REPORT OF THE

NAMMCO SCIENTIFIC COMMITTEE

WORKING GROUP ON

ABUNDANCE ESTIMATES

Bergen, 21-23 November, 2000

North Atlantic Marine Mammal Commission
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1. OPENING REMARKS

Chairman Nils Øien welcomed all participants to the meeting (see Appendix 1). He reviewed the terms of reference for the Working Group.

At its 1999 meeting, the NAMMCO Council noted that abundance estimates from NASS-95 have not been completed for some species. The Council therefore recommended that the Scientific Committee complete abundance estimates for all species, as part of its efforts to monitor the abundance of all species in the North Atlantic.

In response, at their meeting in 2000 the Scientific Committee reviewed the present status of analyses and publications from NASS-95, 89 and 87 as well as West Greenlandic aerial surveys. For the most recent survey (NASS-95), only the abundance estimate for minke whales in the Norwegian survey area has been published in the primary scientific literature. Abundance estimates for some other species have been calculated and accepted by the NAMMCO Scientific Committee. For other species, no abundance estimates have been calculated or published. Abundance estimates have been published from the earlier NASS surveys for most species. Only abundance estimates for the target species (minke and fin whales) of the West Greenland aerial surveys have been published.

The Scientific Committee agreed that further analyses of the abundance of non-target species (i.e. all but minke, pilot, fin and sei whales) from the NASS-95 survey should be conducted if they are warranted. However, as the survey was not optimised for these species, it was recognised that the design and conduct of the survey would make this possible to a varying degree, depending on both the species and area in question. The Scientific Committee agreed to reactivate the Working Group on Abundance Estimates to prioritise and carry out further analyses from NASS-95, and this task comprised the first part of the meeting.

At its 1999 meeting, the NAMMCO Council also recommended that the Scientific Committee continue its efforts to co-ordinate future sighting surveys and analyses of the results from such surveys in the North Atlantic. Priority species should be minke whales and fin whales, and the Council recommended that the survey design be optimised for these species. The survey should also be optimised to cover those areas where abundance estimates are most urgently required. In 2000, the Scientific Committee agreed to assign this co-ordinating role to this Working Group, and this task comprised the second part of the meeting.

2. ADOPTION OF AGENDA

The Draft Agenda (Appendix 2) was adopted without changes.

3. APPOINTMENT OF RAPPORTEUR

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

4. REVIEW OF AVAILABLE DOCUMENTS AND REPORTS

The documents considered by the Working Group are listed in Appendix 3. In addition, working papers from previous meetings of the Working Group, and other published documents, were also available as needed.

5. STATUS OF ANALYSES FROM NASS 95

Working paper SC/9/AE/4 provided a summary of the status of the analyses for each species from NASS-95. The Working Group used this and other information contributed by members to assess the need and potential for further analyses of NASS-95 data.

5.1 Minke whale

Present status of analyses

Norwegian area

An estimate has been accepted by both the NAMMCO and IWC Scientific Committees, and has been published (Schweder *et al.* 1996).

Icelandic aerial survey

Dr David Borchers gave a presentation on the discrepancies between the estimate from the aerial survey done in 1987 from Hiby *et al.* (1989) and that from Borchers *et al.* (MS 1997). The latter estimate was more than double that of Hiby *et al.* (1989). He concluded that the abundance estimate of Borchers *et al.* (MS 1997) was probably positively biased because it neglected errors in measuring angles of declinations. Hiby *et al.* (1989) used duplicate sightings to estimate the magnitude of the measurement errors and had incorporated this into their analysis.

Observer error in distance estimation is a much more severe problem for surveys using cue counting than for those using line transect methods. Borchers presented results of some simple simulations which indicated that positive bias of 100% or more can result if observation error is large. The effect of observation error depends on how wide a shoulder the true detection function has; the narrower the shoulder, the greater the bias for a given level of observation error. This emphasises the need for extreme diligence in obtaining accurate measures of angles of declination in a survey using cue counting.

No duplicate sightings were available from the NASS-95 aerial survey, so bias due to observation error could not be evaluated. Borchers *et al.* (MS 1997) fitted a detection function with a wide shoulder in their analysis, which is less susceptible to bias than a detection function with a narrower shoulder. Nevertheless, the estimate was about 1.8 times that from NASS-87 (Borchers *et al*. 1997) for roughly the same area of coverage. For the reasons given above, the latter estimate might also be positively biased. It was noted that there were problems with the training and performance of the observers during the NASS-95 aerial survey.

In discussing this information the Working Group concluded that the estimate for the NASS-87 Icelandic aerial survey provided in Borchers *et al.* (MS 1997) was very likely positively biased. Although bias in the NASS-95 aerial survey estimate cannot be evaluated with certainty, it too is highly likely to be positively biased.

