, March 2011
SC/18/07	Report of the NAMMCO Working Group on Survey Planning, March 2011
SC/18/08	Report of the NAMMCO Working Group on Coastal Seals, March 2011
SC/18/09	Report of the NAMMCO Working Group on Assessment, April 2011
SC/18/10	Bloch, D., Desportes, G, Mikkelsen, M., Harvey, P. and Lockyer, C. 2011. Risso's Dolphin (Grampus griseus) (G. Cuvier, 1812) off the Faroe Islands.
SC/18/11	NAMMCO Scientific Committee Expenses 2010/11 and Budget 2011/12
SC/18/12	Summary of the Report of the NAMMCO Working Group on Abundance Estimates, March 2011
SC/18/13	Observer's report on activities in ICES
SC/18/14	Summary of the report of the NAMMCO Working Group on Coastal Seals, March 2011
SC/18/15	Summary Of Requests By NAMMCO Council To The Scientific Committee, And Responses By The Scientific Committee, Annual Report 2010
SC/18/16	Report from the 25th Conference of the European Cetacean Society
SC/18/17	Report of participation at the International Polar Year (IPY) Oslo Science Conference 8-12th June 2010
SC/18/18	Approach from the IWC for a joint global review of monodontids

SC/18/19	Summary of the Report of the NAMMCO Working Group on Survey Planning, March 2011
SC/18/20	Summary of the Assessment Working Group meeting 2011
SC/18/21	NSP on walrus: tentative contents
SC/18/22	NSP on walrus: tentative schedule

BACKGROUND DOCUMENTS

Doc.No.	**Title**
SC/18/O/01	IUCN fin whale specialist group – 2008 assessment fig.1
SC/18/O/02	Enquiry by ASCOBANS on Faroese Risso's dolphin catch
SC/18/O/03	Response by the Faroes to the enquiry by ASCOBANS on Risso's dolphin catch
SC/18/O/04	Bloch, D. and Mikkelsen, B. 2009. Catch history and distribution of whitesided dolphin (*Lagenorhynchus acutus*) of the Faroe Islands. Fróðskaparrit 57:90-98.
SC/18/O/05	Pike, D.G., Desportes, G., Gunnlaugsson, T., Mikkelsen, B. and Bloch, D. Estimates of the relative abundance pilot whales (*Globicephala melas*) from North Atlantic Sightings Surveys, 1987 to 2007. Doc prepared for the AE WG meeting 2011.
SC/18/O/06	Report of the ICES Study Group on long-finned pilot whales, Cambridge, April 1996.
SC/18/O/07	T-NASS: a cast of many – Report to the ICES WGMME meeting, Feb 2011
SC/18/O/08	Glover, K.A., Kanda, N., Haug, T., Pastene, L.A., Øien, N., Goto, M., Seliussen, B.B. and Skaug, H.J. 2010. Migration of Antarctic Minke Whales to the Arctic. PLoS ONE 5(12): e15197. doi:10.1371/ journal.pone.0015197
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SC/18/O/10	Richard, P.R., Laake, J.L., Hobbs, R.C., Heide-Jørgensen, M.P., Asselin, N.C., and Cleator, H. 2010. Baffin Bay Narwhal Population Distribution and Numbers: Aerial Surveys in the Canadian High Arctic, 2002–04. Arctic 63(1):85–99.
SC/18/O/11	Heide-Jørgensen, M.P., Laidre, K.L., Burt, M.L., Borchers, D.L., Marques, T.A., Hansen, R.G., Rasmussen, M. and Fossette, S. 2010. Abundance of narwhals (*Monodon monoceros*) on the hunting grounds in Greenland. Journal of Mammalogy, 91(5):1135–1151.
SC/18/O/12	Laidre, K.L. and Heide-Jørgensen, M.P. 2011. Life in the lead: extreme densities of narwhals *Monodon monoceros* in the offshore pack ice. Mar Ecol Prog Ser

SC/18/O/13	Laidre, K.L., Heide‐Jørgensen, M. P., Ermold, W. and Steel, M. 2010. Narwhals document continued warming of southern Baffin Bay. *J. Geophys. Res.* 115, C10049, doi:10.1029/2009JC005820.
SC/18/O/14	To The Ministry of Domestic Affairs, Nature and Environment, P.O. Box 1614, 3900 Nuuk, Greenland. 2011. Standing Non-Detriment Findings for Exports from Greenland of Products derived from Atlantic walrus (*Odobenus rosmarus rosmarus*)
SC/18/O/15	Heide-Jørgensen, M.P., Laidre, K.L., Wiig, Ø., Postma, L., Dueck, L. and Bachmann, L. 2010. Large-scale sexual segregation of bowhead whales. Endang Species Res 13:73–78.
SC/18/O/16	Laidre, K.L., Heide-Jørgensen, M.P., Logsdon, M.L., Delwiche, L. and Gissel Nielsen, T. 2010. A whale of an opportunity: Examining the vertical structure of chlorophyll-a in high Arctic waters using instrumented marine predators. Marine Biology Research 6:519-529.
SC/18/O/17	Ford, J.K.B., Ellis, G.M., Matkin, C.O., Wetklo, M.A., Barrett-Lennard, L.G. and Withler, R.E. 2011. Shark predation and tooth wear in a population of northeastern Pacific killer whales. Aquat Biol 11: 213–224.
SC/18/O/18	O'Corry-Crowe, G., Lydersen, C., Heide-Jørgensen, M.P., Hansen, L., Mukhametov, L.M., Dove, O. and Kovacs, K.M. 2010. Population genetic structure and evolutionary history of North Atlantic beluga whales (*Delphinapterus leucas*) fromWest Greenland, Svalbard and the White Sea. Polar Biol 33:1179–1194.

Appendix 3

Abundance estimate from T-NASS (2007) endorsed by NAMMCO

Survey Areas	West Greenland	Iceland Coastal **(Faroese coastal)**	Iceland-Faroes	Canada GSS	Canada NL	Norwegian mosaic 2003-7
Species / Survey	Aerial	Aerial	Shipboard	Aerial	Aerial	Shipboard
Fin whale	4,359 n,j (1,879-10,114)	-	20,613 n,j (14,819-25,466) 26,117 pj (17,401-39,199)	462 n,j (270-791)	1254 p,j (765-2,059)	To be done
Minke whale	16,609 pa[1] ,j (7,172-38,461) 22,952 pa[2]j (7,815-67,403)	14,638[3] pa, l (7,381-24,919) 20,834[4] pa, l (9,808-37,042)	10,782 n,k (4,733- 19,262)	1,927 j (1,196-2,799)	3,748 pj (2,214-6,345)	IWC
Minke whale 2009		9,588 pa, l (5,274-14,420)				
Humpback whale	3,272 pa,j (1.230-8.710)	1,242 p,j (632-2,445)	11,572 n,j (4,502-23,807)	653 j (385-1,032)	3,712 p,j (2,536-5,428)	To be done
Pilot whale	**2,976 n,j (1,178-7,515)**	-	**Not accepted**	6,134 n,j (2,774-10,573)	-	To be done
Sperm whale	-	-	To be done	-	-	To be done
Bottlenose whale	-	-	To be done	-	-	To be done
Harbour porpoise	**33,271 pa,j (15,939-69,450)**	**43,179 pa, l (31,755-161,899)**	-	3,667 n,j (1,565-6,566)	958 n,j (470-1,954)	To be done
Harbour porpoise **Faroes 2010**		**5,175 pa, l (3,457-17,637)**				

White-beaked dolphins	**9,827 p,j (6,723-14,365)**	To be done	To be done	-	-	To be done
White-sided dolphin	-	-	To be done	4,289 n,j (cv = 0.210)	3,086 p,j (1,781-5,357)	To be done
Common dolphin	-	-	-	53,049 n,j (34,865-80,717)	613 p,j (278-1,355)	-

Estimates in bold are first estimates for the species in the area. Estimates in blue have been endorsed by the AEWG at this meeting, estimates in black have been endorsed at previous meetings. For details about the remaining or recommended supplementary analyses see Appendix 4 below.

n, uncorrected for bias; p, corrected for perception bias; a, corrected for availability bias.

[1] Availability bias is adjusted using aerial photographic images taken in Iceland.

[2] Availability bias is adjusted using satellite tagging data from three different areas.

[3] Using both primary observers

[4] Using only the most effective primary observer (much higher sighting rate)

i, Endorsed at the NAMMCO WG on Abundance Estimate, Copenhagen, April 2008, and subsequent SC Meeting (NAMMCO, 2009)

j, Endorsed at the NAMMCO WG on Abundance Estimate, Quebec, October 2009, and subsequent SC Meeting (NAMMCO, 2011)

k, Endorsed at the NAMMCO WG on Assessment, Copenhagen, March 2010, and subsequent SC Meeting (NAMMCO, 2011)

l, Endorsed at the NAMMCO WG on Abundance Estimate, Copenhagen, March 2011.

Appendix 4

Summary by species and areas of the analyses remaining to be done from the T-NASS data as well as the supplementary analyses recommended by the NAMMCO SC Working Group on Abundance Estimates (AEWG) at their meeting in Quebec, October 2009 and in Copenhagen, March 2011 (in italics).

Species	Areas	Recommendations
All species	Norway	*Provide estimates for species other than minke whales from the most recent survey series.*
	Iceland	*Determine whether there is a problem in using the last distance estimation for each sighting instead of the first, which is standard practice for line transect surveys of cetaceans.*
	Canada	*Correct for availability bias in all areas and perception bias in the GSS area.*
	NAMMCO Secretariat	*Establish a database for storing centrally all NASS survey data*
	Canada, Iceland, Faroes and Norway	*Prepare publications of results for inclusion in an IWC special Issue, according to the list prepared.*
	All	*Future surveys must have a clear and carefully designed protocol for defining groups and estimating group sizes; these are particularly important issues for pilot whales.*
Minke	Canada aerial – GSS	*Investigate possibility of correcting for availability bias using the methods employed in Greenland (SC/17/AE/08).*
Humpback	Iceland-Faroese shipboard	Investigate for the possible presence of responsive movement. If such evidence is found then a MRDS model assuming full independence should be used.
	Iceland-Faroese shipboard and Iceland costal	Combine Iceland-Faroese shipboard and Iceland coastal surveys by employing abundance estimates from the shipboard surveys in the overlapping areas and to use the post-stratified aerial survey for the rest.
Pilot whales	Iceland-Faroes CDS estimate	Correct for perception bias using MRDS assuming PI.
Sperm whales	Iceland & Faroes	*A visual line transect analysis should be prepared for both areas.* *The acoustic data should be reprocessed and an abundance estimate prepared from these data.*

Bottlenose whales	Iceland & Faroese	*Analysis of shipboard sightings data remains to be done*
Dolphins	Iceland-Faroese shipboard and Iceland coastal	*Analysis remains to be done*

ANNEX 1

NAMMCO SCIENTIFIC COMMITTEE WORKING GROUP ON COASTAL SEALS (CS)

Copenhagen, 14-17 March 2011

REPORT

1. CHAIRMAN WELCOME AND OPENING REMARKS

Chairman Kjell Tormod Nilssen welcomed the delegates (Address Section 5.6) to the first joint meeting of the NAMMCO Scientific Committee Working Group on Coastal seals. As Terms of Reference the Working Group was to:

- Review the Norwegian management plans for harbour and grey seals,
- Perform assessments for harbour and grey seals in the NAMMCO areas and when possible in other North-Atlantic areas,
- Develop a common management model for both species in the NAMMCO areas.

2. ADOPTION OF AGENDA

The Agenda (Appendix 1) was accepted with minor changes with respect to the circulated draft.

3. APPOINTMENT OF RAPPORTEURS

Mario Acquarone, 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. Especially papers by invited experts who could not participate to the meeting providing information on important areas were welcomed.

4.1. Management plan for Norway

Management plans for coastal seals (harbour and grey seals) in Norway were presented by Nilssen (grey seals, NAMMCO/SC/18/CS/18) and Bjørge (harbour seals, NAMMCO/SC /19/CS/19). These plans stated that the presence of harbour and grey seals has an intrinsic value as important and naturally occurring species in the Norwegian coastal fauna. Norway has committed itself to protecting the diversity of Norwegian nature through the 'Convention on Biological Diversity'. The governmental goal is to ensure sustainable and viable populations of harbour and grey seals within their natural distribution areas. In practical management, however, the government must weigh the desire for the preservation of relatively large, in local context, seal

populations for the benefit of outdoor life and hunting, against the desire to reduce the damage on fisheries and aquaculture in the coastal zone. This involves weighing of decisions that probably will lead to consequences for fisheries and aquaculture operations. The financial burden for the fishing industry must be evaluated in relation to politically acceptable considerations. On the other hand, the decisions also include a political acceptance of the risk that such management measures will lead to for the seal populations long-term preservation.

The harbour seals are monitored by counting hauled out seals during moult (August). Grey seals are monitored by counting white-coated pups during the lactation period (September-December). The Ministry of Fisheries and Coastal Affairs has decided to stabilize the harbour seal population at a level equivalent to that about 7,000 counted animals during moult using the monitoring methodology that was used in the last two abundance surveys along the Norwegian coast (Bjørge *et al.* 2007; Nilssen 2007). The grey seal population should be stabilized at a level equal to 1,200 pups born annually. These population levels are defined as the Target Level (TL).

Hunting quotas are used to stabilize the populations at the TL. Grey seals are managed within three management units (Northern, Central and Southern Norway) based on pupping time differences and genetics (Haug *et al.* 1994; Nilssen and Haug 2007). Harbour seals are managed in administrative units following county borders. Small, unique and geographically isolated populations of harbour seals will not be exposed to hunting.

Population-regulating measures should be designed to ensure that they have the greatest impact in areas where there is documented significant damage to the fishing industry caused by seals. It is assumed that the removals are set for 5-year periods, so that it will be possible to adjust the removals in relation to new population estimates, new knowledge about the damage to the fishing industry, new environmental threats, etc. Table 1 shows proposed strategies for the determination of appropriate management measures adapted to population levels at TL and at levels above and below TL. As a part of the management plan, there should be established a simple administrative procedure with an algorithm for the calculation of quotas based on updated data on the population development in relation to TL, including withdrawals from the populations. Which means an adjustment of the exploitation level based on the population status (Table 1).

Population size (1+)	Regulations
Above TL	Exploitation between sustainable catch[2] and 1.5 x sustainable catch
Equal to TL	Exploitation equal to sustainable catch
Below TL and 0.7 TL	Exploitation equal to 0.7 x sustainable catch
Between 0.7 TL and 0.5 TL	Exploitation equal to 0.5 x sustainable catch
Less than 0.5 TL	0-quota
Less than 0.5 TL and decreasing with 0-quota	Restrictions on disturbance at the breeding areas

Table 1. Exploitation levels and regulatory measures in the Norwegian management plan.

The WG welcomed the presentation of the Norwegian management plan and recommend that:

- The appropriateness of the division in the present management units has to be investigated against scientific evidence (*e.g.* genetics)
- In particular harbour seal management units be defined based on genetics and other appropriate methods (*e.g.* telemetry and tagging)
- The division in management units be revised in case new evidence becomes available
- Surveys be designed to allow for the estimation of variance and therefore the identification of trends
- The frequency of counts should be intensified if negative trends are detected
- Removals should be allocated based on TL specified for each individual management units
- "Sustainable catches" explored for harbour seals and should be clearly defined for both species
- The effects of age and sex of removals should be explored.

Concerns were expressed about the management reactions to decreasing population sizes. In particular a reduction to 0.5 TL over a 5-year period would represent such a significant decrease in numbers that might impair a speedy recovery of the population. Furthermore, it was noted that a reduction of a population by 50% over three generation (*e.g.* 45 years for harbour seals) would place a population in the endangered category within the IUCN framework.

The WG recommended setting the maximum reaction level up to 0.7 TL over a management action time of five years.

4.2. Management plan HELCOM

Härkönen reported on the development following the HELCOM/ICES/EU Seal Expert Workshop (Stockholm, 6-8 September 2005) which proposed a set of ***General Management Principles*** for seal management applicable to the whole Baltic Sea area

[2] Sustainable catch according to REF for both grey and harbour

(NAMMCO/SC/18/CS/21). These general management principles were designed to allow for National Management Plans to be developed based upon sub-regional and national aspects.

General Management Principles are the following which 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 Reference Levels form an integral part of these principles, and for population size, these reference levels are defined as:

- ***Target Reference Level*****:** the level where the growth rate starts to level off and the population asymptotically approach the current carrying capacity level (*e.g.* 0.8 K);
- ***Limit Reference Level*** (the Safe Biological Level)**:** the Minimum Viable Population Size, which is to be defined for each of the management units;
- ***Precautionary Approach Level*** where the populations are at maximum productivity level (Between 50-80% of K. Likely in the lower portion of this range).

The HELCOM/ICES/EU Seal Expert Workshop defined and agreed on the following ***Management Units*** for Baltic Sea seal populations:

1. Harbour seals in the Kalmarsund region (Sweden);
2. South-western Baltic harbour seals (Denmark, Germany, Poland, Sweden);
3. Gulf of Bothnia ringed seals (Finland, Sweden);
4. South-western Archipelago Sea, Gulf of Finland and Gulf of Riga ringed seals (Finland, Estonia, Latvia, Russia);
5. Baltic Sea grey seals (all Contracting Parties to the Helsinki Convention).

The WG thanked Härkönen for the presentation and noted that Target Reference Levels are dependent on factors such as disease (crowding and contact on land), on access to land sites and distribution of suitable ice (*e.g.* for ringed seals) for breeding and on limitations in food availability. Such limits cannot be set with indefinite validity and have to be adjusted taking into consideration environmental stochasticity. Once the populations are beyond the limit reference level, hunting can be allowed as long as the long-term objectives are not compromised. National quotas have been set on grey seals in Sweden and Finland over the past 5 years.

4.3. Common management model for harbour and grey seals

The Group agreed that a management model for harbour and grey seals should at least include the following steps:

- Management objectives should be set in such a way to secure populations at target levels.

- Identify management units based on population structure taking into consideration population size, location, distribution and dispersal.
- Assess population trends within each management unit. Regular surveys have to be made and designed in such a way that their precision can be estimated (see below for survey design principles).
- Identifying the survey precision needed to meet management objectives.
- Management advice should be provided as total removals which include struck-and-lost, by-catch and hunting quotas.
- Initiate studies that identify the occurrence of impacts on fisheries and aquaculture, including sealworm burden in fish in relation to seal density, and will point out areas where the population size needs to be controlled.
- Include an evaluation of the management plan (at latest after 6 years).

Survey design

An optimal survey design (Teilmann *et al*. 2010) for harbour seals entails surveying every year during the moult with at least three replicate surveys per year. The power to detect changes in population growth rate is typically doubled under the conditions tested when carrying out annual surveys as compared with every second year. The power is also substantially increased when carrying out replicate surveys during the annual moulting period. The gain in power will increase steeply up to three annual replicates, but will then level off. Using the trimmed mean of counts, omitting the lowest value of three annually repeated counts, further increases the power, while the point estimate for the rate of change remains the same as for the mean. Such surveys are being carried out in the Baltic, the Skagerrak, the Kattegat, the Limfjord and the Wadden Sea.

However, in cases when such a design is difficult to obtain (*e.g.* Scotland, Iceland, Greenland and Norway, an alternative feasible approach is to carry out three replicate surveys as frequently as possible. In this case the precision of surveys can be estimated from variances in observed data during surveyed years. A third possibility is to base trend analyses on single annual surveys, where the rate of increase is assumed to be according to the exponential function. Here the estimate of precision is given by the residuals of counts in the time series (Harding *et al.* 2007)

5. STATUS OF HARBOUR SEAL STOCKS[3]

5.1. Population structure and genetic diversity of harbour seals

Recent genetic analyses have indicated a finer scale of population differentiation of North Atlantic harbour seals than the 300-500 km suggested in earlier studies by Stanley *et al.* (1996) and Goodman (1998). Thus 4 genetically differentiated populations have been identified in Denmark and Southern Scandinavia (Olsen *et al*. 2010) with distances separating subpopulations as low as 100-200 km. There are also indications of further subdivision within the semi isolated Limfjord area. New genetic studies have also revealed highly significant differentiation between harbour seals in

[3] Information on catches and regulatory measures – Current Research (Biological parameters, stock identity, distribution/migration) – Population assessments.

North-Norway, Svalbard, southeast Greenland and Iceland (Andersen *et al.* 2010). In this study, additional subdivision was furthermore suggested within Iceland and within the sampling area in North-Norway defined by a 75 km radius around the town of Tromsø. Significant differentiation within current management units is also suggested for Finnmark county, where a significant difference in haplotype composition was found between seals in the Porsangerfjord as compared to seals in adjacent areas on the Barents Sea coast (Frie, unpublished data). A high degree of philopatry is also consistent with observed dispersal distances of harbour seals in central Norway which are generally below 150 km (Bjørge *et al*. 2002).

The study by Andersen *et al*. (2010) showed remarkable differences in genetic diversity between Atlantic harbour seal populations. Severely depleted genetic diversity and signs of inbreeding was found in the completely isolated Svalbard population while harbour seals from North-Norway and southeast Greenland show high diversity levels.

The haplotypic diversity of the latter two populations is close to maximum and is significantly higher than diversity estimates for harbour seals in the U.K. and North Sea area. The majority of haplotypes found in southeast Greenland, North-Norway and Iceland are not shared with other investigated populations in the Northeast and Northwest Atlantic and northern populations therefore likely represent unique and important gene pools in a species context.

The WG welcomed this study and noted that there are indications of the presence of further subdivisions within the current management units. For this reason the WG recommend further investigation of the appropriateness of the current management units. Table 2 provides current abundances of stocks globally.

Subspecies	Area	Observed numbers	Estimated abundance	Year	Reference
P. v. stejnegeri	Hokkaido		350	1980s	Wada *et al*. 1991
P. v. stejnegeri	Kuril Islands		1,900	Early 1990s	Reijnders *et al*. 1993
P. v. stejnegeri	Commander Isl.		1,500	Early 1990s	Reijnders *et al*. 1993
P. v. stejnegeri	Kamchatka		200	Early 1990s	Reijnders *et al*. 1993
P. v. stejnegeri	Aleutian Isl.		3,400	1994	Withrow and Loughlin 1995
P. v. richardii	SE Alaska		112,391	2001-2005	Angliss and Outlaw 2007a
P. v. richardii	Gulf of Alaska		45,975	1996-1999	Angliss and Outlaw 2007b
P. v. richardii	Bering Sea		21,651	2000	Angliss and Outlaw 2007c
P. v. richardii	British Col.		108,000	1996-1998	Olesiuk 1999
P. v. richardii	Wash. inshore		15,440	1993	Huber *et al*. 2001
P. v. richardii	Wash. & Oregon		28,094	1993	Huber *et al*. 2001
P. v. richardii	Oregon		10,087	2002	Brown *et al*. 2005
P. v. richardii	California		34,283	2005	Burns 2009
P. v. mellonae	Canada		120-600	Early 1990s	Reijnders *et al*. 1993
P. v. concolor	Canada		10,000 – 14,000		Hammill *et al*. 2010
P. v. concolor	USA	38,000	99,340	2001	Waring *et al*. 2010
P. v. concolor	Greenland		< 1,000	2007	Rosing-Asvid 2010
P. v. vitulina	Iceland		12,000	2006	Hauksson and Einarsson 2010
P. v. vitulina	Svalbard		1,000	2008	Lydersen and Kovacs 2010
P. v. vitulina	Norway	6,705	10,000		Nilssen *et al*. 2010
P. v. vitulina	Sweden, Baltic	588	850-1050	2008	Härkönen and Isakson 2010
P. v. vitulina	S. Scandinavia	17,826	25,500-32,400	2007-2008	Olsen *et al*. 2010

P. v. vitulina	Wadden Sea	17,500	25,000-31,800	2007-2008	Reijnders *et al*. 2010
P. v. vitulina	UK and N. Ireland	24,250	34,600-44,100	2003-2008	Thompson *et al*. 2010
P. v. vitulina	Ireland	2,905	4,100-5,300	2003	Cronin *et al*. 2010
P. v. vitulina	France	295	400-550	2008	Hassani *et al*. 2010
World population of harbour seals			**~610,000-640,000**	**Recent-2009**	**Bjørge *et al*. 2010**

Table 2. Summary of recent information on abundance of harbour seals globally. Observed numbers are actual counts of hauled out moulting seals and represent a minimum estimate of abundance. The estimated number for Norway is from Bjørge et al. 2007. For other areas where observed numbers are available from the cited literature, estimated abundance is derived from conversions factors of 1.43 – 1.82 (ICES 2007).

5.2. Russian Federation (Murman Coast)

No update since the NSP8.

5.3. Norway

Table 3 represents the Norwegian catch statistics for harbour seals. Until 2002 the quotas followed the advice and catches did not exceed the quotas. From 2003 quotas greatly exceeded the advice and catches exceeded quotas in 2007 and 2008. There were no new abundance estimates available since 2006 except for some sub-areas.

Noting that the set quotas and catches in recent periods have substantially exceeded the recommended quotas, and further noting that the impact of this has not been investigated, this WG expresses great concerns and recommends that set quotas follow the scientific advice. In this light the WG recommend that new assessment of harbour seal should be carried out as soon as possible.

Year	Recommended quota	Set quota	Reported catch
1997	230	230	60
1998	242	242	83
1999	288	370	308
2000	380	438	359
2001	473	508	466
2002	504	508	412
2003	511	949	457
2004	511	949	549
2005	550	989	614
2006	305	750	660
2007	350	860	905
2008	350	860	900
2009	350	704	585
Sum	*5,044*	*8,357*	*6,358*

Table 3. Quotas and catches of harbour seals along the Norwegian coast in 1997-2009. The Directorate of Fisheries sets the quotas after recommendation by the Institute of Marine Research (Source "Norwegian management plan for harbour seals", NAMMCO/SC/18/CS/19).

5.4. Southern Scandinavia (*Skagerrak, Kattegat, Limfjord and south-western Baltic*)

Southern Scandinavia is divided into four geographically distinct sub-populations (Skagerrak (Area 1), Kattegat (Area 2+3), south-western Baltic Sea (Area 4), the Limfjord (Areas 5+6, Olsen *et al*. 2010). Systematic aerial surveys have been conducted during the moult in late August with 1-5 repeated surveys annually or biannually. Surveys in the Skagerrak and Kattegat started in 1979, 1988 in the Limfjord, and 1990 in the western Baltic Sea.

Before the epidemic in 1988 the sub-populations of harbour seals increased with an annual growth rate between 12.1 and 16.9%. After the 1988-epidemic, aerial surveys showed a decrease in the harbour seal population of 44-51%. After the epidemic all sub-populations increased with an annual growth rate between 7.9 and 13.6%. The second epidemic in 2002 resulted in population declines of 18-53% of the different sub-populations (Olsen *et al*. 2010). After the second epidemic the sub-populations generally increased with a slower rate (2.1-8.5% annually, Olsen *et al*. 2010). The number of harbour seals counted in Area 1, 2+3, 4 and 5+6 in 2010 was 4,477; 7,219; 770; 868 and 2,572, respectively. This gives a total for the combined area (1-6) of 15,906 seal in 2010, not corrected for seals in the water at the time of the surveys. Applying a correction factor of 1.75 gives a total number of 27,836 seals (Härkönen and Heide-Jørgensen 1990; Härkönen *et al*. 1999).

Harbour seals are totally protected in all areas although 10-20 seals are shot annually in the south-western Baltic to reduce interaction with fisheries. Licences are issued for hunting to protect fishing and aquaculture gear along the Swedish west coast. However, less than 50 seals have been killed annually over the past years. Current by-

catch estimates are lacking, but earlier studies suggested that about 100 harbour seals are by-caught annually in Sweden (Lunneryd, pers. comm.)

To be able to report on the conservation status of harbour seal every six years according to the Habitats Directive in EU, Teilmann *et al*. (2010) showed that three surveys are required annually during the moult.

The status of the harbour seals in Southern Scandinavia is described in details in Olsen *et al*. (2010).

In Denmark, harbour seals were protected in 1977, and since then a number of seal reserves have been established in Danish waters. Andersen (NAMMCO/SC/18/CS/24) reported about a case study to evaluate the efficiency seal reserves in Denmark. This study took place at the Anholt seal reserve. Specifically, it studied the behavioural responses (alert distance, flight initiation distance, flee distances and return times) of harbour seals towards approaching pedestrians and boats. The project was conducted during three periods related to the breeding cycle of harbour seals in the reserve. In all periods, harbour seals responded to boat disturbances at significantly greater distances compared to pedestrian disturbances, and often boats initiated alert and flight reactions when these were outside the reserve. In contrast, harbour seals did not flee from pedestrian disturbers until after the person had entered the reserve. Harbour seal responses to disturbance also varied with period, and seals seemingly exhibited weaker and shorter-lasting responses during breeding season than outside breeding season. This seasonal difference is most likely attributed to a trade-off between fleeing and nursing during the breeding season.

5.5. Baltic

The small population of harbour seals in the Baltic proper descend from seals that entered into the Baltic some 8000 years ago (Härkönen and Isakson 2010). They form a genetically separate population with private alleles not present elsewhere. They were hunted close to extinction in the beginning of the 20th century and experienced a severe bottleneck with perhaps only ten reproductive females in the 1970s. Protective measures and reduction of xenobiotic substances have improved the situation, and the hauled-out moulting population size was 754 in 2010, and about 110 pups have been born annually during the past few years. The protective measures in form of banned hunting and establishment of protected areas will suffice to allow the population to grow, but it will not reach favourable conservation status within foreseeable future.

5.6. British Isles

Nothing was presented on this area but the following information was extracted from a report (SCOS 2011).

Current status of British harbour seals

- approximately 25,650 harbour seals were counted in the U.K.:
    - 79% in Scotland; 16% in England; 5% in Northern Ireland
- Compared with the mid 1990s, some populations have declined by:

  - 50% in Shetland; 67% in Orkney; 35% in the Outer Hebrides; 40% in the Moray Firth and 85% in Firth of Tay.
- Other populations show no consistent declines:
  - Strathclyde is unclear and may have declined slightly after an apparent increase around 2000
  - The North and West coasts of Highland region appear to be stable
  - The 2009 English East coast counts were 20% higher than in 2008 and only 7% below pre epidemic levels.

The WG noted that the reasons for the decline in population size are mainly unknown although in some areas, as the Moray Firth (Thompson *et al*. 2007), human takes would explain the decreasing trend.

5.7. Iceland[4]

Hauksson presented preliminary information about seal removals in Iceland 2010 as reported in Table 4. In particular he pointed out that the Marine Research Institute (MRI) is no longer involved in seal research and management. While the task of providing management advice has been assigned to the Seal Centre, Hvammstangi, (www.selasetur.is), BioPol Science Hotel (www.biopol.is) has assumed the role of compiling catch statistics and performing prey studies. Hauksson reported that the catch statistics for all years are listed in the annual reports of the Marine Research Institute (www.hafro.is).

Species	Method of capture	Number
Harbour Seal	By-catch in gill nets	63
	Hunted	1
Grey Seal	By-catch in gill nets	13
	Hunted	23
Harp Seal	By-catch in gill nets	13
	Hunted	0

Table 4. Preliminary data on removal of seals in Iceland in 2010.

Information on catch levels and on the age structure (catch-at-age) from the harbour seal hunt, as well as information about harbour seal numbers from aerial surveys in Icelandic waters, is necessary for responsible management. In 1982, the Research Committee for Biological Seafood Quality initiated a bounty system for stimulating seal hunting in Iceland. In the period 1982-1989 this bounty system included harbour seals, but in 1990-1995 harbour seals were excluded. Except for harbour seal pups hunted by seal-farmers, which was subsidized due to utilization of skins. In 1992 and 1993 harbour seals were collected from hunters for the MRI's multispecies research programme. Lower jaws were collected, which were aged by counting growth-layer groups in sections of the canine-tooth, resulting in "reliable" catch-at-age data for harbour seal in the periods 1982-1985 and 1992-1993. Catch-at-age of female and

[4] To consider whether the age data from the catch of grey and harbour seals in Iceland would improve the assessment.

male harbour seals turned out to be different in 1982 and 1992. Adults were more numerous in the hunt in1982, than in 1992. Survival of female harbour seals born in 1982 and 1983 were 25% for pups, 30% for 1 year old, 67% for 2+ seals, and 6% for pups, 61% for 1+ seals, respectively. Survival of female harbour seals born in 1984, was about 43% for all age groups. The generation growth rate was estimated to be 0.04, 0.12 and 0.92, and the generation time was 5.0, 5.7 and 6.0 years, for 1982, 2003 and 2006, respectively (NAMMCO/SC/18/CS/25).

If it was possible to reduce the accidental death of harbour seals due to by-catch in the fisheries and other human activities, the total mortality rate of the Icelandic harbour seal would decrease substantially. In the period 1980-2003, the population fell from about 33,000 to about 10,000 animals, due to low survival, especially in the younger year-classes. In the period 2003-2006, the population increased, probably due to the higher survival of all year-classes, although higher survival in the younger year-classes could be the most important factor.

In the scenario of strongly declining population, the female estimated stable age distribution (SAD) was based on older females and pups, and the estimated reproductive value (RV) was seven to eight times higher in the 3+ age-groups than for pups. In the scenarios of stationary and slightly increasing population SAD was not dominated by pups and older females, and RV of 3+ females was only two to three times higher that of pups. It is hardly meaningful to do further population analysis on the available data on age composition of the catch, because it assumes a stable age composition of the population. Such an assumption is probably not valid, because the age structure probably was unstable due to heavily exploitation of Icelandic harbour seals in the period 1982 to 1989.

It is also open to question in what magnitude unstable age-distribution in the Icelandic harbour seal population affects the results of the present estimates (NAMMCO/SC/18/CS/25). Survival in the population was probably underestimated due to the limited available data. After 1998 hunting of harbour seals in Icelandic waters decreased markedly and the population may have reached a minimum size in the period 2003-2006, and even possibly increased since 2003 (Hauksson and Einarsson, 2010).

The Icelandic government has recently established a management goal for the harbour seal population in Icelandic waters that aims at maintaining it at the 2006 population level. It is therefore necessary to carry out assessment surveys for harbour seals in Iceland. The limited catch-at-age data available after1993, do not make it possible to make prognosis about the future development of the harbour seal population. However, the catch-at-age data can explain why the population has declined –high total mortality due to harvesting and by-catch combined. Given, that the harvest was only 154 animals in 2009 and a simultaneous reduction in by-catch, it is possible that the harbour seal population has increased since 2006.

The WG supports the need for new assessment surveys and further investigation of the population structure of harbour seals in Iceland.

5.8. Greenland

The four groups of harbour seals that have been reported in Greenland since 2000 only sum up to about 150 individuals (Figure 1). There is, however, reason to believe that their numbers are significantly higher, and that there are still undetected groups of seals around.

