# Report of the Scientific Committee

The meeting was held at the Adelaide Convention Centre, Australia, from 14-26 June 2000, and was chaired by J.E. Zeh. A list of participants is given as Annex A.

## 1. CHAIR'S WELCOME AND OPENING REMARKS

Zeh welcomed the participants to the meeting. She reported the sad news that Stu Innes, a Canadian scientist who had contributed to the deliberations of the Committee in recent years, had been killed in a helicopter accident in May of this year. The Committee observed a moment of silence in his memory. She introduced those with her at the top table, noting that introductions were particularly important this year with so many new members, and other members introduced themselves.

## 2. MEETING ARRANGEMENTS

### 2.1 Appointment of rapporteur

Donovan was appointed rapporteur, with various Committee members assisting as appropriate. Chairs of sub-committees appointed rapporteurs for their individual meetings.

### 2.2 Meeting procedures and time schedule

The Committee agreed to a work schedule proposed by the Chair.

### 2.3 Establishment of sub-committees and working groups

The meeting was preceded by two Workshops held at the same venue on 12-13 June: (1) assessing the long-term effects of whalewatching on whales; and (2) bycatch mitigation measures (other than acoustics). A number of sub-committees were established in addition to three Standing Working Groups and the Standing Sub-committee on Small Cetaceans. Reports are given as:

Annex D - Sub-committee on the Revised Management Procedure (RMP)

Annex E - Standing Working Group on the Development of the Aboriginal Whaling Management Procedure (AWMP)

Annex F - Sub-committee on Aboriginal Subsistence Whaling Stock Assessments (AS)

Annex G - Sub-committee on the Comprehensive Assessment of Whale Stocks - In-Depth Assessments (IA)

Annex H - Sub-committee on the Comprehensive Assessment of Whale Stocks - Other Stocks (OS)

Annex I - Working Group on Stock Definition (SD)

Annex J - Standing Working Group on Environmental Concerns (E)

Annex K - Standing Sub-committee on Small Cetaceans (SM)

Annex L - Report of the Workshop on Bycatch Mitigation Measures in Static Fisheries

Annex M - Sub-committee on Whalewatching (WW)

Annex N - Report of the Workshop on Assessing the Long-term Effects of Whalewatching on Cetaceans

Annex O - Report of the Working Group on DNA Identification and Tracking of Whale Products

### 2.4 Computing arrangements

Allison outlined the computing facilities available which included printing facilities for delegate use.

## 3. ADOPTION OF AGENDA

The draft Agenda prepared by the Chairman took account of the priority areas agreed last year and approved by the Commission (IWC, 2000f, pp.62-3) as well as Commission discussions and requests concerning certain Items. An updated list cross-referencing Committee Agenda items to those of the Commission is given as Annex B2. The adopted Agenda is given as Annex B1. Statements on the Agenda are given in Annex X.

In considering Item 12, the Committee discussed how best to respond to the final section of the request by the Commission (IWC, 2000d, p.55) that it should

> provide advice to the Commission on the development and implementation of a transparent and verifiable system of identification and tracking of products derived from whales taken under the RMP, and to provide a means to differentiate such products from those taken outside the RMP.

At the beginning of the discussion, the Chair of the Committee emphasised that the role of the Committee should be to provide the Commission with advice on the suite of potential genetic tools to allow the development of such a system, with an indication of their relative scientific strengths and weaknesses. The Scientific Committee is not the appropriate body to either set the detailed objectives of such a scheme or to recommend a design and an implementation strategy. The latter could perhaps best be achieved by a technical group established by the Commission. In this regard, the Committee noted that aspects of papers SC/52/SD5 and SC/52/SD11 are relevant to the Commission's rather than the Committee's deliberations on this matter.

With this understanding, it was agreed that the matter should be allocated to the Working Group on Stock Definition which would establish an *ad hoc* Group to

consider the Commission's Resolution (IWC, 2000d) and determine its precise terms of reference. It was agreed that the Group would report directly to Plenary. Its report is given as Annex O and discussed under Item 12.5.

## 4. REVIEW OF AVAILABLE DATA, DOCUMENTS AND REPORTS

### 4.1 Documents submitted

The list of documents is given as Annex C.

### 4.2 National progress reports on research

The Committee reaffirmed its view of the importance of national progress reports and **recommends** that the Commission continues to urge member nations to submit them following the approved guidelines (IWC, 1998f). A summary of the information included in the reports is given as Annex R. It was **agreed** that this summary should also include information that assists in the interpretation of the catch and bycatch statistics (see Item 14.5).

### 4.3 Data collection, storage and manipulation

*4.3.1 Catches and other statistical material*

Table 1 lists data received by the Secretariat since the 1999 meeting.

*4.3.2 Progress on data coding projects*

Allison reported that coding and validation of pre-1940 Southern Hemisphere catch data had continued. This work was complicated by the existence of two or more sources of data (e.g. Natural History Museum and BIWS) for many operations, in which case the discrepancies between the sources were being fully documented.

In addition, data from the 1997/98 SOWER sightings cruise had been validated and incorporated into the Database Estimation Software System (DESS) database. New validation programs were developed within DESS last year under contract, and work had begun to test this new software. Once the software is fully tested and put into operation it should substantially reduce the time required to validate the annual SOWER cruise data.

*4.3.3 Progress on program verification projects*

Allison reported on progress with the computing work identified last year (IWC, 2000f, table 14, p.59).

(1) AWMP
The common control program implementing the Fishery type 1 (multi-stock) model had been amended and the input files for each trial produced; the software and data had been distributed by e-mail. The common control program implementing the Fishery type 2 (bowhead) model had been amended to implement the changes agreed last year and subsequently to incorporate many of the additional options agreed at the intersessional meeting of the Standing Working Group (SC/52/Rep3). The set of *Initial Exploration Trials* and *Evaluation Trials* had been conditioned in addition to some of the *Robustness Trials*. These data had been distributed by e-mail together with the software, and been used successfully by procedure developers (see Item 8.2). Some further options remain to be implemented before the full set of *Robustness Trials* can be run (and see Annex E).

(2) RMP – *Implementation Simulation Trials*
The control program for conditioning and running the North Pacific minke whale trials had been amended as specified last year and a sub-set of the trials run. These are discussed under Item 7.1.1.1. No progress had been made on the control program for North Pacific Bryde's whale trials.

(3) RMP – *Catch Limit Algorithm* (*CLA*)
Little progress had been made on tuning the new Norwegian Computing Centre (NCC) program implementing the *CLA*. Before the tuning could be run, an interface between the NCC program and the single stock control program was required; Skaug will supply this (see also Item 6.1). Progress made on the sightings database contract is reported and discussed under Item 18.

*4.3.4 Whale marking, including artificial and natural marks*

Information from the progress reports on natural marking data, artificial marks and biopsy sampling is summarised in Annex R. New information on Soviet mark recoveries is given in SC/52/IA12.

## 5. COOPERATION WITH OTHER ORGANISATIONS

### 5.1 CMS

*5.1.1 Scientific Council and Conference of Parties*

The report of the IWC observer at the Ninth Meeting of the CMS Scientific Council and the Sixth Conference of the Parties in Cape Town, South Africa is given as IWC/52/10E. Sets of documents of the two meetings have been deposited in the Secretariat.