The Working Group noted that the NAMMCO Scientific Committee had concluded that the NASS-95 aerial survey estimate (Borchers *et al.* MS 1997) was the best available estimate for this area (NAMMCO 1998). Given its discussion above, the Working Group agreed that the NASS-95 aerial survey estimate was problematic and some members believed that it should not be considered as an acceptable estimate for this survey area. Although it had identified some further work to be carried out (see below), it did not believe that this would resolve the problems with the 1995 estimate. The Working Group agreed that it was most profitable to ensure that the planning for the 2001 survey avoided the identified problems such that the resultant estimate is acceptable (see Item 10)

Icelandic and Faroese ship surveys

The estimate of abundance for minke whales from the Icelandic and Faroese components of the NASS-95 survey was developed at the 1997 meeting of this Working Group. Unfortunately there is no documentation of this estimate other than a tabular presentation of the numbers by block in the report of the Working Group (NAMMCO 1998). As this estimate forms part of the estimate for the Central

Stock accepted by the NAMMCO Scientific Committee (NAMMCO 1999), the Working Group recommended that a document describing this analysis should be developed and published as a high priority.

A component of the Icelandic shipboard data on minke whale abundance in the CM Small Area northeast of Iceland has been analysed in combination with Norwegian data from the same Small Area in a working paper presented to the IWC Scientific Committee (Borchers *et al.* MS 1998). The IWC Scientific Committee concluded that the estimate would be suitable for use within the Revised Management Procedure (IWC 1999).

Further analyses required
Icelandic aerial survey
The distributions of the declination angles should be investigated to determine if there is evidence of rounding error. A simulation study to determine the sensitivity of the 1995 aerial survey estimate of abundance to various magnitudes of observer error should also be carried out.

Icelandic and Faroese ship survey
The analysis of these data should be documented and published.

5.2 Fin whale

Present status of analyses
Estimates for all areas have been accepted by the NAMMCO Scientific Committee (NAMMCO 1998), but have not been published in a scientific journal. Estimates for species other than minke whales from Norwegian data are presently being re-evaluated, and the intention is to publish results for several species in a single paper. A working paper detailing the Icelandic and Faroese estimates (Borchers and Burt MS 1997) was evaluated by this Working Group in 1997.

Further analyses required
The re-evaluation of the Norwegian analysis should be completed and published. The analyses for the Icelandic and Faroese areas should be published as soon as feasible.

5.3 Sei whale

Present status of analyses
There were too few sightings in the Norwegian and Faroese areas to develop an abundance estimate. A working paper detailing the Icelandic estimate (Borchers and Burt MS 1997) was evaluated by this Working Group in 1997.

Further analyses required
The analysis from the Icelandic area should be published as soon as feasible.

5.4 Pilot whale

Present status of analyses
There were too few sightings of this species to develop an estimate for the Norwegian survey area. An estimate for the Icelandic and Faroese areas has been developed in the form of two working papers (Borchers *et al*. MS 1996, Burt and Borchers MS 1997) and accepted by the NAMMCO Scientific Committee.

Further analyses required
The analyses for the Icelandic and Faroese areas should be published as soon as feasible, including distributional data from the Norwegian survey.

5.5 Humpback whale

Present status of analyses
An abundance estimate for the Norwegian area has been developed but is presently being re-evaluated. There were no observations of humpback whales in the Faroese area.

An abundance estimate for the Icelandic survey area was presented in SC/9/AE/5. A total of 252 sightings of 381 humpback whales were made in the Icelandic survey area. These data were analysed by conventional line transect methodology using the program Distance (Thomas *et al.* 1998). The analysis was stratified by survey block and two Beaufort sea state categories, but estimates of effective strip half-width and mean group size were pooled over these stratification factors. A simple block-stratified analysis was also presented. Both analyses resulted in a point estimate of about 15,000 whales for the survey area, but the precision was much higher for the dual-stratified estimate (95% CI 4,299 - 49,960 for the block-stratified estimate, and 9,675 - 24,093 for the dual-stratified estimate). However, it was noted that the variance in the latter estimate was underestimated to an unknown degree because observations under high and low Beaufort conditions were not independent, and that the estimate of variance will require revision.

In 1995, there were about four times as many sightings, and the resultant point estimate is much higher than that from the NASS-87 (Gunnlaugsson and Sigurjónsson 1990), and also higher than the estimate for the entire North Atlantic from the YoNAH mark-recapture study (Smith *et al.* 1999). A change in the distribution of whales between the 1987 and 1995 surveys was also noted. In 1987, most sightings of humpback whales were made off western Iceland, with a lesser proportion made off eastern and northern Iceland (Sigurjónsson and Gunnlaugsson 1989). In 1995, while sightings were still made off western Iceland, over 50% of the sightings were made in Block 5 off eastern Iceland.

In discussing this estimate, the Working Group noted that the estimate is heavily influenced by the high numbers seen on 1 transect in block 5 off eastern Iceland. While this is an unavoidable consequence of the clumped distribution of humpback whales in this area, it will result in a very high variance for the abundance estimate. As humpback whales are not a priority for the NASS surveys, it is unlikely that a more appropriate survey design for this species will be adopted.

Further analyses required

Norwegian area

The re-evaluation of the estimate for the Norwegian area should be completed and submitted for publication as soon as feasible.

Icelandic area

A further illustration of the sightings and effort by Beaufort sea state category is required, and could probably best be presented as a coded map. The estimate of variance for the dual-stratified estimate should be re-calculated to account for the non-independence of observations across Beaufort categories. Alternatively, this could be done by treating Beaufort sea state as a covariate in the analysis.