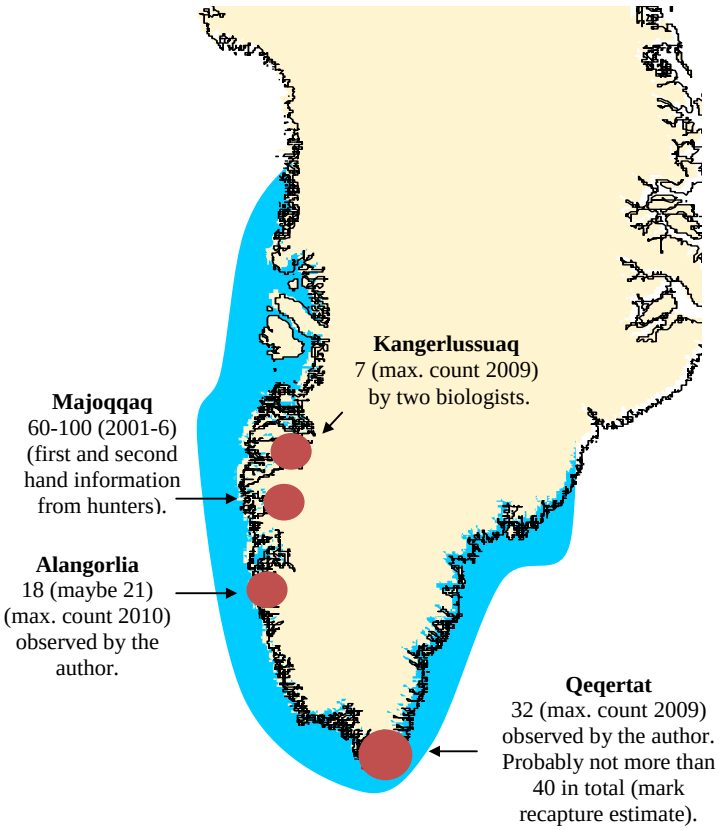

Figure 1. Harbour seal range of distribution in Greenland (blue) and locations of the four harbour seal concentrations reported since 2000.

Estimates using catch statistics and back calculations, based on an assumption of a 5% replacement yield, produced an estimated population in West- and South Greenland of 2,617-2,662 in 1950, and an estimated population in 2006 ranging 400-1,000 (Rosing-Asvid, 2010). The largest uncertainty was contributed by the population in the southernmost part of Greenland, which include the seals in the Qeqertat area and the archipelago north to 60°05'N on the east coast (the area is used by hunters from southwest Greenland). The reported catches in this southern area during 1950-1983 could be sustained (with a replacement yield of 5%) by a population of 350 seals. There are no catch statistics from 1984-92, but catches during 1993-2006 would have required a population of at least 500-600 seals in 1993 in order to have any seals left

in 2007. The number of seals in 2007 was unknown, but a strong indication of overharvesting suggests a lower number in 2007 than in 1993, assumed to be in the range of 100-600 seals (NAMMCO/SC/18/CS/17). Using the same calculations, based on the new estimate of 40 seals in 2009, resulted almost in no change for the total population estimate in 1950, but it changed the present number of harbour seals in West- and South Greenland considerably, to be in the range of 340-440.

Some harbour seals are also likely to live undetected and undisturbed on the pristine but harsh southeast coast. There is a group of settlements about 700 km north of Cape Farwell on the east coast. Hunters from this area tell that harbour seals nowadays are extremely rare around their settlements and along the coast about 300 km southward. Harbour seals are, however, seen on the lower 400 km of the east coast, but there are no estimates and almost no hunting or traffic along this coastline.

The WG welcomes the total protection of harbour seals in Greenland beginning 1 December 2010 and recommends the execution of abundance and distribution investigations in the south east of the country.

5.9. Eastern United States *(not presented – reported in writing)*

Abundance surveys for harbour seals have not been conducted along the east coast of US since 2001; therefore, there is no current abundance estimate for this species. Since 1972, the observed count of harbour seals along the New England coast has been increasing. Aerial surveys along the Maine coast were conducted during pupping in May/June 1981, 1986, 1993, 1997, and 2001. The 2001 survey, conducted in May/June, included replicate surveys and radio tagged seals to obtain a correction factor for animals not hauled out. The corrected estimate (pups in parenthesis) for 2001 was 99,340 (23,722). The 2001 observed count of 38,014 was 28.7% greater than the 1997 count. Over the 1981 to 2001 survey period, the harbour seal population was growing at approximately 6.6% (Gilbert *et al*. 2005). Increased abundance of seals in the Northeast region has also been documented during aerial and boat surveys of overwintering haul-out sites from the Maine/New Hampshire border to eastern Long Island and New Jersey (Payne and Selzer, 1989; Rough 1995; Barlas, 1999; Schroeder, 2000; deHart, 2002). Estimates older than eight years are deemed unreliable, and should not be used for PBR determinations (NAMMCO/SC/18/CS/14).

Human-caused mortality

Historically, harbour seals were bounty hunted in New England waters, which may have caused a severe decline of this stock in U.S. waters (Katona *et al*. 1993; Lelli *et al*. 2009). Bounty hunting ended in the mid-1960s. Other sources of harbour seal mortality include human interactions, storms, abandonment by the mother, disease, and predation (Katona *et al.* 1993; Jacobs and Terhune 2000). Mortalities caused by human interactions include boat strikes, fishing gear interactions, oil spill/exposure, harassment, and shooting.

Based on an observer programme in the period 2005-2009, the total human caused mortality and serious injury to harbour seals was estimated to be 385 per year. Most seals, 377 (CV=0.13), were taken in gillnet fishery, particularly within the Gulf of

Maine. An unknown level of mortality also occurred in the mariculture industry (*i.e.* salmon farming), and by deliberate shooting. Between 2005 and 2009, there are 7 records of harbours seals and 3 of unidentified seals with evidence of gunshot wounds in the Northeast Regional Office Marine Mammal Stranding Network database (NAMMCO/SC/18/CS/14).

The WG noted that a new assessment combining tagging and aerial photo surveys is planned for 2011.

5.10. Eastern Canada *(not presented – reported in writing)*

The Sable Island harbour seal population was the largest in eastern Canadian the late 1980s, however recently the number has drastically declined (Baird, 2001). Similarly, pup production declined on Sable Island from 600 in 1989 to around a dozen pups or fewer by 2002 (Baird 2001; Bowen *et a.*, 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 (Bowen *et al*. 2003). Stobo and Lucas (2000) have documented shark predation as an important source of natural mortality at Sable Island. They suggest that shark-inflicted mortality in pups, as a proportion of total production, was less than 10% in 1980-1993, approximately 25% in 1994-1995, and increased to 45% in 1996. Also, shark predation on adults was selective towards mature females. The decline in the Sable Island population 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 (Stobo and Lucas 2000; Bowen *et al.* 2003).

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 in June 1995, 1996, and 1997, and in August 1994, 1995, 1996 and 1997; different portions of the Gulf were surveyed in June 1996 and 2001 (Robillard *et al*. 2005). Results from the surveys indicating numbers were likely stable or increasing slowly, but there are insufficient data to determine the population trends. Overall, the June surveys resulted in an average of 469 (SD=60, N=3) hauled-out animals, which was lower than a count of 621 (SD=41, N=3) hauled-out animals counted 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). Present data are insufficient to calculate a minimum population estimate for this stock (NAMMCO/SC/18/CS/14).

Human-caused mortality

Currently, scant data are available on by-catch in Atlantic Canada fisheries due to a lack of observer programmes (Baird, 2001). An unknown number of harbour seals have been taken in Newfoundland, Labrador, Gulf of St. Lawrence and Bay of Fundy groundfish gillnets, Atlantic Canada and Greenland salmon gillnets, Atlantic Canada cod traps, and in Bay of Fundy herring weirs (Read 1994; Cairns *et al.* 2000). Furthermore, some of these mortalities (*e.g.* seals trapped in herring weirs) are the result of direct shooting. Aquaculture operations in eastern Canada are licensed to shoot nuisance seals, but the number of seals killed is unknown (Jacobs and Terhune,

2000; Baird, 2001). Small numbers of harbour seals are taken in subsistence hunting in northern Canada, and Canada also issues personal hunting licenses which allow the holder to take six seals annually (DFO 2008).

6. STATUS OF GREY SEAL STOCKS[5]

The approximate distribution and abundance of grey seals in the North Atlantic is presented in Figure 2. Each region is considered separately as follows.

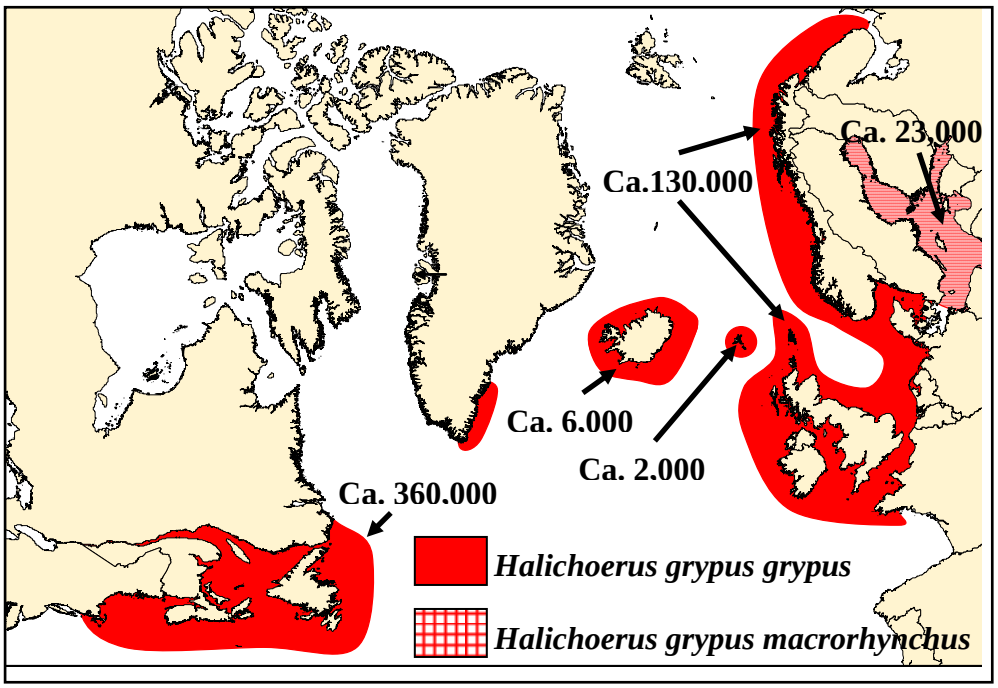

Figure 2. Approximate distribution and abundance of grey seals.

6.1. Russian Federation (Murman Coast) *(not presented – reported in writing)*

The eastern boundary of the distribution area of Atlantic Grey seals is along the Murman Barents Sea coast, where there are two important breeding areas: the Aynov Islands (west) and the Seven-Islands (east). Both of these areas are protected (Kandalaksha State Nature Reserve). The grey seals are red listed in Russia (the Red Data Book of Russian Federation) and hunting was stopped in 1967.

Grey seal pup production surveys covering the entire breeding area along the Murman Coast have not been carried out since 1991 (Haug *et al*. 1994). Pup counts were carried out in parts of the western breeding colony, the Big Aynov Island and Little Aynov, in the period 29 November – 3 December in 2005, 2006 and 2010

[5] Information on catches and regulatory measures – Current Research (Biological parameters, stock identity, distribution/migration) – Population assessments.

(NAMMCO/SC/18/CS/26). These counts are comparable with the 1991 counts (on the two islands) and the results suggest an increase of the pup production in that area. On Big Aynov, the counts were 125 pups in 1991, 214 in 2005, 173 in 2006 and 230 in 2010. On Little Aynov, similar results were 118 pups in 1991, 145 in 2005 and 90 in 2006. In December 2010, two female grey seal pups were tagged with satellite Argos tags on Big Aynov. Both seals moved into Norwegian coastal waters in early winter.

The WG welcomed information on the new studies and recommended full counts on the Murman coast and the continuation of the satellite tagging studies with the inclusion of adult animals in order to account for the behaviour across age classes.

6.2. Norway

Frie reported that an abundance model has been developed for estimation of total population size for Norwegian grey seals and projection of future population trajectories under various catch options (NAMMCO/SC/18/CS/20). The model is based on minimum pup production estimates for six geographical subareas, equivalent to counties, from the period 1979-2008 and total reported catches for the same subareas. The central management unit was represented by the three counties of Sør-Trøndelag, Nord-Trøndelag and Nordland (in order of increasing latitude). The northern management unit encompasses the counties Troms and Finnmark, while the southern management unit only contains one known breeding locality in Rogaland.

The model incorporates by-catch mortality rates estimated for Norwegian grey seals (Bjørge *et al*. 2002), while age specific pregnancy rates were derived from a large study on Canadian grey seals (NAMMCO/SC/18/CS/20). Comparisons of mean age at primiparity (MAP) among 4 published data sets on grey seals as well as a small recent data-set from central Norway indicate low variability in grey seal reproductive rates across the North Atlantic. The largest difference in MAP was found between the chosen Canadian data set and a historical Norwegian data set, but using the Norwegian data set in the model did not have any notable effect on model outputs.

Population trajectories for the period 1978-2010, were increasing in the 4 northernmost subareas Nord-Trøndelag, Nordland, Troms and Finnmark. This development is likely driven by an increase in pup production estimates over the past decade and occurs in spite of a significant increase in annual catches from 2003 and onwards. In contrast, the southern subarea (Sør-Trøndelag) of the central management unit shows a rather stable population trajectory over the entire study period. It should however be noted that the most recent pup production estimate (2007) suggests a 30% decline in pup production compared to the estimate from 2002 and it cannot be excluded that this is a response to an increase in local catch levels since 2003.

For the southern management unit, the model suggests an increasing trend in abundance up to 2005 followed by a slight decline driven by increased catches. There is, however, no evidence of a declining pup production since 2005 and the declining trend may therefore be more likely due to underestimation of the fraction of non native seals taken in the hunt. Tagging data have shown the presence of British grey seals in the southern management unit in Norway (*e.g*. Bjørge and McConnell, 1986). The

fraction of British grey seals in the Norwegian catches for this area was set to 70%. This figure is based on scaling of the ratio of pup production to catch levels from the central management unit where no significant influx of foreign animals is detected. Similarly, influx of Russian seals has been documented for Northern Norway (Henriksen *et al*. 2007; NAMMCO/SC/18/CS/26) and the fraction of Russian grey seals in catches from the northernmost subarea was estimated to be 20-50%.

Based on current catch levels, projections of trajectories for the three official management units suggest continued increase in abundance for the central and northern management units and a sharp decline for the southern management unit. The observed difference in population trajectories among subareas within the central management area may, however, warrant consideration of a finer scale of management units in central Norway. This is further supported by the relatively short (<250 km) median dispersal distances observed for adult grey seals (Bjørge *et al*. 2002) and preliminary analyses of genetic data (Frie, unpublished data).

Model runs indicated an increase in abundance of the total Norwegian grey seal population during the last 30 years, suggesting a total of 8,063 (CI: 7,627 to 8,549) animals (including pups) in 2010. The level of sustainable catches for all areas was estimated. Current catch level will likely result in a depletion of the populations in Rogaland, a reduction of the population size in Sør-Trøndelag, and an increase in the population size in Nord-Trøndelag, Nordland, Troms, and Finnmark.

The WG welcomed this information and recommended new surveys in Troms and Finnmark to explore the impact of the high level of removals since 2005. Likewise it recommended a similar survey to be carried out in Sør-Trøndelag to assess the impact of the decline in pup production in 2007 and a possible continuation of this reduction.

6.3. Baltic

Seal researchers from Estonia, Finland, Russia and Sweden had a meeting over Skype on November 17, 2010 in order to summarize the results on the grey seal surveys carried out in the above mentioned countries in 2010.

The censuses covered the main distribution area of the grey seal in the Baltic Sea. Censuses were performed during a period from May 24 to June 4 and the counts were used to construct an international summary of the whole sea area.

Synchrony is extremely important for censuses, especially in the core area of the Baltic grey seal. Efforts were made to minimize the possibility of double counting caused by seals changing locations. It should be noted that all seals are not hauling-out at the same time and some animals may have escaped the censuses due to human disturbance. Today, all censuses are conducted repeatedly. Most areas are counted three times during the census period.

This time of the year, grey seals are hauling out of water in maximum numbers due to moult. All ice had melted before the survey period, so it is unlikely that the 2010 counts were affected by seals hauling-out on the ice. The seals were counted from

photographs taken during aerial censuses for most areas, except for Russia and the most northern and the southern parts of Sweden where the number of seals are relatively small. More study is needed in next census period to find differences between aerial and land-based counting results. Census results are presented by sea area, as is appropriate in the light of seal biology. Census results should be understood as a relative index of abundance, which is smaller than the real population size. The essential use of these numbers is to serve as guidance for management and conservation of grey seal stocks.

The total number of grey seals counted in 2010 was approximately 23,140 individuals. This figure comprises of the following values by sea area: Bothnian Bay and North Quark 642, Sea of Bothnia 1,288, waters around SW Finnish archipelago including Åland 8,361, Swedish Baltic proper between Gulf of Bothnia and 58°N (northern tip of Gotland) 7,508, Gulf of Finland 726, W Estonia 3,476 (2,074 of them in the Gulf of Riga) and Swedish Baltic proper south of 58°N 1,249. Thus, the major part of the grey seal population (3/4) was concentrated to the Northern part of the Baltic proper during late spring and early summer. It should be noticed that due to migrations, distribution of the grey seal population could be different during other parts of the year.

The total figure of 23,140 is higher than the results from 2009, but it is noticeable that population growth rate for 2008-2010 is considerably lower than in period 2003 – 2007. In the previous years it was 20,400 in 2009; 22,330 in 2008; 22,000 in 2007; 20,700 in 2006; 18,300 in 2005; 17,640 in 2004; 15,950 in 2003; 13,100 in 2002; 10,300 in 2001 and 9,700 in 2000.

6.4. United Kingdom

Bjørge reported that each year, Sea Mammal Research Unit conducts aerial surveys of the major grey seal breeding colonies in Britain to determine the pup production. The annually surveyed sites account for approximately 90% of all grey seal pups born throughout Britain. The remaining sites producing around 10% of the pups are surveyed less frequently.

In 2009 the U.K. production was 47,540 pups. The production has increased since late 1970s but has recently leveled off at Orkney and Hebrides, but continues to increase in the North Sea colonies.

The pup production can be used to estimate the total population. When the population was constantly growing, the demography of the population was stable. Levelling off the population growth will change the demography of the population and this has an impact on the estimation of total population size. The density dependent factors involved in levelling of the increase in pup production seem to be associated with survival rates of pups. Under this assumption the total population in the regularly surveyed colonies at the beginning of the 2009 breeding season was estimated at 106,200 (95% CI: 82,000 to138,700). Including the colonies less frequently surveyed the total U.K. grey seal population is estimated at 119,400 (95% CI: 92,500 to156,200) (SCOS 2010).

6.5. Faroes

Mikkelsen presented an update on the knowledge of grey seals in the Faroe Islands (NAMMCO/SC/18/CS/22). For the last hundred and fifty years the grey seal has been the only pinniped breeding in the islands. Seals are seldom observed in large congregations, but there are a few haul-out locations where numbers can exceed 50 seals. No management regime is implemented on grey seals in the Faroes and present population size is unknown. Today, fish-farmers are the only seal hunters in the islands. Hunting logbooks have been implemented from 2011 onward, which intend to provide reliable numbers of exploitation level in the future. An inquiry amongst the 23 salmon sea-farms in operation today, about number of animals shot at their farms, added up to a total removal of 226-273 animals for 2010. This level seems high given that the population is expected to be about 2,000 animals. From the distribution of salmon farms, it was not surprisingly that most seals were shot on farms situated in areas with high grey seal abundance. All fish-farmers regarded grey seals as a conflict, especially decreasing the appetite of the fish, but sometimes this conflict was direct, when the seals demolished the nets and went inside the cage for feeding; seals have even been shot inside cages.

Distribution and migration of grey seals in the islands were investigated by deploying 10 satellite tags on seals during two field seasons. In June 2007 four juvenile animals, two of each sex, were tagged, and in May-August 2008 six animals were tagged; three pregnant females, two sub-adult males and one juvenile female. Seals were captured in monofilament nylon nets 200 m long and 12 m high, with 28 mm mesh size. Seals were fixed to a board, without use of anaesthetics, and fitted with Wildlife Computers SPOT5 position only satellite tags, glued with a quick setting adhesive to the fur on the neck. The tags comprised 2xAA batteries and total transmissions number was 70.000. A daily 6-hr duty cycle, between 6-12 AM, and a maximum of 250 transmissions, was invented. Also, haul-out statistics were enabled. The satellite tags had a lifetime of between 123 days and 286 days (mean 212 days). For the tag with longest lifetime, the deployment period correspond to 9.5 month of tracking; from June to March. The tracked seals were found to be stationary on the Faroe Plateau, mainly staying close to the islands. Very few of the seals were tracked outside the 100 m depth contour. Also, the seals were for most of the tracking periods distributed close to their preferred haul-out sites, which typically numbered one to three sites. Movements between locations occurred mainly in shallow waters. When making multiple trips to off-shore feeding areas, the seals typically repeated their tracks to the same area. No seal was found to move longer distances from land than 35 nautical miles or for a longer period than three days. The youngest animals did show the most dynamic and sporadic movement behaviours, and did also more frequently make trips to off-shore areas than the older animals. The sub-adult and adult animals were generally more stationary and used fewer haul-out sites. The overall movement pattern demonstrates that Mykines, Dímun and Fugloy are hot spot areas for grey seals in the Faroes. Three adult females, tagged during the project, were all pregnant. Contact was lost with the females for coherent periods of 15 – 21 days, because they were sheltered from contact when at the breeding locations, which indicates that breeding occurs in caves. This agreed with a mean nursing duration of around three weeks documented for other seal populations. Two females were breeding in October and one in

November, which also agree with the breeding period for the populations in UK and Iceland.

Present biological knowledge is very limited and this is partly due to the inaccessible nature of the seals, breeding and moulting in caves, some impossible to explore, in a time of the year usually with harsh weather conditions. A planned study to genotype 68 grey seals, in order to analyse for a potential coherence between the Faroese and UK seal populations, has never been finished (Amos, pers. comm.), so this question is unanswered. Predation by killer whales could induce a significant mortality for the small population in the Faroes. These predators are seen year after year in ever increasing numbers, notably swimming near shore around the islands. In days where killer whales are present, grey seals are absent. Investigations of killer whale stomachs from Faroes in the 1970s have demonstrated predation on grey seals (Bloch and Lockyer 1988).

Mikkelsen also reported that by-catch is likely less than 10 animals annually and this is due to the absence of gillnet fisheries in shallow waters.

The WG expressed concern for the removal levels which seem to be high in relation to the assumed population size. The WG also recommended future investigations, in order to fill gaps in knowledge, including pup counts and conventional flipper tagging for abundance estimations, mapping of potential breeding sites, establishment of a photo-id database for alternative abundance estimation, determining life-history parameters from animals shot at fish farms, explore potential impact from killer whale predations, perform more satellite/radio tagging, including haulout statistics, for ecological studies and finally genetic studies for addressing potential association with adjacent populations.

6.6. Iceland

Hauksson reported (NAMMCO/SC/18/CS/27) that in the period September – December aerial surveys were performed on the coast of Iceland, in 2005, 2008 and 2009. In 2005 a total of 1,377 (95% CI:1,333 to 1,453) grey seal pups were born on the whole Icelandic coast. In 2008/2009 a total of 1,539 (95% CI:1,483 to 1,575) were born, which represents a 5% (4% - 6%) annual increase. The estimated Icelandic grey seal stock size increased from 5,500 (95% CI:4,158 to 6,990) animals to 6,100 (95% CI:4,578 to 7,630) during this period.

Information on catch levels and age structure (catch-at-age) of the hunt, as well as information about seal numbers from aerial surveys, are necessary for responsible management of grey seals in Icelandic waters. Age distribution in the catch indicates that total mortality of females in most year-classes was too high, causing a market decline of the population in the period 1982-2006. A virtual population analysis (VPA) based on age distribution in the female catch indicates that the Icelandic grey seal population decreased significantly from 1990 to a minimum in 2002-2006. A population model, based on the catch-at-age data, estimates of annual pregnancy rate and an assumed survival scheme, indicated that the stock declined from about 12,000

in 1990 to about 5,000 in 2002, and increased to about 6,000 in 2006 (NAMMCO/SC/18/CS/11).

Indirect estimations of population growth by using methods of catch-curves, VPAs and population models, do not give a better picture of the development of the Icelandic grey seal population than aerial surveys, and should not be used instead of the latter. Results from the matrix population model, however, could give more appropriate adult to pup ratios, for use when calculating the total population size based on pup-production data obtained by aerial surveys.

The WG commented that this method is accurate for trend analysis using pup production only. For other applications (*e.g.* harvest) one should use point estimates of total population size accounting for the uncertainty due to the multiplier ranges.

6.7. Greenland

Until 2009 there had been no certain observations of grey seals in Greenland. An adult Grey seal was however photographed near the islands Qeqertat on 30th August 2009 and the following day a seal that might be a young grey seal was photographed at the same location (Rosing-Asvid *et al.* 2010).

The existence of grey seals in Greenland was confirmed again the following year by a live-capture of a grey seal pup-of-the year (Figure 3), also near Qeqertat. The seal was tagged (Argos tag), but unfortunately the tag only lasted for 26 days in which the seal moved around in the tagging area and a little north along the Greenland east coast.

A ban on hunting of grey seals in Greenland was introduced together with the ban on harbour seal hunting by 1 December 2010.

Figure 3. First documented catch of a grey seal in Greenland.

6.8. Eastern Canada *(not presented – reported only)*

Pup production in the Gulf of St. Lawrence was estimated in 2010 using visual strip transect surveys of the whelping patches on the ice in the southern Gulf of St. Lawrence and complete counts on islands. Reconnaissance flights were also carried out to determine if any pupping occurred along the south and southwest coasts of Newfoundland and Anticosti Island. A small number of pups were found on Anticosti while no pupping occurred along Newfoundland. Where possible, counts were corrected for the proportion of pupping completed when the survey was completed. Total pup production in the Gulf of St. Lawrence was estimated to be 11,228 (SE=6,442) animals (NAMMCO/SC/18/CS/13). Total pup production estimates at Sable Island and Coastal Nova Scotia were 62,054 (SE=587) and 2,960 (SE=136), respectively, in 2010 (NAMMCO/SC/18/CS/12).

A stochastic model (NAMMCO/SC/18/CS/12) was constructed of Northwest Atlantic grey seal population dynamics and fit it to available pup production data from 1977-2010 divided into three breeding regions: Sable Island, Gulf of St. Lawrence, and Coastal Nova Scotia (including Hay Island and other small colonies along the coast of Nova Scotia). The model and fitting methods are the same as those used in a previous population assessment (Thomas *et al*. 2007), updated with 2010 pup production data and revised estimates of historical harvest. The model assumes that fecundity rates are age-dependent but are constant over time, that adult survival rates are constant, and that pup survival is density dependent. Females are assumed to be able to move to a new region to breed if pup survival is higher there, but once they start breeding they do not move.

The authors used a Bayesian computer-intensive method (particle filtering) to fit the model, with informative priors on model parameters. The posterior estimates for some parameters were close to their priors, indicating little information about these parameters in the pup production data and highlighting the importance of carefully choosing the priors. Other parameters were far from the prior: in particular the posterior estimates of carrying capacity were far higher than the prior values, indicating little evidence of density dependent population regulation at current levels of pup production. The total estimated population size at the end of the 2010 breeding season (*i.e.* including pups) was 348,900 (95% CI:291,300 to 414,900). This was 4% higher than the equivalent estimate for 2009 of 335,200 (95% CI:292,000 to 395,100) and ten times higher than the estimate for 1977 of 35,800 (95% CI:24,700 to 53,100). Average annual rates of population increase are estimated to be 6% in the 1980s, 9% in the 1990s and 6% in the 2000s. These estimates should be treated with some caution because: (1) the biological model showed clear lack of fit, particularly to the Gulf data where extending the model to account for ice and weather conditions would be useful; (2) sensitivity of the results to the priors used has not been assessed; and (3) the fitting algorithm may have caused some (small) biases.

Human-caused mortality

In Canada, grey seals were hunted for several centuries by indigenous people and European settlers in the Gulf of St. Lawrence and along the Nova Scotia eastern shore, and were locally extirpated (Laviguer and Hammill, 1993). There were culls of about

1,700 animals annually during the 1970s and early 1980s on Sable Island (Anonymous, 1986). Between 1999 and 2009 the annual kill of grey seals by hunters in Canada was: 1999 (98), 2000 (342), 2001 (76), 2002 (126), 2003 (6), 2004 (0), 2005 (579), 2006 (1,804), 2007 (887), 2008 (1,472), and 2009 (254) (NAMMCO/SC/18/CS/15). The traditional hunt of a few hundred animals is expected to continue off the Magdalen Islands and in other areas, except Sable Island where commercial hunting is not permitted (DFO 2003). DFO established a 2008 total allowable catch of 12,000: 2,000 in the Gulf and 10,000 on the Scotian Shelf. Since 2007, a small commercial hunt has taken place on Hay Island in Nova Scotia (http://www.dfo-mpo.gc.ca/fm-gp/seal-phoque/faq-eng.htm). The hunting of grey seals will continue to be prohibited on Sable Island (http://www.dfo-mpo.gc.ca/seal-phoque/index_e.htm). Canada also issues personal hunting licenses which allow the holder to take six grey seals annually. Hunting is not permitted during the breeding season and some additional seasonal/spatial restrictions are in effect (Lesage and Hammill, 2001).

An unknown number of grey seals have been taken in Newfoundland and Labrador, Gulf of St. Lawrence, and Bay of Fundy groundfish gillnets, Atlantic Canada and Greenland salmon gillnets, Atlantic Canada cod traps, and in Bay of Fundy herring weirs (Read, 1994). In addition to incidental catches, some mortalities (*e.g.* seals trapped in herring weirs) were the result of direct shooting (NAMMCO/SC/18/CS/15).

6.9. Eastern United States *(not presented – reported only)*

In U.S. waters, grey seals currently pup at three established colonies: Muskeget Island, MA, Green Island, ME, and Seal Island, ME. They have been observed using the historic pupping site on Muskeget Island in Massachusetts since 1990. Pupping has taken place on Seal and Green Islands in Maine since at least the mid 1990s. Aerial survey data of these sites indicate that pup production is increasing. A minimum of 2,620 pups (Muskeget= 2,095, Green= 59, Seal= 466) was born in the U.S. in 2008 (Wood LaFond 2009). Some of the local breeders have been observed with brands and tags indicating they had been born on Sable Island, Canada (Rough, 1995). The increase in the number of grey seals observed in the U.S. is probably due to both natural increase and immigration. Present data are insufficient to calculate the minimum population estimate for U.S. waters (NAMMCO/SC/18/CS/15).

Grey seals are also observed in New England outside of the pupping season. In April-May 1994 a maximum count of 2,010 was obtained for Muskeget Island and Monomoy combined (Rough 1995). Maine coast-wide surveys conducted during summer revealed 597 and 1,731 grey seals in 1993 and 2001, respectively (Gilbert *et al*. 2005). In March 1999 a maximum count of 5,611 was obtained in the region south of Maine (between Isles of Shoals, Maine and Woods Hole, Massachusetts) (Barlas 1999). No grey seals were recorded at haul out sites between Newport, Rhode Island and Montauk Pt., New York (Barlas 1999), although, more recently several hundred grey seals have been recorded in surveys conducted off eastern Long Island (NAMMCO/SC/18/CS/15).

Human-caused mortality

Grey seals were hunted for bounty in New England waters until the late 1960s (Katona *et al*. 1993; Lelli *et al*. 2009). This hunt may have severely depleted this stock in U.S. waters (Rough 1995; Lelli, *et al*. 2009). Other sources of mortality include human interactions, storms, abandonment by the mother, disease, and predation. Mortalities caused by human interactions include boat strikes, fishing gear interactions, power plant entrainment, oil spill/exposure, harassment, and shooting. The Cape Cod stranding network has documented grey seals entangled in netting or plastic debris and in recent years have made successful disentanglement attempts. Average annual estimated fishery-related mortality (mainly sink gillnet fishery) and serious injury to the grey seals was 678 grey seals (CV=0.14) during 2005-2009 ((NAMMCO/SC/18/CS/15).

7. SEAL INTERACTION WITH FISHERIES AND AQUACULTURE

The potential impact by grey seals on cod stocks in Canadian waters could not be evaluated by this WG due to the absence of the invited participant from Canada.

7.1. Effects of seals on fish stocks and fisheries in the north-east Atlantic

Härkönen reported, based on a review on studies of seals impact on fisheries, that the consumption of seals on commercially valuable fish stocks is typically less than 1% of catches taken by fisheries or spawning stock sizes in offshore areas. Effects of seals on sizes of fish populations are therefore insignificant in oceanic systems. Local high densities of seals in coastal areas can under some circumstances have measurable effects on catches of salmonids, although this only has been shown in few cases. Approximately 90% of all fish are taken by active gear off the coasts of the north-east Atlantic and these fisheries are to a minor or insignificant extent affected by seal predation on catches and damages on gear.

Static gear such as set gillnets in coastal areas and the Baltic are very vulnerable to impacts from seals, and catch losses may vary between 20% and more than 50% in cod gillnets and herring gillnets. Gillnets are difficult to protect against seal damages since seals get accustomed to acoustic deterrents. Fish traps, bag nets and fyke nets are also vulnerable to impacts from seals, which have caused substantial damages to fisheries in the Baltic. Modifications of fish traps have successfully reduced damages both to catches and gear.

Seal worms are found in fillets of cod, hake and other cod fishes. The prevalence of seal worms depends on the proximity to main seal colonies, availability of intermediate hosts, and fish species which accumulate worm larvae. Offshore fisheries are much less affected by seal worms as compared with coastal fisheries. Seal worms are often confused with whale worms, which occur also in oceanic environments. Whale worms are predominantly spread by toothed whales and minke whales.

Fish farms are affected by seals but losses seldom exceed 1% in Norway, Iceland and the Faroes. Losses in Scotland range between 1-5% depending on location and which protective measures are taken. Allocation of farms far away from main seal colonies

reduces losses. Shooting of seals is an effective mitigation method, but hunting pressure needs to be intense enough to deplete local seal populations. Harbour seal populations in Iceland and Norway are stagnant or decreasing whereas Scottish populations are decreasing rapidly and the Faroese population is extinct. Reductions of seal populations are in conflict with the EU-Habitats Directive and the 2006 HELCOM seal recommendation, which state the long-term objectives for management of marine mammals are to attain "natural abundances and distributions".

The WG recognised the need to explore the extent of interactions between seals and fisheries and aquaculture and recommended studies of this phenomenon in particular in Norway.

8. REVIEW OF HARBOUR AND GREY SEAL STUDIES ON ECOLOGY

Nilssen reported that the Institute of Marine Research (www.imr.no) and the University of Tromsø are currently working on the data of a 3 years interdisciplinary project, EPIGRAPH 2009-2011. This is a study on the ecosystem of two large Norwegian fjords: the Porsangerfjord and the Hardangerfjord.

Seal studies are carried out in the Porsangerfjord, Finnmark county. In this fjord the focus of the investigation has been exploring the possible causes for the lack of recovery of the local coastal cod population, after a strong decline in the 1980s. One of the possible causes examined is predation from coastal seals.

In order to determine the effect of predation of harbour and grey seals on coastal cod and other local fish populations, investigations of habitat use and prey consumption of the seals are conducted in this fjord as well as estimations of fish abundance and distribution. So far 6 harbour seals individuals have been tagged in September 2009, 6 in September 2010, and another 10 will be tagged in September 2011. The preliminary results of the deployment of GPS-phone tags on harbour seals have shown that the tagged individuals use a small area, compared to their potential, in the inner part of the fjord. Investigation of the available resources indicates that coastal cod population are mainly to be found in outer part of the fjord.