The Scientific Council considered several topics relating to cetaceans. Difficulties were reported in coordinating cooperative research on the franciscana (*Pontoporia blainvillei*) in Brazil, Argentina and Uruguay; further regional planning meetings were recommended. It was agreed that the Gangetic South Asian river dolphin (Susu, *Platanista gangetica gangetica*) is suitable for listing on CMS Appendix I due to population decline and habitat degradation, and a proposal will be prepared and submitted, probably by India. A review of the status of fin and sei whales resulted in a decision not to further consider them for uplisting to CMS Appendix I. A number of species were

Table 1

List of data and programs received by the IWC Secretariat since the 1999 meeting.

| Date | From | IWC ref. | Comments |
|---|---|---|---|
| **Catch data** | | | |
| 6 Jun. 2000 | Norway: N. Øien | E26 | Individual catch records from Norwegian 1999 commercial catch |
| 14 Jun. 2000 | Japan | C99 | Individual catch records from Japanese 1999 North Pacific and 1999/2000 Antarctic Special Permit catch |
| **Sightings data** | | | |
| 9 Mar. 2000 | P. Ensor | E25 | 1999/2000 SOWER cruise data (sightings, effort, weather, ice-edge, inter-stratum and way points) |
| **Programs** | | | |
| 10 May 2000 | L. Burt | CD5 | New version of DESS database: version 2.0 |

added to the List of Appendix Species for Cooperative Action, clearing the way for funded projects: *P. blainvillei, Lagenorhynchus australis, L. obscurus, Phocoena dioptrica, Cephalorhynchus commersonii* and *C. eutropia*. The Council endorsed a proposal by Australia to list the Indian Ocean bottlenose dolphin (*Tursiops aduncus*) in the Arafura and Timor Seas in CMS Appendix II due to considerable bycatch in drift nets. It was noted that a CMS-funded workshop on conservation and management of marine mammals was to be held in Conakry, Guinea in May. Perrin reported that the workshop was successfully conducted and attended by scientists from Senegal, the Gambia, Guinea, Ivory Coast, Togo, Benin and Equatorial Guinea. Some progress was made toward planning for development of a regional action plan. It was recommended that Rice (1998) be used as the standard nomenclature listing for cetaceans, sirenians and pinnipeds.

At the Conference of Parties, it was announced that ACCOBAMS will likely come into force in 2000; the Secretariat will be hosted by Monaco. A resolution to use Rice (1998) as a taxonomic standard was adopted, and listings were changed accordingly. A resolution on bycatch mitigation was proposed by the UK and adopted. Four proposals for listing in CMS Appendix II were adopted: *T. aduncus* in the Arafura and Timor Seas, and *S. attenuata, S. longirostris* and *Lagenodelphis hosei* (proposed by the Philippines). Funding was approved in principle for projects including a joint Philippines-Indonesia workshop and survey of marine mammals in the Celebes Sea, a survey of captures, distribution and natural history of dolphins and whales in Ghana and Togo, and a joint survey of distribution and abundance of small cetaceans by the Maldives and Sri Lanka.

The Committee thanked Perrin for attending the meeting of the CMS Scientific Council on its behalf. The Committee **agreed** that Perrin should represent the IWC at the next meeting of CMS. The Secretariat will arrange an observer for the ACCOBAMS meeting.

*5.1.2 ASCOBANS*

The report of the IWC observer at the April 2000 ASCOBANS Advisory Committee meeting in Brugge, Belgium is given as IWC/52/10H. A number of issues relevant to the Scientific Committee were raised, including porpoise bycatch mitigation, contaminant burdens and cetacean health, priority directions for research, and seismic and ferry disturbance. Full discussion of bycatch mitigation was postponed pending this year's IWC discussion on non-active-acoustic measures. ASCOBANS is now commissioning a report on the merits and demerits of different bycatch mitigation options for the ASCOBANS area.

Following the April meeting, draft resolutions setting ASCOBAN's next four-year workplan have been developed for the Meeting of Parties, to be held in July 2000. Key draft resolutions include: support for the IWC's POLLUTION 2000+ programme; development of a recovery plan for harbour porpoise in the Baltic; and a resolution to reduce the threshold for unacceptable porpoise bycatch, by making appropriate allowance for uncertainty and population sub-structure. The latter issues are being studied under a research programme that was set up following the joint IWC/ASCOBANS workshop on harbour porpoises in March 1999.

The Committee thanked Bravington and **agreed** that Reijnders should represent it at the ASCOBANS Meeting of Parties, July 2000.

**5.2 ICES**

Although no IWC observer was nominated to attend the meeting of the Annual Science Conference of ICES, Bjørge informed the Committee that some of the topics addressed under its agenda item on environmental concerns were also addressed by ICES. These include the effects of pollution and competition between marine mammals and fisheries. The latter will be addressed as part of a Theme Session at the forthcoming ICES Annual Science Conference (September 2000, Brugge, Netherlands).

In 1999, the ICES Working Group on Marine Mammal Habitats (WGMMHA) developed a detailed outline for a research programme describing the cause-effect relationship between pollutants and biological effects in pinnipeds. The WGMMHA also considered and endorsed the IWC POLLUTION 2000+ programme. The WGMMHA and the ICES Advisory Committee on the Marine Environment encouraged collaboration with the Committee's efforts in POLLUTION 2000+.

The Committee **agreed** that Haug should represent the IWC at the ICES Annual Science Conference, September 2000.

**5.3 IATTC**

The report of the IWC observer at the 65th meeting of the IATTC, La Jolla, USA is given as IWC/52/10C. Consideration of bycatch related primarily to juvenile tunas, although non-target species were also discussed. Issues of relevance to cetaceans were considered during the 2nd Meeting of Parties to the AIDCP (Agreement on the International Dolphin Conservation Program). Items considered were establishment of a system for setting per-stock, per-year dolphin mortality caps for the purse-seine fishery for tuna in which dolphins are chased and encircled, and, setting per vessel dolphin mortality limits (DMLs) for the year 2000; the total limit of 5,000 (less a 2% reserve) was allocated equally among the 130 vessels in the fleet. It was agreed that current per-stock, per-year mortality caps would continue to be set using abundance estimates from NMFS surveys during 1986-1990, rather than new estimates of absolute abundance available for 1998. This was because the lower variance of the earlier, five-year combined estimates was considered more important than the more current 1998 estimates. This issue is to be reconsidered next year.

The Committee thanked Reilly for attending the meetings on its behalf. It noted that Tillman was representing the IWC at the IATTC meeting currently taking place.

**5.4 CCAMLR**

The report of the IWC observer at the 18th meeting of the Scientific Committee of CCAMLR, Hobart, Australia is given as IWC/52/10D.

The main topics were fishery status and trends, dependent species, harvested species, ecosystem monitoring and management, stock size and sustainable yield uncertainty conditions for management, and new and exploratory fisheries.

The main item of relevance considered the existing cooperation between CCAMLR and the IWC. Two planning workshops were held in Aberdeen and Cambridge, UK in preparation for the CCAMLR 2000 krill survey to be conducted in the western Atlantic sector of the Southern Ocean. These preparations were finalised during two further CCAMLR meetings. The Committee noted that Hammond had represented the IWC at the meeting of the CCAMLR

Working Group on Ecosystem Monitoring and Management in Tenerife in July 1999 at which details of the survey had been discussed. Four vessels conducted the survey during January-February 2000; IWC observers were present on three of the vessels.