5.6 Blue whale

Present status of analyses

There were too few sightings in the Norwegian and Faroese areas to warrant analysis. There were 44 sightings of 65 blue whales in the Icelandic survey area (Sigurjónsson *et al.* MS 1996). However it was noted that not all of these were confirmed sightings of blue whales, but that some were recorded as "like blue" whales. Similarly, an unknown proportion of the many whales recorded as "like fin" whales may have been blue whales. Even if a small proportion of these were blue whales, this would have a major effect on the accuracy of the analysis. These data have not been analysed.

Further analyses required

The proportion of confirmed vs. "like" blue whales in the Icelandic data should be determined. It can then be decided if further analyses are warranted.

5.7 Sperm whale

Present status of analyses

There were 53 primary sightings of sperm whales in the Norwegian survey area. These data have been analysed but the analysis is being re-evaluated.

There were 76 sightings of 95 animals in the Icelandic area (Sigurjónsson *et al.* MS 1996), and 3 sightings of 3 animals in the Faroese area (Desportes *et al* MS 1996). These data have not been analysed. The Working Group noted that the assumption that all animals are seen on the trackline is certainly false for this deep-diving species, and that correcting for this is problematic. Any estimates produced from conventional line transect methods will therefore be negatively biased. Nevertheless such estimates may be useful as illustrations of the distribution and relative abundance of this species.

Further analyses required

The Working Group recommended that standard line transect analyses should be completed for this species in the Norwegian and Icelandic areas.

5.8 Killer whale

Present status of analyses

There were 38 sightings of this species in the Norwegian survey area, primarily in the Norwegian sea. An abundance estimate has been developed but is presently being re-evaluated. There were 8 sightings of 53 animals in the Icelandic area, and no sightings in the Faroese area. These data have not been analysed.

Further analyses required

The Working Group noted that the sample size was rather low and that there may be problems with group size estimation that will preclude development of a reliable abundance estimate. Nevertheless it would be potentially valuable to analyse all areas simultaneously and perhaps to combine all the NASS surveys to get a synoptic view of distribution and relative abundance over the entire survey area.

5.9 Northern bottlenose whale

Present status of analyses

There were 3 sightings in the Norwegian area, 26 sightings of 95 animals in the Icelandic area and 17 sightings of 68 animals in the Faroese area. These data have not been analysed. The Working Group noted that abundance estimation for this deep-diving species would suffer from the same problems noted for sperm whales above. It was also noted that the distribution of this species was extremely clumped in the Faroese area.

Further analyses required

The Working Group recommended that a standard line transect analysis in the Faroese and Icelandic areas should be conducted as an illustration of the distribution and relative abundance of this species.

5.10 Harbour porpoise

Present status of analyses

There were more than 100 sightings of this species in the Norwegian area, primarily in the North Sea. An analysis of these data will be completed in the near future.

There were 5 sightings of 6 animals in the Faroese area, and 9 sightings from the Icelandic shipboard survey. There were many more sightings from the Icelandic aerial survey. These data have not been analysed. The Working Group considered that it might be valuable to conduct further analyses on the Icelandic aerial survey data, with a view to approximating the distribution and abundance of this species in the area. Other surveys have shown that aerial surveys are only reliable in Beaufort sea conditions of 2 or less for this species, so the data would have to be restricted. Estimates of the proportion of animals seen on the trackline are available from other surveys and could potentially be applied to the Icelandic data.

Further analyses required
The Working Group recommended that the data from the Icelandic aerial survey should be reviewed to determine if there are sufficient observations under Beaufort conditions of 2 or less to warrant analysis.

5.11 Small Delphinidae

Present status of analyses
The Norwegian components of the NASS-95 survey were conducted in passing mode and it was not possible to identify dolphins to species in most cases. There were 180 sightings of dolphin groups. These data have been analysed and presented to the IWC Scientific Committee in a working paper (Øien MS 1996), but have not been published.

The Faroese and Icelandic components of the NASS-95 survey were conducted in delayed closure mode and more effort was made to identify dolphins to species. Sigurjónsson *et al*. (MS 1996) reported 39 sightings of 486 white-sided dolphins, 106 sightings of 1054 white-beaked dolphins and 174 sightings of 1020 unidentified dolphins in the Icelandic area. There were 27 sightings of 341 white beaked dolphins, 106 sightings of 817 common dolphins, 7 sightings of 142 bottlenose dolphins and 60 sightings of 290 unidentified dolphins in the Faroese area (Desportes *et al.* MS 1996).

In 2000 the Scientific Committee noted that previous NASS surveys in the Faroes and Icelandic areas offered the best available opportunities to develop information on the distribution and at least relative abundance of these species. The Working Group considered that the problems of uncertain species identification, uncertain group size estimation, and possible responsive movement of these species would present significant problems for abundance estimation. Nevertheless it was considered that such an analysis would be worthwhile because it would provide a first approximation of the distribution and abundance of this species.

Further analyses required
The Faroese component of the survey was conducted in double-platform mode, and therefore offers some opportunity to deal with the problems of responsive movements and animals missed by the observers. The Icelandic component was conducted in single platform mode and therefore these problems cannot be addressed. There were many unidentified sightings in both areas, but it is possible that some of these sightings might be dropped if they are far from the trackline, and that a method of allocating to species according to the prevalence of known-species animals by area might be developed. The analysis will in any case be "non-standard" and will therefore require more time than usual. It was estimated that the analysis would require up to 3 months of consultant time, at a total cost of approximately NOK 150 K. A more standard or partial analysis could be done for less. As a first step, the Icelandic members agreed to inspect the data for these species to determine if further analyses are feasible.