Grey seals, on the other hand, are not permanent residents of the fjord, while they can migrate in and out in numbers of between 100 and 200 seals, particularly during moult. Diet studies, based on examination of stomach and intestinal contents sampled from the local hunt, suggest that cod, haddock, saithe and wolfish are the most important prey species during the moulting period (March-April). Cod spawning occur in the western outer part of the fjord at the same time as grey seals moult.

The WG noted the importance of this study and encouraged the presentation of progress at its next meeting.

9. RECOMMENDATIONS FOR RESEARCH AND MANAGEMENT

9.1. General recommendations for future research:

- Quantification and standardisation of methods to assess struck and lost and by-catch
- Exploration of the distribution and impact of sealworm on fisheries
- Exploration of the impact of seals on fish catches, gear and fish farms
- Evaluation of the ecological role of seals in coastal ecosystems
- Development of appropriate survey methods for all areas
- Development of common sampling protocols for all areas in the north Atlantic in preparation for epidemic disease outbreaks
- Establishment of blood serum stores for seals sampled
- Compilation of a database of samples stored in the NAMMCO countries
- Establishment and continuation of standardised monitoring programmes for seal abundance in all countries to obtain compatible results in time series.

9.2. Recommendations by area and stock:

- Reporting of by-catch in Iceland
- Securing seal catch records and associated data for Iceland
- Assessment surveys of harbour seals at the coast of Iceland
- Assessment surveys of grey seal pups on the breeding sites in Iceland
- Analyses of catch-at-age data from the grey seal hunt in Icelandic waters
- Estimation of the stock identity, size, distribution and structure of the Faroese population of grey seals
- Completion of the ongoing genetic analyses of grey seal population structures for the north Atlantic including new samples from the Faroe Islands
- Conduction of further studies to identify the population structure of Norwegian harbour seals
- Exploration of the sex and age of the caught animals for both species in Norway
- New assessment of harbour seals in the whole of Norway and grey seals in Sør-Trøndelag, Troms and Finnmark
- Population assessment of Russian seals of both species
- Exploration of the south-eastern Greenland coast for the presence of both harbour and grey seals.

10. OTHER BUSINESS

The WG is concerned about the continuation of seal research programmes, the preservation of archives of existing information and knowledge in Iceland in view of the recent changes in responsibility for seal studies.

The WG agreed on changing their name to WG on harbour and grey seals.

For future meetings of this WG it was recommended to include scientists working on all main areas for these two species in the north Atlantic.

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Appendix 1

AGENDA

1. CHAIRMAN WELCOME AND OPENING REMARKS
2. ADOPTION OF AGENDA
3. APPOINTMENT OF RAPPORTEURS
4. REVIEW OF AVAILABLE DOCUMENTS AND REPORTS
    a. Management plan for Norway
    b. Management plan HELCOM
    c. Common management model for harbour and grey seals
5. STATUS OF HARBOUR SEAL STOCKS
    a. Information on catches and regulatory measures
    b. Current Research (Biological parameters, stock identity, distribution/migration)
    c. Population assessments
        i. Russia (Murman Coast)
        ii. Norway
        iii. Sweden
        iv. Denmark
        v. Mainland Europe
        vi. United Kingdom
        vii. Iceland[6]
        viii. Greenland
        ix. Eastern Canada
        x. Eastern US
6. STATUS OF GREY SEAL STOCKS
    a. Information on catches and regulatory measures
    b. Current Research (Biological parameters, stock identity, distribution/migration)
    c. Population assessments
        i. Russia (Murman Coast)
        ii. Norway
        iii. Baltic
        iv. Mainland Europe
        v. United Kingdom
        vi. Faroes
        vii. Iceland
        viii. Eastern Canada
        ix. Eastern US
7. SEAL INTERACTION WITH FISHERIES AND AQUACULTURE
    a. Geographical review
    b. Problem size
    c. Mitigation methods in use

[6] To consider whether the age data from the catch of grey and harbour seals in Iceland would improve the assessment.

8. REVIEW OF HARBOUR AND GREY SEAL STUDIES ON ECOLOGY
9. RECOMMENDATIONS FOR RESEARCH AND MANAGEMENT
    a. Recommendations for future research
    b. Recommendations for management, by area and stock
10. OTHER BUSINESS

TERMS OF REFERENCE

A. To review the Norwegian management plans for harbour and grey seals.
B. To perform assessments for harbour and grey seals in the NAMMCO areas and when possible in other North-Atlantic areas.
C. To develop a common management model for both species in the NAMMCO areas.

Appendix 2

DOCUMENT LIST

Document no	Title
NAMMCO/SC/18/CS/01	Participants
NAMMCO/SC/18/CS/02	Agenda
NAMMCO/SC/18/CS/03	Document list
NAMMCO/SC/18/CS/04	B. Johan L. Hansen, Karin C. Harding. 2006. On the potential impact of harbour seal predation on the cod population in the eastern North Sea. Journal of Sea Research 56 (2006) 329–337.
NAMMCO/SC/18/CS/05	Outcome of the HELCOM/ICES/EU Seal Expert Workshop, Stockholm, Sweden, 6-8 September 2005.
NAMMCO/SC/18/CS/06	Report Of The Nammco Scientific Committee Working Group On Grey Seals, Reykjavik, 9-11 April, 2003
NAMMCO/SC/18/CS/07	NAMMCO Scientific Committee Working Group On Harbour Seals, Copenhagen, 3-6 October 2006
NAMMCO/SC/18/CS/08	Liselotte W. Andersen, Christian Lydersen, Anne K. Frie, Aqqalu Rosing-Asvid, Erlingur Hauksson And Kit M. Kovacs. 2011. A population on the edge: genetic diversity and population structure of the world's northernmost harbour seals (*Phoca vitulina*). *Biological Journal of the Linnean Society*, 2011, 102, 420–439.
NAMMCO/SC/18/CS/09	Härkönen, T., Brasseur, S., Teilmann, J., Vincent, C., Dietz, R., Abt, K. and Reijnders, P. 2007. Status of grey seals along mainland Europe from the Southwestern Baltic to France. NAMMCO Sci. Publ. 6:57-68.
NAMMCO/SC/18/CS/10	Teilmann, J., Rige´t, F., and Harkonen, T. 2010. Optimizing survey design for Scandinavian harbour seals: population trend as an ecological quality element. – ICES Journal of Marine Science, 67: 952–958.
NAMMCO/SC/18/CS/11	Hauksson, 2011. Summary of the catch and catch-at-age data for grey seals in Icelandic waters,1982 to 2006, and model estimates of grey seal numbers-at-age
NAMMCO/SC/18/CS/12	Thomas, Hammill, Bowen, 2010. Estimated size of the Northwest Atlantic grey seal population 1977-2010

NAMMCO/SC/18/CS/13	Hammill, Stenson, 2010. Pup production of Northwest Atlantic grey seals in the Gulf of St. Lawrence and along the Nova Scotia Eastern Shore
NAMMCO/SC/18/CS/14	Waring, 2011 Harbor Seal: Western North Atlantic Stock
NAMMCO/SC/18/CS/15	Waring, 2011 Gray Seal: Western North Atlantic Stock
NAMMCO/SC/18/CS/16	Aqqalu Rosing-Asvid, Jonas Teilmann, Rune Dietz and Mort en Tange Olsen. 2010. First Confirmed Record of Grey Seals in Greenland. ARCTIC 63(4):471–473.
NAMMCO/SC/18/CS/17	Rosing-Asvid, 2011. Status of harbour seals and grey seals in Greenland
NAMMCO/SC/18/CS/18	Management plan for Norwegian grey seals
NAMMCO/SC/18/CS/19	Management plan for Norwegian harbour seals
NAMMCO/SC/18/CS/20	Øigård, Frie, Nilssen, 2011. The 2010 abundance of grey seals in Norway
NAMMCO/SC/18/CS/21	HELCOM RECOMMENDATION 27-28/2. Conservation of seals in the Baltic Sea area.
NAMMCO/SC/18/CS/22	Mikkelsen, 2011. Update of knowledge of grey seals in the Faroe Islands
NAMMCO/SC/18/CS/23	Hauksson, E. 2006. Growth and reproduction in the Icelandic common seal (*Phoca* vitulina L. 1758). Marine Biology Research 2:59-73.
NAMMCO/SC/18/CS/24	Andersen, Teilmann, Dietz, Schmidt, Miller, 2011. Behavioural responses of harbour seals to human-induced disturbances
NAMMCO/SC/18/CS/25	Hauksson, 2011. Summary of the catch and catch-at-age data for harbour seals in Icelandic waters 1882-2006.
NAMMCO/SC/18/CS/26	Kondakov, 2011. Grey seals on Murman 2010.
NAMMCO/SC/18/CS/27	Hauksson. 2011. Results of aerial surveys of grey seal pups, in 2005, 2008 and 2009 and estimated changes in the abundance of grey seals in Icelandic waters.

ANNEX 2

NAMMCO SCIENTIFIC COMMITTEE WORKING GROUP ON ABUNDANCE ESTIMATE (AEWG) T-NASS M8

7-9 March 2011, Copenhagen

REPORT

1. CHAIRMAN WELCOME AND OPENING REMARKS

Chairman Daniel Pike and Working Group Convenor Geneviève Desportes welcomed all participants (Address Section 5.7) to the Working Group. This is the third meeting of the Working Group since the completion of the T-NASS, and several abundance estimates have been completed and accepted, including ones for fin, humpback, and minke whales from the shipboard surveys, and several species from aerial surveys in Greenland and Canada. In addition to further refining these estimates, the Group will concentrate on completing remaining estimates for target species from the T-NASS, as well as estimates from some earlier surveys. The Chairman noted particularly that the 5 NASS over a 20 year period (1987-2007) presented an unparalleled opportunity for assessing long-term changes in the distribution and abundance of cetaceans.

2. ADOPTION OF AGENDA

The agenda (Appendix 1) was adopted without changes.

3. APPOINTMENT OF RAPPORTEURS

As no rapporteur was available from the NAMMCO Secretariat, the Group agreed to share reporting duties.

4. REVIEW OF AVAILABLE DOCUMENTS AND REPORTS

SC/17/AESP/04 (Appendix 2) presented the documents available to the Working Group.

5. DEVELOPMENT OF NAMMCO SURVEY DATA ARCHIVE

The NAMMCO Scientific Committee recommended in 2008 (NAMMCO 2009a) that "T-NASS data be transformed to a format similar to the one employed by the IWC and be archived at the NAMMCO Secretariat with the necessary clauses for use restrictions." At the 2009 Working Group meeting (NAMMCO 2011b), Acquarone reported that the Secretariat was prepared to receive the data and had funding to develop a data archive suitable to this need.

The Working Group was informed that this process had not yet begun. The Group reiterated that they considered it important to have a centralized database to protect the integrity of the dataset and to facilitate its use by interested researchers. This database should hold validated data for all the NASS and T-NASS surveys. In addition a record of the original survey documentation, either as paper files or scans thereof, should be assembled and maintained. One option might be to establish an agreement with the IWC to share their existing database, which already holds all or most of these data. The Working Group **strongly recommended** that the Secretariat should take the lead in establishing the database, and contact relevant national authorities to obtain the data in the required format as soon as possible and before the next survey.

6. REVIEW OF ABUNDANCE ESTIMATES AND TRENDS

6.1 Fin whales

6.1.1 Greenland

A number of issues had been raised at the last meeting regarding analyses to estimate fin whale abundance off West Greenland from aerial surveys. In responding, Heide-Jørgensen referred to the paper published last year in the Journal of Cetacean Research and Management (Heide-Jørgensen *et al*. 2010a and SC/18/AESP/O04).

Concern had previously been expressed that lack of coverage in strata 4 and 7 could adversely affect the overall (stratified) abundance estimates. These strata had high estimated density relative to most other strata and made a substantial contribution to overall abundance. Only about half of the planned effort had been conducted because of poor sighting conditions.

The WG discussed whether the areas where transect lines had not been run should be considered as non-surveyed areas to which density had been extrapolated or randomly missed areas to which density had been interpolated. These areas were within the original survey design so such interpolation would only be a problem if there were reason to believe that the missing effort was not at random (*i.e*. was related to whale density). The WG agreed that this was not the case and that there were no remaining concerns about this issue.

Regarding whether pooling group size estimation over strata could be beneficial, the WG agreed that it was most appropriate to use stratum-specific group size estimates because one stratum had very large atypical group sizes and there was no advantage to be gained by pooling.

At the last meeting, an issue relating to the consistency of estimates from analyses with perpendicular distances subject to different right truncation distances had been raised. Heide-Jørgensen referred to Tables 2 and 3 in Heide-Jørgensen *et al.* (2010a), in which results are presented for a MRDS stratum-based analysis with right truncation of 800m, a CDS stratum-based analysis with right truncation of 250m, and CDS pooled analyses for right truncation distances of 250m and 800m. The WG agreed that there was no lack of consistency in these estimates. It was therefore agreed that the MRDS estimate of 4,468 (95% CI 1,343; 14,871) was acceptable for the

purpose of assessment while noting that this is 3% higher than the previously accepted (NAMMCO 2011b) CDS estimate and that the latter might be preferred for some purposes.

Heide-Jørgensen informed the WG that a trend analysis will be conducted after the next survey.

6.1.2 CODA

Hammond informed the WG that since the last meeting a reanalysis had been undertaken of the combined SCANS-II, CODA and Faroese T-NASS data. In the CODA analysis for fin whales (Hammond *et al.* 2009), plots of Tracker vs. Primary perpendicular distance had been interpreted as evidence for responsive movement (attraction) and a full independence model had been used in the MRDS analysis to take account of this. In the new analysis, data on heading at first sighting were investigated (as described in Palka and Hammond 2001 and SC/18/AESP/O11) and no evidence was found for any attraction. Consequently, the point (trackline) independence model was used in the MRDS analysis. This model is more robust and is the model of choice if responsive movement does not need to be accounted for. Estimates of abundance for fin whales from this analysis were larger than the CODA estimates previously presented (NAMMCO 2011b), but details were not available to the meeting.

A possible explanation for the disparity in Tracker and Primary perpendicular distances is bias in distance measurement by the Primary. Leaper *et al*. (in press) have shown evidence of such measure bias in reticule readings (over-estimation of close distances and under-estimation of far distances) but this does not explain the patterns seen. Another explanation is simply that because more whales will be detected that are moving towards the trackline than are moving away from it (Hiby 1982, Palka and Hammond 2001), and Primary observers are searching closer to the vessel, Primary distances will tend to be smaller than Tracker distances. This tendency will be greater for species where Tracker detections are made far away, as they are for fin whales.

Additional to the above considerations is that the CODA estimate for fin whales took no account of the substantial number of detections classified as unidentified large whales. The reason for this was that, although the large majority of unidentified large whale sightings were likely to have been fin whales, on one vessel this identification code was used for all large whales and some could have been sperm whales. One way to deal with this would be to prorate unidentified sightings according to the proportion of identified sightings in that category (fin, sei, humpback, sperm whale), as is done in other studies with similar data.

The WG noted that these issues are planned to be considered in further analyses and that the results should become available later in the year.

6.1.3 Norway

No new results were available at the meeting. The Chair emphasized the need for the results from the latest Norwegian mosaic survey in 2002-2007 to be completed and presented. Øien informed the WG that this will be completed by the end of May 2011.

6.1.4 Revised combined estimate

The WG looked forward to new estimates from the latest Norwegian mosaic surveys, the 2007 SNESSA, and new estimates from the combined SCANS-II/CODA/Faroes analysis, following which, it would be possible to calculate a revised combined estimate for the North Atlantic.

6.2 Common minke whales

6.2.1 Canada: T-NASS aerial – correction for availability bias

Lawson informed the WG that the new Canadian analyses corrected for availability bias would be available within about one month. The Group welcomed this information and looks forward to receiving the paper in due course.

6.2.2 Iceland/Faroes: T-NASS shipboard combined with T-NASS extension

At its last meeting, the WG was provided with a model-based estimate of minke whale abundance but could not accept it as the information provided was not sufficient to interpret the methods and estimates (NAMMCO 2011b). At the time the Group reiterated its previous request that Iceland and the Faroes should provide a simple CDS estimate for these data, uncorrected for *g(0)*, recognizing that the data are not sufficient for an estimate of this parameter – this estimate should be kept consistent with earlier estimates for similar surveys in the area (Pike *et al.* 2009a). It was noted in this regard that a CDS estimate had been prepared and presented to the WG on Assessment at their meeting in April 2010 (NAMMCO 2011c and SC/18/AESP/18), and that the estimate had been accepted and used by that group. Abundance was estimated as 10,782 (95% CI, 4,733 to 19,262) for entire survey area covered by the dedicated vessels. Adding effort and sightings from the extension vessels reduced this estimate by 32%, probably because of a lower *g(*0*)* on these vessels.

6.2.3 Iceland: h(0) correction for the 2007 and 2009 aerial survey and subsequent revised estimates

Estimates of minke whale abundance from aerial surveys conducted in coastal Icelandic waters in 2007 and 2009 have previously been reviewed by the NAMMCO Working Group on Abundance Estimates (NAMMCO 2009b and SC/18/AESP/O05) and the NAMMCO Working Group on Assessment (NAMMCO 2011c) respectively. The 2009 survey was carried out primarily because the abundance of minke whales estimated from the 2007 survey was substantially lower than in earlier surveys. Pike *et al.* (2008 and SC/18/AESP/O05) estimated that the abundance of minke whales in 2007 was just 24% of that estimated for 2001 by Borchers *et al.* (2009). Results from a partial survey carried out in 2008 suggested that the 2007 results might be anomalous (Gunnlaugsson *et al.* 2009b), which led to the decision to carry out another full survey in 2009. However the uncorrected estimate from the 2009 survey was even lower at 5,900 (95% CI, 3,423 to 8,803) (SC/18/AESP/15), or 55% of that estimated in 2007. Neither of these estimates was corrected for visible whales that were missed by observers, and there was evidence that this bias did exist.

The WG was pleased to receive two papers presented to the Workshop that further examined the aerial survey results off Iceland.

An earlier version of SC/18/AESP/15, that presented a survey report and minke whale estimate from the 2009 aerial survey around Iceland, was examined by the NAMMCO Working Group on Assessment in 2010 (NAMMCO 2011c). The present paper presents an extended analysis of the common minke whale data, incorporating results from a partial survey conducted in 2008 and extending the index of abundance based on line transect density derived by Pike *et al.* (2009b) to include the surveys conducted after 2001. This index allowed inclusion of surveys conducted in 1986 and 1995 for which that data collected are not suitable for cue counting analysis. The authors also examined sighting distances for *Lagenorhynchus spp.* dolphins and humpback whales to ascertain whether the exceptionally wide effective search half width found for minke whales in the 2009 survey was characteristic for other species. Their comparison of perpendicular sighting distances for dolphins and humpback whales in 2009 to earlier surveys showed that they were quite similar, which suggests that the anomalous results for minke whales were not characteristic for other species. The minke whale estimate for block 1 (see Figure 1 at the end of this report) from the 2008 partial survey was 7,751 (95% CI 2,328 to 20,472) which is similar to that estimated for 2001 and much higher than those estimated for 2007 and 2009. The trend in line transect density of minke whales is very similar to that for the available corrected estimates. Density was stable or increasing in most strata from 1986 to 2001. There was a sharp decline in 2007, with density in the survey area only 26-28% that from the 2001 survey. Density in block 1 recovered to earlier levels in 2008, only to decline sharply again in 2009. Overall density in 2009 was 22-26% that observed in 2001. The authors noted that the new evidence presented strengthens the conclusion that the observed decline in minke whale abundance is not a result of error in measuring distances or analytical problems. However the inclusion of the 2008 survey results does demonstrate that minke whale abundance exhibits great fluctuations from year to year.

The WG also received SC/18/AESP/08 which examined perception bias in the aerial surveys. The authors use Mark-Recapture Distance Sampling (MRDS) techniques, using an independent observer configuration and assuming full independence, to estimate $p(0)$ for these surveys and apply the correction to the previously completed standard estimates. For the 2007 survey, the best MR model for the right side duplicate data included radial distance, platform and their interaction term as covariates, and resulted in an estimated $p(0)$ of 0.71 (CV=0.25) for the primary platform The corrected total estimate was 14,838 (95% CI 7,381, 24,919). Using only data from the most effective observer, the best MR model again included radial distance, platform and their interaction term, and resulted in an estimated $p(0)$ of 0.72 (CV=0.24) for the primary platform, and a corrected total estimate was 20,834 (95% CI 9,808, 37,042). The authors considered this the best estimate for 2007 because a lack of duplicated data for the less effective observer likely resulted in overestimation of $p(0)$ when that observer was included. For the 2009 survey the best MR model for the right side duplicate data included only radial distance as a covariate and resulted in

an estimated $p(0)$ of 0.55 (CV=0.10) for the primary platform. The corrected total estimate was 9,588 (95% CI 5,274, 14,420). The corrected abundance estimates for 2007 and 2009 presented here change previous conclusions about the observed decline in minke whale abundance in the area since 2001 only by degree (Figure 1 at the end of this report). The best available estimate of abundance for 2007 was 48% that for 2001. Abundance in 2009 remains the lowest yet seen in all areas, just 46% that observed in 2007 and 22% that estimated in 2001. The latter difference is significant ($P<0.05$).

There was considerable discussion of these papers. The general conclusions reached can be summarised as follows:

(1) the WG accepted the corrected single observer estimate of 20,834 (95% CI 9,808, 37,042) as the best estimate for the 2007 survey, and the corrected estimate of 9,588 (95% CI 5,274, 14,420) as the best for the 2009 survey. A single paper combining AESP/08 and AESP/15 will be an important paper for publication (see item 7.);

(2) given the importance of cue rates to the present cue-counting approach, it would be timely to consider a full review of the available data as it is some time since this was last done – this should also examine the issue of possible changing cue rates (by behaviour, area, over time, with different prey species *etc*.) and the implications of this for trend analyses;

(3) more data are required to estimate availability bias and its spatial and temporal variability. This could best be done through tagging studies using time-depth recording tags.

(4) the previous assumption that the most important component of the Central Atlantic stock is found within Icelandic coastal waters in summer is not valid every year – there can be considerable annual variation as shown by the 2007, 2008, and 2009 results;

(5) although it had been suggested that the common minke whales absent from Icelandic coastal waters may have moved further north and/or east towards Greenland, preliminary results from Norwegian surveys in the CM area suggest that the numbers there from the 2010 surveys compared to previous surveys will not explain the difference;

(6) areas close to East Greenland have not been well covered in recent years due *inter alia* to poor weather and varying ice conditions; these have been shown to have high densities in some previous surveys (Pike *et al.* 2009a).

(7) consideration should be given to following the practical and analytical approach used in Greenland for aerial surveys for common minke and fin whales, recognising the financial implications (*e.g*. see Heide-Jørgensen *et al.* 2010a,b);

(8) the above points should be taken into account when planning for future surveys;

(9) spatial modelling approaches for all of the past surveys (separately and where possible combined) should be considered to see if these provide some information on key variables that might help explain the changes in distribution;

(10) while difficult to incorporate directly into spatial modelling, it would also be valuable to examine other time series of data *e.g.* prey species or proxies for prey species (such as capelin, sand eels, seabirds) that may help to explain changes in distribution, including both annual variation and possible longer term future changes;

(11) Víkingsson agreed to consult with whale watching operators in Iceland to see if their data might provide insights into changes in distribution.

6.2.4 Greenland: T-NASS shipboard - documentation for estimate

The Workshop had been given a shipboard estimate at the last meeting without any documentation, and recommended that it be brought to the next meeting. The WG was informed that no analysis will be forthcoming because the estimates so produced would be inferior to those from the aerial surveys conducted in the same year.

6.2.5 Revised combined estimate – including a new estimate from Norway

The Workshop agreed with the previous conclusions on this issue made by from the assessment committee (NAMMCO 2011c) with regard to the Central Area. Comprehensive coverage took place in three years: 1987, 2001, and 2007, with abundance estimates totalling 37, 62, and 21 thousand whales, respectively. The drop from 2001 to 2007 is primarily a consequence of a much reduced estimate from aerial surveys of the Icelandic coastal region, representing only a small proportion of the distribution area of the Central North Atlantic stock.

6.3 Humpback Whales

6.3.1 Canada: T-NASS aerial – revised estimates corrected for availability

No new analysis results were ready to present at this meeting. The WG was pleased to hear that Greenland has new humpback whale tagging data that Canada could use to inform their availability bias corrections. The WG agreed that the correction for perception bias estimated using a double platform approach on the Twin Otter aircraft in the Newfoundland and Labrador strata could be applied to data from the Skymaster survey data as it would likely be conservative (*i.e.* result in a negatively biased estimate of abundance) for this platform.

6.3.2 Iceland/Faroes: T-NASS shipboard: investigate presence of responsive movement (if so revise estimate using MRDS with full independence)

No new analysis results were ready to present at this meeting, and the WG again **recommended** this approach.

6.3.3 Iceland/Faroes: T-NASS aerial-shipboard combined

At their previous meeting the Group agreed that a first approach to combining estimates from the aerial and shipboard surveys, which overlapped in some areas, could be to employ abundance estimates from the shipboard surveys in the

overlapping areas and to use the post-stratified aerial survey results for the rest. No new analysis results were ready to present at this meeting, and the WG again **recommended** that Iceland and the Faroes complete this task.

6.3.4 Greenland: T-NASS shipboard Greenland and combined aerial-shipboard estimate

See item 6.2.4.

6.3.5 Norway: Results from mosaic survey 2002-2007

No new analysis results were ready to present at this meeting, and the WG recommended that Norway finish the analyses of these survey data. See item 6.1.3.

6.3.6 Revised combined estimate

Previously (NAMMCO 2011b) the WG had concluded that it was unlikely (but not impossible) that there would be movements of humpback whales between survey areas over the course of the surveys and that the estimates would be additive once the new estimates for indicated areas are carried out according to the guidelines suggested. The Group had no new information available to update this conclusion or complete the combined estimate.

6.4 Pilot whales

6.4.1 Iceland-Faroes shipboard

6.4.1.1 TNASS Iceland/Faroes CDS estimate

Working paper SC/18/AEWG/05 (summarized under 6.4.1.3 below) provides estimates of pilot whale abundance using a CDS analysis, both including and excluding the extension vessel data. The estimate for the total area, using the combined platform sightings from the dedicated vessels only, is 128,093 (75,682; 216, 802). Inclusion of extension vessel effort and sightings reduces this estimate by 24% because of the low encounter rate of these vessels relative to the dedicated vessels in the same strata, which implies that the extension vessels had a low $g(0)$ compared to the dedicated vessels. This estimate was accepted by WG for use in assessments.

A further CDS estimate can be expected once AEWG/10 (summarized under 6.4.1.2 below) has been revised.

6.4.1.2 Revised MRDS T-NASS estimate

Working paper SC/18/AESP/10 on the 2007 Iceland and Faroes shipboard and Icelandic aerial surveys was presented in a previous form to the last meeting of the WG and recently revised to take account of recommendations made then. The document provides estimates of the abundance of pilot whales by fitting a generalized additive model with spatially referenced covariates to data collected during the 2007 Icelandic (shipboard and aerial) and Faroese (shipboard) components of the T-NASS as well as the extension surveys conducted during the same period. The shipboard surveys extended from the east coast of Greenland, around Iceland, to the Norwegian Sea as far south as the northern British Isles. In contrast, the aerial surveys were limited to Icelandic coastal waters only. The aim of this analysis was to predict density, and hence abundance, of long-finned pilot whales throughout this survey

region. Density was estimated in two stages; presence-absence of whales was modelled logistically, then density given presence was assumed to be constant. The product of the predictions obtained from the two models provided an estimate of density. The spatially referenced covariates considered were longitude, latitude, depth, as well as survey platform type (ship/vessel/*etc*.). Additionally, shipboard $g(0)$ was estimated from shipboard double-platform data, using both the full independence (FI) and point independence (PI) methods. Variance was estimated using non-parametric bootstrapping. In addition, a CDS estimate for the shipboard areas was provided.

In discussion the WG confirmed that differences between $g(0)$ on different kinds of survey platform are accounted for by estimating $g(0)$ from the double-platform shipboard platform and introducing a factor for vessel type when fitting the density surface model to all platform types (aerial, combined mode, single platform and full BT).

The WG discussed the appropriateness of the assumptions for the double platform data. It was felt that the PI would provide the best approach for analysis as there is no expectation or evidence that pilot whales exhibit responsive movement. (PI estimates are less biased when there is no responsive movement, but if there is responsive movement then the FI model may be preferable.) It was also noted that the authors had not used some sightings where the duplicate status was uncertain.

The WG expressed concern that the RS and FX strata, where the highest predicted densities in the whole survey region occur, are in areas where there is zero or very low survey effort. These parts of the RS and FX strata contribute substantially to overall abundance but as this would be on the basis of an extrapolation of the density surface beyond the range of the data, their inclusion may undermine the reliability of the abundance estimates obtained from the density surface modelling approach. The WG recommended that the southwest parts of block RS and the southeast parts of block FX be excluded from the density surface model prediction because of lack of data in these regions together with atypical depths.

Some concern was expressed that single-platform survey vessel data had been treated the same as data from the extension vessels, which may not be appropriate as another analysis has indicated that these vessels have a low $g(0)$ for pilot whales relative to the dedicated vessels (see item 6.4.1.1). While the Group felt that including the extension vessel data as an additional survey mode would be optimal, they noted that this would involve substantial and relatively time-consuming revision of data and therefore suggested that as an interim measure, the authors revise the density surface model excluding these data. Until this revised model is fitted, and the southwest part of block RS and southeast part of block FX are excluded from the model prediction, the WG felt it could not draw conclusions about the appropriate population estimates for pilot whales in this survey area from a density surface modelling approach.

In summary the working Group requested the following revisions to the analysis:
1. Carry out modelling both including (*i.e*. as it is now) and excluding extension vessels.

2. Provide diagnostic plots of presence/absence and density against explanatory variables.
3. Post-stratify blocks FX and RS to exclude predicted high-density areas that had little or no survey effort.

These changes were completed by the authors subsequent to the meeting and reviewed by correspondence. The most robust estimated pilot whale abundance over the entire region of interest from the density surface modelling was 152,200 (95% CI) 38,900; 1,441,300). The design based equivalent was 140,900 (56,800; 1,087,800). Post-stratification as described above reduce the density surface modelling estimate to 122,400 (45,800; 1,013,500). Excluding data from the extension vessels increased these estimates by 48% and 28% respectively but reduced precision. The equivalent estimate, based on a conventional distance estimate for the ship component of T-NASS 2007 (including extension vessel effort and not taking into account perception bias on the trackline) was 121,800 (19,300; 138,900). The authors suggested that the increase in the estimate and decrease in precision relative to the conventional estimate was caused by multiple factors: the correction for detectability on the trackline, greater encounter rates in the conventional analyses (as trackers sightings were considered), the prediction in the density surface models of non-zero densities in blocks (FE) where no animals were seen by primaries (although seen by trackers) and low effort leading to wild extrapolations on the periphery of the survey in the density surface model bootstraps.

In discussion the WG noted that, as expected, the exclusion of the extension vessel data resulted in an increase in the abundance estimates, probably because the observers on these vessels had a more severe perception bias than those on the dedicated vessels. Similar results have been found for minke, fin and humpback whales (NAMMCO 2011b). Post-stratification had the expected effect of reducing the estimates by a margin greater than would be expected based on the reduction in area alone, because of the exclusion of high-density (but unsurveyed) areas. However post-stratification did not improve the precision of the estimates.

The model-based estimates are very imprecise, with extreme upper confidence intervals. Exclusion of the extension vessel data worsens this problem. The WG had concluded the model-based analysis did not provide estimates of abundance superior to design-based estimates for use in assessments, probably because there were an insufficient number of sightings and/or the environmental covariates used did not explain much of the spatial variance in pilot whale distribution. As such, the design-based CDS estimate detailed under 6.4.1.1 should be preferred for assessment. This estimate could be corrected for perception bias using MRDS assuming PI, and the WG **recommended** that this be done.

6.4.1.3 Index of relative abundance for NASS - T-NASS surveys, including trends in school size estimate

The NAMMCO Scientific Committee recommended in 2008, 2009 and 2010 (NAMMCO 2009a, 2010, 2011a) that an index of relative abundance be developed and applied to the area that is common to all surveys, with the aim of determining

trends in abundance over the full period of the NASS. Working paper SC/18/AESP/05 described an index estimate approach to examine pilot whale population trends over time. NASS have been conducted in 1987, 1989, 1995, 2001, and 2007. These surveys have covered a large but varying portion of the central North Atlantic. Long-finned pilot whales occur throughout the southern part of the survey area, especially around the Faroe Islands and south of Iceland. Previous estimates of pilot whale abundance, derived using conventional distance sampling (CDS), are not directly comparable to one another because of different survey extent and, in the case of the 1989 NASS, different survey timing. The authors of this working paper used a CDS approach to develop an index of relative abundance as a means to ascertain if pilot whale abundance has changed over the 20 year period from 1987 to 2007. The varying spatial coverage of the surveys is accommodated by delineating a common area that was covered by all the surveys, here called the index area and arbitrarily divided into two sub-regions, East and West. Post-stratification was used to obtain abundance estimates for the index area only. Estimates are provided using the sightings from the combined platforms or the primary platform only for surveys that used double platforms, and including and excluding extension vessel sightings in 2007.

Estimation of pilot whale group size had a strong influence on estimated abundance and varied significantly among the surveys. Mean group size was larger (n=118) in 1987 than for the other years, especially for the Faroese vessel. It appears that the definition of a "group" and the estimation of its size have changed over the course of the surveys (see discussion, below). Other potential biases include differences in survey timing and changes in the number of observers on the primary and combined platforms (*e.g*. the WG learned that later surveys have more observers in total [with a rise in the numbers of observers on the tracker platform], but fewer observers on the primary platforms [recently limited to two observers on the primary]).

Abundance was greater in the West sub-region than in the East in all survey years except 1995. Abundance in the East sub-region was lowest in 2007 and highest in 1995 but there was no significant difference between survey years. Abundance in the West sub-region was highest in 1989 and lowest in 2001 but again there was no significant difference between survey years. Total index area abundance for the combined platforms (TOTAL) ranged from a low of 36,739 (95% CI 16,604; 81,289) in 2007, to a high of 114,520 (95% CI 33,730; 388,810) in 1995. Point estimates of population growth rates for the East, West and TOTAL regions were negative in all years but only significantly different from 0 for the East and TOTAL regions using data from the primary platforms only. In contrast, the density of pilot whale groups (cluster density) in the index areas did not show a decline over the period and in fact showed no unidirectional trend over time. The index area comprises only a small portion of the summer range of the species and changes in distribution may have influenced the results. Because of this, and possible changes in operational biases among the surveys, the authors could reach no firm conclusions about trends in pilot whale abundance in the area.

The Working Group agreed with the authors of AESP/05 that what has being defined as a pilot whale "group" appears to have changed over time, and this might influence

the estimated abundance, especially for the early surveys. Initially, different pilot whale group definitions were tried as a means to deal with large aggregations of pilot whales that were difficult to count. The early surveys (87 and 89) were conducted using a closing mode which usually results in larger estimates of group size. The WG **suggested** that there may be some ways to review the old survey planning documents, or look at the survey data (*e.g.*, is the group size on the Faroese vessel in 1987 a multiple of 10?), as a means to investigate the influence of group definition. Further, in the Working Paper's Appendix 1 there is a review of closing experiments during surveys; when a survey vessel closes upon a large aggregation of pilot whales it appears that more subgroups are detected, and more animals are detected in each of these subgroups, although the results of these experiments have not been used to derive corrections factors for pilot whale surveys.