A workshop, planned for 2001, will analyse whale sightings in relation to oceanographic features and prey abundance in order to examine whale movements in association with these data. Continued close collaboration between the IWC, CCAMLR and SO-GLOBEC was recommended for a future survey in 2001.

The Committee thanked Kock for attending the meeting on its behalf. It **agreed** that Kock should represent the IWC at the next meeting of the CCAMLR Scientific Committee.

### 5.5 NAMMCO

The report of the IWC observer at the Ninth Meeting of the NAMMCO Council, Akureyri, Iceland is given as SC/52/10A.

Topics of consideration were the assessment of white-sided and white-beaked dolphins, stock structure of white whales and narwhals, and stock structure of fin whales.

Detailed recommendations were provided by the NAMMCO Scientific Committee for further research into white whale and narwhal stock structure. It was noted that a reduction in harvesting of white whales in some areas was necessary due to the decline associated with overexploitation. It was also noted that the present level of exploitation of narwhal in the Avanersuaq and Disko Bay areas is probably sustainable. However, the catches in the Uummannaq area are a cause for concern. The Council recognised the concerns and underlined that further management decisions would require better catch statistics and information on stock delineation.

In 1999, the NAMMCO Scientific Committee completed an assessment of the stock structure of fin whales in the North Atlantic. The Management Committee accepted that removal of 200 animals per year in the area around Iceland and East Greenland would be sustainable if spread throughout the area, even under the least optimistic scenarios. It was recommended that stock assessment be continued.

The NAMMCO International Observer Scheme was implemented for the second time in 1999 and involved land-based observations of sealing and whaling in Norway and Greenland, and pilot whaling in the Faroe Islands.

The Committee thanked Fischer for attending the meeting on its behalf.

The report of the IWC observer to the annual meeting of the NAMMCO Scientific Committee is given as IWC/52/10B.

Following a request from the Council, a working group was established to investigate the economic aspects of marine mammal and fisheries interactions, in particular the existing sources of uncertainty. It was recognised that significant uncertainties remain in the calculation of prey consumption by marine mammals, and data on seasonal distribution is lacking for all species and areas. Model development for consumption by minke whales and harp seals in the Barents and Norwegian Seas, and the consumption of prey by minke whales around Iceland are likely to be topics for further work. The NAMMCO Scientific Committee reiterated that the estimation and model uncertainties are such that quantification of the economic aspects cannot be expected for some time.

An international symposium on harbour porpoises held in September 1999 addressed the following topics: (1) distribution and stock identity; (2) biological parameters; (3) ecology and pollutants; and (4) abundance, removals and sustainability of removals. Donovan had attended this symposium and presented a paper outlining the harbour porpoise component of POLLUTION 2000+.

The working group established to examine the population status of narwhals and white whales in the North Atlantic met in March 1999. It was concluded that white whales of West Greenland were likely to be declining due to overexploitation. Sustainable utilisation advice on this population, and similarly for narwhals is to be discussed at a further working group meeting in June 2000.

The working group on North Atlantic fin whales was re-established to continue assessment of the status of fin whales in Faroese EEZ waters. Results of population modelling indicated that fin whales around the Faroe Islands, and the extended area, are heavily depleted. It was therefore recommended that a research programme should be undertaken to elucidate the stock structure of fin whales in this area, giving highest priority to investigation of whether this is a separate local stock. Donovan had attended this Working Group meeting as an invited participant.

The NAMMCO Scientific Committee concluded that there was insufficient information to carry out the assessment of white-sided and white-beaked dolphins as requested in 1998. A sampling programme was therefore recommended for collection of, *inter alia*, information on feeding ecology, life history and stock delineation.

Minke and fin whales were identified as major target species for sightings surveys to be conducted by the Faroe Islands and Iceland in 2001. These plans were postponed from 2000 in order to take advantage of simultaneous surveys in adjacent areas.

The Committee thanked Øien for attending the meeting on its behalf.

### 5.6 Southern Ocean GLOBEC (SO-GLOBEC)

The IWC was not represented at the SO-GLOBEC planning meeting that occurred during the intersessional period. However, Dr Eileen Hofmann, Chair of SO-GLOBEC, was aware of the IWC Scientific Committee interest in collaboration and added this to their agenda. SO-GLOBEC continues to extend an invitation for IWC collaboration in their 2001-2002 field programme, and awaits a specific proposal for this collaboration. This is discussed further in Annex J.

### 5.7 FAO (CWP)

The report of the 18th session of the Co-ordinating Working Party on Fishery Statistics (CWP) held in Luxembourg from 6-9 July 1999 is given as IWC/52/10G.

Issues discussed by CWP included methods of dissemination of data particularly on the World Wide Web, the development of a Fisheries Global Information System (FIGIS) by FAO, which will be an Internet-based integrated system of world-wide information on fisheries, and the necessity of regular archiving of databases. Individual agencies were recommended to take all due measures to ensure that archiving occurs on a regular basis and in the most contemporary format available and to give consideration to the formal drafting of a 'Doomsday' plan to secure their data from permanent loss should circumstances destroy the on-site repository for such data.

The CWP also discussed the Precautionary Approach in the context of its need for more extensive data on the effects to the ecosystem from fishing. In addition, the problem of use of different nomenclature by different organisations for concepts that are virtually identical was discussed. CWP recommended that a table of terminology used by different organisations should be prepared by FAO based on input from the organisations.

The 19th Session of CWP will be held in 2001 in Noumea, New Caledonia. The suggested dates are during the week of 9-13 July.

The Committee thanked Allison for attending the meeting on its behalf.

### 5.8 CITES

The report of the IWC observer at the 11th Conference of Parties, Nairobi is given as IWC/52/10F. It had previously been decided that representation at the meeting was a matter for the Commission and therefore the Chairman, Mr Michael Canny, attended on its behalf.

The proposals to downlist four species of whale (eastern North Pacific gray, Southern Hemisphere minke, Okhotsk Sea/West Pacific minke, northeast Atlantic and North Atlantic central stocks of minke) from Appendix I (no trade) to Appendix II (trade limited by quota) were defeated by vote. Proposed changes to the existing relationship between CITES and the IWC were also defeated. Therefore, CITES support of IWC decisions, in particular the listing of all species covered by the IWC moratorium on Appendix I, remains unchanged.

### 5.9 PICES

Kato introduced the activities of PICES (North Pacific Science Organisation) which address the assessment of food consumption and requirements of top predators in the North Pacific (including pinnipeds, sea birds, cetaceans). The working group established in 1997 to address these issues presented its report to PICES in October 1999. Kato agreed to present the report to the IWC Scientific Committee when it is officially available. Official cooperation with the IWC has yet to be established.

It was also noted that a workshop and symposium on food consumption by top predators, including cetaceans, and the possible ecosystem implications, will be held during the PICES Annual Meeting (October, 2000) in Japan.

## 6. COMPREHENSIVE ASSESSMENT OF WHALE STOCKS - REVISED MANAGEMENT PROCEDURE (CA/RMP) – GENERAL ISSUES (SEE ANNEX D)

### 6.1 Evaluation of *CLA* program and tuning – report on progress

At last year's meeting the Committee had agreed that the new program implementing the *Catch Limit Algorithm* (*CLA*) written by the NCC under contract to the IWC (with additional funding from Norway) should be fully evaluated by application to a set of selected combinations of input data (IWC, 2000g, p.79-80).