An analysis of the common dolphin data from the Faroese survey will be conducted in the near future.

6. PLAN FOR CARRYING OUT REQUIRED ANALYSES: WHO WILL DO WHAT, WHEN?

The Working Group developed a prioritised workplan for carrying out further required analyses, and for developing and submitting papers detailing the results of the survey (Table 1). The re-analysis of the Icelandic aerial survey minke whale data, and the documentation of the Icelandic and Faroese shipboard survey for minke whales, were accepted as the highest priority by the Working Group. Abundance estimates from previous analyses of these data have already been accepted by the NAMMCO Scientific Committee and used in the assessment of the Central Stock of minke whales, so the revision of these data might have management implications. The analysis of the Icelandic and Faroese data on *Lagenorhynchus* dolphins was also given high priority because of the importance assigned these species by NAMMCO Council. Other species and areas were considered of somewhat lesser priority.

July 1 2001 was accepted as a target date for submission of papers for publication. However it was recognised that this will depend on the availability of funding and manpower to carry out required analyses and for writing the papers. It was considered preferable to combine the publications in one volume if possible. Donovan indicated that the subject matter was appropriate for the *Journal of Cetacean Research and Management (JCRM)*. He noted that subject to the normal review process and timing considerations, it should be possible to include all NASS-95 papers in the same JCRM issue.

7. IDENTIFICATION OF PRIORITY SPECIES FOR NASS-2001

Minke whales will continue to be of highest priority for the Norwegian component of the surveys, while minke whales and fin whales will be of highest priority in the Icelandic, Faroese and Greenlandic areas. Humpback whales were identified as a secondary priority for the Icelandic and Greenlandic surveys.

8. PRESENT SURVEY PLANS OF NATIONAL RESEARCH PROGRAMMES

8.1 Faroes

The survey will be carried out with one vessel with approximately 28 sea days. The main area of interest is the Faroese Exclusive Economic Zone (EEZ), but the survey area will be defined in cooperation with the other partners. As in previous surveys, a double-platform tracker configuration and delayed closure mode will be used. A crew of 10 observers will be required for the survey. Other activities such as biopsy and bird surveys will be considered but only insofar as they can be done without detraction from the cetacean survey.

8.2 Greenland

Survey plans for large cetaceans in Greenland are coupled to the development of a long-term monitoring program aimed at providing data for the Aboriginal Whaling Management Procedure being developed by the IWC. The present plan for 2001 is for a vessel survey with about 3 weeks of ship time. The area of interest will be the inshore waters of Western Greenland from Kap Farvel north to approximately Sisimiut. The preferred time will be August to September, as this is considered to be the time of greatest minke whale abundance and most stable weather in western Greenland. Plans for the survey will be finalised at a workshop to be held in Seattle in December 2000.

The Working Group noted that the objectives of the Greenlandic survey will be somewhat different from those of the other jurisdictions, which might limit the potential for co-ordination. However, given the potential benefits of such co-ordination, which had not been achieved in previous NASS surveys, the Working Group recommended that the Greenlandic authorities take all possible measures to co-ordinate the timing, area and methodology of the Greenlandic survey with NASS-2001.

8.3 Iceland

Icelandic survey plans are similar to those for 1995 and 1987. Two vessels will be used with approximately 72 days of time. Inshore waters will be surveyed by plane, with about 100 hours dedicated to the survey. The survey area will be defined in concert with the other partners. There is a desire to increase the effectiveness of the survey for small cetaceans insofar as this does not detract from its effectiveness for the target species.

8.4 Norway

Norway has a six-year rotational monitoring program designed to produce abundance estimates for the small areas EB, EC, ES, EN and CM to be used in calculating catch limits by the Revised Management Procedure. The year 2001 is set aside for supplementary coverage of areas which have received less coverage than originally planned. Two blocks in the southeastern Barents Sea (GA and KO) were missed in 2000 and must be covered this year. This will leave approximately six vessel weeks for survey in other areas, with the priority being those blocks that have received less coverage than originally planned. As some of these blocks are adjacent to Faroese and Icelandic areas of interest, this should contribute to an extension of the total survey area. The Norwegian survey will be conducted in passing mode in a double platform configuration.

8.5 Others

Members of the working group will contact officials in the USA and Canada to determine if there are any plans for cetacean surveys in 2001 that might be coordinated with NASS-2001. It was also noted that there are tentative plans for another SCANS survey no earlier than 2002, which should cover portions of the North Sea and waters west of the British Isles.

9. CO-ORDINATION OF SURVEY EFFORT

9.1 Timing

The Working Group agreed that consistent timing was important to the success of the survey. Since 3 jurisdictions (Iceland, Faroes, Norway) agreed that July was the most appropriate month for the survey, it was agreed to centre the survey around mid-July. Greenland will re-consider its plan to survey in August or September in order to co-ordinate more closely with NASS-2001.

9.2 Coverage

To determine the appropriate survey area, the Working Group examined the locations of the sightings of minke and fin whales from NASS-95 and NASS-87. It was considered desirable to cover the coastal waters around Cape Farewell in southern Greenland, as this area is a border between two putative stock areas. It was agreed that Norwegian coverage should be concentrated on the North Sea, while the Icelandic area will include the Jan Mayen (JMC) area. The Faroese portion of the survey will include the Faroese EEZ and adjacent areas. The survey area for NASS-2001 is shown in Fig. 1.