In addition, the WG was informed that the average group size in the Faroese drive fishery was 149.3 in the period 1709-1990, with a decreasing trend over the last fifty years and a yearly average of 85 in the period 1987-2007 (Bloch *et. al*. 1993, Zachariasen 1993, Mikkelsen, pers. commn.)

The WG concluded that these surveys may not be the best approach to surveying pilot whales as this species is highly clumped in distribution. Further, since the index area is a small subset of this species' entire range, and the proportion of the total number of pilot whales within the index area likely varies from year to year, trends inferred from the index areas alone may not be representative of overall abundance trends. Because of this and possible changes in operational biases among the surveys, the WG agreed with the authors that no firm conclusions about trends in pilot whale abundance could be inferred from this work.

The Working Group **recommended** that future surveys must have a clear and carefully designed protocol for defining groups and estimating group sizes, as these are particularly important issues for this species.

6.4.2 Greenland: comparison of distribution and sighting rates between 2007 and previous surveys

In 2009 the WG accepted an uncorrected CDS estimate of 2,976 animals (95% CI 1,178 - 7,515) from the 2007 survey (NAMMCO 2011b), and recommended that the authors compare these results with those from past surveys conducted off West Greenland. Rikke Guldborg Hansen presented a brief summary presentation of the results of two surveys in western Greenland in 2007 and 2009. There were earlier surveys as well, but very few pilot whales were sighted during these, so an analysis of longer term trend was not feasible. There were 13 sightings of pilot whales in 2009, with 10 located in the same stratum in which the pilot whales were sighted in 2007. Density was 0.11 whales/km^2 (CV=0.64) in 2007 and 0.14 whales/km^2 (CV=0.96) in 2009; the very clumped distribution was likely related to a nearby fishing bank. Given that only two imprecise estimates are available, the WG was unable to comment on trends in abundance in this area.

6.4.3 Combined estimate

The Working Group considered the possibility of combining the pilot whale survey estimates from the CODA, T-NASS, and SNESSA surveys.

There is likely little exchange between Canada and Greenland as few pilot whales were seen on the Labrador Shelf during the 2007 T-NASS, and historically; thus, their abundance estimates should be additive. Further, there appears to be little exchange with the SNESSA survey area so it is likely that the concurrent abundance 2007 estimates for the U.S. (when it is available) and Canada can be combined. Similarly it was considered that the Iceland/Faroes/CODA and Greenland estimates can be combined.

The WG noted with concern the difficulties it faced in providing estimates of abundance of pilot whales appropriate for management purposes given the absence of adequate information on *inter alia* movements and population structure, and an agreed assessment and management procedure (note that the IWC management procedures apply only to baleen whales).

It draws this matter to the attention of the Scientific Committee, and **recommends** that it should be addressed by the Assessment Group as a matter of urgency. It should be noted that (a) a timely research focus on a better understanding of stock structure and movements is essential as this will allow a more focussed survey area in the future, ideally for the next NASS, that relates directly to the provision of management advice; and (b) in this regard it is not possible to obtain robust abundance estimates for the entire North Atlantic. At least initially, a management regime that does not require population abundance estimates and is robust to stock uncertainty should be developed. The Assessment Group may also consider attempting to estimate the population size that would be required for the present Faroese hunt to be sustainable for comparison with available abundance estimates.

It notes that the 1989 pilot whale estimate (Buckland *et al.* 1993) has long been used as a 'reference' estimate for pilot whales in the North East Atlantic because it covered the widest geographical area. The WG **agrees** that this estimate is too old to be considered a current reference abundance estimate. For the reasons documented above, the WG is not able to provide reliable information on trends in abundance of North Atlantic pilot whales. In terms of an accepted recent abundance estimate, it agrees that the estimate of 128,093 (75,682; 216, 802) for the Iceland/Faroese survey area (see 6.4.1.1) is the best that is currently available; this applies to a considerably smaller area than the 1989 estimate. It is not known how this relates to animals that may be available to the Faroese hunt. The WG also notes that an abundance estimate of pilot whales from the combined CODA and Faroese data will soon become available.

6.5 Harbour Porpoise

6.5.1 and 6.5.2 Iceland and Faroe Islands

SC/18/AESP/11 presented an overview of the survey methods and results for aerial surveys carried out to estimate harbour porpoise abundance in Iceland (2007) and the Faroe Islands (2010). The estimates presented are the first ones for Iceland and the

Faroe Islands based on surveys where the harbour porpoise was a main target species. In Iceland, the cue counting procedure, which also produces the data required for line transect analysis, was used, while in the Faroes standard line transect sampling was applied, following the SCANS-II protocol. In both surveys a Partenavia aircraft was flown at 600 ft altitude at an air speed of 90-100 knots. Estimates of *esw* (incorporating *g*(0)) derived during the SCANS-II 2005 survey were used for abundance estimates as the principal observers took part in this survey as well. In Iceland, realised effort in good or moderate harbour porpoise sighting conditions totalled 8,289 km in 13 survey blocks where 77 sightings (109 individuals) were made by the experienced harbour porpoise observer only. In Faroese waters, only the three inshore blocks could be surveyed and 1,564 km were surveyed in good or moderate porpoise sighting conditions; 39 sightings (49 individuals) were recorded. The total abundance estimates were 43,179 porpoises (CV=0.45; 95%CI: 31,755-161,899) for Icelandic waters and 5,175 porpoises (CV=0.44; 95%CI: 3,457-17,637) for Faroese waters.

The Icelandic survey was changed especially to obtain a better estimate for this species by (1) reducing survey altitude from 750 to 600 ft, (2) using an observer with significant porpoise survey experience, and (3) applying effort in some fiords that were not in the original survey design. However, only one porpoise was sighted in the additional fiord strata. Additionally, a subjective assessment of porpoise "sightings conditions" was conducted by the specialist porpoise observer, and used as an analytical covariate as had been done successfully in SCANS-II. This porpoise specialist was the only primary observer who had significant experience in previous harbour porpoise surveys and participated in SCANS-II. This observer was far more effective in terms of sighting rates, and thus this survey employed this person's data as part of a one-sided survey analysis.

The Faroe Islands survey, the first in these waters, employed the same methods as during SCANS-II, with the same aircraft as in the Icelandic survey. During the Faroese survey there were weather and logistical issues which decreased realized effort. This pilot study was judged to be a success, although the offshore blocks could not be covered in the time available.

In response to concerns about applying the SCANS-II *esw* and *g*(0) corrections to these surveys, the authors stated that the detection functions were similar in these surveys and that the observers were from one of the observer teams used in SCANS II, which supports the application of the SCANS-II *esw*. Given that no "circle backs" were carried out and there were no viable double platform data from either survey, there was no other alternative to obtain corrected estimates. It was also noted that school sizes were similar among strata and between surveys, and that this therefore should not introduce any bias in the application of the Hiby (1999) methods.

In response to a question the authors noted that porpoises were commonly sighted offshore around the Faroes, and that the largest porpoise groups were indeed sighted at the outer margins of the survey strata. Therefore, it could be expected that complete coverage of all strata would result in a substantially higher estimate.

The WG concluded that the Iceland survey has produced the best available estimate for harbour porpoises in this area, and is a large improvement relative to previous NASS surveys for this species and area (Pike *et al.* 2009b). This improvement was a result of the presence of a specialist porpoise observer, adapted survey techniques for this species, and corrections for bias. The estimate has a rather low precision, due to large variance of the combined *esw* and *g*(0) estimate. However, it is not possible to partition the variance because of the analytical methods used.

The WG felt that given the differences in survey methods used in 2007 (specialist porpoise observers, lower altitude), and the known extreme differences between observers evident for this species, the trend analysis contained in Pike *et al* (2009b) was probably not applicable. In order to estimate trends in abundance in these waters further surveys optimized for harbour porpoises are required.

The pilot harbour porpoise survey for Faroese waters was deemed a success as a basis for planning future surveys, despite the poor weather and logistical issues.

The WG, while acknowledging that survey correction factors ideally should be derived during the survey rather than from other surveys, found the practice acceptable in this case for the reasons noted above.

6.5.3 Norway

No new analysis results were ready to present at this meeting.

6.5.4 Combined

Given the likely lack of movement between survey areas, there would be no barrier to summing regional estimates to obtain a combined estimate should that be deemed useful.

6.6 Dolphins

6.6.1 Greenland – trend in abundance for white-beaked dolphins

At its last meeting the WG recommended that all relevant Greenlandic aerial surveys be examined to determine trends in abundance in the area. However the Group was informed that the available data for this species were not sufficient to support such an analysis.

6.6.2 Iceland/Faroes: T-NASS shipboard estimate and trend in abundance

Acquarone had agreed to carry out this work but it has not yet been completed. The Group **strongly recommended** its completion before its next meeting, and noted its importance for planned assessments of dolphins within NAMMCO.

6.6.3 Iceland: T-NASS aerial

Estimates of *Lagenorhynchus* spp. dolphin abundance have not yet been developed from the two most recent aerial surveys. Víkingsson informed the Group that this would be done when the required resources became available.

6.6.4 Combined estimate

Much work remains to be completed before estimates for the entire T-NASS area can be developed. The Group encouraged the completion of this work but noted that a lack of resources will slow the process as these are not priority species for most jurisdictions. See also 6.10.2.

6.7 Sperm whales

6.7.1 Iceland: Acoustic T-NASS shipboard

The T-NASS acoustic data from Iceland should have been analysed following a methodological course held in Iceland in November 2009 under the leadership of René Swift (SMRU). The course was successfully conducted and the analysis of the sound files subsequently performed. However when looking at the 'acoustic sightings' and comparing with the visual data, it appear that there was a problem, with no acoustic recordings in areas with visual sightings. Although the problem has not yet been fully identified, a closer inspection of the data revealed that a problem had likely arisen when the hydrophones were connected with different hydrophone separations used for each different vessel. The data are not lost, however a new analysis will require lengthy (a minimum of 1 person-week per vessel) reprocessing of the data. Considering both the interest in the potential abundance estimates and the investment already made in acquiring the acoustic data *(e.g.* the equipment), holding the course and performing the first analysis, the WG **strongly recommends** that the analysis of these data be carried out again and the abundance estimate finalised. It urges NAMMCO to find a suitable agreement with SMRU/RS, so the analysis can be redone in a timely manner.

6.7.2 Faroes: Acoustic T-NASS shipboard

The T-NASS acoustic data from the Faroese vessel had not been incorporated into the analysis procedure mentioned above, and therefore it is not clear whether the same technical difficulties had been encountered. The WG urges the Faroes to investigate this and carry out the analyses of these data in parallel with the Icelandic data.

From the CODA survey, visual estimates for blocks 1-4 corrected for perception bias were only slightly lower than acoustic estimates for blocks 2-4 only. This suggests that availability bias may not be high for this species. The WG encourages that simultaneous visual and acoustic estimates be obtained for the Icelandic-Faroese area. Visual estimates will also allow comparison with earlier estimates derived from the NASS series (Gunnlaugsson *et al.* 2009a).

6.7.2 Norway: mosaic survey 2002-2007

See Item 6.1.3.

6.8 Sei whale: T-NASS Icelandic-Faroes shipboard and trends

Previous estimates of sei whale (*Balaenoptera borealis*) from NASS have ranged from 1,293 (95% CI 434; 3,853) in 1987 to 10,300 (95% CI 6,150; 17,260) in 1989 (Cattanach *et al*. 1993), and an estimate of 9,249 (95% CI 3,700; 23,116) for 1995 (Borchers and Burt 1997). The 1989 survey was exceptional in that it extended farther

south and was conducted later in the season than other NASS, and was therefore considered to be optimal for this species.

The authors of SC/18/AESP/07 present conventional distance sampling (CDS) and mark recapture distance sampling (MRDS) abundance estimates for the 2001 and 2007 surveys, incorporating 2 levels of certainty about species identification in sensitivity analyses. In 2001 sightings of sei whales were distributed over a broad area to the south of Iceland. Nearly half of the sightings were made in the Faroese block, an area where sightings were very rare in previous and subsequent surveys. In 2007 sei whales were sighted to the south and southwest of Iceland, and none were sighted southeast of Iceland. A large proportion was sighted at the southern extremity of the survey area. In 2001 uncorrected (CDS) abundance estimated for the combined platforms was 1,494 (95% CI 843; 2,245), spread fairly evenly over the SW, W, and FAROES strata. Inclusion of the lower certainty sightings increased this estimate by 40%. MRDS analyses assuming point independence indicated, counter intuitively, that the probability of detection was greater at higher Beaufort sea states. The mean estimated value of $p(0)$ for the primary platform was 0.53 (CV=0.35) for the high probability sei whales and total abundance was 2,716 (95% CI 851; 8,668), 82% higher than the equivalent combined estimate. In 2007 the CDS estimate was 4,924 (95% CI 1,224; 10,591); inclusion of lower certainty sightings increased this estimate by 1%. Inclusion of extension vessel effort and sightings was not attempted because it would have lowered the estimate, given that there was only one sighting by these vessels in 1,643 nautical miles of effort within the survey area. MRDS analyses assuming point independence were attempted but did not produce credible results, probably because there were only 9 trials and no duplicate detections close to the trackline. These surveys did not cover the seasonal range of the species during the summer, and larger numbers would likely have been seen had the survey been conducted later in the season. Nevertheless the estimates are similar to previous ones when constrained to overlapping areas, except for the 1995 estimate which is higher. This confirms the observations of whalers that the migratory behaviour of sei whales can vary greatly from year to year.

The Group discussed the possible reasons for the observed higher probability of detection at higher Beaufort sea states in the 2001 survey. One possibility is that the sighting cue must be quite obvious in order to be seen at all at higher Beauforts, so these strong cues are more likely to be duplicated. A possible implication of this would be that $p(0)$ is underestimated because weaker cues are not seen frequently at higher Beauforts. Inclusions of covariates relating to sighting cue, if available, in the mark-recapture model might therefore improve the estimation of $p(0)$ and therefore abundance.

Recent satellite tag applications near the Azores in May and June (Olsen *et al.* 2009, Prieto *et al.* 2010) have shown that most of the 7 animals tagged migrated northwards through the Labrador Sea and had reached southwest Greenland by July. Unfortunately the tags did not transmit long enough to determine if these same animals moved into Denmark Strait in August. However this does indicate that sei whales would have been present south and west of the survey area during the time of

the survey, as does sightings of sei whales southwest of Iceland by one of the extension vessels during T-NASS. Heide-Jørgensen noted that sei whales were seen off southwest Greenland during the 2005 and 2007 aerial surveys, conducted in August and September. Lawson suggested that passive acoustic monitoring could be used to further elucidate the seasonal and spatial distribution of this species, and that there may be existing data available from deployed autonomous acoustic recorders in the North Atlantic.

The Group accepted both the CDS estimates and the MRDS estimate for 2001 and the CDS estimate for 2007 as the best recent estimates of abundance available for this species in the area. However it was reiterated that the NASS are not ideal for estimating the abundance of this species, both because of survey timing and extent. If a better estimate of sei whale abundance is needed, surveys will have to extend farther to the south and/or be conducted later in the season than has been the norm for NASS.

6.9 Bottlenose whales

The T-NASS shipboard data only includes 26 sightings of northern bottlenose whales + 1 Sowerby's beaked whale + 11 of unidentified beaked whales, with 33 of the sightings in the two adjacent southerly blocks, of which the eastern one is contiguous to the CODA area. At its last meeting the WG, therefore, recommended that the T-NASS shipboard data be combined with the CODA data and incorporated in the model based reanalysis of the SCANSII/CODA data which was then planned (and since carried out). This combined analysis was not supported by NAMMCO. However, the Faroese data (13 northern bottlenose whale sightings) were included in the re-analysis, and the WG recommended that the results of this analysis be made available as soon as possible.

Adding the remaining sightings from the Icelandic area (9 sightings of northern bottlenose whales + 1 Sowerby's beaked whale + 10 of unidentified beaked whales) area at this point would represent a substantial amount of work and was not currently feasible.

6.10 Additional analyses to be carried out

6.10.1 Combined distribution maps T-NASS/NASS/CODA/SNESSA/SCANS II and common T-NASS/CODA/SNESSA survey report

See. Item 7.

6.10.2 Combined T-NASS/CODA combined model based analysis

At its last meeting (NAMMCO 2011b), Hammond informed the Working Group that he and Cañadas would be conducting a reanalysis of the combined CODA and SCANS-II data using model-based methods in the next 6 months. The Group considered that this would be an ideal opportunity to undertake integrated model-based analyses of CODA and T-NASS data. The Group considered that most added value could be gained from combined estimates for pilot, minke, fin and sperm whales as well as white-beaked and common dolphins. The Group tasked Hammond, Desportes, and Víkingsson with developing a proposal with costs and sourcing any

necessary additional funding to make this happen. A project proposal was developed, however funding for this project was rejected by NAMMCO.

Although recognizing the financial constraints, the WG reiterates that the proposed study represented a cost-effective means of obtaining a better understanding of the distributions of the species, particularly in light of the great resources involved in collecting the data. It also notes the great value of the proposed work towards the effective planning of future surveys, particularly to optimize coverage and effort for the target species. Therefore, the WG **strongly recommends** that such a study be undertaken with the T-NASS data before the planning of the next survey – see report of the Survey Planning Working Group meeting, item 4.1, for more detailed information.

6.10.3 Other

At its last meeting the WG discussed the use of the last distance estimation for each sighting instead of the first, which is not standard practice for line transect surveys of cetaceans, although it has been used consistently in analyses of the Iceland/Faroese shipboard data. Gunnlaugsson noted that in theory. using the distance to the last surfacing before abeam eliminates a possible positive bias due to random movement of the animals detected far ahead on the track line, and that the last measurement is generally more accurate because it is done when the animal is closer to the vessel, but others suggested the approach may introduce other biases because animals moving towards the trackline will have a greater chance of being resighted, and thus having later distance measurements, than those moving away from the trackline. For some species responsive movement might also be an issue. This issue was not fully resolved at the last meeting, and Hammond and Gunnlaugsson volunteered to search the literature about this specific issue.

Hammond reported that a primary reference in this context was a paper by Palka and Hammond (2001), which demonstrated through simulations that the random movement of animals favours detection of animals moving towards the trackline, and would therefore also result in a higher proportion of these animals having more than one detection.

The WG agreed that the issue must be investigated further to determine if this practice introduces a bias into recent abundance estimates that have used these data. Gunnlaugsson agreed to do a comparative analysis of first and last sighting distances to the same sighting, in NASS and T-NASS datasets in which this practice has been used, while noting that any differences found may have explanations other than random movement of animals. Donovan will also investigate the availability of simulated datasets that could be analyzed. This analysis will be reported to an inter-sessional correspondence group consisting of Gunnlaugsson, Hammond and Borchers, which will report directly to the Scientific Committee in time for their next meeting if possible.

7. PUBLICATION OF SURVEY RESULTS

In 2008, 2009 and 2010, the NAMMCO Scientific Committee recommended that a primary publication on the planning, conduct and results of the T-NASS, particularly pertaining to the general distribution of cetaceans throughout the entire survey area, including the extension areas, be produced as a priority (NAMMCO 2009a, 2010, 2011a). The coordinators of CODA and SNESSA had agreed to participate in this. Noting that Acquarone and Desportes had already agreed to lead in preparing this paper, the Group considered that it would be the ideal introduction to a series of papers covering abundance estimates from the survey, preferably published together in a single issue. In this regard the Group noted the offer of Greg Donovan to publish T-NASS papers in a single issue of *J. Cetacean Research Management*. Working papers reviewed at this meeting could form the basis of this publication. It was agreed that Acquarone would lead in developing this publication, initially by contacting lead authors for the papers and negotiating a suitable publication agreement. It had also been agreed that a deadline of June 2010 would be set for submission of papers for this publication.

Desportes informed the Group that there had been no progress in producing the general introductory publication, or in coordinating the production of the proposed series of papers. The Group also noted that Greenland had already published relevant results from their portion of the T-NASS.

The Group reiterated its original recommendation that these publications be developed. It was considered necessary to appoint someone to take charge of coordinating this effort, and the Group recommended that this be done by Scientific Committee in cooperation with the NAMMCO Secretariat. The Group developed a list of publications, based on work that has already been completed, that should be included (see Table 1). The Group stressed the importance of this matter and recommended that it be initiated in a timely manner.

8. OTHER ITEMS

It was noted that the T-NASS section of the NAMMCO web site had not been updated to include an account of the work that has been done since 2007, including three meetings of Abundance Estimates Working Group, distribution maps, and abundance estimates for several species. It was considered important to disseminate information about the T-NASS to as wide an audience as possible, as there is considerable interest and the project was largely publicly funded. This might also have funding implications for future surveys in some jurisdictions. The WG therefore encouraged the dissemination of current information about the project through the NAMMCO web site in a timely manner. This could be done through the development of the stock status section proposed for the web site.

9. NEXT MEETING

Unfortunately the completion of all priority analyses from the T-NASS had not proven to be possible at this meeting. Remaining work includes completion of abundance estimates for pilot whales, dolphins and sperm whales, large whales from the

Norwegian mosaic surveys, correction of estimates from Canadian aerial surveys for availability bias, and resolution of some methodological issues (see 6.10.3). Noting the amount of treasure and sweat that has gone into the T-NASS, the WG urged members to complete these tasks as soon as feasible. The Scientific Committee should recall the WG once sufficient work has been done to warrant a meeting.

10. ADOPTION OF REPORT

The Report was adopted in draft form on March 11, and the final version was approved by correspondence on March 31, 2011. Table 2 provides a summary of the T-NASS abundance estimate that have been endorsed by NAMMCO to date, while Table 3 summarises the analyses remaining to be done and additional work recommended by the WG on existing analyses.

The Chairman thanked all participants for their contributions to the meeting and particularly Lawson, Donovan, Hammond, and Desportes for acting as rapporteurs. He also thanked Desportes for her work in convening the Working Group. All members thanked the Greenland Representation for the fine meeting room and hospitality provided during the meeting, and especially Laila Heilmann.

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SUBJECT	**SURVEY**	**LEAD**
Introduction, general distribution	All	Lawson
Fin, sei, hump, blue	Ship+air	Víkingsson
Minke	Ship+air	Víkingsson
Pilot whales, Trends	Retrospective ship	Mikkelsen
Small toothed whales	Ship+air	Desportes
Baleen whales	Can-air	Lawson
Porpoises	Can-air	Lawson
Belugas	Can-air	Gosselin
??	SNESSA	Palka
Sperm whales	Ship acoustic	Gunnlaugsson
Baleen	Nils surveys 2002-7	Øien
Odontocetes	Nils surveys 2002-7	Øien
Large whales retrospective	Ship+air	Víkingsson

Table 1. List of prospective scientific papers from T-NASS and earlier surveys to be prepared for a coordinated publication in a single volume. The identified "Lead" is responsible for ensuring that all deadlines are met in completing the paper.

Survey Areas	**West Greenland**	**Iceland Coastal (Faroese coastal)**	**Iceland-Faroes**	**Canada GSS**	**Canada NL**	**Norwegian mosaic 2003-7**
Species / Survey	Aerial	Aerial	Shipboard	Aerial	Aerial	Shipboard
Fin whale	4,359 n,j (1,879-10,114)	-	20,613 n,j (14,819-25,466) 26,117 pj (17,401-39,199)	462 n,j (270-791)	1254 p,j (765-2,059)	To be done
Minke whale	16,609 pa[1] ,j (7,172-38,461) 22,952 pa[2]j (7,815-67,403)	14,638[3] pa, l (7,381-24,919) 20,834[4] pa, l (9,808-37,042)	10,782 n,k (4,733- 19,262)	1,927 j (1,196-2,799)	3,748 pj (2,214- 6,345)	IWC
Minke whale 2009		9,588 pa, l (5,274-14,420)				
Humpback whale	3,272 pa,j (1.230-8.710)	1,242 p,j (632-2,445)	11,572 n,j (4,502-23,807)	653 j (385-1,032)	3,712 p,j (2,536-5,428)	To be done
Pilot whale	**2,976 n,j (1,178-7,515)**	-	**Not accepted**	6,134 n,j (2,774-10,573)	-	To be done
Sperm whale	-	-	To be done	-	-	To be done
Bottlenose whale	-	-	To be done	-	-	To be done
Harbour porpoise	**33,271 pa,j (15,939-69,450)**	**43,179 pa, l (31,755-161,899)**	-	3,667 n,j (1,565-6,566)	958 n,j (470-1,954)	To be done
Harbour porpoise **Faroes 2010**		**5,175 pa, l (3,457-17,637)**				
White-beaked dolphins	**9,827 p,j (6,723-14,365)**	To be done	To be done	-	-	To be done

White-sided dolphin	-	-	To be done	4,289 n,j (cv = 0.210)	3,086 p,j (1,781-5,357)	To be done
Common dolphin	-	-	-	53,049 n,j (34,865-80,717)	613 p,j (278-1,355)	-

Table 2. Abundance estimate from T-NASS (2007) endorsed by NAMMCO
Notes: Estimates in bold are first estimates for the species in the area. Estimates in blue have been endorsed by the AEWG at this meeting. Estimates in black have been endorsed at previous meetings. For details about the remaining or recommended supplementary analyses see Table 3.
n, uncorrected for bias; p, corrected for perception bias; a, corrected for availability bias.
[1] Availability bias is adjusted using aerial photographic images taken in Iceland.
[2] Availability bias is adjusted using satellite tagging data from three different areas.
[3] Using both primary observers
[4] Using only the most effective primary observer (much higher sighting rate)
i, Endorsed at the NAMMCO WG on Abundance Estimate, Copenhagen, April 2008, and subsequent Scientific Committee Meeting (NAMMCO, 2009)
j, Endorsed at the NAMMCO WG on Abundance Estimate, Quebec, October 2009, and subsequent Scientific Committee Meeting (NAMMCO, 2011)
k, Endorsed at the NAMMCO WG on Assessment, Copenhagen, March 2010, and subsequent Scientific Committee Meeting (NAMMCO, 2011)
l, Endorsed at the NAMMCO WG on Abundance Estimate, Copenhagen, March 2011.

Species	Areas	Recommendations
All species	Norway	*Provide estimates for species other than minke whales from the most recent survey series.*
	Iceland	*Determine whether there is a problem in using the last distance estimation for each sighting instead of the first, which is standard practice for line transect surveys of cetaceans.*
	Canada	*Correct for availability bias in all areas and perception bias in the GSS area.*
	NAMMCO Secretariat	*Establish a database for storing centrally all NASS survey data*
	Canada, Iceland, Faroes and Norway	*Prepare publications of results for inclusion in an IWC special Issue, according to the list prepared.*
	All	*Future surveys must have a clear and carefully designed protocol for defining groups and estimating group sizes; these are particularly important issues for pilot whales.*
Minke	Canada aerial – GSS	*Investigate possibility of correcting for availability bias using the methods employed in Greenland (SC/17/AE/08).*
Humpback	Iceland-Faroese shipboard	Investigate for the possible presence of responsive movement. If such evidence is found then a MRDS model assuming full independence should be used.
	Iceland-Faroese shipboard and Iceland costal	Combine Iceland-Faroese shipboard and Iceland coastal surveys by employing abundance estimates from the shipboard surveys in the overlapping areas and to use the post-stratified aerial survey for the rest.
Pilot whales	Iceland-Faroes CDS estimate	Correct for perception bias using MRDS assuming PI.
Sperm whales	Iceland & Faroes	*A visual line transect analysis should be prepared for both areas.* *The acoustic data should be reprocessed and an abundance estimate prepared from these data.*
Bottlenose whales	Iceland & Faroese	*Analysis of shipboard sightings data remains to be done*
Dolphins	Iceland-Faroese shipboard and Iceland coastal	*Analysis remains to be done*

Table 3. Summary by species and areas of the analyses remaining to be done from the T-NASS data as well as the supplementary analyses recommended by the NAMMCO Scientific Committee Working Group on Abundance Estimates (AEWG) at their meeting in Quebec, October 2009 and in Copenhagen, March 2011 (in italics).

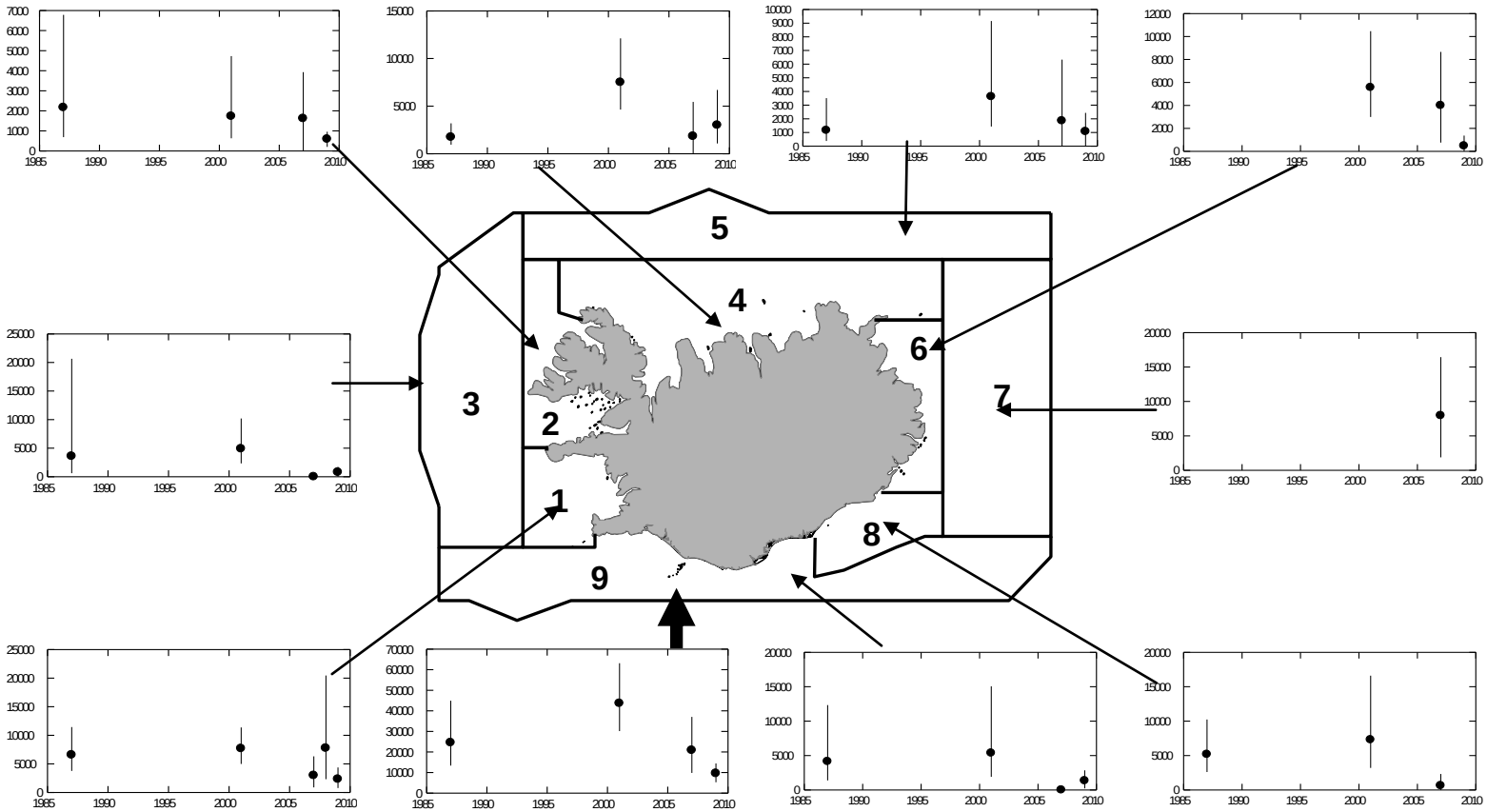

Figure 1. Trend in the abundance of minke whales in the Icelandic aerial survey area, 1987-2009. Thick arrow for total area.

Appendix 1

AGENDA

1. CHAIRMAN WELCOME AND OPENING REMARKS

2. ADOPTION OF AGENDA

3. APPOINTMENT OF RAPPORTEURS

4. REVIEW OF AVAILABLE DOCUMENTS AND REPORTS

5. DEVELOPMENT OF NAMMCO SURVEY DATA ARCHIVE

6. REVIEW OF ABUNDANCE ESTIMATES AND TRENDS

- 6.1 Fin whales
  - 6.1.1 Greenland: T-NASS aerial - Further analysis recommended in Quebec & trend analysis
  - 6.1.2 CODA
  - 6.1.3 Norway: Results from mosaic survey 2002-2007
  - 6.1.4 Revised combined estimate
- 6.2 Minke whales
  - 6.2.1 Canada: T-NASS aerial – correction for availability bias
  - 6.2.2 Iceland/Faroes: T-NASS shipboard combined with T-NASS extension
  - 6.2.3 Iceland: h(0) correction for the 2007 and 2009 aerial survey and subsequent revised estimates
  - 6.2.4 Greenland: T-NASS shipboard - documentation for estimate
  - 6.2.5 Revised combined estimate – incl. new estimate from Norway
- 6.3 Humpback whales
  - 6.3.1 Canada: T-NASS aerial – revised estimates corrected for availability
  - 6.3.2 Iceland/Faroes: T-NASS shipboard: investigation of presence of responsive movement
  - 6.3.3 Iceland/Faroes: T-NASS aerial-shipboard combined
  - 6.3.4 Greenland: T-NASS shipboard Greenland and combined aerial-shipboard estimate
  - 6.3.5 Norway: Results from mosaic survey 2002-2007
  - 6.3.6 Revised combined estimate
- 6.4 Pilot whales
  - 6.4.1 Iceland-Faroes shipboard
    - 6.4.1.1 TNASS Iceland/Faroes CDS estimate
    - 6.4.1.2 TNASS revised MRDS T-NASS estimate
    - 6.4.1.3 Index of relative abundance for NASS-T-NASS surveys, including trends in school size estimate

6.4.2 Greenland: comparison of distribution and sighting rates between 2007 and previous surveys
6.4.3 Combined estimate
6.5 Harbour porpoises
6.5.1 Iceland: T-NASS aerial
6.5.2 Faroes: 2010 aerial Faroes
6.5.3 Norway: any analyses
6.5.4 Combined estimate
6.6 Dolphins
6.6.1 Greenland – trend in abundance for white beaked dolphins
6.6.2 Iceland/Faroes: T-NASS shipboard estimate and trend in abundance
6.6.3 Iceland: T-NASS aerial
6.6.4 Combined estimate
6.7 Sperm whales
6.7.1 Iceland: Acoustic T-NASS shipboard
6.7.2 Faroes: Acoustic T-NASS shipboard
6.7.2 Norway: mosaic survey 2002-2007
6.8 Sei whale: T-NASS Icelandic-Faroes shipboard and trends
6.9 Bottlenose whales
6.10 Additional analyses to be carried out
6.10.1 Combined distribution maps T-NASS/NASS/CODA/SNESSA/SCANS II and common T-NASS/CODA/SNESSA survey report
6.10.2 Combined TNASS/CODA model based analysis
6.10.3 Other

7. PUBLICATION OF SURVEY RESULTS

8. OTHER ITEMS

9. NEXT MEETING

10. ADOPTION OF REPORT.

Appendix 2

LIST OF DOCUMENTS

Document	Title
SC/18/AESP/01	List of participants
SC/18/AESP/02	Annotated Agenda WGAE
SC/18/AESP/04	List of Documents
SC/18/AESP/05	Estimates of the relative abundance of pilot whales (*Globicephala melas*) from North Atlantic Sightings Surveys, 1987 to 2007. Pike, Desportes, Gunnlaugsson, Mikkelsen and Bloch.
SC/18/AESP/07	Estimates of the abundance of sei whales (Balaenoptera borealis) from the NASS Icelandic and Faroese. Pike, Gunnlaugsson, Vikingsson and Mikkelsen. Ship surveys conducted in 2001 and 2007.
SC/18/AESP/08	Correcting perception bias in Icelandic aerial survey estimates of minke whales, 2007 and 2009. Pike, Gunnlaugsson, Elvarsson and Víkingsson.
SC/18/AESP/10	Density surface fitting of the T-NASS 2007 Pilot Whale Sightings. Paxton, Gunnlaugsson & Mikkelsen
SC/18/AESP/11	Harbour porpoise *Phocoena phocoena* summer abundance in Icelandic and Faroese waters, based on aerial surveys in 2007 and 2010. Gilles, A., Gunnlaugsson, T., Mikkelsen, B., Pike, D.G., Víkingsson, G.
SC/18/AESP/13	Summary of endorsed abundance estimates and recommendations coming from the NAMMCO SC WG on Abundance Estimate (2009) and Assessment (2010). Desportes and Pike.
SC/18/AESP/14	Update on the analysis of acoustic data from the Icelandic shipboard survey -Sperm whale. Swift.
SC/18/AESP/15	Icelandic aerial survey 2009: Survey report and a preliminary abundance estimate for minke whales. Pike, Gunnlaugsson and Víkingsson.
SC/18/AESP/17	T-NASS: a cast of many (overview of T-NASS, results and remaining analyses). Submitted to the ICES WGMME. Desportes
SC/18/AESP/18	Estimates of the abundance of minke whales (*Balaenoptera acutorostrata*) from the T-NASS Icelandic and Faroese ship surveys conducted in 2007. Pike, Gunnlaugsson, Víkingsson and Mikkelsen.
SC/18/AESP/O01	NAMMCO. 2011. Report of the NAMMCO SC Working Group on Abundance estimates, Quebec, October 2009. Pages 64-97. In: NAMMCO. Report of the 17th meeting of the NAMMCO Scientific Committee.
SC/18/AESP/O02	Hátún, H. and Gaard, E. 2010. Marine climate, squid and pilot whales in the northeastern Atlantic. *In*: Bengtson, S-A.,

Buckland, P., Enckell, P.H. and Fosaa, A.M. (eds). *Dorete - her book*. Faroe University press, supplementum 52: 50-68.