SC/52/RMP1 reported comparisons of the accuracy of the new program (CATCHLIMIT) with the program that has been used by the Secretariat to compute catch limits in simulation studies of the behaviour of its Revised Management Procedure (MANAGE). Details are given in Annex D, item 5.

The Committee **agreed** that the CATCHLIMIT program performed better, in that it obtained more accurate answers more rapidly, and **recommends** its use by the Secretariat.

Remaining issues requiring attention include adjusting the convergence procedure to be robust when less precise integration is used, possibly optimising the two level convergence criteria, developing and implementing a convergence criterion that is relative to the magnitude of the catch limit or to the level of depletion, and incorporating the sub-program into the Secretariat suite of programs, including incorporating the diagnostic warnings into the simulation programs previously used. The Committee **recommends** that this work be undertaken by the Secretariat, and that the previously established approach to computing a more accurate tuning of the RMP to meet Commission specifications (IWC, 1999c, p.61) should now be followed for this new program. An Intersessional Steering Group was established with membership Hammond (convenor), Allison, Cooke, Hakamada, Skaug, Smith, Walløe to oversee this work.

SC/52/RMP1 also presented a comparison of the difference between catch limits computed using the CATCHLIMIT program and those from MANAGE with the level of numerical integration precision used in RMP simulation studies. The effect of the differences observed could be evaluated by re-running some of those simulations using the CATCHLIMIT program using the appropriate tuning values, which would differ for the two programs. The appropriate value for MANAGE would be that used in the simulations, while for CATCHLIMIT it would be the value computed as described above. The Committee **agreed** that such a comparison should be made for a limited number of simulations, possibly the base-case trials, and referred this to the Intersessional Steering Group established above.

### 6.2 Total catches over time

The Committee established a Working Group (Butterworth, Cooke and Donovan) to consider the Commission's request from last year for the Committee to provide 'suitable wording for consideration by the Commission for inclusion in the RMS in time for next year's meeting'. The report of the Working Group is given in Annex D, Appendix 2. The Committee agreed with the proposals of the Working Group and **recommends**: (a) that the text given below be forwarded to the Commission for its consideration; and (b) that the estimation of incidental catch and other human induced mortality of baleen whales should be placed on the Committee's agenda next year.

Wording in response to the request from the Commission:

> Catch limits calculated under the Revised Management Procedure shall be adjusted downwards to account for human-induced mortalities due to sources other than commercial catches.
>
> Each such adjustment shall be based on an estimate provided by the Scientific Committee of the size of adjustment required to ensure that total removals over time from each population and area do not exceed the limits set by the Revised Management Procedure. Total removals include commercial catches and other human-induced mortalities, to the extent that these are known or can reasonably be estimated.

### 6.3 Abundance estimation

*6.3.1 Report of Intersessional Working Group*

The objectives of this Working Group were to review proposed methods that estimate abundance from multi-year data and to evaluate abundance estimators that might be used to produce estimates used in the RMP when heterogeneities occur and assumptions are violated and, in particular, to evaluate the precision and bias of estimates when heterogeneities are present, when responsive movement is occurring and when there are duplicate identification errors.

No new methods to estimate abundance from multi-year data were presented to the Intersessional Working Group to review. To evaluate estimators when heterogeneities were present, simulated datasets were analysed with five methods and the results reported in SC/52/RMP18. Details of this are given in Annex D, item 8.1. To evaluate estimators when responsive movement is occurring, the computer code that created the above simulated data was modified to incorporate responsive movement. The next step will be to ensure that the resulting simulated data are reasonable and then to mass produce simulated data that can be analysed by methods that attempt to account for responsive movement. No attempt was made to incorporate errors due to duplicate identification into the simulated datasets.

The Committee **agreed** that the most appropriate analytical method to be used in the future depends on the desired performance, information collected and ease of implementation. The Committee suggested a number of other potential issues to investigate, as described in Annex D, item 8.1.

*6.3.2 Future work*

The Committee considered the estimation of abundance from multi-year surveys, in particular the method presented in SC/52/RMP12, details of which are given in Annex D, item 8.2. The Committee **agreed** that this method was conceptually appropriate but that there were a number of technical issues to be addressed (see Annex D, item 8.2).

A Working Group was established to consider the technical issues when estimating additional variance using methods described in SC/52/RMP12 and issues relating to the use of multi-year survey estimates in the RMP. The report of the Working Group is given in Annex D, Appendix 4.

The Committee **agreed** that the outstanding technical and RMP implementation issues had been resolved as described in Annex D, Appendix 4 and **recommends** that annotations to the RMP should now be drafted to reflect this. To this end, the Committee established an Intersessional Working Group to continue work on matters relating to abundance estimation under the RMP, with membership: Palka (convenor), Borchers, Bravington, Butterworth, Cooke, Hakamada, Hammond, Hedley, Kingsley, Okamura, Polacheck, Schweder, Skaug and Smith. The highest priority issue for the intersessional Working Group is to develop and present to next year's meeting draft annotations to the RMP relating to abundance estimates from multi-year surveys that will be used in the RMP. The next highest priority issues are to continue work suggested in past years, including, in particular, conditioning simulated datasets on North Pacific sighting surveys for minke and/or Bryde's whales and evaluating abundance estimators that might be used to produce estimates used in the RMP when responsive movement is occurring.

**6.4 Component of population to which MSYR, MSYL and density-dependence should apply in the RMP**

The RMP has a non-age structured model at its core, but in the age structured model used in *Implementation Simulation Trials*, density-dependence had been assumed to be determined by the abundance of mature whales. In contrast, the AWMP currently being developed used trials with population models that assumed that density-dependence was determined by the density of age one and older animals (1+). An earlier evaluation of the differences between these two approaches had identified a number of issues (IWC, 1998e, pp.205-7).

One of these issues, the segregation of population components on the feeding ground, was addressed by SC/52/RMP20, details of which are given in Annex D, item 7.

The Committee **agreed** that there were likely differences in segregation between *Balaenoptera* and other species, and noted that the focus of the AWMP had so far been on bowhead whales, where such segregation was less apparent. Further, the Committee **agreed** that the results in SC/52/RMP20 suggested that the choice of the population component to which density-dependence applies in the simulation trial models may be of little import in the behaviour of the RMP as it exists. It was noted that for both the RMP and AWMP some of the simulation trials were case specific, and it was **agreed** that the form of the density-dependence should not be considered fixed for implementation trials for either management procedure but should be determined on a case-by-case basis.

Of particular concern, however, was the potential for the use of different population dynamics models in simulation trials for the RMP and the AWMP when applied to the same population, for example minke whales in the North Atlantic. In such a case, it was considered undesirable to have different specifications used, both conceptually (because the biological parameters of a population are independent of who harvests it) and, as noted previously, in terms of having a common currency to allow determination of comparability of risk. The Committee **agreed** that it should aim for consistency in such cases, especially in the context of explaining the results of its work to the Commission and elsewhere.

The Committee discussed the differing implications of defining MSYL (maximum sustainable yield level) in terms of the 1+ or the mature component of the population to set population parameter values in *Implementation Simulation Trials* for both the RMP and the AWMP. This raised the question of whether the choice could lead to major differences in interpretation of the results.

A Working Group was established with terms of reference to define modelling work that would assist the Committee in understanding the implications of the choices of modelling density-dependence and defining MSYL in the implementation process of management procedures.