9.3 Potential for increasing survey coverage

See 8.5.

9.4 Funding issues

It was considered unlikely that additional funding for the survey could be found in the limited time available.

10. METHODOLOGY

10.1 Platforms

The survey area will be covered by ship, except for the inshore Iceland area, which will be covered by plane as in previous NASS surveys. It is presently intended that the Greenlandic area will be covered by ship. The Working Group recommended that the Greenlandic survey planning group should give careful consideration to the most appropriate survey platform for this area.

10.2 Survey modes

For both the aerial and ship surveys, it was considered essential that a detailed written protocol be developed. This could be easily adapted from available protocols for other surveys. The protocols for NASS-2001 will be developed by an intersessional subcommittee of the Working Group.

Ship survey

Norway has used a double-platform configuration in previous NASS surveys and the Faroes did the same in the last survey. The Icelandic surveys have been conducted using a single platform, as the main target has been fin whales and it has been assumed that all animals on the trackline are seen. The Working Group agreed that a two-platform configuration will be used by all vessels in 2001. While this will result in increased cost over a single-platform configuration, it has significant advantages including generating data to estimate $g(0)$ for both target and non-target species, and to account for responsive movements. It will also assist in species identification and group size estimation.

The Norwegian component of the survey will be conducted in passing mode to maintain consistency with their monitoring program. A delayed closure mode will be used in the Faroese and Icelandic components, with pre-defined rules for closure. In general, the procedure will be to close on all large whales of uncertain identity within 2.5 nm of the trackline in low density areas. In high density areas, a certain proportion of survey time will be allocated to closures, and closures will be conducted on a

systematic basis (e.g. every fifth sighting) on large whales within 2.5 nm of the trackline. The frequency of closures will be varied in response to animal density and available survey time, and this will be left to the discretion of the cruise leader.

Aerial survey

The aerial survey will use the cue-counting approach (Hiby and Hammond 1989) for minke and fin whales. An independent observer mode will be used throughout. A detailed survey protocol will be developed intersessionally.

10.3 Stratification and coverage

Figure 1 shows the block structure agreed upon by the Working Group. The Icelandic area was divided into high and low effort blocks according to the expected densities of minke and fin whales based on previous surveys. Table 2 shows the effort allocation to each block. Tracklines will be established at a later date. Factors to be taken into account include the expected movement of some species from south to north and the co-ordination of survey effort on either side of block boundaries.

The outer part of the aerial survey area around Iceland is difficult to survey by plane because of frequent unacceptable weather. It was therefore considered advisable for the vessel survey in the Icelandic area to overlap with the outer part of the aerial survey area. This will allow the estimation whale numbers in this area if portions are missed by the aerial survey, at the expense of a small amount of extra effort in the ship survey.

10.4 Training of observers

The great importance of thorough training of cruise leaders and observers was emphasised by the Working Group. The availability of written survey protocols for both the ship and aerial surveys will be essential in this regard. For the ship surveys, it was considered desirable to have a joint training meeting with all cruise leaders. The cruise leaders in turn would be responsible for training the observers. For the aerial survey, it will be necessary to dedicate some flying time to training flights. In addition, computer simulation software is available for training of observers, and this will be utilised.

10.5 Distance and angle estimation experiments

In recent surveys several methods have been used to look at bias in angle and distance estimation during shipboard surveys. During SCANS (Hammond *et al*. MS 1995) distance estimation by naked eye and binoculars were tested by a stationary vessel with a dinghy target. Bias was found in both cases and estimated distances during the survey were bias corrected accordingly before use in the analyses. During the NILS survey, angle estimation from angle boards as well as distance estimation by naked eye were tested with a vessel moving in changing tracks towards two stationary buoys. Angle measurements were found to be unbiased but distance estimates were biased. Bias and error in angle and distance estimation was incorporated in the analysis process. During the IWC SOWER Circumpolar cruises, angle and distance estimation are tested by a vessel moving towards two targets.

Training should be carried out throughout the survey. Angle and distance experiments should be conducted at the beginning, midway and at the end of the cruise. There will typically be no bias in angle measurement when angle boards are used correctly. Ideally the experiments should take place under the same conditions as the survey conditions.

In aerial surveys, training is really the only option to ensure accuracy and precision in angle measurement.

10.6 Data collection procedures

Ship survey

The priority for data collection will be the identified target species (see 7.), however data will be collected for all species encountered insofar as this does not compromise data collection for the target species.

On the Norwegian part of the survey, methodology and data collection procedures will be similar to the previous surveys.

On the Faroese and Icelandic parts of the survey, a double-platform configuration will be used. Observers on the tracking platform (TP) will search ahead of the primary platform (PP) and track sightings of target species (minke, bottlenose whale and dolphin groups), until they have been seen by the primary platform or have passed abeam. For other species the tracker platform will act as a primary platform. This methodology follows the one established for the SCANS survey (Hammond *et al*. 1995) and followed by the Faroese vessel during the NASS 95 survey (Desportes *et al*. MS 1996).