SC/18/AESP/O03 Heide-Jørgenensen, M.P., Witting, L., Laidre, K.L., Hansen, R.G. and Rasmussen, M. 2010. Fully corrected estimates of common minke whale abundance in West Greenland in 2007. *J. Cetacean Res. Manage.* 11(2): 75–82.

SC/18/AESP/O04 Heide-Jørgenensen, M.P., Laidre, K.L., Simon, M.L., Burt, D.L., Borchers, D. and and Rasmussen, M. 2010. Abundance of fin whales in West Greenland in 2007. *J. Cetacean Res. Manage.* 11(2): 83–88.

SC/18/AESP/O05 Pike, D., Gunnlaugsson, T. and Víkingsson, G. 2008. T-NASS Icelandic aerial survey: Survey report and a preliminary abundance estimate for minke whales. IWC SC/60/PFI12.

SC/18/AESP/O06 Glover, K.A., Kanda, N., Haug, T., Pastene, L.A., Øien, N., Goto, M., Seliussen, B.B. and Skaug, H.J. 2010. Migration of Antarctic Minke Whales to the Arctic. *Plos One*, December 2010, Volume 5, Issue 12, e15197.

SC/18/AESP/O07 Hiby, L. and Lovell, P. 1998. Using aircraft in tandem formation to estimate abundance of harbour porpoise. *Biometrics* 54: 1280-89.

SC/18/AESP/O08 Thomsen, F., Ugarte, F. and Evans, P.G.H. (eds). 2005. Proceedings of the Workshop on estimation of g(0) in line-transect surveys of cetaceans. *ECS Newsletter* no. 44 – Special Issue.

SC/18/AESP/O09 Hiby, L. 2006. Effective strip width estimates from aerial survey data. Appendix D3.1 *In SCANSII* (2008) Small Cetaceans in the European Atlantic and North Sea. Final Report to the European Commission under project LIFE04NAT/GB/000245. Available from SMRU, Gatty Marine Laboratory, University of St Andrews, St Andrews, Fife KY16 8LB, UK. Available at http://biology.st-andrews.ac.uk/scans2/inner-finalReport.html

SC/18/AESP/O10 Burns, W. 2000. Bibliography: Climate Change and its Impact on Species/Ecosystems. Pacific Institute for Studies in Development, Environment, and Security & American Society of International Law – Wildlife Interest Group

SC/18/AESP/O11 Palka, D. and Hammond, P. 2001. Accounting for responsive movement in line transect estimate of abundance. *Can. J. Fish. Aquat. Sci.* 58: 777-87.

ANNEX 3

NAMMCO SCIENTIFIC COMMITTEE WORKING GROUP ON SURVEY PLANNING (SPWG)

Trans? North Atlantic Sighting Survey 2
First Planning Meeting

9-11 March 2011 – Copenhagen

1. PURPOSE OF PAST AND FUTURE SURVEYS

1.1 Introduction

Chairs Pike and Desportes welcomed participants (Address Section 5.8) to the meeting, the first step in planning another large-scale, internationally coordinated cetacean survey in the North Atlantic. They informed the Group that the meeting would be less formal than a regular NAMMCO Scientific Working Group meeting, as planning was at a very early stage and no working documents were yet available. However it was considered necessary for all parties to commit to the planning process and to come to a consensus on our goals, general methodologies, required resources, and timing for the next survey. Appendices 1 and 2 contain the agenda and document list respectively. Considering that there had been five NASS over a 20-year period, there was also a great opportunity to use the information from these surveys in a more rigorous manner to plan the next so that it can be optimized to meet its objectives in a cost effective way.

1.2 Participation

Pike opened the meeting by asking a simple question to all delegations: **Do you want to survey, and if so, why?**

Víkingsson replied for **Iceland** that there was a strong will to continue the survey series. Iceland was using the IWC Revised Management Procedure (RMP) in its management of commercial whaling of fin and minke whales. The RMP requires estimates of abundance every 6 years; a longer gap between surveys results in a phase-out of catches within 5 years. However it was noted in this regard that the RMP had not been implemented by the IWC and that Iceland was not strictly obliged to abide by all its tenets. The target species for Iceland would be fin and minke whales, with sei whales and harbour porpoises as secondary targets. Beyond the strictly management-oriented requirements, Iceland was also interested in monitoring the long-term trends in distribution and abundance of all species as input into studies of fisheries interactions, climate change, and general ecology.

Mikkelsen replied for the **Faroes** that estimates of the abundance of pilot whales were needed in the management of the Faroese hunt, particularly for input into projected assessments through NAMMCO, and that they were committed to a continued participation in surveys. However he noted that the survey extent and timing were not optimal for pilot whales, and that the survey should be tailored to the data requirements of any new management system. Fin whales would be a secondary target

species. The Faroes also shared Iceland's interest in the long-term trends of all cetaceans in the area.

Øien reported that **Norway** will continue its "mosaic" survey programme, in which a portion of the overall area is surveyed every year on a 6-year rotation. The current cycle began in 2008 and ends in 2013. The main objective, as with Iceland, is to obtain abundance estimates of minke whales for input into the RMP. Øien noted that a new feature of the RMP applies phase-out to small areas, which means that these should ideally be surveyed on a 6-year rotation as well. This will have to be considered in deciding where to survey each year of the cycle. Generally, however, there should be most flexibility in the final year of any cycle, which is normally used to cover any areas that were missed or covered poorly.

Hansen on behalf of **Greenland** informed the WG that new data on whale diving patterns in Greenlandic waters were required to derive correction factors for availability bias, and that new surveys would ideally not be carried out until this work was completed. However the IWC Aboriginal Whaling Management Procedure (AWMP) requires new surveys at 10-year intervals, so the next survey will probably take place before 2017. The target species will be minke, fin, and humpback whales.

Lawson reported that under the **Canadian** Species at Risk Act (SARA), they are required to provide information on the distribution and absolute abundance of listed species. For this reason, as well as a general interest in the long-term trends of cetacean abundance in the area and their relation to environmental changes, Canada saw benefit to participating in another large-scale international survey. In the past, Lawson had worked with St. Pierre and Miquelon (France) to carry out surveys in their waters contiguous to Canada and it was expected that this practice would continue. Canada will also work closely with the USA in planning its survey activities.

Zabavnikov reported that **Russia** will continue its annual monitoring programmes, which include integrated ecosystem surveys in the Barents Sea and biannual international redfish surveys. A major objective is a better understanding of marine mammal – fisheries interactions in the area. There is interest in participating in a coordinated international effort but the extent of that participation will depend on what is proposed.

The **CODA** (Europe) and **SNESSA** (USA) are independent surveys that were associated with T-NASS in 2007. Hammond noted that the CODA/SCANS surveys are driven primarily by the information requirements of the European Habitat Directive. The surveys were seen as decadal in time scale, and Hammond thought it unlikely that a new survey could be conducted before 2015 given the current fiscal climate. The issue of whether or not the SCANS (inshore) and CODA (offshore) should be combined and conducted simultaneously was under consideration. Lawson informed the group that the USA conducted some survey activity annually off its eastern seaboard, primarily to satisfy requirements under the Marine Mammal Protection Act. There was some flexibility in the system to coordinate survey activities with a larger international effort, as was done in 2007. In any event Canada

would be coordinating their surveys with those of the USA in order to achieve a more complete synoptic coverage of the area.

The Working Group **concluded** that the interests of Iceland, the Faroes, Norway, Canada, and the Russian Federation could be well-served by mounting another international synoptic survey. In addition there was a strong will to continue to coordinate with other ongoing surveys in the area, especially CODA/SCANS and SNESSA, however this will depend largely on timing.

1.3 Other surveys

Aurore Sterckeman briefed the Working Group (SC/18/AESP/19) on recent initiatives concerning the management of marine habitat in France. The main missions of the French Marine Protected Area Agency are to provide support to public policy concerning the creation and management of protected marine areas, to manage the resources of marine nature parks, and provide assistance to the administrators of protected marine areas. Based on the work of a group of experts that brings together the French Natural History Museum (the scientific authority for seabirds), the Centre for Research on Marine Mammals (the scientific authority for marine mammals), the Chizé Centre for Biological Studies, and the Centre for Functional and Evolutionary Ecology, a programme of knowledge acquisition (2011 – 2013) concerning seabirds and marine mammals has been drawn up within the scope of Natura2000 network needs. There will be dedicated aerial campaigns, observations from platforms of opportunity to enhance the data obtained in the aerial campaigns at a lesser cost, and to establish a functional link between prey and predator, the deployment of a network of hydrophones for acoustic detection of harbour porpoises and support for local projects (ship based or tagging). Sterckeman informed the Group that their interest in the planning meeting is, first of all, to inform each other of ongoing and future projects, but also to better understand differences between each approach; the link with the CODA/ SCANS survey and the possible participation of St. Pierre and Miquelon in future surveys.

Frank Urtizbéréa informed the Working Group (SC/18/AESP/16) about ongoing work around the French islands of St. Pierre and Miquelon, small islands situated 20 km south off the southern coast of Newfoundland. Examining the marine fauna of the archipelago and especially its marine mammal diversity indicates that it is a kind of "hot spot". One of the reasons is likely that dolphins and turtles congregate in this area because they are driven out of the Gulf of St. Laurence Gulf by the winter ice. For the last 30 years, an organization, called SPM Frag'iles, has collected sightings data and photo identification material on marine mammals and turtles in and around the waters of the archipelago. A programme of photo-identification, in cooperation with Canadian and USA efforts, has allowed, for example, the match of an individual humpback whale at a 15-year interval. The pictures and databases that have been developed over the years bring a lot of information on the animal use of the waters, and also on their health and behaviour. For the last few years, programmes on acoustics and abundance estimation by aerial survey have been implemented. In cooperation with DFO, Canada, aerial surveys have been conducted in 2002, 2003, and 2006. The two last surveys in 2007 and 2009 followed the T-NASS aerial

protocol. The results have confirmed that this area is important to several species of marine animals

2. REQUIRED INFORMATION TO BE GENERATED

Table 1 below summarises the target species and required information for each jurisdiction.

JURISDICTION	TARGETS	INFORMATION	FREQUENCY
Iceland	Primary: minke, fin	Absolute abundance	Every 6 years (RMP)
	Secondary: sei, harbour porpoise	Abundance and trends	No requirements
Faroes	Pilot	Absolute or relative abundance according to management needs (not yet defined)	Not yet defined.
Norway	Minke	Absolute abundance	Every 6 years (RMP)
Canada	All, priority to SARA listed spp.	Absolute abundance, distribution	No requirements.
Russia	All	Relative abundance, distribution	No requirements
CODA/SCANS	All	Absolute abundance	Decadal.
All	All	Trends in distribution and abundance, for ecosystem monitoring.	No requirements.

Table 1. Summary of survey target species and required information for each jurisdiction.

Synoptic vs. mosaic surveys

The mosaic survey programme conducted by Norway has been effective in producing estimates of minke whale abundance acceptable for use in the RMP. A mosaic survey programme has practical advantages in that some survey activity is conducted every year, which simplifies budgeting, allows a more efficient use of survey platforms and equipment, and facilitates the retention of a core group of experienced observers. However a mosaic survey is not as effective in describing large scale trends in distribution and abundance, primarily because the overall estimates cannot be ascribed to any one year.

Noting that the monitoring of trends in the distribution and abundance of all species was a goal for all jurisdictions, the WG considered that a synoptic survey would best

meet the needs of all participants. This would also make the survey comparable to the previous five NASS.

3. LESSONS LEARNED FROM THE SERIES OF NASS SURVEYS

Pike gave a presentation (included as SC/18/AESP/06) that outlined the history of the NASS series and showed how participation, survey extent, stratification, effort, design, and methodology had evolved over 20 years and 5 surveys. NASS have been carried out in 1987, 1989, 1995, 2001, and most recently 2007. While the motivations for doing cetacean surveys varied among participants, one constant objective has been to generate estimates of absolute abundance as input to management for recommending safe catch (direct or indirect) limits. The number of participating countries declined from five in the first NASS to a low of three in 2001, but the most recent survey again had five participants and was conducted in association with two other surveys. The area covered by the surveys and the total amount of survey effort declined after 1989, primarily because fewer countries participated and the initiation of mosaic rather than synoptic surveys by Norway after 1995 reduced that nation's contribution. The stratification and shape of the survey area has also been variable such that the "common" area covered by all or most surveys amounts to only 40 to 60% of the total area covered. A lack of correlation between effort intensity and fin whale density in several surveys suggests that stratification has not been optimal for this and probably other target species. Transect design resulted in acceptable coverage in most years but some examples of inadequate design and/or survey execution were illustrated.

Field methodologies have also changed over the course of the surveys, primarily with the move to double platform methods by all participants after 1995. This has resulted in an increase in the total number of observers on vessels but a decrease in the number on the primary platforms. Methods for incorporating uncertainty in species identification have also changed. The definition of a "group" and methods of estimating group size have obviously changed for some species such as pilot whales. In addition, closing mode was used to confirm species identity and group size more frequently in the early surveys. These changes limit the comparability of the estimates and make it challenging to estimate valid trends in density and abundance for some species. In this regard, Pike urged that changes in field methods should, if possible, retain comparability with previous methods so that the surveys retain their usefulness as a series.

Pike concluded by urging that the common area covered by all surveys be retained in future ones, and that a stable stratification scheme for this area be developed. Stratification of all areas should be defined with regard to the target species, with effort allocations higher in high density areas. Surveys should be designed such that there is equal coverage probability within strata, the survey should be sailed (or flown) as designed. There is a need for a central database for NASS data, with key components protected once the database is validated. Finally, results from the surveys should be published in the primary literature in a timely manner, as there is widespread interest both in the scientific community and among the general public.

The WG noted in discussion that the NASS have essentially been a group of adjacent, loosely-coordinated national surveys, rather than a centrally-coordinated survey like SCANS and CODA. Thus it is not surprising that each survey is somewhat different from the previous one. The issue of how much central coordination is desirable and possible is one that must be dealt with by the Planning Group.

While surveying the same area at the same time in the same way is desirable for monitoring trends in distribution and abundance, it is not a requirement for input into the RMP, which requires periodic estimates of absolute or relative abundance. Nevertheless the monitoring of trends is important to all participants as noted under item 2.

With regard to the retention of a core area covered by all surveys, it was noted that the distribution of some species (*e.g.*, fin, minke, and humpback whales) has changed over the course of the NASS and it is possible that the present core area may not be optimal for them in the future. If so a choice might have to be made between inter-survey comparability and optimization for the target species.

4. OVERALL STRATEGY FOR FULFILLING CURRENT GOALS

4.1 Spatial extent and stratification

The WG agreed that the wealth of information from previous NASS should be utilized fully to plan the next survey. For example it would be useful to know in which areas the applied methodology needs to encompass requirements for several target species and in which areas the methodology can focus on for accommodating only one target species. This might in turn influence the field methodology and acceptable survey conditions for particular strata. To this end, the Group **recommended** the development of a spatial analysis, looking at spatial patterns of encounter rates and/or density of target species. In its simplest form this could be gradient maps of relative abundance, while a more complex analysis would relate relative abundance to available physical and environmental variables such as depth and surface temperature. The resulting plots of high and low density areas would be used to optimize the area to be covered and the stratification of the survey to obtain the best possible estimates for the target species.

4.2 Survey timing (seasonal)

The WG agreed that the timing of the surveys should, ideally, coincide with the peak period of occupancy by the target species of the survey area. This has of course been the case for past NASS, and the importance of consistency in timing with past surveys was also acknowledged. However it was recognized that the period of occupancy may have changed over the past 20 years due to climate change or other factors. Therefore the Group **recommended** that any new information on the seasonal occurrence of cetaceans in the survey area be assembled and brought to the next meeting.

4.3 Transect design

It was agreed that the standard principles of good survey design, such as equal coverage probability within strata and random systematic placement of transects, should be followed. Adaptive designs were not favoured as they have not proven to be effective in practice. The amount of effort expected to be realized can be based on a thorough analysis of past surveys. It was also agreed that a "double" transect design (*i.e.* 2 sets of non-overlapping transects in each stratum) was advantageous because it ensured that the entire stratum was covered at least once.

The idea of "nonstop" survey, in which the vessel continues regardless of weather conditions and conducts survey effort when conditions are acceptable, was discussed. This approach was used successfully by Norway in 2010. The approach has some advantages in that it is straightforward to estimate the amount of effort available from ship speed, it requires no complex decision protocols for the vessel leaders, and it could, under favourable conditions, result in a greater amount of realized effort than might be achieved under the standard process of allocating effort based on past success. The main disadvantage was seen to be the higher cost of keeping the vessel at speed at all times. The Group agreed that the merits of this approach should be considered further.

4.4 What level of coordination is desirable?

Coordination of international surveys can range from the very loose association of national survey efforts characteristic of some NASS, to the tight central coordination of the CODA and SCANS surveys. Coordination helps to ensure that the maximum possible area is covered without overlap or duplication of effort, and that data are collected in a consistent way that will make combined analyses feasible. It is also advantageous for practical matters such as designing and purchasing equipment and software, recruiting and training observers and sourcing survey platforms. At its previous meeting (NAMMCO 2011) the WG had agreed that coordination at least at the level of the T-NASS was desirable and should be pursued for the next round of surveys. The WG **reiterated its previous recommendation** that the survey should be coordinated to the maximum extent possible, though recognising differing national priorities.

Canada will continue to coordinate its efforts closely with St. Pierre and Miquelon. Outside of the coordinated survey, Canada will also work closely with the USA so that American surveys are timed and located such that the maximum area is covered without duplication.

Concerning the French surveys described under item 1.3, these will be conducted before the earliest possible date for the next NASS. However it was agreed that a free exchange of information, particularly with regard to aerial survey methods (see item 5), would be encouraged. France will participate in the next CODA and SCANS surveys.

5. REVIEW OF BEST METHODOLOGIES FOR TARGET SPECIES

5.1 Aerial *vs* shipboard

Aerial surveys are generally preferred under one or more of the following circumstances: 1) areas with very geographically complex coastlines; 2) areas with short windows of acceptable weather; and 3) during animal migrations when the survey must be completed quickly. Previous NASS have use aircraft in the coastal areas of Iceland, Greenland, and Canada. Aerial survey has also been used in SCANS, and the proportion covered by air was increased in the second SCANS. The recent pilot survey conducted in the Faroes (SC/18/AESP/11) demonstrated that aerial survey could be successful there as well.

Shipboard surveys are considered better for large offshore areas because they can stay out for many days or weeks and cover very long distances. All offshore areas in previous NASS and SCANS, and all of the CODA strata, were surveyed by ship.

This general pattern of using aircraft for coastal areas and ships for offshore areas was expected to hold for the next survey. However the possibility of using larger, faster aircraft to survey offshore areas is being investigated by Canada and Iceland.

5.2 METHODOLOGICAL ADVANCES SINCE TNASS

5.2.1 Shipboard

The WG agreed that the use of a double platform configuration was advantageous because it provided important data with which to correct biases. While these biases tended to be more important for smaller, cryptic species such as minke whales than for larger species such as fin whales, analyses have demonstrated that they exist even for the latter. Therefore the Group **recommended** the used of double platform methods for the shipboard component of the survey.

It was recognized that there had been problems with the implementation of the vessel-based BT survey method in both 2001 and 2007. In 2007 particularly there were problems with the equipment, which was delivered very late and proved to be insufficiently robust. Difficulties were also experienced on some vessels in implementing the BT protocol, in part due to problems in the communication system. Other types of double platform survey methodology, such as I/O as used by Norway, and BT with post-survey duplicate identification as used in SNESSA, are available. The Group considered that the advantages and disadvantages of these approaches should be compared in the context of the target species mix and other circumstances expected in the next NASS. The WG therefore **recommended** that Desportes be tasked with preparing a document describing and comparing the various approaches available. The Group also **recommended** the establishment of a Shipboard Methodologies sub-Working Group, under Desportes, which will use this documentation to recommend a common shipboard methodology for the next NASS.

5.2.2 Aerial

At least three aerial survey methodologies are in use in the NASS area: 1) cue counting with double platform on one side by Iceland; 2) double platform I/O by Canada; and 3) single platform with “circle back” by SCANS, SNESSA, and in the Faroese pilot survey. Other variations are used elsewhere, and there is an increasing use of technology such as video, still, and infra-red photography, and even drone

aircraft. The WG considered it advantageous to compare and contrast these methodologies and their advantages and disadvantages for use with the NASS species mix, and therefore **recommended** that Pike be tasked with preparing a document comparing the available approaches. The Group also **recommended** the establishment of an Aerial Methodologies sub-Working Group, under Pike, which will use this documentation to recommend aerial methodologies for the next NASS.

6. RESOURCES NEEDED FOR FULFILLING GOALS

6.1 Survey timing

The year of the next survey will depend on several factors, some of which require clarification before a specific year can be designated: 1) "Phase-out" under the RMP will begin in 2014 for Iceland if a survey is not conducted before then. However Iceland is not legally required to abide by this rule; 2) It is very unlikely that Canada can mount a survey before 2014; 3) The last year of the current Norwegian survey cycle is 2013, and it is likely that the survey would have most flexibility to coordinate with the overall effort in this year or in 2014, the first year of the next cycle; 4) It is very unlikely that another CODA and/or SCANS could be mounted before 2014 at the earliest. Taken together, this makes it unlikely that another international survey can be conducted before 2014. It is expected that this situation will be further clarified within the next year.

The WG considered it very important to continue with the planning process given the commitment of participants to mounting a survey, even if the actual timing is unclear at this moment. Equipment and software must in some cases be designed and built, and in all cases must be ordered, well in advance of the survey, to avoid problems with late delivery and lack of familiarity with equipment that were experienced in the T-NASS. The recommended methodological planning process outlined under item 5 will aid in this process, however it was recognized that having a single point of contact and a motive force for the planning process is also critical. Therefore the WG **recommended** that NAMMCO appoint an overall Survey Coordinator to drive the planning process forward.

6.2 Foreseeable resources and possibilities for external funding

The WG considered it likely that, as with previous NASS, the next survey will depend to a large extent on funding from participating national governments. However there is the possibility of external funding from industry in some areas and from inter-governmental and non-governmental organizations. It was noted that the inclusion of monitoring objectives related to climate change could create some funding opportunities. The WG urged participating governments to note the timing of the next survey in 2014 or later and to anticipate the budget implications of a survey at that time.

7. PLANNING SCHEDULE & ACTION ITEMS (ITEM, WHO, WHEN)

ITEM	WHO	DELIVERY
Development of a spatial analysis of all previous NASS for use in survey planning. (4.1)	NAMMCO to fund.	December 2011.
Assemble any new information on the seasonal occurrence of cetaceans in the survey area (4.2).	All.	January 2012.
Prepare a document describing and comparing ship survey methodologies (5.2.1)	Desportes, NAMMCO to fund.	December 2011.
Prepare a document describing and comparing aerial survey methodologies (5.2.2).	Pike, NAMMCO to fund.	December 2011.
Appoint an overall Survey Coordinator to drive the planning process forward (6.1).	NAMMCO	June 2011.

8. ANY OTHER ITEMS

There were no other items.

9. NEXT MEETING

The WG **recommended** that its next meeting be scheduled for around January 2012. By that time the factors affecting the timing of the survey should be clarified and a final decision can be made. It was considered very important that the work outlined under Item 7 be completed well before the next meeting. The sub-Working Groups described under items 5.2.1 and 5.2.2 will meet separately during the period of the overall WG meeting.

10. ADOPTION OF REPORT

The major points of the report were agreed on 4 March, and the completed report was adopted by correspondence on 25 March 2011.

REFERENCES

[NAMMCO] North Atlantic Marine Mammal Commission. 2011. Report of the NAMMCO Scientific Committee Working Group on Abundance Estimate. *NAMMCO Annual Report 2010*: 299-332.

Appendix 1

AGENDA

1. Purpose of past and future surveys

(Absolute abundance of particular specie(s)?, Trends in abundance of particular species?, Relative abundance and trends for input into management models?, Assess changes in distribution and abundance that may be due to environmental changes?)

2. Required information to be generated by target species and goals

- **Level of precision required?**
- **Spatial extent?**
- **Frequency?**

3. Lessons learned from the series of NASS surveys

- Did we fulfil – or progress – in fulfilling the goals for the target species

- Spatial extent
  - Does it cover the seasonal range of target species?
  - Is it consistent to facilitate valid trend analyses?
- Stratification
  - How and why it has changed.
  - Should it be the same for every survey?
- Transect design
- Level of effort
  - How it has changed.
  - Has it been sufficient?
  - Use of extension vessels- was it successful?
- Changes in field methodology
  - Consistency vs improved precision and accuracy
  - Co-platform surveys- advantages and disadvantages.
- Data acquisition, transcription, storage and distribution.
- Analyses
  - Is the level of spatial pooling appropriate?
  - Are we getting the estimates we need?
  - Are the trend analyses sufficiently powerful?

4. Overall strategy for fulfilling current goals

(Overall design & methodology, coordination, spatial extent, archive, necessary choices/prioritization…)

- **What level of 'within' coordination is desirable?**

(Costs and benefits of various levels of coordination…)

- **Coordination with other surveys, dedicated or not**

5. Review of best methodologies for target species

- **Methodological advances since TNASS, incl. acoustics**
- **Preparation/technical requirements for applying them the best way**

6. 'Resources' needed for fulfilling goals

- **Timing 2013 – 2015**
- **Foreseeable resources and possibilities for external funding**

7. Planning schedule & Action items (item, who, when)

8. Any other items.

9. Next meeting
10. Adoption of report

Appendix 2

LIST OF DOCUMENTS

Document	Title
SC/18/AESP/01	List of participants
SC/18/AESP/03	Provisional Agenda WGSP
SC/18/AESP/04	Provisional List of Documents
SC/18/AESP/06	North Atlantic Sightings Survey – a review. Pike
SC/18/AESP/09	Practical lessons learned from TNASS. (extract form last Report)
SC/18/AESP/16	Studies of biodiversity and ecology of marine mammals & leatherbacks near St Pierre & Miquelon (France). Urtizbéréa (Presentation)
SC/18/AESP/19	French Marine Protected Area Agency. General presentation. Focus on project for acquisition of knowledge in mainland France. What link with NASS-TNASS surveys? Sterckeman (presentation).

ANNEX 4

NAMMCO SCIENTIFIC COMMITTEE
WORKING GROUP ON ASSESSMENT (WGAS)

5-7 April 2011, Copenhagen, Denmark

REPORT

1. OPENING REMARKS

Chair Lars Walløe welcomed the Delegates (Address Section 5.9) and reminded them of the Terms of Reference of this working group (WG) previously circulated as notes to the Agenda (Appendix 1).

In particular it was noted that at its last meeting the Management Committees endorsed the Scientific Committee recommendation to use an "RMP implementation simulation process (IST)-like approach – as modified by Norway" as a general model for conservation and management of baleen whales in NAMMCO. However it also recognised that advice based on the RMP work conducted by the IWC, though it might not be applicable for all stocks and may limit the questions that can be raised within NAMMCO. Therefore it recommended that the Scientific Committee Assessment Working Group investigate how NAMMCO can take over a larger and more direct role in this work and become less dependent on other organisations, while also avoiding unnecessary duplication of work. Furthermore it also recommended that the Scientific Committee Working Group investigate the trade-off space between catches and conservation for management procedures that have already been thoroughly investigated but not examined in detail by NAMMCO.

2. ADOPTION OF AGENDA

The Agenda (Appendix 1) was adopted in a slightly modified form.

3. APPOINTMENT OF RAPPORTEURS

Acquarone (Scientific Secretary) was appointed rapporteur and help from the Participants will be required for specific sections of the report.

4. REVIEW OF AVAILABLE DOCUMENTS AND REPORTS

The available documents are listed in Appendix 2.

5. DISCUSSION ON POTENTIAL MANAGEMENT PROCEDURE(S) FOR NORTH ATLANTIC WHALING CARRIED OUT UNDER NAMMCO RULES

5.1. General discussion on IWC management procedures and trials

Management Procedures are an approach to providing harvest-regulation advice for renewable marine resource management that was developed in the IWC Scientific

Committee in the late 1980s. Essentially a Management Procedure is a formula for setting a catch limit based on pre-specified input data, which has been simulation tested to show robust performance in terms of keeping future catches high and the risk of unintended depletion low over a range of uncertainties concerning the dynamics of the resource concerned.

In the mid-1970s the IWC had introduced the "New Management Procedure" which provided a formula for setting catch limits. However the approach had failed because of problems related to reaching agreement on inputs to the formula and because of arguments about how best to make allowance for uncertainties. The Revised Management Procedure (RMP) adopted by the IWC in the early 1990s was developed to overcome these problems.

Particular advantages of this Management Procedure approach are:

- The formula for the catch limit incorporates a feedback mechanism, so that these limits are modified up or down by appropriate amounts in response to positive or adverse trends in resource monitoring indices such as abundance surveys.
- Pre-specification of all data inputs (forthcoming from resource monitoring) avoids arguments about which are to be used in the provision of advice.
- The simulation testing provides a basis for formal checks that adequate allowance has been made in the formula for uncertainties about the resource's dynamics.
- Approaches that may appear sensible superficially do not always work in practice because of data fluctuations and other uncertainties; the simulation testing approach provides a check against adopting such approaches for providing advice.

Management Procedures such as the RMP are generally designed to select an appropriate trade-off between maximizing catch and minimizing the risk of unintended depletion. The IWCs Aboriginal Whaling Management Procedures (AWMPs) differ in that their aim is to satisfy a pre-specified need rather than to maximize catch. Thus they will output this fixed need (catch) unless resource monitoring indices suggest undue resource depletion so that an appropriately reduced catch is recommended.

The Group agreed on the high value of the process of developing the RMP and AWMP and especially of the concept of feedback control mechanisms based on abundance, catch history and a population model. It also agreed that these principles are valuable and worth carrying over into any NAMMCO management procedure.

Species/ area	NAMMCO			Approach under IWC	Comments (requirements for long-term management)
	Request from	Advice to	Approach used by		
Fin whales					
EGI	Yes	2011-2015	RMP, CLA 0.60 TL	RMP 0.72	ISTs for 0.6 required because of stock structure questions but yet to be completed
WG	No*			Interim	Implementation trials needed + MP development
NE Atlantic	Yes	No			Implementation trials needed to check RMP
Minke whales					
CN Atlantic	Yes	2011-2015	RMP, CLA 0.60 TL		ISTs for 0.6 not seen as a priority because stock structure questions are not major
NE Atlantic	No*			RMP 0.60 (Norwegian)	
WG	No*			Interim	Implementation trials needed + MP development
Humpback whales					
CN Atlantic	Yes	No			Implementation trials needed to check RMP
WG	Yes	2010-2015	Interim	Interim	Implementation trials needed + MP development
NE Atlantic	No				Implementation trials needed to check RMP
Sei whales					
CN Atlantic	Yes	No			Implementation (trials) needed to check RMP
WG	Yes	No			Implementation (trials) needed + MP development
NE Atlantic	No				

Bowhead whales					
WG	No*			Interim	Implementation trials needed for MP development

Table 1. List of assessment status by species and area (* management advice provided by the SC of the IWC). Interim as in Allison et al (2009), longer term approaches involving simulation trials and AWMP development occurs in IWC. EGI: East Greenland and Iceland; WG: West Greenland; CN Atlantic: Central North Atlantic; NE Atlantic: North East Atlantic. RMP: Revised Management Procedure; MP: Management Procedure; IST: Implementation Simulation Trials; CLA: Catch Limit Algorithm.

5.2. Generic procedures or species or stock specific procedures?

The Group, noting that NAMMCO had endorsed the recommendation by the Scientific Committee to adopt an RMP-like approach, recognized that this approach cannot in most cases be applied directly to stocks of baleen whales in the NAMMCO area. Even in a case like EGI fin whales, where implementation trials have been set up and carried out in IWC for the 0.72 tuning of the RMP, a long-term NAMMCO advice based on another tuning requires the run of implementation trials with that tuning. This is a substantial amount of work (see item 9). While the IWC has conducted implementation trials for both minke and fin whales for the whole North Atlantic, essentially these trials have focused (and considered whaling operations) for only the EGI fin whales and CN and NE Atlantic minke whales.

In all other cases, should NAMMCO want to proceed on its own, we will need initial assessments approaches in all cases, the setting up and running of implementation trials in many if not most cases, and the development of a management procedure (MP) in some cases (MP development is expected in relation to the Greenlandic fisheries – work that currently is progressing in IWC). Apart from the assessment part of this work, it is questionable if the NAMMCO SC is currently in a position where it can carry out this work. The question is not only related to time and the extra funding required, but also to the fact that the setting up and running Implementation trials is very specialised work and it cannot be expected that it will be possible to hire external experts that have the time and to be able to do this at short notice. Should management procedure implementation be an essential part of NAMMCO SC work in the future, it might require that an expert is employed directly by NAMMCO.