The report of the Working Group is given as Annex D, Appendix 3. The Committee **agreed** that the results of the trials described in Annex D, Appendix 3 should facilitate an evaluation of the magnitude of differences in statistics caused by changing the component for MSYL and density-dependence and whether such differences are easily interpreted after translating the results to a scale appropriate for the component choices. The Committee **recommends** that the Secretariat run these trials, assisted by Punt. Allison noted that some of the work is already planned to be undertaken as part of the development of the AWMP.

**6.5 Work plan**

The Committee agreed that the following items should be part of its work plan.

(1) Incorporate program CATCHLIMIT into the Secretariat suite of programs that implement the RMP and its *Implementation Simulation Trials*, including modifying the convergence criteria as appropriate (see Item 6.1).
(2) Retune the RMP using program CATCHLIMIT and rerun a selection of simulation trials (see Item 6.1).
(3) Undertake simulation trials to assist the Committee in understanding the implications of the choices of

modelling density-dependence and defining *MSYL* in the *Implementation Simulation Trials* (see Item 6.4).

(4) Evaluate abundance estimates against simulated datasets. In particular, initiate the process of evaluation of estimators against datasets conditioned on data from North Pacific surveys for minke and Bryde's whales and, secondarily, against datasets incorporating responsive movement (see Item 6.3).

(5) Plan for a Working Group to meet at next year's meeting to address the issue of estimation of incidental catch and other human-induced mortality of baleen whales, particularly with respect to stocks of current interest in the development of *Implementation Simulation Trials* (see Items 6.2 and 7.1.1.1).

Work under item (4) will be taken forward by the Intersessional Working Group established under Item 6.3.2. Items 1 and 2 will be overseen by the Intersessional Steering Group established under Item 6.1. The Committee gave priority to those items requiring Secretariat time in the following order: (1), (2), (3).

## 7. CA/RMP – PREPARATIONS FOR IMPLEMENTATION (ANNEX D)

### 7.1 North Pacific minke whales

*7.1.1 Final Implementation Simulation Trials*

**7.1.1.1 REVIEW RESULTS OF TRIALS RUN INTERSESSIONALLY**

Last year the Committee recommended that the Secretariat conduct a set of *Implementation Simulation Trials* for North Pacific minke whales (IWC, 2000f, p.10). The Committee noted that not all the trials had been run intersessionally because it was evident from discussions during the JARPN review (SC/52/Rep2) that re-specification of the trials was highly likely.

Annex D, Appendix 5 lists results for six trials for the case in which the RMP *Small Areas* are assumed to be the sub-areas and the J(i) variant for incidental catches is assumed for Japan. These trials differ from those for which results were presented last year because: (i) the CPUE data for the Korean past commercial fishery had been re-analysed intersessionally; (ii) the approach used to model incidental catches had been changed; and (iii) the proportions of 'J' stock animals in the sub-areas around Japan had been updated.

The slope in the CPUE data for the Korean past commercial fishery is used in the conditioning of these *Implementation Simulation Trials*. It is the primary source of data in these trials used to determine the abundance of the 'J' stock; the survey estimates for sub-areas 6 and 10 are treated as minimum estimates. Discussion of the use of these data to condition the trials is recorded in Annex D, item 9.1, and this matter is taken up under Item 7.1.1.2.

Hatanaka stated that last year the Committee had agreed to use the Korean CPUE data for estimating J stock abundance, and this was confirmed intersessionally. However, several members were now strongly opposed to the use of Korean CPUE data. He expressed regret that this agreement had now been disregarded and hoped that this would not happen in the future.

Kim expressed his concern that the revised analysis of Korean CPUE data was now being questioned. He noted that the status of the minke whale 'J' stock should only be determined based on careful analysis of the available information. He believed that the most reliable indication of the status of the stock was made by using the revised CPUE analysis according to his view of the results of the Korean sightings surveys undertaken in June 1999 and May 2000 and recent bycatch and opportunistic information.

The Committee discussed the level of detail needed when modelling the 'J' stock in the *Implementation Simulation Trials*. Some members emphasised that the trials were originally designed to evaluate variants of the RMP (e.g. capping, cascading) when the fishery targets the 'O' stock. These members did not believe that the *Implementation Simulation Trials* constituted an 'assessment' although it was necessary to consider the impact of unintended harvests of 'J' stock whales. Other members emphasised the value of the results of *Implementation Simulation Trials* in the context of the status of the 'J' stock and therefore highlighted the importance of carefully considering the specifications that relate to this stock. Butterworth was of the opinion that the process of conditioning *Implementation Simulation Trials* was synonymous with 'assessment' as the term is conventionally used in fisheries, as such these *Trials* implicitly 'assessed' the 'J' stock.

The procedure used to condition the trials in the past would not necessarily constitute an adequate basis for a re-assessment of the 'J' stock when this is conducted because of uncertainties surrounding the Korean CPUE data and the limited coverage of the survey data. The Committee **agreed** that a future reassessment of this stock would need to be based on a comprehensive review of the available information.

The information (inferences from data on conception dates and flipper colour) used to determine the proportion of 'J' stock animals in sub-area 12 (the northern Sea of Okhotsk) is limited. The consequences for the number of 'J' stock animals taken of the manner in which this proportion is specified could be substantial for the RMP variant for which trials had been run to date, because the results of these trials indicate that the bulk of the catch will be taken from sub-area 12. This was variant (i) (IWC, 2000g, p.114) for which *Small Areas* and sub-areas are synonymous. Butterworth noted that for RMP variants (iii) and (iv) with larger *Small Areas*, none of the commercial catch is taken from sub-area 12 (by definition).

The Committee **agreed** that future trial results should distinguish between commercial and incidental catches when listing the catches for the 'J' and 'O' stocks.

(A) INCIDENTAL CATCHES

New information about incidental catches off Korea in 1999 was received (Annex D, Appendix 6). The Committee welcomed this information, noting that almost half of the animals had been sampled. It encouraged continued sampling of bycatch and strandings. It was noted that that the strandings were in too poor a condition for the cause of death to be determined so some of these animals may have died as a result of a fishery interaction. The Committee **agreed** to update the specifications for the trials to include the information on the size of the Korean bycatch (56 animals), including its seasonality and sex-structure.

The Committee noted that the reported bycatch off Japan for 1999 was 19 (SC/52/ProgRepJapan) and **agreed** to update the information on bycatch off Japan used in the appropriate trials to reflect this new information.

The Committee received a new estimate of Japanese incidental take of 100 minke whales based on a two-tiered analysis of molecular genetic variation of whale products purchased from retail markets in Japan from 1993-99 (Baker *et al*., 2000). Details are given in Annex D, item 9.2. The Committee also received an estimate of Korean incidental

take of 98 minke whales based on individual identification of whales by means of microsatellite profiling of products from commercial markets in the Republic of Korea (SC/52/RMP19). Details are given in Annex D, item 9.2. The Committee also received the results of a molecular genetic analysis of whale products collected from the Japanese retail markets during surveys in 1996 and 1999/2000, which the authors recommended should not be used in the *Implementation Simulation Trials* for the North Pacific minke whales (SC/52/SD7). Details are given in Annex D, item 9.2. The Committee also noted that 15 of 25 minke whale market samples collected in August 1999 in Korea (SC/52/SD6) had unique sequences.

The Committee considered whether the *Implementation Simulation Trials* should be modified based on the information contained in Baker *et al*. (2000), SC/52/RMP19, SC/52/SD6 and SC/52/SD7.