The primary platform will have two observers searching with naked eyes in a standard way for line transect surveys and concentrating their searching effort within 1000 m of the vessel. They will be allowed to use binoculars for species identification. Their data will be used to estimate sighting rate and effective strip width. Distances to sightings will be estimated and angles from the trackline to the cues will be read from mounted angle boards. The PP will be audibly and visually isolated from TP, but will be linked to the TP by telephone. Bridge, crew, and other observers will be instructed not to indicate any sightings to the PP.

The TP will have two observers (trackers) searching with mounted binoculars and one other observer, the duplicate identifier (DI). Trackers will search with binoculars, further ahead of the ship than the observers on the PP (i.e. beyond 1000m), within a field of 60° to -10° on each side of the trackline (i.e. 20° overlap between trackers). They should detect animals sufficiently far ahead of the vessel so that they would not yet have reacted to the vessel's presence. Such responsive movement by minke whales may begin 300 to 1,100 metres from the vessel (Palka and Hammond forthcoming). Trackers will attempt to track whales via multiple sightings as they are approached by the vessel, until the animals have either passed abeam or have been detected by the primary platform. The trackers will record their observations on a tape recorder.

Trackers will estimate distances using binocular reticules. The binoculars will be mounted on rotating monopods with a pointer aligned with the binoculars and passing through an angle board to measure angle from the trackline.

The DI will act as a raporteur/co-ordinator. The DI will maintain contact with the PP, assign sighting numbers to all observations and make judgements about duplicate sightings. The DI will also record sighting conditions in real time onto a computer connected to a GPS.

At least 50% of every leg will be covered in a Beaufort sea state not exceeding 4 and with visibility exceeding 1000 m with no rain. Ideally these portions should be equally distributed along the whole leg.

In the Denmark Strait area, legs will be assigned according to the expected position of the ice edge. These legs will be adjusted according to the actual position of the ice edge, with the overall objective of maintaining equal coverage probability. A procedure for adapting the cruise track according to the position of the ice edge will be incorporated into the survey protocol.

Draft protocol and data entry forms will be drafted and circulated to WG members for approval. The same protocol and forms will be used by the Faroese and the Icelandic vessels. In addition a common data entry software will be used.

Aerial survey

The data collection procedures for the aerial survey will be fully explained in the survey protocol (see 10.2).

10.7 Collection of behavioural and ancillary data

Generally, the collection of behavioural data will be of lesser priority than sighting target or non-target species, and will only be carried out insofar as it does not interfere with sightings. Iceland identified a need to collect surfacing data for sperm whales, and this was considered feasible as it will not likely detract from the primary goals of the survey.

The availability of real-time sea surface temperature and other remote sensing information will be investigated by the Secretariat, as this will be useful in interpreting the results of the survey.

10.8 Collection of biopsy samples and tagging

Collection of biopsy samples will be a secondary activity and will be carried out if time and conditions allow at the discretion of the cruise leader. During the Norwegian surveys, biopsy samples are generally collected when conditions will not allow surveying. Priorities for the collection of biopsy samples relate to previously identified stock delineation problems, and will be as follows:

- Minke whales off SE and S Greenland, and in the eastern North Sea;
- Fin whales in the Faroese blocks, off eastern Iceland and in the Jan Mayen area.

It was also noted that minke whale biopsy samples are presently being collected off western Scotland, which will be useful for comparative purposes.

A small number (2-3) of satellite tags will be deployed on fin whales in the Icelandic area.

10.9 Other considerations

The Working Group was informed of the existence of a towed acoustic array for recording vocalisations of small cetaceans. The recorder is designed to be maintenance free once deployed. This was considered to be potentially a valuable addition to the survey, particular to the Norwegian portion in the North Sea. The Working Group agreed to investigate the availability and suitability of this system, and decide on its use at a later date.

11. OTHER ISSUES

Data coding and entry should be carried out during or as soon as possible after the survey. The importance of stringent verification and validation procedures for survey data was emphasised by the Working Group. In this regard Donovan informed the Working Group of the software that is used to validate data from IWC IDCR/SOWER cruises. The data are validated by running a series of programs which check that the value of a variable in a record lies within a certain range, the compatibility of one variable with another variable within the same record, and the consistency between records (eg. calculating speed needed to travel between two points based on their times and positions). Files listing all the errors are produced. Other programs are also available to plot and check positions. The Working Group recommended that similar procedures should be used to validate data produced during the NASS-2001 survey.

The Working Group emphasised that every effort should be made to complete analyses of the abundance of target species as quickly as possible after the completion of the survey. Analyses of the abundance of non-target species are of lesser importance, but should be completed within a reasonable time frame. Analyses of target species abundance should ideally be completed jointly by a standardised methodology.

12. ADOPTION OF REPORT

A draft version of the report was adopted at the meeting, and a complete version was adopted by correspondence on January 17, 2001.

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Table 1. Further analyses to be carried out from NASS-95. Priority- H = High, M = Medium, L = Low, Area- F = Faroes, I = Iceland, N = Norway.