In order to provide an overview of the work needed for each species and stock, the Group decided to list in Table 1 the status for the baleen whales in the NAMMCO area in this regard.

5.3. Distinction between types of whaling operations (commercial versus aboriginal or some other distinction)?

A potential distinction in NAMMCO between different types of whaling operations is not a scientific decision. These operations range from Subsistence over Small-Type Local to Fully Commercial (with potential for international export). For a variety of

reasons, it can be argued that different levels of acceptable biological risk should apply across this range, for example because of differing possibilities of unforeseen overexploitation. Thus, for example, the IWC applies different levels of tuning to AWMPs and the RMP. The WG has no specific comment on the appropriate tuning level (trade-off between catch and resource risk) to apply for different types of fishery, and considers that the Council should determine both this level and whether it should differ amongst the different fishery types.

5.4. Abundance information needed and how should it be obtained?

The group agreed that if an RMP approach is to be employed the necessary abundance information should be derived from surveys, alternatively or in addition abundance estimates based on mark-recapture methods could be considered. The group recommended that, as a general rule, the interval between surveys should not exceed 10 years and a phase-out regulation in case of non-compliance might need to be established. Further details should be decided after more precise definition of the management approach.

5.5. How much stock structure information is needed, and how should it be used?

Recent assessments have generally identified stock structure issues as a major source of uncertainty. Stock structure can be investigated by a variety of methods such as genetics, tracking, morphometrics, etc. Population genetics techniques have not been successful in unequivocally distinguishing and identifying management units. However kinship comparison (SC/18/AS/O/03) has provided some promising results that need to be pursued further. The Group agreed that the need for stock structure information from a variety of sources should be considered on a case by case basis.

5.6. What kind of Catch Limit Algorithm(s) should be adopted for the NAMMCO management procedure(s)?

The WG did not directly consider which management procedure or tuning should be adopted by NAMMCO. It did though note that the IWC CLA for the three original tuning levels (0.60, 0.66, 0.72) and the two extra tuning of the Norwegian RMP-approach (document O02) are all realistic candidates, that the 0.6 tuning has currently been applied in the two cases where an RMP procedure has been applied within NAMMCO. New management procedures may have to be developed for the Greenlandic fisheries should long-term advice have to be given for these by NAMMCO.

5.7. How much simulation testing should potential management procedures be put through before they can be accepted?

The IWC's CLA (and similarly the Norwegian CLA) have been subject to a range of simulation trials considered sufficient to allow them to be implemented to recommend catch limits dependent on:

- The resource to which they are applied being considered a single stock, and
- The tuning level chosen for the procedure yielding trial results considered to offer acceptable trade-offs between catches and risks of unintended depletion.

Each implementation should be initiated with an assessment, and if there are reasons to suspect that the dynamics of the resource differs from those assumed in these simulation trials, further simulations would need to be conducted using models with different dynamics before such algorithms could be applied. Such reasons will typically arise from considerations of fits of simple population models to past catches and abundance estimates. If discrepancies are evident between observations and model fits, either immediately or during implementation reviews held at regular intervals after a management procedure is first implemented, these further simulated trials should be carried out using models of the dynamics which are more consistent with the observations.

6. ASSESSMENT OF CENTRAL NORTH ATLANTIC MINKE WHALES

Víkingsson presented document SC/18/AS/05. In response to a request for management on this stock the SC had previously agreed that implementation of the IWC RMP (IWC 1994a, 1994b) to calculate catch limits provided an appropriate basis to address the Council's request. The RMP can be applied at a "Small area" level, or to combinations of such Small areas. For the Central North Atlantic minke whale population, four such areas are concerned: the Jan Mayen area (CM), the Icelandic coastal area (CIC) in which Icelandic catches would concentrate, the East Greenland area (CG) and the Icelandic pelagic area (CIP) (NAMMCO 2010b). In 2010 the working group on assessment and subsequently the SC agreed to a management advise for the CIC area, based on the RMP CLA with level of 0.60 (NAMMCO 2010a,b). The CLA was run with two different tuning levels (0.60 and 0.72) and variable inclusion of the two most recent abundance estimates, 2007 and 2009 (see Table 4 in NAMMCO 2010b). Based on this assessment the SC concluded that annual removals of up to 216 minke whales from the CIC area are safe and precautionary. The advice was considered conservative in the sense that it was based on the uncorrected, downward biased 2009 abundance estimate as well as the lower of the two accepted abundance estimates from 2007. Similarly, an annual removal of 121 minke whales from the CM area is a safe and precautionary management advice. (NAMMCO 2010, p. 30). The SC recommended that the management advice should be re-considered when corrected abundance estimates from 2007 and 2009 were available.

The AE WG meeting in March 2011 updated the abundance estimates for both 2007 and 2009 (NAMMCO SC/18/AESP/08). The new approved estimates are both higher than the ones previously accepted (Table 2). Using these 2 corrected estimates and the catch for 2010 of 60 minke whales, the new catch limit calculations give a recommended catch limit of 229 for 2011.

The WG concluded that annual removals of up to 229 minke whales from the CIC area are safe and precautionary. As for the previous advice, this catch level can apply for the next five years before a revision is needed.

Survey year	Uncorrected abundance estimate	Corrected abundance estimate
2007	15,055 (0.36)	20,834 (95% CI: 9,808 to 37,042)
2009	5,900 (0.23)	9,588 (95% CI:5,274 to 14,420)

Table 2. Uncorrected and corrected abundance estimates for CIC minke whales.

In 2010 SC also recommended to "Calculate catch limits on a medium area with catch cascading" (this has not been done). The WG concluded that, as a first step in this process, decisions must be made on input parameters before the calculations are performed. The exercise has been initiated by the IWC in 2010 (IWC 2011 Annex D, Appendix 8) using a series of input parameters that NAMMCO could consider.
In order to advance on this subject the Group suggested that Gunnlaugsson work with Skaug, in particular to suggest abundance estimates to be used as input including considerations of additional variance if surveys from different years are combined.

In 2010, the SC recommended that line transect density should be estimated for the 2007 and 2008 and 2009 aerial surveys (NAMMCO 2010a). Such a line transect analysis was presented to the meeting of the working group of abundance estimates in March 2011 (NAMMCO SC/18/AESP/15). The authors concluded that the trend in line transect density of minke whales was very similar to that for the available corrected estimates.

7. ASSESSMENT OF NORTH ATLANTIC PILOT WHALES

The reports of the AE WG which met in Copenhagen in March as well as the Report of the ICES Study Group on long finned pilot whales which completed an assessment on pilot whales in 1996 were available to the group.

The AE WG noted with concern the difficulties it faced in providing estimates of abundance of pilot whales appropriate for management purposes given the absence of adequate information on *inter alia* movements and population structure, and an agreed assessment and management procedure (note that the IWCs management procedures apply only to baleen whales).

Specifically the AE WG stated:
"it drew this matter to the attention of the Scientific Committee, and recommended that it should be addressed by the Assessment Group as a matter of urgency. It should be noted that

a) a timely research focus on a better understanding of stock structure and movements is essential as this will allow a more focused survey area in the future, ideally for the next NASS, that relates directly to the provision of management advice; and
b) in this regard it is not possible to obtain robust abundance estimates for the entire North Atlantic. At least initially, a management regime

> that does not require population abundance estimates for the North East Atlantic and is robust to stock uncertainty should be developed."

The AE WG noted that the 1989 pilot whale estimate (Buckland *et al.* 1993) had long been used as a 'reference' estimate for pilot whales in the North East Atlantic because it covered the widest geographical area. The AE WG agreed that this estimate is too old to be considered a current reference abundance estimate. For the reasons documented above, the AE WG was not able to provide reliable information on trends in abundance of North Atlantic pilot whales. In terms of an accepted recent abundance estimate, it agreed that the estimate of 128,093 (CI: 75,682 to 216,802) for the Iceland/Faroese survey area (see page 30; item 6.4.1.1 in ICES 1996) is the best that is currently available; this applies to a considerably smaller area than the 1989 estimate. It is not known how this relates to animals that may be available to the Faroese hunt. The AE WG also noted that an abundance estimate of pilot whales from the combined CODA and Faroese data will soon become available."

***(From ICES 1996...* copy from page 11 point 8 paragraph 2 and 3**) The ICES group concluded that the effects of documented catches of pilot whales in the eastern Atlantic depend critically on what assumptions are made about the geographic range of the population that is affected by these catches and on the maximum population growth rate....

Since the last assessment was completed in 1996, the data which have become available from the 2001 and 2007 NASS surveys, as well as satellite tagging data originating from two tagging experiments conducted in the Faroes in July 2000 and in August 2004. No further studies or analyses have been reported to the WG, though samples have been taken from the hunt since the last assessment.

With respect to updating the 1996 assessment, the group noted that it needed abundance estimates which were relevant to the areas considered important in the 1996 assessment (SC/18/AS/O/08 text and Figure 6.3.1 map therein), in particular those close to the Faroes, and also the sea east of the Faroes. The group suspected there might be abundance estimates for the area east of the Faroes (Norwegian survey area) and recommended that the Faroese insure that these estimate be calculated if not available already.

As pointed out by the AE WG, the common area used for developing an index of relative abundance for the NASS series (SC/18/AS/06) is very limited spatially and representing only a small part of the species' entire range. Given that this species shows important distributional changes from survey to survey, it is difficult to draw any firm conclusion about trends using such a small area. The group recommends that trends be estimated for surveys of the areas/blocks closest to the Faroes, accepting that some of the surveys do no cover these areas. In this regard it would be very important to include the abundance estimate from the CODA (2007) survey. Comparing the 1989, 1995 to the 2007+CODA surveys would make it possible to consider the widest common area closest to the Faroes.

The primary concern remains the identification of the area over which the pilot whales harvested in the Faroes range. Tagging appears to offer the best prospects here. In July 2000, 4 animals were tagged, and the position of 3 of the whales was recorded, with one tag emitting for 47 days. In August 2004, seven animals were tagged, the two longest surviving tags sent positions over 133 and 105 days. The tagging results are limited because the tagged animals belonged to only two schools, with overall little variation in movements of animals from the same school. Nevertheless the results do indicate wide ranging movements of over 350 Nmiles for the second experiment. However these movements were mainly in the area east of the Faroes for which no abundance estimate are yet available, while the assessment from 1996 was based on areas west of the Faroes (SC/18/AS/O/08 map Figure 6.3.1), for which abundance estimate are available. The group recommend that further tagging of animals across as large a number of schools as possible encountered near the Faroes be attempted.

With regards to genetics, provided samples are available from more than just the Faroes, possibly the best area line of investigation would be the microsatellite genetic information available for the eastern north Atlantic to determine whether spatial differences can be identified. (Mitochondrial DNA would likely be more difficult to interpret because with confounding with maternal fidelity within schools). The group reiterated the recommendation of the ICES Study group that the several previous genetic analyses of the biological samples be reviewed by an appropriate group of experts in the light of new technical and analytical development, with the goal of developing priorities for further genetic studies of spatial and social structure which would be relevant to the assessment.

A difficulty with identifying a minimum abundance for which the current harvest can be considered sustainable (as suggested in the AE WG report) is the absence of precise population trend information which would allow MSYR estimate. The best that could likely be done at this stage is to calculate a number corresponding to a minimum realistic value for MSYR (perhaps 1% of the total abundance).

In result the WG recommends (in order of priority):

1. That tagging be given the highest priority with the goal to track animals from as many schools as possible and if possible throughout the whole year.
2. That survey estimates from 1989, 1995 and 2007 (including CODA) are divided into comparable blocks so that recent estimates and trends can be investigated for the areas close to the Faroese.
3. That a list of available abundance estimates for the area E and NE of the Faroes is compiled, and that the Faroese contact Norway and SCANS to investigate if other estimates can be developed from these areas, and that such estimates are developed.
4. That the area NE of the Faroes is taken into consideration when planning future surveys.
5. That, provided samples are available from more than just the Faroes, an appropriate group of genetic experts be contacted to discuss whether further genetic studies can help resolving stock structure issues.

The SC should monitor progress on the above tasks to decide when most appropriate to attempt to conduct an assessment.

8. DISCUSSION ON POSSIBLE FUTURE ASSESSMENT OF NORTH ATLANTIC SEI WHALES

Last year the SC recommended that an assessment be made after the 2007 abundance estimate is available. At the moment five estimates are available but refer to different areas (Table 3).

Year	Abundance estimate	
1987	1,293	(95% CI:434 to 3,853)
1989	10,300	(95% CI:6,150 to 17,260)
1995	9,249	(95% CI:3,700 to 23,116)
2001	1,494	(95% CI:843 to 2,245)
2007	4,924	(95% CI:1,224 to 10,591)

Table 3. Abundance estimates for sei whales in the North Atlantic (Pike *et al*).

The sei whale's seasonality does not fit into the timing of the NASS surveys. The last sei-whale-optimized survey was in 1989 (two weeks later and much further south than the usual mid summer).

At the moment the time series includes 5 estimates of abundance; however the area coverage is small and the time of the year for the surveys is not optimal for this species. Though the RMP could be applied using the existing data, the resulting catch limits would consequently be lower than the stock could sustain.

Further work would ideally involve surveys, for optimal abundance estimation, executed both over a larger area and at a more appropriate time of the year. However, this could raise further problems related to:

a) how to combine those new estimates with the existing ones, and that
b) the assumption that the wider area contains a single stock.

A prerequisite for initial assessment work is the recalculation (including considerations of extrapolation) of abundance estimates for a comparable area and assessing the extent of negative bias for the reasons mentioned above.

Advice based on an RMP approach would require an initial assessment and likely the development of implementation trials.

9. FIN WHALES IWC RMP TESTING

In 2010 the SC recommended, *inter alia*, that the RMP Implementation Simulation Trials (ISTs) for North Atlantic fin whales be rerun for a 0.6 tuning level of the RMP CLA, and that some further investigation related to Hypothesis IV (SC/17/AS/O07) which underlies some of those trials (and whose plausibility is under question) be conducted.

Elvarsson reported that he plans to rerun the trials for the 0.6 tuning level within 2011. The Group considered that it would be most appropriate to first review the results

from that process, and the acceptability of the RMP performance indicated, in the WG before deciding on possible further related analyses.

Elvarsson drew the Group's attention to work he has underway for report to the IWC Scientific Committee on simulation testing of whether implementation of a tag-recapture programme could resolve the matter of the plausibility of Hypothesis IV. The previous meeting had also suggested that the consistency between CPUE trends and IST outputs for Hypothesis IV be investigated. The Group decided that this would better first await response to results of the two processes above.

10. OTHER BUSINESS

The WG recommends the SC to include requests for preparatory work when listing the priority areas for the next meeting of this group.

11. ADOPTION OF REPORT

This report was adopted at 12:07 on 7 April 2011.

REFERENCES

Allison, C., Punt, A. and Witting, L. 2009. Simulation trial runs for fin, humpback and bowhead whales. Appendix 2, Annex E. Report of the Standing Working Group on the Aboriginal Whaling Management procedures. *Journal of Cetacean Research and Management* 11 (Suppl.), 156-166.

Appendix 1

ANNOTATED AGENDA

1. OPENING REMARKS
2. ADOPTION OF AGENDA
3. APPOINTMENT OF RAPPORTEURS
4. REVIEW OF AVAILABLE DOCUMENTS AND REPORTS
5. DISCUSSION ON POTENTIAL MANAGEMENT PROCEDURE(S) FOR NORTH ATLANTIC WHALING CARRIED OUT UNDER NAMMCO RULES[7]
   - 5.1. General discussion on IWC management procedures and trials
   - 5.2. Generic procedures or species or stock specific procedures?[8]
   - 5.3. Distinction between types of whaling operations (commercial versus aboriginal or some other distinction)?
   - 5.4. Abundance information need and how should it be obtained?[9]
   - 5.5. How much stock structure information is needed, and how should it be used?[10]
   - 5.6. What kind of Catch Limit Algorithm(s) should be adopted for the NAMMCO management procedure(s)?[11]
   - 5.7. How much simulation testing should potential management procedures be put through before they can be accepted?[12]
6. ASSESSMENT OF CENTRAL NORTH ATLANTIC MINKE WHALES[13]
7. ASSESSMENT OF NORTH ATLANTIC PILOT WHALES[14]
8. DISCUSSION ON POSSIBLE FUTURE ASSESSMENT OF NORTH ATLANTIC SEI WHALES
9. FIN WHALES IWC RMP TESTING
10. OTHER BUSINESS
11. ADOPTION OF REPORT

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[7] It is expected that this agenda item will be completed on Tuesday.

[8] IWC has developed a generic procedure for whaling of "baleen whales on their feeding grounds". Whalers from NAMMCO countries catch also toothed whales (*e.g.* pilot whales), and not necessarily on their feeding grounds.

[9] At present IWC focus on line transect abundance estimate information. Other possibilities include mark-recapture methods and relative abundance measures (*e.g.* CPUE).

[10] If there is clear genetic or other evidence of more than one stock of a certain species, this information should of course be taken into account. If such information is lacking, should the ocean still be divided in a number of management areas for precautionary reasons? IWC has divided "ocean basins" in "medium areas" and each medium area in "small areas" and has established a system to distribute quotas between small areas (*i.e.* "catch cascading").

[11] One possibility is the IWC RMP type of procedure. Other possibilities include the different IWC AWMP types of procedures.

[12] IWC RMP has been extensively tested for "tuning levels" 0.72, 0.66 and 0.60, and a similar type of procedure has also been tested nearly as extensively for two levels of a different tuning parameter (IWC SC/59/RMP4).

[13] Icelandic scientists have promised to bring revised data to the WG.

[14] This will only be done if new abundance numbers are available from the NAMMCO WG on Abundance Estimates in week 10 (7-9 March).

Appendix 2

LIST OF DOCUMENTS

Doc. No.	Title
SC/18/AS/01	List of participants
SC/18/AS/02	Annotated Agenda
SC/18/AS/03	List of Documents
SC/18/AS/04	Report of the meeting of the NAMMCO SC Working Group on Abundance Estimates, Copenhagen, March 2011
SC/18/AS/05	Víkingsson G.A., Elvarsson, B. Þ. and Gunnlaugsson, Þ. Sustainable catch levels for common minke whales (*Balaenoptera acutorostrata)* for the Icelandic coastal area (the CIC small area) – an update based on revised abundance estimates.
SC/18/AS/06	Pike, D.G., Desportes, G., Gunnlaugsson, Þ., Mikkelsen, B. and Bloch, D. Estimates of the relative abundance pilot whales (*Globicephala melas*) from North Atlantic Sightings Surveys, 1987 to 2007.
SC/18/AS/07	Pike, D.G., Gunnlaugsson, Þ., Víkingsson, G.A. and Mikkelsen, B. Estimates of the abundance of sei whales (*Balaenoptera borealis*) from the NASS Icelandic and Faroese ship surveys conducted in 2001 and 2007.
OTHER DOCUMENTS	
SC/18/AS/O/01	[NAMMCO] North Atlantic Marine Mammal Commission. 2010. Annex 4 - Report of the NAMMCO Scientific Committee Working Group on Assessment in NAMMCO Annual Report 2010:367-403.
SC/18/AS/O/02	Aldrin and Bang Huseby ”Simulation trials 2007 for a re-tuned Catch Limit Algorithm” (IWC/SC/59/RMP 4, 2007)
SC/18/AS/O/03	Skaug, H., Danielsdottir, A.K. and Vikingsson, G.A. Relatedness of North Atlantic fin whales. IWC SC/58/PFI9.

SC/18/AS/O/04	Allison, C., Punt, A. and Witting, L. 2009. Simulation trial runs for fin, humpback and bowhead whales. Appendix 2, Annex E. Report of the Standing Working Group on the Aboriginal Whaling Management procedures. The Journal of Cetacean Research and Management, 11 (Suppl.), 156--166
SC/18/AS/O/05	[IWC]. 1994. Annex H – The Revised Management Procedure (RMP) for Baleen Whales. *Rep. int. Whal. Commn* 44:145-152.
SC/18/AS/O/06	[IWC]. 1994. Annex I – A Programme to Implement the Catch Limit Algorithm. *Rep. int. Whal. Commn* 44:153-167.
SC/18/AS/O/07	[NAMMCO] North Atlantic Marine Mammal Commission. 2010. Report of the seventeenth meeting of the Scientific Committee in NAMMCO Annual Report 2010:235-410.
SC/18/AS/O/08	[ICES] 1996. Report of the study group on long-finned pilot whales, Cambridge, UK, 22-26 April 1996
SC/18/AS/O/09	Buckland, S.T., Bloch, D., Cattanach, K.L., Gunnlaugsson, Þ., Hoydal, K., Lens, S. and Sigurjónsson, J. 1993. Distribution and abundance of long-finned pilot whales in the north Atlantic, estimated from NASS-87 and NASS-89 data. In Donovan, G.P., Lockyer, C.H. and Martin, A.R. Eds. Biology of Northern Hemisphere Pilot Whales. *Rep. int. Whal. Commn.* Special Issue 14:33-49.
SC/18/AS/O/10	[IWC] 2008. "Excerpts from IWC reports regarding NA fin stock structure hypothesis IV". Source document: IWC SC/60 Annex D-RMP page 5 24/06/2008 5:14:00 PM
SC/18/AS/O/11	[IWC] 2010. Annex D – Report of the Sub-Committee on the Revised Management Procedure.

ANNEX 5

THE JOINT NAMMCO-ICES WORKSHOP ON BY-CATCH MONITORING

28 June – 1 July 2010, ICES, Copenhagen, Denmark

EXECUTIVE SUMMARY

The Workshop was the result of an initiative from the North Atlantic Marine Mammal Commission who had expressed a wish to improve fishery by-catch monitoring among its Member States. Recognising that this is an area where the International Council for the Exploration of the Sea holds some expertise, a joint workshop was agreed with the aim of developing guidelines describing best practice for conducting marine mammal and seabird by-catch monitoring.

The workshop consisted of a series of informal invited presentations on a range of topics covering the agenda agreed by a joint NAMMCO/ICES steering group. Each presentation was followed by a group discussion focusing on the relevant topic. It was agreed that a manual providing guidelines for best practice would be drawn up after the workshop and would be published in the ICES Co-operative Research Report Series.

By-catch monitoring is mandated under several national and international laws and agreements on both sides of the Atlantic and further afield. Schemes to monitor by-catch play an important role in the development towards and process of managing the oceans from an ecosystem perspective.

Usually by-catch monitoring is addressed through direct on board observer schemes, but these can be expensive to implement, particularly in the early exploratory phase when by-catch levels are not known and costly sampling effort may be focused in inappropriate areas. In such cases there are a number of other less direct approaches that can be used to obtain some initial information about possible by-catch levels.

Indirect approaches include the collation of anecdotal accounts, the systematic examination of dead stranded animals or those found floating at sea, the examination of live animals by photo-monitoring for evidence of past entanglements, interviews of fishermen, collation of fishery logbook data, and through ‘parasitising’ or piggybacking on other research programmes.

Wherever possible, results from any of these methods should be compared with one another. An example was discussed from Iceland where porpoise by-catch rates from research surveys in a limited time and area were compared with results from a questionnaire survey and with official logbook data. In this case by-catch rates calculated from logbook data were considerably lower than those estimated using the other by-catch methods.

The workshop reviewed recruitment and training procedures using examples from the USA and the UK. Basic training and safety standards were outlined and the Workshop recommended that standardised training should be implemented at a European level for observers working on by-catch monitoring programmes in European fisheries.

Two further presentations examined the operational aspects of a marine mammal by-catch observer scheme in the USA and a seabird by-catch observer scheme in Chile. The Workshop was able to identify a number of useful and practical strategies and tactics for implementing such schemes.

Several alternative by-catch monitoring systems involving independent observations, but not relying on dedicated onboard observer programmes were discussed. A system of GPS-linked video surveillance was described on boats in Denmark, where by-catches of porpoises and seabirds had clearly been identified and recorded. In the USA a system employing an alternative platform has been developed, where two observers used a fast power boat to monitor fishing operations by inshore gillnet vessels. Although daily costs were higher than using onboard observers, this approach enabled monitoring of a fleet sector that had been previously under-represented. Another scheme was described in which Norwegian fishermen were paid to complete detailed activity and catch logs which had provided useful information on porpoise by-catch in coastal gillnet fisheries. Integrating fishery effort data with information on cetacean strandings and at-sea acoustic monitoring of porpoises in Polish waters was also described as another means of monitoring by-catch. Finally, the discard sampling scheme mandated at a European level under the data collection framework was also described, and its advantages and disadvantages as a means of collecting marine mammal and seabird by-catch data were discussed.

The Workshop discussed data collection methods and aspects of data and sample storage, and agreed that the retention of biological samples, including wherever possible whole animals, whilst logistically challenging, should be an important aim.

The Workshop discussed how fishing effort data can be used to plan and stratify sampling at sea, and how it can be used to raise observed by-catch rates to the fishery or fleet level. Problems with the reliability of effort data were described and discussed. Some of the statistical methods for raising by-catch estimates were also reviewed. It was stressed that there is not a single preferred way to determine overall total by-catch for a fishery, and that generally caution is required because sampling levels tend to be low and by-catches of protected species are generally rare events. It was also noted that total by-catch estimates are highly dependent on the raising factor, and that a detailed knowledge of the fishery is important to obtain the most reliable estimates.

Finally the workshop considered relations between industry partners and by-catch monitoring programmes. It was stressed that transparency is critical to maintaining good relations with industry and examples from three EU funded projects were presented to demonstrate this point.

The workshop agreed that a summary report of the meeting would be produced but that a more detailed manual or set of guidelines on best practice would be drawn up and, with the prior agreement of ACOM, would be submitted to ICES for publication under its Co-operative Research Report Series.

REPORT

1. INTRODUCTION

1.1 Opening of the Workshop

The workshop convened at 14:00 hr on 28 July. All participants were welcomed by the Co-Chairs, Simon Northridge and Droplaug Ólafsdóttir. There followed a round of introductions. The participants (Section 5.10) numbered 25 and represented geographical regions and countries worldwide, as well as governmental departments, universities, industry and non-governmental organizations, with a wide range of expertise on marine mammal and seabird by-catch monitoring. The draft agenda was adopted (Appendix 1), which allowed flexibility in the way the workshop proceeded and allowed for extended discussions and sub-group sessions when appropriate.

1.2 Overview – Origins of Workshop and Expected Outcomes

Northridge described the background to the workshop. NAMMCO had found progress on marine mammal by-catch monitoring issues unsatisfactory, and had made the decision to expand its work to include external experts. This had resulted in a proposal for a joint workshop with ICES which has a background and an established expertise in many aspects of by-catch. The invitation to involve ICES was addressed through the Study Group for By-Catch of Protected Species (SGBYC). By agreement between a joint NAMMCO and ICES steering group for the workshop, the terms of reference were expanded to include seabirds and the aim was to produce guidelines for best practice in monitoring and assessing by-catch. ICES had agreed to publish such guidelines as a cooperative research report. The deadline for completion of the guidelines would be in October 2010 with publication thereafter.

The agreed Terms of Reference for the Workshop were:

1. Review and describe the advantages and disadvantages of existing observation schemes for marine mammals and seabirds;
2. Recommend best practice when establishing and implementing by-catch observation schemes.

It was agreed that abstracts of all presentations and papers should be available before the end of the workshop, and these would be incorporated in a formal report of the workshop proceedings to ICES and NAMMCO. This report is to be submitted to the NAMMCO Council via the Scientific Committee of NAMMCO, and eventually be published in the NAMMCO Annual Report for 2011. This report is separate from the published guidelines.

1.3 The Motivation for By-catch Monitoring Schemes

The issue of ecosystem management has become an increasingly important concept both in fisheries management arenas and in international agreements concerning the marine environment. Driven most recently by public concerns over the poor management of the oceans, the drive for more integrated ecosystem management has been mandated or encouraged in several international, European, and national agreements or regulations.

The general principles for ecosystem based management were established during the 1980s in the United Nations (UN) Convention on the Law of the Sea (UNCLOS), where the management of fishery impacts on associated and dependent species is repeatedly addressed. Later, under the UN Food and Agriculture Organisation's (FAO) 1995 Code of Conduct for Responsible Fishing, the issue of minimising by-catch was explicitly addressed, and was taken further by the FAO in the development of an International Plan of Action (IPOA) on Seabirds. The Convention on Biodiversity also requires signatory states to identify processes and activities that are likely to have significant adverse impacts on the conservation of or sustainable use of biological diversity, and to monitor those effects (Article 7). Several Regional Agreements have been established under the Bonn Convention on Migratory Species that specifically address by-catch of marine mammals and seabirds, including ASCOBANS, (Agreement on the Conservation of Small Cetaceans of the Baltic, North East Atlantic, Irish and North Seas), ACCOBAMS (Agreement on the Conservation of Cetaceans in the Black Sea Mediterranean Sea and Contiguous Atlantic Area) and ACAP (the Agreement on the Conservation of Albatrosses and Petrels).

Domestic legislation that underpins efforts to monitor by-catch include the U.S. Marine Mammal Protection Act, the Canadian Species at Risk Act, and within member states of the European Union, the Habitats Directive and Council Regulation 812/2004 concerning incidental catches of cetaceans in fisheries operations.

Although legislation has been important in driving the development of by-catch monitoring and assessment, commercial pressure has also been important. Public concerns about the impacts of fishing on the environment and specifically on non-target species has led to the development of labelling and accreditation schemes designed to ensure certain environmental or welfare standards are maintained during fishing operations. Such schemes require information on by-catch of protected species and may also require ongoing monitoring systems to ensure standards are maintained, and that by-catch rates are being minimised through the appropriate use of mitigation tools.

Independent monitoring schemes are now widespread in many fishery management areas, not only to ensure compliance with fishery regulations, but also to improve fish stock management and to address concerns about impacts on non-target species. While observer schemes have usually been regarded as the most reliable way to obtain information on catch composition and on biological aspects of the catch, other monitoring methods are gaining acceptance in several areas, and these were considered further during this workshop.

Monitoring schemes in the present context – monitoring by-catch – are primarily designed to determine how frequently animals of specific groups get caught in specific fishing operations, but they are also useful in determining how and why animals of specific groups get caught, which may be an important factor in developing technical means of reducing by-catch. Monitoring schemes need to be augmented by an

assessment process that determines whether the by-catch rates observed present a significant concern. How such 'significant concerns' are defined is an important issue, that may depend variously on the conservation status and population dynamics of the species involved or on other societal values that over-ride conservation concerns.

It is important at the outset to understand that monitoring schemes will always have their limitations. They cannot be used to prove that no by-catch of a certain species will ever occur in a fishery, and in most cases they can only be used to sample a proportion of total fishing effort in order to make a probabilistic assessment of how prevalent by-catch may be. Where very rare animals are concerned the by-catch rate may be too low to be quantifiable by any realistic monitoring scheme. The monitoring scheme must also be underpinned by an appropriate assessment of the significance of any quantified by-catch, and this depends on knowing something about the conservation status of the species concerned, and also on having agreed conservation goals. These are often poorly-defined in legislation, and are driven largely by societal values.

By-catch monitoring schemes enable us to quantify the effects of fishing operations on non-target as well as on target species, and as such have an important role to play in the development of multi-species management approaches. They can also provide useful biological information on both target and non-target species, and technical information on aspects of gear use that can inform management decisions. Schemes to monitor by-catch can also be integrated with other aspects of independent monitoring that help improve both information flow and the development of more reliable ecosystem management tools.

2. INDIRECT MEANS OF MONITORING BY-CATCH

2.1 Overview of Indirect Means of Monitoring By-catch

Although direct observations are the preferred means of estimating by-catch rates, these are sometimes impractical, usually because they are expensive or because space on small vessels limits the acceptance of observers onboard. Several other ways to estimate by-catch rates indirectly have been proposed.

Anecdotal accounts

Anecdotal accounts of marine mammal and seabird by-catches in fisheries may provide the initial evidence that high by-catch rates occur in an area. Anecdotal accounts are usually not random as news of exceptional rather than common events are more likely to be spread. The information may not be very detailed and may be biased. Anecdotal information may increase awareness of the potential for high by-catch risk in a fishery which may then lead to more specific monitoring measures.

Stranding/floating

The presence of dead animals on coasts or at sea may highlight the fact that some by-catch is occurring in a region. As a quantitative measure such observations are not usually of much use because the number of dead animals that wash ashore is not

necessarily directly related to the number of animals that are by-caught in any given region. Byrd *et al.* (2008), however, showed that observer-generated annual estimates of bottlenose dolphin (*Tursiops truncatus*) by-catch in a gillnet fishery for spiny dogfish (*Squalus acanthias*) in North Carolina (USA) were correlated with numbers of stranded animals. Large-scale strandings of porpoises (*Phocoena phocoena*) in England and in the Netherlands and Belgium have also been used to highlight the existence of by-catch in coastal fisheries, but have not been directly linked to any change in fishing effort or actual by-catch rates. Care must be taken not to over-interpret data from stranded animals, and protocols for establishing cause of death must be followed. Strandings can help augment other data sources and raise awareness of by-catch in an area. However, low stranding rates do not provide proof of low by-catch rates in an area and furthermore, strandings of small animals on remote or inaccessible shores are likely to go unnoticed.

Photo-identification studies

Studies of scars and injuries on cetaceans resulting from fisheries interactions can provide information on exposure risk to different fishing gears and help identify species at high by-catch risk in a fishing area (Kiszka *et al.* 2008). These studies can be taken a step further by estimating the entanglement mortality rate. Estimation of the ratio of lethal versus non-lethal entanglements can be carried out by monitoring eye-witnessed entanglements to grade each event on the scale of seriousness (Robbins *et al.* 2009). Such studies are suitable in small areas were fishing effort and entanglement risks are relatively high. Migration of animals between areas with different levels of fishing effort may however lead to erroneous interpretations. Photo-identification studies are not always suitable for obtaining information on "shy" species such as harbour porpoises that rarely expose large parts of the body at the surface. Furthermore, photo-identification studies may show injuries on dorsal fins well, whereas injuries to jaws and beaks, which are frequently affected by fishing gears but are less often exposed at the surface, may not be visible for photography.

Interviews

Interviewing fishermen is a relatively inexpensive means of collecting information on by-catch of non-target species in comparison to dedicated by-catch observer programmes. Interviews can serve as a first step to gain an impression of the scale of by-catch and/or damage to fishing gears in a region before decisions are taken to implement more detailed but expensive monitoring measures. Limitations of interviews are that they are based on fishers' memory or interpretation of events, their skills in species identification, and require a willingness to cooperate. There may be strong incentives in some areas for the scale of by-catch to be misrepresented when public or legal censure is possible. Error-checking strategies such as call-back interviews provide a means to assess the variability and reliability of responses.

Fishery Logbooks

Reporting of detailed fishery data in official logbooks is practiced widely in many fisheries. Large quantities of detailed information on the catch, fishing effort, and by-catch can be extracted from logbook data and can be used for estimating removals of animals other than the targeted species. However, while in theory all catch should be

recorded in the logbooks, such systems rely on the cooperative spirit and awareness of the fishers and there are many examples where fishery logbooks have been shown to be inconsistent with data collected by independent observations. In practice it is impossible to interpret logbook data without investigating the fishers' response rates and correct the data for possible "non-reporting".