Considerable discussion ensued regarding the representativeness of the sampling schemes used when sampling markets and the use of the resultant data to estimate incidental bycatch off Korea and Japan. Two of the views expressed are summarised in Annex D, Appendices 8 and 9. Several members believed that the sampling designs on which the market surveys in SC/52/RMP19 and Baker *et al.* (2000) are based were inadequately described and hence it was not possible to evaluate the resultant estimates. Some of these members believed that the non-random nature of the sampling scheme meant that any inferences from the data collected during the market surveys were flawed. Pastene indicated that more information on the geographic and temporal details of the market surveys would assist evaluating the value of the data and Kasuya commented that the value of the data would be enhanced if the spatial distribution of 'J'/'O' stock animals in the market surveys conducted by Baker and colleagues and those conducted by the Government of Japan agreed.

The Committee noted that some information on the sampling scheme was provided in other papers including SC/52/SD17 and Dizon *et al*. (2000). Baker commented that the sampling methodology differed between Korea and Japan. He noted that although the market surveys were not designed to be random, there is considerable consistency among the results of surveys conducted in different years and that the problem identified in previous years that duplicates could be sampled had now been overcome (SC/52/RMP19). He believed that the split of the catch in the Japanese market was particularly relevant for the purposes of the Committee.

In relation to the level of bycatch off Japan, the Committee recalled that it had been unable to reach agreement last year on the value of data collected during market surveys, the implications of the data provided in Tobayama *et al.* (1992), and the re-analysis of those data in Inoue and Kawahara (1999). However, it agreed last year that an appropriate range for the purposes of *Implementation Simulation Trials* would be 25-75 even though use of these options for trial purposes did not constitute agreement by all members of the Committee that the entire range was plausible (IWC, 2000g, p.85) or indeed that this was the entire plausible range. The Committee **agreed** to continue to use this range in future trials. It recalled the comment by Butterworth last year that the results for levels of incidental catch in the range 25-75 could be adequately approximated by interpolation.

The Committee received a presentation of Annex S1 which, together with SC/52/SD7 and unpublished material discussed by the sub-committee on the RMP, provided information on the spatial distribution across Japan of the proportion of 'J' stock market samples to 'O' stock market samples. The information suggested that the proportion changes with region. Time constraints prevented a full discussion but the Committee welcomed the information presented and recognised that appropriate consideration must be given to spatial distribution in samples when considering the estimation of incidental catch levels. This issue should be examined further at next year's meeting under point (5) of Item 6.5 above.

In relation to the level of Korean bycatch, concerns were raised about the estimate of 98 whales calculated in SC/52/RMP19 because, *inter alia*, no estimates of uncertainty were available for the estimate and a sampling design that attempted to minimise sampling duplicates would tend to overestimate incidental catch. Baker did not consider that this last point applied to the sampling strategy for the Korean market. The Committee **agreed** not to modify the approach agreed last year (IWC, 2000g) to include incidental catches off Korea in the trials, and to use an incidental catch off Korea of 56 for 1999.

The Committee noted that no account is taken in trials of possible additional incidental catches in fisheries of countries other than Japan and Korea. The Committee again encouraged the collection and analysis of data for these fisheries/nations. The Committee noted that the catches used in RMP applications need to be based on the best estimates of all non-natural removals (IWC, 1999f, pp.251-8). It again encouraged collaborative work with the aim of determining the best estimates of incidental take off Japan and Korea.

The Committee noted that, regarding bycatch of other cetaceans in other geographical areas, it has recommended that reliable estimates of bycatch mortality be obtained using statistically-based observer programmes (IWC, 1996a, p.90).

Many members believed that there is a need for the Committee to devote time to develop and test methods that could be applied to the information collected during market surveys to provide acceptable estimates of incidental catches, as this information is valuable and should be used, *inter alia*, in the specification of *Implementation Simulation Trials* (see also Item 6.2).

Walløe disagreed, and stated that market sampling with the objective to provide useful estimates of incidental catches is extremely difficult. Not only must the retailers be sampled randomly across Japan, which in itself is demanding, but the results from each sample must be weighted with the retailer's (annual) sales volume of whale meat, which will probably not be available.

The Committee encouraged members presenting papers addressing this issue to next year's meeting to include information on the sampling strategy and methodology.

### (B) MIXING AND STOCK STRUCTURE

The Committee considered several papers presenting analyses in response to recommendations from the JARPN review (SC/52/Rep2).

SC/52/RMP3 used GLM and GAM analyses to investigate if there are any abrupt geographical changes in the density of western North Pacific minke whales in response to comments in SC/52/Rep2 that the pre-stratification of the western North Pacific minke whale distribution might be inappropriate, but could not identify any obvious changes in the density index in the central part of the western North Pacific. Details are given in Annex D, item 9.4.

In discussion, it was suggested that examination of the residuals about the fits would give information on whether the selected model actually fits the data. If the fit is overdispersed relative to that expected under the assumption of a Poisson process, this may lead to the selection of overly complicated models.

SC/52/RMP16 used regression analyses to examine morphological heterogeneity in North Pacific minke whales based on an alternative stratification of sub-area 9 using the results of a mtDNA analysis. No significant differences between the western and eastern sectors of sub-area 9 were found, providing no evidence for additional stock structure (e.g. 'W' stock) in sub-area 9. Details are given in Annex D, item 9.4.

Taylor commented that the analyses reported in SC/52/RMP16 were based on implementing the recommendations of the JARPN review (SC/52/Rep2 Section 10.2.3) but that the recommendation of the JARPN review did not fully reflect the intent of the meeting. She suggested that the analyses in SC/52/RMP16 could be extended by taking a multi-variate approach and by including the data for sub-areas 7, 8 and 9.

SC/52/RMP17 presented further analyses of biological information using a logistic regression model using categorical variables. The authors concluded that the results did not change the conclusion from previous analyses that there is no evidence for a 'W' stock. Details are given in Annex D, item 9.4.

Taylor queried whether analyses had been conducted to assess whether the hypothesis that all of the 'O' stock juveniles are found in coastal areas of Japan could be supported. Punt responded that the *Implementation Simulation Trials* were designed to ensure that the model predictions of the age- and sex-structure of minke whales in the western North Pacific are roughly compatible with the available information. Schweder commented that better resolution of the data might be possible by treating sex and maturity as joint categorical variables.

SC/52/RMP7 examined the relationship between space and/or time and genetic distance for different partitions in the western North Pacific using 'isolation by distance' analyses and Mantel tests of mtDNA sequence data from sub-areas 7, 8 and 9 collected during JARPN. Results obtained for different stratifications of the data suggested no significant correlation between geographical and genetic distances. Details are given in Annex D, item 9.4.

Taylor commented that sub-areas 7, 8 and 9 do not necessarily constitute the best strata for testing stock structure hypotheses and that Mantel tests were unlikely to detect stock structure even if there were multiple stocks. She suggested that consideration should be given to examining the outliers in SC/52/RMP7 to assess whether they tend to correspond to the same time or location. Pastene noted that the analyses conducted were specifically requested during the JARPN review but nevertheless welcomed Taylor's suggestion and agreed to work with her to implement it. Baker suggested that consideration could be given to taking a full matrix approach as the location of each sample is known.

SC/52/RMP6 re-examined the estimate of the mixing proportion between 'O' and 'J' stocks in coastal areas of Japan to investigate the sensitivity of the estimate to the omission of the samples from sub-area 9 taken in 1995. No substantial differences in the estimation of stock mixing in sub-area 7 between the two stratifications were found. Details are given in Annex D, item 9.4.