Priority	Species	Area	Task	Who	Target Date
H	minke	I (aerial)	Evaluate the frequency distributions of the radial distance data to determine if there is evidence of rounding error. Carry out a simulation study to determine the sensitivity of the analysis to various degrees of observer error.	Consultant	Jul. 1 2001
H	minke	I,F (ship)	The analysis of these data should be documented and published.	Consultant	Jul. 1 2001
H	Delphinidae	I,N,F	Inspect Icelandic data to determine if the level of analysis that is warranted. Carry out required analyses on the Icelandic and Faroese data. Submit paper for publication.	Consultant	Jul.1 2001
H	fin	N	Complete re-evaluation of abundance estimate.	Øien	Jul. 1 2001
H	humpback	N	Complete re-evaluation of abundance estimate.	Øien	Jul. 1 2001
M	humpback	I	Provide information on sightings and effort by Beaufort sea state category. Revise variance estimate to account for non-independence of observations across Beaufort sea state categories.	Pike, Gunnlaugsson	Apr. 1 2001
M	N. bottlenose	I,F	Complete standard line transect abundance estimates.	Pike, Gunnlaugsson	Jul. 1 2001
M	H. porpoise	N	Complete abundance estimate and submit paper.	Øien	Jul. 1 2001
M	H. porpoise	I	Review Icelandic aerial survey to determine if there are sufficient observations under Beaufort conditions of 2 or less to warrant analysis. If so, proceed with analysis.	Gunnlaugsson, consultant	Jul. 1 2001
M	blue	I	Determine proportion of confirmed vs. "like" blue whale sightings. If it is determined to be sufficient, proceed with standard line transect analysis	Gunnlaugsson, Pike	Jul. 1 2001
L	sperm	N,I	Complete standard line transect abundance estimates.	Øien, Gunnlaugsson, Pike	Jul. 1 2001
L	killer	N,I	Complete standard line transect abundance estimate, perhaps combining data from 2 or all NASS surveys.	Gunnlaugsson,	Jul. 1 2001

Table 2. Estimated effort allocation to survey blocks, NASS-2001.

Area	Ship Days	Hrs/day	Realisable Effort (%)	Block	Area (K nm^2)	Effort (nm)	Coverage (nm/nm^2)	Effort Allocation (% of Total)
Norway	35	18	40	N-1	100	2,500	0.025	23
Faroes	28	18	40	F-1	150	2,000	0.013	19
Iceland North	33	20	50	I-1	150	2,200	0.015	20
				I-2	50	1,100	0.022	10
Iceland South	33	18	50	I-4 and I-5	65	2,000	0.031	19
				I-3	65	1,000	0.015	9
TOTAL	**129**				**580**	**10,800**		**100**