Discard/ biological sampling /research survey programmes

Monitoring of by-catch in discard and biological sampling schemes or fishery research programmes can approach dedicated by-catch observer programmes in terms of data quality. Survey personnel can be trained in identification of by-catch species, and reporting of fishery data may be expected to be of high quality and can provide an opportunity to extrapolate observed by-catch events to the entire fishery or fleet. The main drawbacks regarding by-catch monitoring under these circumstances is that the research programme and the personnel on board will have other priorities which could impact on their ability to carry out effective by-catch monitoring. For example, observers may not be located in a suitable place when the gear is being hauled and may therefore not observe animals falling out of the nets. This particular problem can be solved if the rate of "drop-outs" is known and the by-catch data are corrected retrospectively. It is more difficult to address the fundamental problems associated with sampling stratification when combining different research or monitoring schemes, because the aims of a by-catch monitoring programme may compromise the aims of the other programme or vica versa.

2.2 Optimising Indirect Observations by Synthesis of Different Surveys

Large quantities of detailed data on by-catch and fishing effort are often available in logbooks and may give estimated by-catch levels with good precision and low CVs. However good precision estimates may be misleading in terms of the accuracy of by-catch estimates if the analyses are based on biased assumptions. Logbook data, for instance, may be detailed and extensive, but not necessarily reliable. There are also concerns about the representativeness of by-catch data obtained from indirect observations and with the selection of appropriate raising procedures in order to minimise biases in by-catch estimates. When indirect means of quantifying by-catch in particular are adopted, it is important to keep these concerns in mind. Ideally more than one method should be applied and a comparison of the results may help to evaluate and optimize the best practice of monitoring and estimating by-catch in each particular fishery.

Droplaug Ólafsdóttir presented information on marine mammal by-catch, in a bottom-set gill-net fishery in Iceland, that had been obtained by several methods: fishery logbooks, a questionnaire, and fishery research surveys. The estimated numbers of the most frequently by-caught mammal species, harbour porpoise, were compared to evaluate the reliability of these three different methods.

In Iceland, gill-net fishers are obliged to record incidences of marine mammal and seabird by-catch along with detailed information on fishing effort and associated commercial catch in official logbooks. In the years 2002-2008 by-catch data were reported by about 5% of all operating vessels. However, it was difficult to determine

for the remaining vessels which had actually had no by-catch and which had simply neglected their by-catch reporting obligations. In October 2004, a questionnaire was therefore sent to captains of all operating gill-netters asking whether any by-caught marine mammals had been observed on their vessels during the three previous fishing years. The results revealed that 81-96% of the vessels had observed some marine mammals in the nets in 2002-2004. This information was used in analyses of by-catch data from logbooks. The assumption was made that fishers who report marine mammal by-catch in logbooks at least once do so consistently and all their fishing effort regarded as "reporting effort". The by-catch data from the reporting vessels were corrected for the proportion of vessels that had by-catch but didn't report it. The corrected by-catch data were then extrapolated over the entire fleet where fishery data were stratified by years, two seasons and 10 areas. Unit of effort was fishing days.

In the questionnaire, the captains were also asked to estimate the total number of harbour porpoises observed in their nets in the previous fishing year. The results provided estimates of 2,012 and 2,600 animals with simple calculations using the number of vessels and number of nets as units of effort, respectively (Table 1 below).

The third source of information was obtained from fishery research surveys carried out annually during April by the Marine Research Institute, Reykjavik. Data on marine mammal by-catch have been collected since 2003. Harbour porpoise by-catch data were extrapolated over all the gill-net fisheries in March and April using fishing days as unit of effort. Confidence limits in all porpoise by-catch estimates discussed above were obtained by the bootstrap method.

The results for the estimated number of entangled harbour porpoises in the gill-net fishery in Iceland obtained by various methods are shown in Table 1 below. All sources of by-catch data gave estimates of harbour porpoise entanglements within the same order of magnitude. The data presumably of highest quality are the data collected by research personnel during fishery research surveys. The drawback of these data is however, a narrow time frame, and can therefore only reflect the situation in the spring. The logbook data show similar levels of harbour porpoise by-catch for the entire year compared to the March/April scope in the survey data. This may indicate under-evaluation derived from the logbook data even after correcting for vessels not reporting their by-catch. The assumptions that fishermen who report by-catch once do so consistently may therefore not be valid.

The questionnaire produced the highest estimate of porpoise by-catch of the 3 data sources and thus supports the indication from the research survey data of under-estimated by-catch derived from the log book data. The information from the questionnaire is however based on fishers' memories of events in the previous year. Secondly, no stratification was feasible for the questionnaire data and the data were extrapolated over the entire fleet, regardless of potential seasonal and regional differences.

The significance or importance of strandings in relation to by-catch events was discussed extensively by the workshop. Clearly some stranded cetaceans may be

discarded by-catches, but there were varying opinions as to the usefulness of collating strandings data in order to assess the scale of by-catches, especially if there were no clear indications on the carcasses that could link them to fisheries by-catch. The importance of reliable post mortem diagnostics is therefore crucial. Increases in the number of recorded stranding events may indicate a by-catch problem, but quantifying the scale of the overall by-catch is generally not possible.

Source of Information	**Season and estimated by-catch of porpoises**		
Questionnaire Total with unit of effort: N vessels / N nets		**Sept 2003 - Sept 2004**	
		2012 / 2600	
Logbooks: Total (95% CL)	**2002**	**2003**	**January-June 2004**
	839 (488-1,216)	1049 (505-1,599)	989 (673-1,310)
Research surveys: Total (95% CL)		**March-April 2003**	**March-April 2004**
		929 (291-1,418)	958 (296-1,472)

Table 1. Estimated number of harbour porpoises by-caught in the bottom-set gill-net fishery in Iceland obtained from 3 sources of information.

The workshop agreed that the Icelandic study provided a useful example of how integrating information from more than one source can help shed light on the nature and scale of a by-catch issue. It was also noted that the reliability of logbooks and other forms of self reporting are likely to depend on differences in views of marine mammal by-catch. In some countries, *e.g.* USA, there may be legal or other consequences to by-catch, whereas in Iceland, there are not. In Iceland and Norway, it is mandatory to report by-catches, whereas reporting is voluntary in most European countries. There are differences in attitudes to by-catches that are dependent on culture. In Iceland, Norway, Greenland, and other countries by-catches may even be consumed locally, whereas in some other countries the retention and consumption of protected species such as cetaceans would be illegal. In Norway the general lack of reporting may be because discarding of any catches is illegal, so that mammals should be landed and reported, but such by-catches are generally undesirable and in fact very few are landed or reported. The fear of repercussions from conservation and animal welfare groups in some countries may also prevent reporting. However, the workshop was informed that in Brazil logbooks are given to fishery vessel captains for seabird by-catch recording and the method was found useful after a couple of years trial.

The workshop noted that some opportunistic observer schemes – for example those based on fish discard or biological surveys – can provide very good data, especially if

personnel are specially trained to observe and identify by-catch, and there is clearly no rigid dividing line between such surveys and dedicated by-catch observer schemes.

The Workshop noted that, in guidelines of best practices in monitoring, it may be useful to point out common pitfalls and specify which practices in particular should be avoided. A flow chart designed to help the process of selecting the appropriate monitoring scheme may also be a useful tool in the guidelines.

3. DIRECT OBSERVATIONS OF BY-CATCH

3.1 Observer Qualifications, Training, Reliability, and Liaison

Sara Wetmore and Grant Course explained how observers are recruited and trained in the USA and the UK.

Recruitment

In the USA the National Marine Fisheries Service has developed nationally recognised minimum educational, general and safety standards for observer programmes. The Northeast Fisheries Observer Program (NEFOP) recommends hiring of observer candidates following minimum eligibility standards and then provides appropriate training. In the UK selection of observer candidates is seen as the first and most critical step of the whole process of using observers. The Centre for Environment, Fisheries and Aquaculture Science (CEFAS) observer scheme prefers to employ candidates that have seagoing experience on small commercial vessels rather than recent graduates with no practical seagoing experience, so that the potential observers are fully aware of the conditions they would face. Working conditions at sea can be dangerous and may involve long hours in an unpleasant and sometimes unfriendly environment. Interviewers have to be certain that potential observers do not suffer from such things as chronic seasickness or have an unrealistic or rose-tinted view of the marine working environment. The interview process should be used both to inform candidates about what to expect when working at sea and to determine their suitability for the role of an observer.

Training and Safety Equipment

In the USA, the Northeast Fisheries Observer Program conducts 3-week training sessions for observer candidates that cover a broad range of skills including fish, mammal, seabird and sea turtle species identification, fishing gear information, sampling protocols, electronic data collection and safety. Insurance costs, conflict of interest and confidentiality standards are discussed and implemented during training sessions. Observers are trained, certified, then deployed, and collect by-catch and other fisheries data onboard vessels fishing with multiple gear types along the Northeast Atlantic coast of the United States.

In the UK there are four main subject areas that are targeted for training observers; these are safety, sampling, company and data procedures, and species specific training (for example, in this case cetaceans). Safety takes equal priority with all work objectives and managers of the observer programmes work on the basis that all

observers should be provided with at least the minimum safety training required for a general deck hand on board a fishing vessel. This includes training in: -

- Personal Survival Techniques (basic sea survival)
- Fire fighting and prevention at sea
- Personal and social responsibilities
- Elementary first aid
- VHF Radio operators course.

A Seafarers medical Certicate ("ENG1") is also required of all observers to ensure they are fit to work at sea safely.

In addition, the observers receive further formal safety training in manual handling, defensive driving, vessel visual safety checking, and will then have at least four accompanied sea trips with a competent trainer/observer to evaluate safe practice as well as sampling best practice.

Training to take samples obviously depends on what the objectives of the specific programme are but safety and principles of randomising sub-sampling need to be considered at all steps. Data quality is one of the most important issues facing observer programmes and it is important that correct procedures are established at the outset.

In the UK, the CEFAS discard survey observer programme was set up to monitor finfish and commercial shellfish by-catch as prescribed under the EU Data Collection Framework (DCF). However observers also collect data on cetacean, seal and seabird by-catch. The training on cetaceans however, has been limited to a one-week identification course in 2006, and has never been renewed. Thus all recruits since have not had any formal training in cetacean identification and no staff have been trained in seal or bird identification. This lack of training is due to these species groups not being a requirement of the DCF, and that there is no available funding for these additional observations. Unless the training is formalised and given frequently, then the skills base will be lost and the data will become less reliable.

A list of suggested essential safety equipment was presented and included in the items listed below. In addition it was felt that when it came to safety equipment, managers should provide observers with whatever they think is necessary, as they are more likely to utilise equipment they have insisted on, rather than had forced on them.

- Wet and cold weather clothing and gear (oilskins, jumpers, hats, steel-toed rubber boots, etc.)
- Life jackets –(twin-chambered 275N and 150N are used in the UK)
- EPIRB (emergency position-indicating radio beacons)
- Flotation Suit (*not immersion suit)*
- First Aid Kit
- Flashlight
- Fire Extinguisher
- Flares (mini rockets, day/night)

- Safety Harness
- Portable Life Raft for under 10m vessels, if required
- Risk assessments, operating procedures, communication instructions, emergency response plans
- Anything else an observer requires and can justify.

Communications

A useful management and safety tool that the CEFAS United Kingdom discard observer programme has employed is a formalised Checking In Procedure for observers on field work. Before going on a sea trip an observer must complete a safety file that details all expected movements for the time away from the office, including details of sea trips (dates at sea, etc.), boats being sampled, hotels residing in, other useful contact numbers *e.g.* the local fish agent, skippers' home telephone number and expected time out of the office. The observer also provides an estimate of docking time with a trigger period, which if exceeded alerts the manager to start tracking down an observer and if necessary start an emergency response procedure. Trigger times though should be treated with caution as all docking times are subject to change depending on fishing, weather conditions etc.

At all times the programme has an on-call shore-based contact, and observers are required to text on sailing, text on landing, and text on returning to base/home. The shore-based contact should always send a response to reassure the observer that the message was successfully communicated and that someone out there is mindful of where the observer is.

In the USA observers are managed by contractors who must have adequate insurance for observer, boat owner and company. The NEFOP has been running since 1989, and it is overseen by two committees – one focusing on training and the other on safety.

The workshop learned that in Denmark training courses are not so comprehensive as in the United Kingdom and United States. Norway has detailed courses for contracted fishermen but not safety at sea certification. In Spain observers who were employed before as fisheries /discards inspectors or at-sea personnel are used for by-catch reporting. In Spain, training is not as detailed as CEFAS.

During discussions the question of costs was raised. In the NEFOP there are usually about 8-16 trainees per course and costs are about 5 000 USD per trainee. In the UK, training courses funded by CEFAS cost about 20 000 UKP per trainee over a 3-month programme. It was noted that many aspects of training can be brought in from other training sources and need not be exclusively developed for marine mammals or seabird by-catch monitoring.

The Workshop recommended that training programmes and collection procedures for data and samples in European fisheries need to be standardized: it is important to have common European training standards as there are shared common waters, and it was agreed that this point should be introduced into the guidelines.

It was further suggested that there might be a case for two types of courses – a general core course for sampling at sea, and another specifically for sampling marine mammal by-catch which should include biological sampling.

It was suggested that identification booklets for species should be provided, and it was also suggested that video footage may be helpful.

3.2 Direct Observation Schemes of By-catch – Marine Mammals

Amy van Atten described the working of the US by-catch monitoring scheme in some detail. There are 9 regional areas in the United States with Federally-managed fisheries observer programmes: Northeast, Southeast (3), Northwest, Southwest, Pacific Islands, and Alaska (2). Some observer programmes may be fishery-specific, and others are multi-fishery within specific geographic areas. There is one coordinating office, called the National Observer Program (NOP), based at National Oceanic Atmospheric Administration (NOAA) Fisheries Headquarters in Silver Spring, Maryland. The NOP has several staff members working on funding, political aspects of observer programmes and monitoring, agency priorities, characterization of Federal use of funds, and coordination of national efforts to form working groups in order to share information and have a unified approach to nationally important issues. The NOP organizes the activities of the National Observer Program Advisory Team (NOPAT), which is made of the programme manager of each observer programme, including staff from the NOP and representatives from Protected Resources, General Counsel, Office of Law Enforcement, and US Coast Guard. The NOPAT meets, usually every 3 months, around the United States, to address common issues and challenges of observer and monitoring programmes, such as contract structure, sampling protocols, safety issues, training requirements, data management and access, and outreach and education. Having this team of programme experts share their experiences in managing observer programmes has helped to develop new or evolving programmes, to promote fair treatment for observers, and to pro-actively address industry, management, and other stakeholders' concerns.

The Northeast Fisheries Observer Program (NEFOP) covers several fisheries in the Northeastern USA. NEFOP offers certifications for NEFOP observers, at-sea monitors, and dockside monitors. It is a multi-purpose scientific data collection programme, collecting data that can be used for enforcement purposes and to test general compliance with certain regulations – in both state and Federal waters, out to the edge of the E.E.Z. from Maine through North Carolina. There are approximately 80 NEFOP observers, 110 at-sea monitors, and 100 dockside monitors, expecting to accomplish more than 15,000 days at sea per year. The majority of the funding is from congressional funds (Federally supplemented), although one fishery, a component of the Atlantic scallop fleet, has an industry funded observer programme that is also managed by NEFOP.

The source of funding for NEFOP and other such programmes is critical as this will have a major influence on operational plans – and may in some cases restrict observations to certain fisheries or areas or times. Regular, even, smooth, and predictable funding is strongly desired for observer programmes, as start up costs can

be high, and cyclic funding makes it hard to maintain an experienced cadre of observers and programme staff.

Other key undertakings are to define the programme objectives, design the sampling strata, determine vessel selection methods, set standards while maintaining the ability to adapt as mandates and needs change, and allow for a process for stakeholder input. It is also important to assess and evaluate what platforms to use (*e.g.*, deploying onboard observers, using an alternative platform alongside the fishing vessel, doing beach-based observations, using electronic monitoring), what level of funding is available, how much time is available to pre-plan and develop, and what legal structure there is to support programme goals.

Observers are great multi-taskers, but it is important not to "over-task" them. Data collection should focus on observable, quantifiable traits, and avoid subjective judgment calls. The importance of tagging dead animals so as not to double count mortalities should be stressed. It is also important to acknowledge the limiting factors of the sampling platform (storage space, size of vessel, sleeping accommodation, lighting conditions, mobility, length of time out at sea, lack of refrigeration or fresh water, etc.). Clearly it is necessary also to prioritize and streamline data collection and reporting, and quick reference waterproof guides can help.

In gill-net operations in the Northeastern US, harbour porpoises are occasionally by-caught, mostly resulting in their mortality. During haulback, the porpoises often get dislodged from the gill-net twine and are freed from the gear. The carcasses float in some cases, and sink in others. NEFOP data have shown that if observers are not focusing their view on the gill-net string during haulback, they will probably not observe such porpoise by-catch. For this reason, observers are instructed to do a marine mammal haul watch and limit fish sampling during a portion of the trips. On other trips, they would record the known takes of porpoise, but they do not do a dedicated "marine mammal haul watch" as they are sampling and recording retained and discarded fish. It is important to explain the difference between these two sampling methods to the industry, or they just think they have a lazy observer if they are not sampling fish. The results of such data collection can be used to calibrate marine mammal watch hauls with fish sampling hauls.

Regular outreach with industry members can help with cooperation in obtaining and retaining samples for further processing onshore. Things that the NEFOP has done include a Shadow Trip Program, captain interviews, Fishermen Comment Cards, invitations to necropsies or special sample workups, providing copies of research findings, and sending letters of appreciation for sample retention. It is great to find a benefit to collecting the data back to the fishing industry, such as perhaps providing summaries on where unwanted by-catch can be avoided in order to extend the opening of their fisheries. Open and transparent operations and offering opportunities to share data are important to the overall success of the programme.

3.3 Direct Observations of By-catch – Seabird Monitoring

Oliver Yates provided an overview of seabird by-catch monitoring based on experience from BirdLife International's Albatross Task Force which is active in 7 countries in South America and southern Africa. It was noted that by-catch during fishing operations is widely recognised as the main cause of declining populations of albatrosses and many vulnerable petrel species. When developing monitoring programmes to detect and quantify by-catch in these fisheries it is important to consider appropriate operational factors that may be associated with by-catch. Interactions with seabirds can be cryptic and as such may go unnoticed or unrecorded if the protocol is not orientated to dedicated observation of specific fishing gear and aspects of its operations.

Mortality events result from four main factors: entanglement in nets, collisions with fishing gear, drowning on hooks during setting and, although less frequently, fatal injuries incurred as hook lines are hauled. Such mortality occurs as fishing gear is set or throughout the fishing operation. However, it is not until gear is retrieved that mortality can be recorded (caught on hooks, entangled in nets or on trawl cables).

The most appropriate means of collecting seabird mortality data is therefore through observations during hauling operations; the hook line in longline fisheries, the trawl warp cables and net in trawl fisheries and the mesh in net fisheries. Observer programmes should therefore include dedicated periods of observation of these operational procedures to a degree that by-caught species are accurately detected and registered. This monitoring needs to be reported in terms of fishing effort and gear type (configuration) so that by-catch estimates can be raised to the fleet level.

Significant efforts are currently being made to work on monitoring in developing countries, with a focus on fisheries impacting vulnerable seabird populations. Onboard observers were encouraged to work together with crews and develop a suitable monitoring protocol for the fleet.

In accurately recording the extent of by-catch, there are 3 stages: setting, soak time, and hauling up in the demersal and pelagic longline and trawl fisheries. Gear configurations on vessels are important factors in calculating by-catch and monitoring tasks will vary depending on the gear type and specific use.

Longlines

Birds are attracted to baited hooks on longline gear and offal discards. Incidental capture of seabirds occurs during setting operations as birds take baited hooks, become hooked and drown. To monitor this impact, dedicated observation is needed during the hauling operation when birds can be accurately recorded as they are recovered with the fishing gear. Longline hooks number in the thousands (pelagic) and tens of thousands (demersal) and while 100% of fishing gear can be monitored in pelagic longline fleets, it is more challenging to observe all hooks in demersal fleets. In such cases, observation of 40% of the longline gear that was set is achievable.

Trawling

In trawl fishing fleets, seabirds are attracted to offal discards and fishery remains in nets. Vessel design and offal discard procedures lead to foraging seabirds being in close proximity to trawl warp cables and fishing gear. As the vessel pitches and rolls, birds collide with trawl cables, are forced underwater and drown. In fleets with large mesh sizes, birds are also captured in nets during both the setting and hauling of fishing gear. The key time for observing by-catch on trawlers is during the hauling operation as birds that have been trapped on trawl cables can be counted. However, it must be taken into consideration that due to the nature of the interaction, this provides an underestimate of total mortality. During setting and trawling operations, observers can record contact rates between birds and cables – light touch, collision, dragged underwater - and relate this to the dead birds that are recovered during the haul.

3.4 Use of CCTV to Monitor By-catch

Lotte Kindt-Larsen reported on Danish trials of CCTV to monitor by-catch. Between September 2008 and July 2009, 6 Danish commercial fishing vessels, (4 trawlers, 1 seiner, and 1 gill-netter) had an Electronic Monitoring System installed onboard. The aim was to test whether a "fully documented fishery" could help develop a fisheries control system in which all catches (including discards of fish above and below minimum landing size) are counted against the vessels' catch quotas rather than the present landings quota system. As a premium for carrying out a fully documented fishery, the participating vessels got additional quota opportunities based on the fact that there was complete catch documentation and records of both retained and discarded cod (*Gadus morhua*). The total catch report was audited by use of a sensor system and 4 CCTV cameras, each filming different angles of the catch handling as well as the hauling of the gear. Since the system was recording all catch events it was expected that the Electronic Monitoring System could also be used for recording by-catch of marine mammals and seabirds. All 732 hours of video recording from the gill-net vessel were therefore analyzed in order to record the number of by-caught marine mammals and sea birds. A total of 3 harbour porpoises (*Phocoena phocoena*), 1 harbour seal (*Phoca vitulina*), 2 cormorants (*Phalacrocrax carbo*) and 1 seagull (*Laridai*) were caught. The quality of the images showed that by-catch of marine mammals and seabirds could easily be verified on the images and the images could be processed at the highest possible speed. In Denmark the project is now continued onboard 6 gillnet fishing vessels. All vessels will be monitored by use of CCTV cameras for one year and data will be analyzed for both discards of cod and of marine mammal and seabird by-catch.

3.5 Direct Monitoring using a Separate Observation Platform

Barbie Byrd reported on an Alternative Platform Observer Program (APOP) in North Carolina (NC), USA that was implemented between March 2006 and May 2009 to increase overall observer coverage of ocean gill-nets and to ensure coverage was representative of NC's diverse gill-net fisheries. Prior percent observer coverage by the National Marine Fisheries Service, Northeast Fisheries Observer Program (NEFOP) had been low (<3%) and skewed to larger vessels (>7.2 m) fishing in federal waters (5.6 – 370.4 km from shore), whereas the majority of fishing effort and observed by-catch of bottlenose dolphins (*Tursiops truncatus*) occurs within 5.6 km of land. This disparity was, in part, due to challenges associated with the large

proportion (~50%) of small gill-net vessels (<7.3 m) in the fleet. The small size of some of these vessels does not allow accommodation of an onboard observer. Additionally, fishers using small vessels can be difficult to locate because they often launch from private or public ramps in contrast to larger vessels that are docked at seafood dealers. Conducting observations using an alternative platform (*i.e.* a separate vessel) can potentially mitigate those challenges. As a result, 2 people were hired to conduct observer trips in the NC APOP: an observer trained by the NEFOP and a biologist with extensive boating experience. The observer used NEFOP's methods and data logs so that the data could be integrated with those from traditional observers for subsequent by-catch estimation. Allocation schedules were developed from previous years' fishing effort data with a 10% coverage goal and, after intensive outreach in the fishing community, observer coverage began. Initial requests for observer trips were made in advance through outreach activities, or in person at public boat ramps and on the water. Information on fishers (*e.g.* contact information and homeport) was then compiled in a database to aid in scheduling future trips. Although 10% coverage of small vessels was not achieved, a large proportion (25 – 48%) of observed vessels had never carried a traditional observer indicating that overall (APOP + NEFOP) coverage was more representative of the fleet. In addition, APOP trips resulted in a 21 – 40% increase over NEFOP in ocean gillnet trips. No by-catch of marine mammals or sea turtles was observed by the APOP; however, 20 by-caught seabirds were observed. Although using an alternative platform was more advantageous for observing small vessels, it may not be applicable in all situations. For example, the APOP in NC observed fisheries close to shore and it may not always be feasible (*e.g.*, cost, logistics) to use an alternative platform far from shore. In addition, the daily running costs of the APOP ($3 500 USD) were more than double that of a traditional trip ($1 200 USD) due to the need for 2 crew members per observation as opposed to one. The cost for the APOP, however, included additional tasks by APOP crew for the programme and other research projects. Finally, funding may constrain a programme's ability to maintain an alternative platform vessel (if one is already available) or to purchase a vessel. Unfortunately, funding issues led to the termination of the APOP for NC ocean gill-nets in May 2009.

3.6 Monitoring Marine Mammal By-catch in Small Boat Fleets

A general problem for monitoring marine mammals or bird by-catch is found where there are inshore fleets of very large numbers of small vessels each of which may take relatively few animals per year. Sampling such fleets presents very particular logistical problems.

Arne Bjorge described work in Norway aimed at monitoring marine mammal by-catch without the use of independent observers in a 'modern artisanal fleet'. The Norwegian coast spans an area from 58°N to 71°N. The extremely convoluted shoreline including islands is more than 83,000 km long, (more than twice the earth's circumference at the equator). About 5,000 commercial small vessels (length less than 15 m) are operating a variety of gears in these coastal waters. The long coastline, the large number of vessels and the inability of the small vessels to carry an observer for multi-day trips were constraints faced when designing a marine mammal by-catch monitoring programme. Landing statistics for target species are generally good for fisheries in

Norway. However, information on the fishing effort and catch composition of non-target fish species is poor for coastal fisheries. Therefore, improvement of monitoring and management of takes of non-target species was needed. Starting in 2006 2 fishing vessels were contracted in each of 9 domestic fishery statistical areas to provide detailed statistics of effort, target species catch, by-catch of all non-target fish and marine mammals. The value of the contract is a significant proportion of the annual revenue of the contracted vessels. Each of the vessels is visited regularly by scientific staff, and they stay onboard on day trips. Any discrepancy between statistics of trips with and without scientific staff on board will result in cancellation of the contract. The first 2 years of monitoring revealed frequent takes of 3 marine mammal species: the annual takes by the contracted vessels were in the low hundreds for harbour porpoise, and less than one hundred for harbour and grey seals. The collected data from contracted vessels in combination with landings statistics of target species from the same vessel category and gear types will enable extrapolated marine mammal by-catch totals in entire fisheries to be produced. Extrapolation to the entire fisheries will be made when data from the third year of monitoring becomes available.

Krzystof Skóra described an alternative approach in the Baltic. In Poland the small scale fleet activity is monitored in one reference area of the Puck Bay where over 40% of harbour porpoise by-catch was reported between 1990 and 1999. Gill-nets are the main fishing gear used by this fleet and on occasions over 1,200 nets are in place in Puck Bay. There had been a much larger area of gillnet fishing in the period after World War II but previous fishing effort levels have been restricted around Puck Bay, and there has also been a decline in fishing effort in Puck Bay over the past 30 years. The fishing activity is monitored *in situ* by a separate vessel rather than relying on logbooks. Fishing effort (*e.g.* number of fishing nets, area of fishing, fishing strategy, seasonal changes) has been estimated and an attempt has been made to compare this with information on by-caught and stranded porpoises as well as live porpoises in Puck Bay detected by passive acoustic monitoring. The overall aim is to correlate areas and times of highest fishing effort with those of highest porpoise density. If the SAMBAH project (Static Acoustic Monitoring of the Baltic Sea Harbour Porpoise) delivers information on the number and distribution of harbour porpoise in the entire Baltic Sea and the fishing sector provides reliable data on set gillnet fishing in Polish waters, it will be possible to identify when and where by-catch is most likely to occur. A part of the background for obtaining data from the small boat fishery is good cooperation with fishermen through information and education. While cooperation was good in the past, the ban on the use of driftnets in the Baltic has resulted in the cessation of voluntarily by-catch reporting.

3.7 Using Other Monitoring Programmes: EU Data Collection Framework

The workshop had noted that one less direct means of monitoring by-catch could be through other ongoing research programmes (see 2.1 above). A major relevant programme in European waters is conducted under the European Data Collection Framework (DCF) to collect data on fish discards and biological data on fish caught in European fisheries, which was reviewed at the workshop by Jørgen Dalskov.

In 2008 the EU Council had adopted a regulation concerning the establishment of a Community framework for the collection, management and use of data in the fisheries sector and support for scientific advice regarding the Common Fisheries Policy (CFP) for the period 2009-2013.

Data collected under the DCF should be collected for the purposes of scientific evaluation and therefore include information on fleets and their activities, biological data covering catches, including discards, survey information on fish stocks and the environmental impact that may be caused by fisheries on the marine ecosystem. Another aspect of the regulation, unrelated to by-catch monitoring, is that it also has provisions for the collection of economic data which may facilitate an assessment of economic and employment trends in this sector.

In general, data are to be collected in order to protect and conserve living aquatic resources and ensure their sustainable exploitation, following the ecosystem-based approach to fisheries management. Data collection under the DCF should therefore facilitate an assessment of the effects of fisheries on the marine ecosystem. However, it should be noted that in order to streamline collection and use of these data throughout the CFP and to avoid any duplication of collection of data, other regulations such as Council Regulation (EC) No 812/2004 of 26 April 2004 laying down measures concerning incidental catches of cetaceans in fisheries should be taken into account.

Each EU coastal Member State is required to establish a multi-annual national programme including the following modules:

1. **Module of the evaluation of the fishing sector**
   - General description of the fishing sector
   - Economic variables
   - Biological metier related variables
   - Biological recreational fisheries
   - Biological stock-related variables
   - Transversal variables
   - Research surveys at sea

2. **Module of the evaluation of the economic situation of the aquaculture and the processing industry**
   - Collection of economic data for the aquaculture
   - Collection of data concerning the processing industry

3. **Module of the evaluation of effects of the fishing sector on the marine ecosystem.**
   In order to monitor total catches which include both landings and discards, data collection programmes at the landings sites as well as at-sea observer programmes have to be established under the DCF. These programmes should be métier-based,

where a métier is defined as a combination of fishing gear, mesh size and target species (*e.g*. demersal fish or small pelagic).

The métiers are ranked according to their share in the total commercial landings. The shares should be added up, starting with the largest, until a cut-off level of 90% is reached. All métiers within the top 90 % are selected for sampling (landings and discards). A minimum of 2 fishing trips per quarter year is then sampled for discards (unless there is a justified reason for derogation). The data collection includes weight and length per species. For at-sea observer sampling both the retained and discarded parts of the catch have to be sampled.

Because most by-catch of cetaceans are recorded in gillnet fisheries, which usually do not land a large proportion of total commercial catches, the opportunity for cetacean by-catch monitoring under the DCF is limited. Nevertheless the DCF can provide a useful means of determining even low level by-catch rates in those fishery sectors that are monitored.

4. DATA COLLECTION AND MANAGEMENT

4.1 Data Collection, Collation, Control

Sara Wetmore described the approach to data management within the Northeast Fisheries Observer Program. NEFOP covers a variety of fisheries ranging geographically from Maine to North Carolina, USA. Observers onboard commercial fishing vessels collect confidential information that is utilized by multiple end-users. Data are collected electronically and are used in marine mammal and fish stock assessments, marine mammal, seabird and sea turtle by-catch estimations, in-season quota and total allowable catch management. Data are collected at the trip, haul and individual incidental take level including biological sampling of takes of marine mammals, seabirds and sea turtles. Specific fields are collected that aid in the estimation of by-catch and those fields include: DNA sample, species identification, tagging, entanglement and animal condition. Data quality is related to the level of training, editing, auditing and IT support process and relies on diligent observers, editors and programme staff that must be knowledgeable in regard to fishing practices, gear and operations in order to improve the accuracy of the data real-time.

The Workshop discussed the relative merits of paper and electronic records. A well-organised electronic data collection system can greatly facilitate data management, but there are many technical difficulties to overcome. Paper has the advantage of being durable, cheap, and easy to use.

The Workshop discussed the desirability of returning by-caught marine mammals and seabirds to shore. While this should clearly be a priority in most cases, it can also be difficult to organise logistically The NEFOP usually collects whole cetaceans, but in the case of birds, the head and feet should be collected where possible.

5. RELATED FLEET DATA FOR RAISING BY-CATCH RATES

5.1 Describing Fleet Effort and Reliability of Effort Data

Al Kingston addressed the ways in which fishing effort data can be used in by-catch monitoring programmes for designing surveys and for raising by-catch observations to fishery or fleet level. Understanding and quantifying fishing effort is usually critical to the estimation of by-catch at a fleet level.

Within the European Union all vessels of more than 10m in length are required to complete official logbooks, which in theory include information on fishing effort. Vessels over 15m are also required to carry an electronic Vessel Monitoring System (VMS) that uses a GPS to report the vessels location at regular intervals. VMS data are widely used for enforcement of area based fishery regulations. Fishery Inspection agencies also collect data on vessel activities through aerial and ship based patrols, but again this information is generally used solely for enforcement purposes. Questionnaires can be used to describe and assess fishing effort (as well as by-catch – see 2.1), while observer programmes can provide detailed information on fishing activity but generally only for a portion of the fleet's effort.

Logbook effort data can provide detailed information on net sizes and deployment times, but more usually provides only the number of fishing operations or simply the number of days at sea. It is usually possible to at least determine the general area of fishing (for example the ICES rectangle) and the gear type used. Where monitoring programmes are being planned, such data can provide a basis for planning which vessels, gear types or areas should be sampled and when, and can provide a basis for determining the amount of sampling required. Once data on by-catches have been collected, the same data provide a means of raising the by-catch observations to produce fishery or fleet level estimates of by-catch.

In reality, all fishing effort data recording systems have flaws or shortfalls. Many of the fields in the European official logbook are not mandatory, and so may be left blank, or may be completed by port officials. There is considerable evidence of human error in data collected from logbooks, and it is common that the data lack the necessary detail that would make them most useful. Furthermore, effort data reflect what has happened and cannot necessarily be taken as an accurate guide to what might occur in the future, which complicates planning of monitoring schemes. Much of the more detailed electronic data (such as VMS) are collected primarily for enforcement purposes and, if they can be obtained for assessment purposes, can be difficult and time consuming to interpret in a useable way.

Typical errors in effort data may include observed trips that are simply not found in official logbook records or trips with incorrect landing dates, and trips with missing information on gear types or the number of fishing operations. Pair trawling represents another problem as either one or the other or both of a pair team may file logbook records, and such records need to be reconciled. Where polyvalent vessels are concerned it is often very difficult to determine how much effort should be attributed to which gear type, and gear types may be incorrectly specified. In the UK this is a particular problem for under 10m vessels, which are not legally obliged to

keep official logbooks, and as a result effort data for this fleet are often aggregated into relatively meaningless catch-all categories.

Inaccuracies in effort data can lead to a sampling plan that is unrepresentative of the fleet that is being studied, can increase uncertainty due to poor stratification and can ultimately bias by-catch estimates in unpredictable ways. This could in turn lead to inappropriate management decisions.

Exactly these sorts of problems with records of effort data have led to the use of records of landed catch being used to raise by-catch estimates in the US fishery observer programme and in Denmark.