Baker expressed disappointment that the analyses in SC/52/RMP6 continued to be based on the 28 samples collected off Korea almost 20 years ago. Analyses (e.g. SC/52/RMP19) have suggested that samples of 'J' stock animals from Korea exhibited a statistically significantly greater haplotype diversity than these 28 samples. Baker argued that the additional samples from the Sea of Korea should be used in analyses such as those conducted in SC/52/RMP6. Pastene agreed that future analyses should be based on the larger sample. However, he reminded members that SC/52/RMP6 was written in response to a specific recommendation from the JARPN review.

At the JARPN review, an example of how statistical power could be estimated for a given dispersal rate using the genetic data gathered in JARPN was presented (SC/F2K/J5). An addendum to SC/F2K/J5 presented results of further simulations conducted at different dispersal and mutation rates. Of these, a dispersal rate of 0.002 had the highest probability of obtaining the observed value, which corresponded to a power of 0.90 using the decision criterion of $\alpha = \beta$, and a power of 0.81 using $\alpha = 0.05$. The latter result translates to the result that a decision to manage for one stock when there were really two would be made four times more often than a decision to manage for two stocks when there was really one. Details are given in Annex D, item 9.4.

In response to a question about sample size, Taylor noted that doubling the sample size would increase power greatly but commented that the relationship between sample size and power should be based on analyses conducted for several alternative sample sizes.

SC/52/SD10 was prepared to clarify a statement in the JARPN review where some members questioned inferences made 'regarding the management implications of dispersal rates of the order of 0.5% per year, noting that previous examinations of performance of the RMP suggested that unintended stock depletion becomes less likely with dispersal rates of this magnitude' (IWC, 1993c, p.189). Taylor was concerned that those not involved in the 1992-1993 RMP trials could interpret this statement to mean that dispersal rates suggested by analysing the JARPN data would make unintended stock depletion unlikely. SC/52/SD10 illustrated how such dispersal estimates could be interpreted within a management/harvest framework using a simple source/sink model, characterised by an 'O'-'W' type stock scenario where harvests come only from 'O' stock and are based on abundance estimates of both stocks combined. Intermediate dispersal rates, including those suggested by the observed values for minke whales, were most risky because low dispersal rates would be easily detected and high dispersal rates allowed a rescue effect from the neighbouring population. Further details are given in Annex D, item 9.4.

Butterworth considered that SC/52/SD10 had misinterpreted the context of the comment quoted, which was RMP *Implementation Simulation Trials*. The earlier decision to drop dispersal (leakage) from North Pacific minke *Implementation Simulation Trials* (IWC, 1994b, p.133) had been based upon the fact that, when retaining the same number of underlying populations, it was easier to satisfy risk-related criteria (avoid unintended depletion) under spatially non-homogenous catch regimes when dispersal rates were set greater than zero. This decision was based upon consideration of the results of *Implementation Simulation Trials* for North Atlantic minke whales in precisely this context (IWC, 1993b, p.156).

Cooke clarified why earlier findings suggested that unintended depletions were less likely when dispersal was allowed. Previous trials of the RMP for North Atlantic and

Southern Hemisphere minke whales showed that, for given management boundaries (which may or may not correspond to biological stock boundaries), the risk of depletion was lower in scenarios with dispersal than in comparable scenarios without dispersal. However, the presence of small but non-zero dispersal rates can reduce genetic distinctions between populations and make it less likely that appropriate management boundaries will be selected. The results of SC/52/SD10 show that dispersal rates of the order of 0.5% per year can increase the risk of unintended depletion by causing an inappropriate choice of management boundaries.

The Committee considered the conclusions of the JARPN review (SC/52/Rep2) and the new information presented to the current meeting in the context of the specifications of the *Implementation Simulation Trials* for western North Pacific minke whales.

Hatanaka stated that he maintained the position he took at the JARPN review, namely that the available information does not provide any evidence for the existence of a 'W' stock. He believed that future trials should not consider any 'W' stock hypotheses. Other members did not support this conclusion based on the discussions at the JARPN review, including the results of the genetic analyses for sub-area 9 and the generally low power of methods of identifying stock structure. Walløe believed that the results from JARPN had reduced the likelihood that there is a 'W' stock. Noting the disagreement, the Committee **agreed** to continue to include trials that incorporate 'W' stock hypotheses as well as trials in which there is no 'W' stock.

The JARPN review had agreed that if the analyses it recommended did not provide evidence for the presence of a 'W' stock west of sub-area 9, then sub-areas 7 and 8 need not be distinguished. Taylor commented that several of the recommendations of the JARPN review were designed to attempt to find a more suitable boundary between the putative 'O' and 'W' stocks. For example, the GAM analysis of SC/52/RMP3 aimed to identify a hiatus in distribution which would provide a natural place for a boundary for the trials that involve a 'W' stock. Taylor further noted that the p-values based on the application of the $\chi^2$ test comparing mtDNA haplotype frequencies between sub-areas 7+8 and 9 was 0.06 (SC/F2K/J6) and 0.7 between sub-areas 7 and 8.

Based on the results presented in the JARPN review and the new information reviewed, the Committee **agreed** to consider three stock-structure hypotheses in the Pacific:

(a) no 'W' stock;
(b) 'O' stock in sub-areas 7 and 8 - 'W' stock in sub-area 9; and
(c) 'O' stock in sub-areas 7, 8 and 9 - 'W' stock in sub-area 9.

It also **agreed** that for trial purposes sub-areas 7 and 8 would be combined, but that 'J' stock animals will be assumed to be found in sub-area 7 only. The population structure for the 'O' stock in these sub-areas would be assumed to be the same and sub-areas 7 and 8 would be combined into a single *Small Area* when applying the RMP in the context of *Implementation Simulation Trials* (see Item 7.1.1.2).

#### 7.1.1.2 RE-SPECIFICATION OF FINAL TRIALS

The Committee considered several issues relating to the specification of trials, as discussed below, and **agreed** revised specifications for the North Pacific minke whale *Implementation Simulation Trials* (Annex D, Appendix 10). The Committee **recommends** that the Secretariat conduct the trials during the intersessional period and report the results to next year's meeting.

Four years ago, the Committee had established an Intersessional Steering Group to consider and resolve any inconsistencies that remained in the trials, and to make decisions about the choices related to the selection of trials to run. The Committee re-established this Steering Group with membership Allison, Butterworth (Chair), Cooke, Hatanaka, Kim, Kawahara, Okamura, Polacheck, Punt, Smith, Taylor and Walløe, with a revised set of terms of reference (Annex D, Appendix 11).

In trials in which the existence of a 'W' stock is assumed, the Committee **agreed** to take account of a dispersal rate between the 'O' and 'W' stocks. Trials will be conducted for three alternative values for this dispersal rate: the 5%, mean and 95%iles of the distribution for the dispersal rate based on the methods outlined in SC/F2K/J7 with the assumption that the mutation rate, $\mu$, is 0.00005. It was noted that the values for the dispersal rate would depend, to some extent, on the values chosen for the initial population sizes for the 'O' and 'W' stocks. However, it **agreed** that estimates of dispersal rate need only be calculated for three trials (numbers 101, 103 and 112 – see Annex D, table 1) unless the estimates based on these trials are notably different. The calculations will be conducted intersessionally by Taylor with guidance from the Intersessional Steering Group.