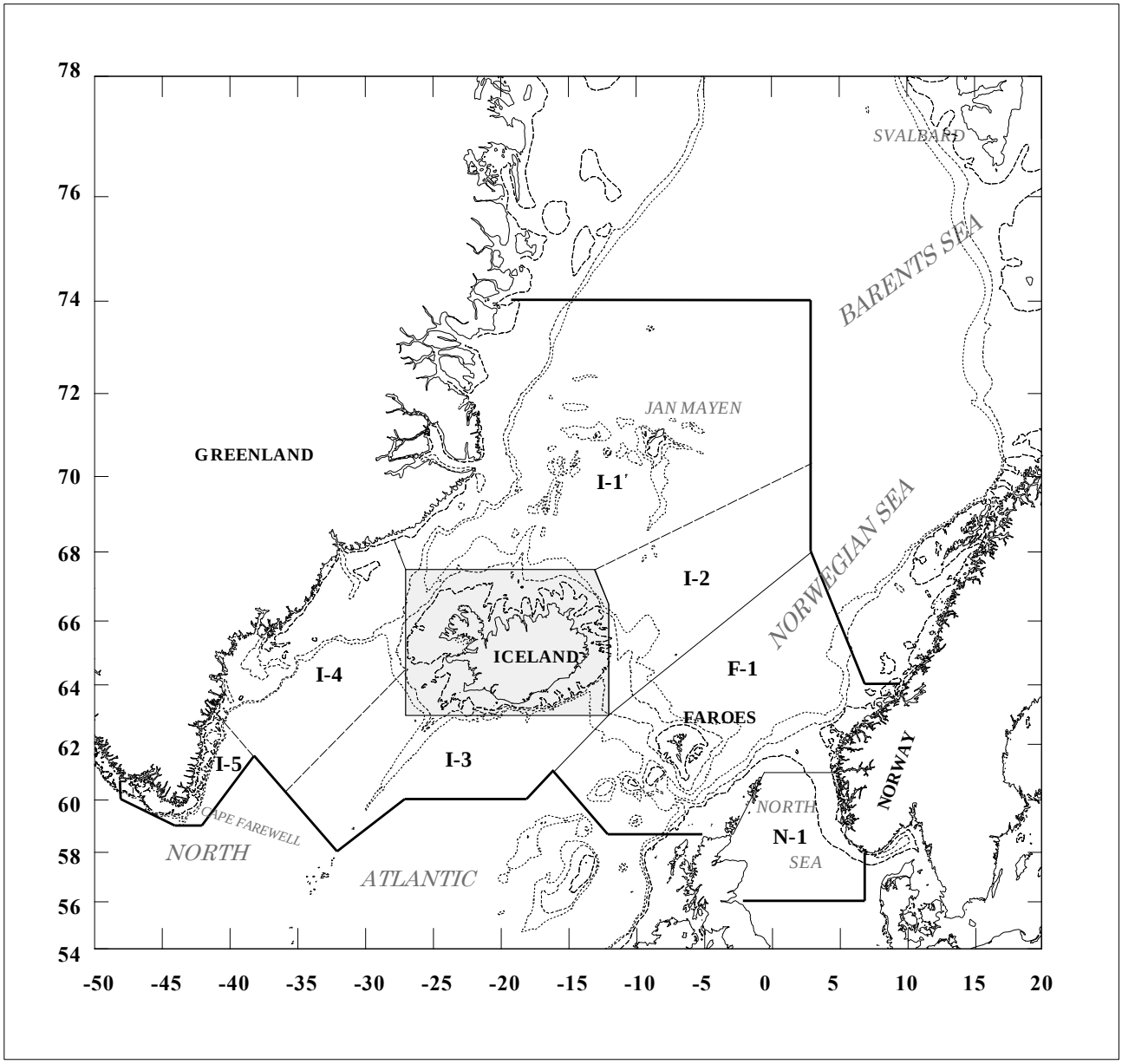

Fig. 2. NASS-2001 survey area, identifying blocks to be covered by Faroese, Icelandic and Norwegian vessels. The shaded area around Iceland will be covered by aerial survey.

Appendix 1

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Appendix 2

AGENDA

1. Opening remarks

2. Adoption of Agenda

3. Appointment of Rapporteur

4. Review of available documents and reports

Part 1: Further development of abundance estimates from NASS 95

5. Status of analyses from NASS 95
   - 5.1 Minke whale
     - 5.1.1 Present status of analyses
     - 5.1.2 Further analyses required
   - 5.2 Fin whale
     - 5.2.1 Present status of analyses
     - 5.2.2 Further analyses required
   - 5.3 Sei whale
     - 5.3.1 Present status of analyses
     - 5.3.2 Further analyses required
   - 5.4 Pilot whale
     - 5.4.1 Present status of analyses
     - 5.4.2 Further analyses required
   - 5.5 Humpback whale
     - 5.5.1 Present status of analyses
     - 5.5.2 Further analyses required
   - 5.6 Blue whale
     - 5.6.1 Present status of analyses
     - 5.6.2 Further analyses required
   - 5.7 Sperm whale
     - 5.7.1 Present status of analyses
     - 5.7.2 Further analyses required
   - 5.8 Killer whale
     - 5.8.1 Present status of analyses
     - 5.8.2 Further analyses required
   - 5.9 Northern bottlenose whale
     - 5.9.1 Present status of analyses
     - 5.9.2 Further analyses required
   - 5.10 Harbour porpoise
     - 5.10.1 Present status of analyses
     - 5.10.2 Further analyses required
   - 5.11 Small delphinidae
     - 5.11.1 Present status of analyses
     - 5.11.2 Further analyses required

6. Plan for carrying out required analyses: Who will do what, when?
   - 6.1 Prioritising required analyses
   - 6.2 Workplan
   - 6.3 Plans for publication

Part II: Planning NASS 2001

7. Identification of priority species

8. Present survey plans of national research programmes
   - 8.1 Faroes
   - 8.2 Greenland
   - 8.3 Iceland
   - 8.4 Norway
   - 8.5 Others

9. Co-ordination of survey effort
   - 9.1 Timing
   - 9.2 Coverage
   - 9.3 Potential for increasing survey coverage
   - 9.4 Funding issues

10. Methodology
    - 10.1 Platforms
    - 10.2 Survey modes
    - 10.3 Stratification and coverage
    - 10.4 Training of observers
    - 10.5 Distance and angle estimation experiments
    - 10.6 Data collection procedures
    - 10.7 Collection of behavioural and ancillary data
    - 10.8 Collection of biopsy samples and tagging
    - 10.9 Other considerations

11. Other issues

12. Adoption of report

Appendix 3

LIST OF DOCUMENTS AND ORAL PRESENTATIONS

Document No.	Agenda	
SC/9/AE/1		List of participants
SC/9/AE/2	2.	Draft agenda
SC/9/AE/3	4.	Draft list of documents
SC/9/AE/4	5.	Pike, D.G. Status of analyses and publications from NASS-95.
Oral pres.	5.1	Borchers, D.L. Status of analyses of minke whale abundance in the Icelandic and Faroese survey areas from NASS-95 and earlier surveys.
SC/9/AE/5	5.5	Pike, D.G. A preliminary estimate of humpback whale (*Megaptera novaeangliae*) abundance in the North Atlantic, from NASS-95 shipboard survey data.
SC/9/AE/6	8.1	Desportes, G. Survey plan, 2001, Faroes
SC/9/AE/7	8.2	Witting, L., Heide-Jørgensen, M-P. and Kingsley, M. Survey plans for large cetaceans in Greenland 2000. Includes as a supplement: Witting, L. (MS) 2000. Protocols for the West Greenland inshore sighting survey 2000. Working Paper SC/52/AS/6 for the Scientific Committee of the International Whaling Commission.
SC/9/AE/8	8.3	Víkingsson, G.A. and Gunnlaugsson, Th. North Atlantic Sightings Survey 2001 (NASS-2001). Survey plans in Icelandic and adjacent waters.
SC/9/AE/9	8.4	Survey plan, 2001, Norway.
Oral pres.	10.	Borchers, D.L. Cue counting, considerations for survey design and data collection.