6. RAISING PROCEDURES

6.1 Accuracy and Precision Issues Associated With By-catch Estimation

Charles Paxton described some of the issues surrounding bias and precision of estimates. Before considering how to assess bias and precision, the questions of interest have to be identified as this directly relates to the statistical methods to be employed. For example, questions can vary from "What is the overall level of (relative or absolute) by-catch?" to "What level of effort is required to estimate total (absolute or relative) by-catch with a certain degree of precision?" The exact data to be used in answering the question have to be identified as well as the appropriate sampling unit. Typically inferences from the samples are generated up to fleet level. Sampling units can thus vary from individual nets, through hauls to trips to vessels. Users should be aware of potential biases in the data and collect the data in such a way that those biases can be minimised. Biases can exist in the collection of data because observer deployment may not be representative (different gears, temporal discrepancies, observers may miss drop-outs, *etc.*). Precision can be increased by increasing sample sizes but there are diminished returns and it may not be economic to massively increase sample sizes. The fundamental problem with most by-catch data is that by-catches occur at low frequencies meaning that the data are often over-dispersed.

Estimates of by-catch are raised by design or model-based methods. Model-based estimation, whilst more complicated than more standard design-based estimation, allows interpolation of by-catch into combinations of variables that have been little sampled. Often by-catch data are highly over-dispersed and here zero-inflated models can deal with the over-dispersion in the models. The data are often hierarchical and with random effects. A mixed modelling approach can deal with this. By-catch data may be spatially correlated. This can be dealt with by modelling the spatial autocorrelation or consideration of independent spatial units only, by omitting data.

Existing spatial density estimates could be built into by-catch estimation models or density estimates could theoretically be used to identify hotspots for megafauna which should be avoided by fishermen.

One final point of consideration in cetacean by-catch in enclosed environments such as bays *etc.* is that the probability of by-catch is a product of the probability of

encounter with the net and the probability of capture given encounter. Probability of encounter is not necessarily a simple function of fishing effort but the *concentration* of the effort in time. The risk of by-catch in an enclosed area can be a higher for effort that is concentrated in time rather than the same level of effort spread in time.

6.2 By-catch Estimation Techniques for Rare Events: Case Studies in North Atlantic Fisheries

Kimberly Murray described three different analytical approaches used by staff at the Northeast Fisheries Science Center to estimate by-catch of sea turtles, seabirds and marine mammals in commercial sink gill-net gear. Prior to estimating total by-catch, observer data are evaluated with respect to the choice of sampling unit (*i.e.* hauls or trips), and the choice of the raising variable (*i.e.* hours fished or total landings). The choice will likely affect the amount of total estimated by-catch and uncertainty around the estimates. Commercial data are evaluated for comprehensiveness (*i.e.* do the data represent a complete census of all commercial effort?) and representativeness (do the data represent the general spatial and temporal distribution of all commercial effort?), with respect to the fishery or gear type of interest.

Techniques presented here to estimate by-catch include Generalized Additive Models (Murray 2009), Generalized Linear Models with model averaging (Warden, in press), and ratio estimators (Orphanides 2009). Uncertainty around by-catch estimates (CVs and CIs) are generally computed via bootstrapping routines. Each of these methods was briefly described to workshop participants and compared.

There is not a single preferred method to estimate by-catch; suitable models are developed based on the structure of the data and the quality and quantity of data available. In general when estimating total by-catch of a rare event, one needs to proceed cautiously with inference from observer data, which often represent low levels of sampling (*i.e.* <5%).

6.3 By-catch Estimation in Atlantic Canada – Influences of Data Characteristics, Data Credibility, and Scale of Analysis

Jack Lawson addressed certain aspects of by-catch estimation using examples from Canada. He noted that in general the processes by which these estimates are derived are rarely consistent across studies. Two incidental catch estimates for the same fishery, using different metrics to approximate fishing effort and incidental catch rates, may differ in magnitude of both the estimates and their associated variability. To assess the differences of incidental catch estimates based on different methods, researchers at Fisheries and Oceans Canada had calculated incidental catch estimates for harbour porpoise in the nearshore gill-net fishery for Atlantic cod (*Gadus morhua*) in Newfoundland, Canada, based on several types of official fisheries statistics, and on data collected directly from fishers through interviews and logbooks (Benjamins *et al*. 2007). Incidental catch estimates were lowest when using net-days as a measure of fishing effort, likely due to the considerable day-to-day variability in landed catches due to small-scale changes in cod distribution. When using net-days, the use of trips per fisher as sampling units also contributed to lower overall estimates. Performing the analysis at the coastline scale, rather than per fisher, or over larger geographic

areas, appears to be a reasonable compromise between the need for geographic detail and the realities of imperfect data collection.

The results of this study, and similar efforts undertaken to estimate seabird (Benjamins *et al*. 2008) and shark (Benjamins *et al*. 2010) by-catch in Newfoundland gillnet fisheries, confirm the importance of accounting for underlying variability of landed catch and fishing effort-related data when estimating incidental catch, and reiterate the importance of collecting credible information on fishing effort. The sometimes large differences between these various by-catch estimates indicate the extent to which estimations of by-catch are influenced by characteristics of available data (*e.g.*, sample size and coverage, skewness) and underlying methodology (*e.g.* scale of analysis, sampling unit). The harbour porpoise example illustrates the benefits of a more comprehensive monitoring approach to obtain information, including mandatory logbook programmes and focused observation of fishing effort, particularly on nearshore, small-boat fisheries (*e.g.* using post-fishery interviews and digital imagery to confirm species identity and train observers). Deploying dedicated observers on every boat is impractical for many fisheries as most vessels are small and the cost of such a programme would be prohibitive. At the moment, fostering a long-term, trusting relationship with a number of representative fishers appears to be the best strategy to obtain information on incidental catch in these fisheries.

The Workshop reiterated the importance of reliability of effort data in the need for adequate stratification. The Workshop also noted that extrapolated by-catch estimates are only useful if they can be compared with an estimate of total population size.

7. INDUSTRY COOPERATION AND OUTREACH

7.1 A View from Industry

Alec Wiseman presented a perspective on by-catch monitoring schemes from the perspective of the Scottish Pelagic trawl fleet. This fleet consists of 25 vessels between 60 and 75m, and lands 85% of the total UK quota for pelagic species. Mackerel alone is the highest earning fishery by value in the UK. The fleet has been hosting observers from the Fisheries Laboratory in Aberdeen and from the Sea Mammal Research Unit for many years. In general the fleet has no reason <u>not</u> to take observers as there are no by-catch problems of concern. One exceptional case is the midwater pair trawl fishery for bass, a very seasonal and local fishery that takes place in the English Channel during winter. In this fishery by-catch of common dolphins was a concern, and the Scottish Pelagic Fishermens Association collaborated with the Sea Mammal Research Unit to combine monitoring with attempts to minimise dolphin by-catch, and this programme has led to a dramatic decrease in dolphin by-catch rates.

More generally the potential problems that may arise with such schemes include the misuse of data collected on board vessels and the personal behaviour of observers. An example was given where skippers had been unaware that data were being collected on discards as well as on the biology of the fish. Discard data were then used in a way that the industry felt was inappropriate where unwarranted assumptions had been made, and this led to a breakdown in trust between skippers and the agency collecting

the data. Subsequently an observer code of conduct has been established which defines broadly what data will be collected, how discards will be assessed and what the data will be used for. In addition, observer reports are sent to the skipper for comment, observers have to have the relevant certification and their general behaviour is also guaranteed. However, there is a remaining problem that the monitoring agency is now a part of the same organisation as the compliance agency, so that any data collected for monitoring purposes is now also available to enforcement officials, and this makes industry uneasy.

The benefits that can be derived from collaborating with a protected species by-catch monitoring scheme are important where environmental certification is sought ('eco-labelling') as in such cases the presence of an ongoing observer programme can validate industry claims that by-catch rates are low. Observations of fish biology can also help in stock assessment work, which benefits industry, and indeed many industry vessels have also been involved in chartered surveys of fish stock so that industry has become more involved in the entire assessment and management process.

Certification schemes are clearly an important factor in driving the need for observer schemes to document levels of by-catch. The Workshop noted that such schemes are usually driven by the processing or retail sectors, but that once a fishery has become certified it is usually very important to keep that certification from a commercial perspective. As more and more fisheries become certified it becomes less and less attractive to remain 'uncertified'. The Workshop noted therefore that certification schemes can play a highly significant role in validating by-catch monitoring schemes and can in some cases even insist upon their establishment.

7.2 Reconciling Industry and Scientific Views of By-catch Estimates

A growing number of experiences worldwide have demonstrated the programmatic benefits of collaborative research involving fishers and scientists. Doug Wilson presented a summary of the results of 3 relevant EU Framework projects.

The UNCOVER project was asking what kinds of governance arrangements were needed for species recovery plans and found that, under certain conditions, these plans had resulted in effective partnerships with concrete benefits for recovery plans. In these cases collaborative research programmes increased the overall resilience of fisheries management under the difficult circumstances of reducing fishing effort for species recovery. The support of science and government at all levels was important in each successful case and this is an important lesson for future management policy.

The JAKFISH project investigated the kinds of institutional arrangements that allow stakeholders and scientists to work together in dealing with uncertainty. These arrangements are also helpful in encouraging effective collaborative research.

The GAP 1 project linked 12 fisher-scientist partnerships in 11 European countries, gave their efforts opportunities to pool their experiences, and carried out an in-depth analysis of three of them. The project found that both partners recognised the benefits of working together, but also identified a number of factors that influence the

effectiveness of cooperation, as well as some ongoing dilemmas that affect these programmes that are difficult to fully resolve.

The Workshop noted that in reconciling industry and scientific views of by-catch estimates, it was always best to communicate and be honest with fishers about the situation. It is usual that fishers and scientists may place different values on resources. In dealing with the industry, scientists should not be selective about which facts are conveyed. Transparency is most important even if it is unpalatable.

Ideally, data should be used only for purposes for which they are collected. However, data have sometimes been used in a subversive way. The Workshop agreed that transparency is best and that it should always be made clear to industry that there will always be a possibility that information may not be used as intended or expected.

The Workshop also discussed at some length the problem that observers may also be required to collect data that can be accessed and used by enforcement and regulatory bodies. There is a tension here that representative data quality may be compromised if the data that are collected are available to enforcement bodies, and this may compromise the scientific integrity of the sampling programme. This is an issue that all observer programmes need to be aware of and is not one that can easily be resolved.

The Workshop also acknowledged that working conditions for observers are not always ideal. For example EU regulations on working hours are very hard to abide by when observers are at sea, and it is likely that working hour limits are often exceeded by observers, so that in practice a flexible approach needs to be taken. It is unusual for observers to actually work by the hour, but rather it is left to their own discretion to try to cover the task that needs to be done (*e.g.*, monitoring net hauls) whilst ensuring they have adequate rest.

In the US, observer hours have not been challenged. In general observers are content to work long hours but problems start if precise hours have to be documented on paper as these may exceed the regulations.

8. GENERAL CONCLUDING DISCUSSION

The Workshop agreed to some interim conclusions and recommendations but agreed that more substantive recommendations would be laid out in the proposed guidelines for the development of by-catch monitoring schemes in the ICES Cooperative Research Report.

The Workshop agreed that although independent observer schemes are usually the best way to determine by-catch levels, where financial constraints make this impossible there is a range of other options, including the use of logbooks, interviews and research surveys. It was agreed that results from such methods should be interpreted with caution and that it is best to integrate the results from several different methods to obtain a range of possible estimates.

The Workshop agreed that standardised training is an important aspect of the development of by-catch monitoring schemes and recommended that training programmes and data collection procedures for marine mammal and seabird by-catch monitoring should be standardised at a European level. Further work was therefore definitely needed on defining region wide standards and also in establishing appropriate training schemes.

The Workshop recognised that there are several alternative measures that still involve independent monitoring, but that do not necessarily involve a dedicated on board observer scheme. The workshop agreed that several of these showed promise, especially on board video monitoring as has been trialled in Denmark.

The Workshop agreed that returning whole animal carcasses to port for further biological examination is always desirable though not always straightforward for various logistical and legal and social reasons.

The Workshop agreed that raising by-catch observations to the fleet level could best be achieved with accurate fleet effort data, but also recognised that these data are rarely reliable. Caution in interpreting results is always necessary.

The Workshop noted that scientific data collection is frequently confounded by the fact that such data may be available to enforcement agencies, and this can jeopardise relations with industry.

Finally, the Workshop agreed that building trust with industry is crucial at all stages and that the key issue is transparency at all times.

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Appendix 1

AGENDA

Monday 28th June 2010:

14:00 Welcome and Introductions
14:15 Overview discussion – origins of workshop and expected outcomes
14:30 Introduction: Why do we need by-catch observer schemes and what are they good for? - Simon Northridge
14:40 Indirect means of quantifying by-catch: Overview of indirect means and integrating different approaches. - Droplaug Ólafsdóttir
15:00 DISCUSSION – ALL focusing on the merits and problems associated with indirect means
15:45 Break

Direct observations of by-catch: session 1
16:00 Using Observers – Sara Wetmore
Observer training – some general issues: - Grant Course
18:00 Break for the evening

Tuesday 29th June:

Direct observations continued: session 2
09:00 On board observer schemes 1: marine mammals –Amy van Atten
09:30 On board observer schemes 2: birds –Oliver Yates
10:00 Use of CCTV to monitor by-catch – Lotte Kindt-Larsen
10:30 Separate observation platforms – Barbie Byrd
11:00 Break
11:15 Contracted fleet - Arne Bjørge
11:45 Monitoring the Baltic small boat fleet – Krzystof Skora
11:45 DISCUSSION –All: focusing on issues surrounding observations schemes Strandings schemes, photo-id, ...
13:00 Lunch

Data management issues
14:00 Discard sampling and by-catch observations – Jørgen Dalskov
14:30 Data collection, collation, control – Sara Wetmore
DISCUSSION – on data management issues
15:30 Break

Related fleet data
16:00 Describing fleet effort and reliability of effort data – Al Kingston
DISCUSSION on fleet effort data
18:00 Break for the evening

5.4
NAMMCO SCIENTIFIC COMMITTEE
and
Participants to the 18th Scientific Committee Meeting

Dr Mario Acquarone (Scientific Secretary)
NAMMCO
P.O. Box 6453
N-9294 Tromsø, Norway
Tel +47 77 68 73 73
Mobile +47 40 62 62 66
Fax +47 77 68 73 74
mario@nammco.no

Dr Genevieve Desportes (FO)
Faroese Museum of Natural History
c/o Gdnatur
Stejlestræde 9, Bregnør
DK-5300 Kerteminde, Denmark
Tel.: +45 65 32 17 67
Mobile +45 20 25 02 67
Fax +45 65 32 17 76
genevieve@gdnatur.dk

Dr Tore Haug (NO)
Institute of Marine Research
PO Box 6404
N-9294 Tromsø, Norway
Tel +47 77 60 97 22
Mobile +47 95 28 42 96
Fax +47 77609701
tore.haug@imr.no

Dr Christian Lydersen (NO)
Norwegian Polar Institute
Polar Environmental Centre
N-9296 Tromsø, Norway
Tel +47 77 75 05 23
Mobile +47 90 93 07 76
Fax +47 77 75 05 01
lydersen@npolar.no

Mr Bjarni Mikkelsen (FO)
Natural History Museum
Fútalág 40
FR-100 Tórshavn, Faroe Islands
Tel.: +298 35 23 23
Mobile +298 21 85 80
Fax +298 35 23 21
bjarnim@ngs.fo

Dr Shingo Minamikawa (Observer JPN)
National Research Institute of Far Seas Fisheries
2-12-4 Fukuura, Kanazawa ward
Yokohama City, Kanagawa
236-8648 Japan
Tel: +81 45 788 7500
Fax: +81 45 788 5004
sminami@affrc.go.jp

Dr Aqqalu Rosing-Asvid (GR)
Greenland Institute of Natural Resources
P.O.Box 570
DK-3900 Nuuk, Greenland
Tel +299 36 12 47
Mobile +299 28 78 61
Fax +299 36 12 12
aqqalu@natur.gl

Mr Fernando Ugarte (GR)
Greenland Institute of Natural Resources
P.O. Box 570
DK-3900 Nuuk, Greenland
Tel +299 36 12 42
Mobile +299 26 23 57
Fax +299 36 12 12
feug@natur.gl

Mr Gísli Víkingsson (IS)
Marine Research Institute
PO Box 1390
IS-121 Reykjavik, Iceland
Tel.: +354 57 52 080
Mobile +354 69 90 475

Fax +354 57 52 001
gisli@hafro.is

Dr Lars Witting (GR – SC Chair)
Greenland Institute of Natural Resources
P.O. Box 570
DK-3900 Nuuk, Greenland
Tel +299 32 10 95
Mobile +299 29 11 63
Fax +299 36 12 12
larsw@natur.gl

Dr Vladimir Zabavnikov (Observer Russia)
PINRO
6 Knipovitch Street
Murmansk 183763, Russian Federation
Tel.: +7 (8152) 472572
Mobile +7 (921) 5130781
Fax: +7 (8152) 473331
ltei@pinro.ru

Addresses

5.6
NAMMCO SCIENTIFIC COMMITTEE WORKING GROUP ON COASTAL SEALS

Mario Acquarone (Scientific Secretary)
NAMMCO
PO Box 6453
N-9294 Tromsø,
Email: mario@nammco.no
Phone: +47 77687373

Signe May Andersen (Invited Expert)
National Environmental Research Institute
PO Box 358
DK-4000 Roskilde, Denmark
Email: sia@dmu.dk
Phone: +45 46301942

Arne Bjørge (Invited Expert)
Institute of Marine Research
PO Box 1064, Blindern
N-0316 Oslo, Norway
Email: arne.bjoerge@imr.no
Phone: +47 22958751

Rune Dietz (Invited Expert)
National Environmental Research Institute
PO Box 358
DK-4000 Roskilde, Denmark
Email: rdi@dmu.dk
Phone: +45 46301938

Anne Kirstine Frie (Invited Expert)
Institute of Marine Research
PO Box 6404
N-9294 Tromsø, Norway
Email: anne.kirstine@imr.no
Phone: +47 77609729

Mike Hammill (Invited Expert)
Fisheries and Oceans Canada
PO Box 1000, 850 route de la Mer
Mont-Joli, QC G5H 3Z4, Canada
Email: hammillm@dfo-mpo.gc.ca
Phone: +1 418 7750580

Tero Härkönen (Invited Expert)
Swedish Museum of Natural History
Höga 160
S-44273 Kärna, Sweden
Email: tero.harkonen@nrm.se
Phone: +46 8 51954029

Erlingur Hauksson (Invited Expert)
Icelandic Fisheries Laboratories
Fornistekkur 14
IS-109 Reykjavík, Iceland
Email: erlingurhauks@simnet.is
Phone:

Christina Lockyer (General Secretary)
NAMMCO
PO Box 6453
N-9294 Tromsø,
Email: christina@nammco.no
Phone: +47 77687372

Bjarni Mikkelsen (Scientific Committee)
Faroese Museum of Natural History
Fútalág 40,
FR-100 Tórshavn, Faroe Islands
Email: bjarnim@ngs.fo
Phone: +298 352323

Kjell Tormod Nilssen (Chair of Working Group)
Institute of Marine Research
PO Box 6404
N-9294 Tromsø, Norway
Email: kjell.tormod.nilssen@imr.no
Phone: +47 77609724

Tor Arne Øigård (Invited Expert)
Institute of Marine Research
PO Box 6404
N-9294 Tromsø, Norway

Email: tor.arne.oeigaard@imr.no
Phone: +47 77609730

Aqqalu Rosing-Asvid (Scientific Committee)
Greenland Institute of Natural Resources
PO Box 570
DK-3900 Nuuk, Greenland
Email: aqro@natur.gl
Phone: +299 361247

Jonas Teilmann (Invited Expert)
National Environmental Research Institute
PO Box 358
DK-4000 Roskilde, Denmark
Email: jte@dmu.dk
Phone: +45 46301947

5.7
NAMMCO SCIENTIFIC COMMITTEE WORKING GROUP ON ABUNDANCE ESTIMATES

David Borchers (IP)
Head of Statistics Division, School of Mathematics and Statistics
Centre for Research into Ecological and Environmental Modelling
University of St Andrews
The Observatory, Buchanan Gardens, St Andrews, Fife KY16 9LZ, Scotland
United Kingdom
Phone: +44 1334 461843
E-mail: dlb@mcs.st-andrews.ac.uk

Geneviève Desportes (NAMMCO SC, Convener, SPWG Co-chair, T-NASS Coordinator)
Faroese Museum of Natural History
c/o GDnatur, Stejlestræde 9,
DK-5300 Kerteminde
Danmark
Phone: +45 2025 0267
E-mail: genevieve@gdnatur.dk

Greg Donovan (IP)
International Whaling Commission
The Red House, 135 Station Road,
Impington, Cambridge CB4 9NP,
United Kingdom
Phone: + 44 1223 233971
E-mail: greg@iwcoffice.org

Anita Gilles (IP)
Forschungs- und Technologiezentrum Westkueste (FTZ)
University of Kiel
Werftstr. 6, 25761 Büsum
Germany
Phone: +49 4834 604 105
E-mail: gilles@ftz-west.uni-kiel.de

Rikke Guldborg Hansen (IP)
Greenland Institute of Natural Resources
c/o Greenland's Representation
Strandgade 91, 3, P.O. Box 2151, DK-1016 Copenhagen K
Denmark
Phone: +45 3283 3800
E-mail: rikkeguldborg@hotmail.com

Þorvaldur Gunnlaugsson (NAMMCO SC)
Marine Research Institute,
PO Box 1390,
IS-121 Reykjavík,
Iceland
Phone: +354 5752081
E-mail: thg@hafro.is

Phil Hammond (IP, CODA Coordinator)
Sea Mammal Research Unit
University of St Andrews
St Andrews, Fife KY16 8LB
Scotland
Phone: +01 334 462630/463222
Email: psh2@st-andrews.ac.uk

Mads Peter Heide Jørgensen (IP)
Greenland Institute of Natural Resources
c/o Greenland's Representation
Strandgade 91, 3, P.O. Box 2151, DK-1016 Copenhagen K
Denmark
Phone: +45 32833827
E-mail: mhj@ghsdk.dk

Jack Lawson (IP, Canada T-NASS Coordinator)
Marine Mammal Section, Fisheries and Oceans Canada, NAFC
P.O. Box 5667, 80 East White Hills Road, St. John's, NL
A1C 5X1 Canada
Phone: +1 709 772 2285
E-mail: Jack.Lawson@dfo-mpo.gc.ca

Addresses

Bjarni Mikkelsen (NAMMCO SC,
Faroes T-NASS Coordinator)
Faroese Museum of Natural History
Fútalág 40, FR-100 Tórshavn
Faroe Islands
Phone: +298 352323
E-mail: bjarnim@ngs.fo

Daniel Pike (IP, AEWG Chair, SP WG Co-chair)
Esox Associates
1210 Ski Club Road, North Bay, Ontario,
P1B 8E5, Canada
Phone: +1 (705) 4788632
E-mail: kinguq@gmail.com

Gísli Víkingsson (NAMMCO SC,
Iceland T-NASS Coordinator)
Head of Whale Research
Marine Research Institute,
PO Box 1390, IS-121 Reykjavík
Iceland
Phone: +354 5752080
E-mail: gisli@hafro.is

Vladimir Zabavnikov (IP, Russia T-NASS Coordinator)
PINRO
6 Knipovitch Street, Murmansk 183763
Russian Federation
Phone: +7 8152) 472572
E-mail: ltei@pinro.ru

Nils Øien (IP, Norway T-NASS Coordinator)
Institute of Marine Research
P.O.Box 1870 Nordnes, N-5024 Bergen
Norway
Phone: +47 55 23 86 11
E-mail: nils@imr.no

5.8
NAMMCO SCIENTIFIC COMMITTEE WORKING GROUP ON SURVEY PLANNING

David Borchers (IP, in part)
Head of Statistics Division, School of Mathematics and Statistics
Centre for Research into Ecological and Environmental Modelling
University of St Andrews
The Observatory, Buchanan Gardens, St Andrews, Fife KY16 9LZ, Scotland
United Kingdom
Phone: +44 1334 461843
E-mail: dlb@mcs.st-andrews.ac.uk

Geneviève Desportes (NAMMCO SC, Convener, SPWG Co-chair, T-NASS Coordinator)
Faroese Museum of Natural History
c/o GDnatur, Stejlestræde 9,
DK-5300 Kerteminde
Danmark
Phone: +45 2025 0267 E-mail: genevieve@gdnatur.dk

Greg Donovan (IP)
International Whaling Commission
The Red House, 135 Station Road, Impington, Cambridge CB4 9NP,
United Kingdom
Phone: + 44 1223 233971
E-mail: greg@iwcoffice.org

Rikke Guldborg Hansen (IP, in part)
Greenland Institute of Natural Resources
c/o Greenland's Representation
Strandgade 91, 3, P.O. Box 2151, DK-1016 Copenhagen K
Denmark
Phone: +45 3283 3800
E-mail: rikkeguldborg@hotmail.com

Þorvaldur Gunnlaugsson (NAMMCO SC)
Marine Research Institute,
PO Box 1390,
IS-121 Reykjavík,
Iceland
Phone: +354 5752081
E-mail: thg@hafro.is

Phil Hammond (IP, CODA Coordinator)
Sea Mammal Research Unit
University of St Andrews
St Andrews, Fife KY16 8LB
Scotland
Email: psh2@st-andrews.ac.uk
Phone: +01 334 462630/463222

Mads Peter Heide Jørgensen (IP, in part)
Greenland Institute of Natural Resources
c/o Greenland's Representation
Strandgade 91, 3, P.O. Box 2151, DK-1016 Copenhagen K
Denmark
Phone: +45 32833827
E-mail: mhj@ghsdk.dk

Jack Lawson (IP, Canada TNASS Coordinator)
Marine Mammal Section, Fisheries and Oceans Canada, NAFC
P.O. Box 5667, 80 East White Hills Road, St. John's, NL
A1C 5X1 Canada
Phone: +1 709 772 2285
E-mail: Jack.Lawson@dfo-mpo.gc.ca

Bjarni Mikkelsen (NAMMCO SC, Faroes T-NASS Coordinator)
Faroese Museum of Natural History
Fútalág 40, FR-100 Tórshavn
Faroe Islands
Phone: +298 352323
E-mail: +bjarnim@ngs.fo

Addresses

Daniel Pike (IP, AEWG Chair, SP WG Co-chair)
Esox Associates
1210 Ski Club Road, North Bay, Ontario,
P1B 8E5,
Canada
Phone: +1 (705) 4788632
E-mail: kinguq@gmail.com

Aurore STERCKEMAN (IP)
Chargée d'études 'acquisition de connaissances',
Agence des aires marines protégées
16 quai de la douane, BP42932, 29229 Brest cedex 02.
France
Phone : +33 2 9833 9457 / +33 6 3328 2040
E-mail : aurore.sterckeman@aires-marines.fr

Frank Urtizbéréa (IP)
Head of the Environmental Department in St. Pierre
24 route de la Pointe Blanche, BP 770
97500
Saint Pierre et Miquelon
Phone : +33 508412104/ +33 508552100
E-mail : frank.urtizberea@agriculture.gouv.fr

Gísli Víkingsson (NAMMCO SC, Iceland TNASS Coordinator)
Head of Whale Research
Marine Research Institute,
PO Box 1390, IS-121 Reykjavík
Iceland
Phone: +354 5752080
E-mail: gisli@hafro.is

Vladimir Zabavnikov (IP, Russia T-NASS Coordinator)
PINRO
6 Knipovitch Street, Murmansk
183763
Russian Federation
Phone: +7 8152) 472572
E-mail: ltei@pinro.ru

Nils Øien (IP, Norway T-NASS Coordinator)
Institute of Marine Research
P.O.Box 1870 Nordnes, N-5024 Bergen
Norway
Phone: +47 55 23 86 11
E-mail: nils@imr.no

5.9
NAMMCO SCIENTIFIC COMMITTEE WORKING GROUP ON ASSESSMENT

Mario Acquarone (Scientific Secretary)
NAMMCO
PO Box 6453
N-9294 Tromsø
Norway
Email: mario@nammco.no
Phone: +47 77687373

Doug S. Butterworh (Invited Expert)
University of Cape Town
Rondebosch 7701
South Africa
Email: Doug.Butterworth@uct.ac.za
Phone: +27 (21) 650 2343

Geneviève Desportes (Scientific Committee) [only 6 April 2011]
Faroese Museum of Natural History
c/o GDnatur,
Stejlestræde 9
DK-5300 Kerteminde
Danmark
Email: genevieve@gdnatur.dk
Phone: +45 20250267,

Bjarki Elvarsson (Invited Expert)
Marine Research Institute
PO Box 1390
IS-121 Reykjavik
Iceland
Email: bjarki.elvarsson@gmail.com
Phone: + 354 6181681

Thorvaldur Gunnlaugsson (Scientific Committee)
Marine Research Institute
PO Box 1390
IS-121 Reykjavik
Iceland
Email: thg@hafro.is
Phone: +354 5752081

Christina Lockyer (General Secretary) [only 5-6 April 2011]
NAMMCO
PO Box 6453
N-9294 Tromsø
Norway
Email: christina@nammco.no
Phone: +47 77687372

Gisli A. Víkingsson (Scientific Committee)
Marine Research Institute
PO Box 1390
IS-121 Reykjavik
Iceland
Email: gisli@hafro.is
Phone: +354 5752080

Lars Walløe (Working Group Chair)
University of Oslo
PO Box 1103 Blindern
N-0317 Oslo
Norway
Email: lars.walloe@medisin.uio.no
Phone: +47 22851218

Lars Witting (Scientific Committee Chair)
Greenland Institute of Natural Resources
PO Box 570
DK-3900 Nuuk
Greenland
Email: lawi@natur.gl
Phone: +299 361202

Addresses

5.10
THE JOINT NAMMCO-ICES WORKSHOP ON BY-CATCH MONITORING

Arne Bjørge
Institute of Marine Research,
Gaustadalléen 21,
0349 Oslo,
Norway.
Phone +47 22958751
Mobile +47 91314810
arne.bjoerge@imr.no

Christer Blomqvist
Swedish Board of Fisheries,
Institute of Coastal Research,
Fiskeriverket Skolgatan 6,
SE-742 42 Öregrund,
Sweden.
Phone +46 17346495
christer.blomquist@fiskeriverket.se

Barbie Byrd
NOAA Beaufort Lab,
National Marine Fisheries Service,
Protected Resources Branch,
101 Pivers Island Road,
Beaufort, NC 28516,
United States.
Phone +1 252 7288793
barbie.byrd@noaa.gov

Grant Course
Centre for Environment, Fisheries and Aquaculture Science,
Whitehaven Laboratory,
West Strand,
Cumbria, CA28 7LY,
United Kingdom.
Phone +44 1946692654
grant.course@cefas.co.uk

Jørgen Dalskov
National Institute of Aquatic Resources Section for Fisheries Advice,
Technical University of Denmark,
Charlottenlund Slot,
Jægersborg Alle 1,
DK-2920 Charlottenlund
Denmark.
Phone +45 35883380
jd@aqua.dtu.dk

Allen Kingston
Sea Mammal Research Unit,
Gatty Marine Laboratory,
University of St Andrews,
St Andrews, Fife, KY16 8LB,
United Kingdom.
Phone +44 1334462630
ark10@st-and.ac.uk

Lotte Kindt-Larsen
National Institute of Aquatic Resources Section for Fisheries Advice,
Technical University of Denmark,
Charlottenlund Slot,
Jægersborg Alle 1,
DK-2920 Charlottenlund
Denmark.
Phone +45 21154484
lol@aqua.dtu.dk

Jack Lawson
Marine Mammals Section,
Fisheries and Oceans Canada,
St. John's,
Newfoundland, A1C 5X1,
Canada.
Phone +1 709 7722285
jack.lawson@dfo-mpo.gc.ca

Santiago Lens
Instituto Español de Oceanografía
Centro Oceanográfico de Vigo,
P.O. Box 1552,

Addresses

E-36200 Vigo (Pontevedra),
Spain.
Phone +34 986492111
santiago.lens@vi.ieo.es

Christina Lockyer
NAMMCO,
PO Box 6453,
N-9294 Tromsø,
Norway.
Phone +47 77687372
christina@nammco.no

Kimberly Murray
Northeast Fisheries Science Center,
Protected Species Branch,
166 Water Street,
Woods Hole, MA 02543,
United States.
Phone + 1 508 4952197
kmurray@mercury.wh.whoi.edu

Simon Northridge (chair)
Sea Mammal Research Unit,
The Gatty Marine Laboratory,
University of St Andrews,
St Andrews, KY16 8LB,
United Kingdom.
Phone +44 1334462654
spn1@st-andrews.ac.uk

Droplaug Ólafsdóttir (chair)
Marine Research Institute,
PO Box 1390,
IS-121 Reykjavík,
Iceland.
Phone +354 5752000 / 5752082
droplaug@hafro.is

Charles Paxton
CREEM, University of St Andrews
The Observatory,
Buchanan Gardens,
St Andrews, KY16 9LZ,
United Kingdom.
Phone +44 1334461811
cgp2@st-and.ac.uk

Emer Rogan
Dept of Zoology, Ecology and Plant Science,
University College,
Distillery Fields,
North Mall, Cork
Ireland.
Phone +353 214904645
e.rogan@ucc.ie

Marjorie Rossman
National Marine Fisheries Services,
Northeast Fisheries Science Center,
166 Water Street,
Woods Hole MA 02543,
United States.
Phone +1 508 4952111
marjorie.rossman@noaa.gov

Rita Maria Santos
European Commission
MARE A2 - Environment Unit for Common Fisheries Policy and Aquaculture
Directorate General for Maritime Affairs & Fisheries,
Rue Joseph II, 99, 01/40,
1040 Brussels
Belgium.
Phone +32 22956453
rita-maria.santos@ec.europa.eu

Krzysztof E. Skóra
Hel Marine Station,
Institute of Oceanography
University of Gdansk,
Morska 2
84-150 Gdansk
Poland.
Phone +48 58 6750836
oceks@univ.gda.pl

Mark Tasker
Joint Nature Conservation Committee,

Inverdee House,
Baxter Street,
Aberdeen, AB11 9QA
Scotland, United Kingdom.
Phone + 44 1224266551
mark.tasker@jncc.gov.uk

Amy Van Atten
NOAA Fisheries,
Northeast Fisheries Science Center
166 Water St,
Woods Hole MS, MA 02543
United States.
Phone +1 508 952266
amy.van.atten@noaa.gov

Sara Wetmore
National Oceanic and Atmospheric
Administration NOAA,
Northeast Fisheries Observer Program,
166 Water St,
Woods Hole MS, MA 02543
United States.
Phone +1 508 952227
sara.wetmore@noaa.gov

Doug Wilson
Innovative Fisheries Management –
An Aalborg University Research
Centre,
Department of Development and
Planning,
Room 85, Fibigerstræde 13,
9220 Aalborg Ø,
Denmark.
Phone +45 99403674
dw@ifm.dk

Alex Wiseman Scottish Pelagic
Fishermen's Association,
1 Frithside Street,
Fraserburgh,
AB43 9AR
United Kingdom.
alexwisefish@aol.com

Oliver Yates
Albatross Task Force, Global Seabird
Programme, BirdLife International,
Calle Del Almacen, 170,
La Herradura, Coquimbo,
Chile
Phone +56 51497303
oli.yates@gmail.com

Vladimir Zabavnikov
PINRO
6 Knipovitch Street,
183763 Murmansk,
Russian Federation.
Phone +7 81 52472572
ltei@pinro.ru