The Committee **agreed** to conduct trials in which the fraction of 'O' stock animals in sub-area 9 is zero (no 'O' stock in sub-area 9), 0.8 and 1.0 (no 'W' stock). The value 0.8 is based on the observation that the only area that has shown some genetic difference from sub-areas 7 and 8 over three years of sampling is the west sector of sub-area 9 and that only in 1995. Hatanaka argued that there was no basis in data for the scenario in which no 'O' stock animals are found in sub-area 9. Taylor responded that the purpose of the trials was to bracket the plausible set of hypotheses. She believed that the hypothesis that 'W' stock animals occur only in the west of sub-area 9 surrounded to the east and to the west by 'O' stock animals was implausible and hence that the scenario that only 'W' stock animals are found in sub-area 9 was plausible given the available information.

The Committee reviewed the information used to specify the proportion of 'J' stock animals in sub-area 12 (IWC, 1997d, pp.214-5). Several members commented that the data for this sub-area, both spatial and temporal, are limited and believed that it was appropriate to consider a scenario in which the trials are conditioned so that the fraction of 'J' stock animals in sub-area 12 is higher than is implied by the current specifications. Kato commented that it was entirely plausible that 'J' stock females do not enter sub-area 12 in large numbers given the differences between 'O' and 'J' stock animals in their conception dates and hence when females give birth.

The Committee **agreed** to consider an alternative hypothesis in which the average proportion of 'J' stock animals in sub-area 12 in 1973-75 is greater than the current value of roughly 4% (as implied by analyses of conception date/flipper colour data). This case will use the highest proportion less than 20% that is consistent with the other data used for conditioning, and that does not lead to more than 50% (median of simulations) of mature 'J' stock females in sub-area 12. The median percentage of mature 'J' stock females in sub-area 12 in 1973-75 in June-August will be output by the control program to examine the extent to which this specification can be satisfied.

Several members commented regarding limitations of the Korean CPUE data, the analysis of these data, and the use of CPUE data generally. The Committee considered whether the existing survey estimates of abundance could be used for conditioning the 'J' stock but **agreed**, after some discussion, to consider three pre-determined values (15%, 30% and 50%) for the depletion of the mature female component of the 'J' stock in 2000. Some members wished to consider higher values for this depletion. However, most members believed this to be unnecessary because results from such trials would not be informative about the performance of the RMP which takes catches primarily from the 'O' and 'W' stocks. The Committee **agreed** that the number of 1+ animals in sub-areas 6 and 10 in 1992 and 2000 (August and September) will be output by the control program for diagnostic purposes; 1992 and 2000 were chosen because they are the years for which survey data are available for the Sea of Japan. It was noted that the average annual rate of decline in the recruited population in the Sea of Japan over the period 1973-86 is already output by the control program and would be available to interested members.

The Committee **agreed** the trials in Annex D, table 1. The four baseline trials (101-104) consider two bounding scenarios regarding the 'W' stock (no 'W' stock, no 'O' stock animals in sub-area 9) and MSY rates of 1% and 4%. The specifications related to the depletion of the 'J' stock in 2000, the percentage of 'O' stock animals in sub-area 12, and the dispersal rate between the 'O' and 'W' stocks for the baseline trials are the intermediate values, and sensitivity is explored to the ends of the ranges considered for *MSYR* and the 'W' stock. In addition to sensitivity tests that examine the bounds for these factors, sensitivity tests also examine the three factors identified last year to have a substantial impact on the results of trials (112, 113 and 115), a trial in which the depletion of the 'J' stock is set to 0.15 and the proportion of 'J' stock animals in sub-area 12 is as close to 20% as possible given the constraint on the fraction of mature females in sub-area 12 (as described above). It was noted that this last trial may be too extreme. All the trials in Annex D, table 1 will be run for the J(i) and J(ii) scenarios regarding bycatch off Japan (see Annex D, Appendix 10).

The Committee **agreed** to change the initial year for the future projections from 1999 to 2000 to allow the new information on incidental catches to be incorporated in the trials. It noted that the specifications for when future (and past) surveys are conducted need revision and agreed that this would be completed intersessionally by the Steering Group. The Committee revised the RMP management options to be examined based on its decision not to distinguish sub-areas 7 and 8. Its deliberations are reflected in Annex D, Appendix 10. The Committee **agreed** to follow previous practice and divide the task of conducting the trials into first performing a set of initial trials (Annex D, table 2) and then conducting the full set of 30 trials for a subset of the *Small Area* definitions/RMP management options.

It was noted that, as has occurred in the past, it will not be possible to finalise Annex D, Appendix 10 before the end of the Scientific Committee meeting. The Committee **agreed** that the draft of this Appendix would be sent prior to publication for comment to all members of the Steering Group and any other members of the Scientific Committee who request it.

*7.1.2 Review of reports of sightings surveys*

The Committee received a report on a joint Japanese and Russian sightings survey conducted in 1999 in the Okhotsk Sea (SC/52/RMP4). Details are given in Annex D, item 9.3. The results of the survey are intended to be used for abundance estimates in the RMP, although there were insufficient data to allow this to be done from this survey alone.

Miyashita had overseen the survey for the Committee. The Committee **agreed** that the conduct of the survey was appropriate for use in the RMP and noted with appreciation that the survey was conducted jointly with the Russian Federation.

The Committee **agreed** that additional information should be routinely reported for such surveys to allow more complete monitoring of survey methodology. This information should include plots of the sighting angles and distances, as well as the perpendicular distances, and a fuller description of the angle and distance experiments conducted.

The Committee was pleased to receive a research plan for a joint Japanese and Russian sightings survey to be conducted in the Okhotsk Sea from July to September 2000. Details are given in Annex D, item 9.3.

The Committee discussed the survey design and some details of the survey plan. It noted that the offshore area may have too many strata for the likely numbers of sightings, and that this may need to be treated as a single stratum. The importance of obtaining improved survey coverage in the northern portions of the Okhotsk Sea was emphasised. The need for collection of additional dive time data was noted, including both in the inshore area as planned, but also in the offshore area.

The Committee asked Miyashita and Nishiwaki to provide Committee oversight for this survey, suggesting that Nishiwaki participate in survey training with Miyashita because the two would not overlap during the survey.

The Committee **recommends** that the Commission request the relevant authorities of the Russian Federation to grant permission in a timely fashion for Japanese vessels to survey in its EEZ, including both the southern and the northern portions of the entire Sea of Okhotsk and associated gulfs and bays because of the apparent higher density in the immediate nearshore areas.

The Committee received reports of a joint Korea-Japan minke whale pilot sighting survey conducted in 1999 (SC/52/RMP11, SC/52/RMP21). The surveys were designed to provide additional information for use in the western North Pacific minke whale *Implementation Simulation Trials* under the RMP. The Japanese survey was conducted over the south-west portion of the Sea of Japan in June and July, and covered 560 n.miles of trackline. Of the sixteen sightings of cetaceans, none were of minke whales. The Korean survey was conducted in the eastern waters of Korea in June and July, and covered 850 n.miles of trackline. Twenty two sightings of minke whales were made on primary effort. It was noted that the survey area was selected from past commercial catch information, from the same time period and a little later in the year.

The Committee also received a report of a whale sighting survey conducted in May 2000 in the eastern waters of Korea (SC/52/RMP22), also designed to provide information for the North Pacific minke whale *Implementation Simulation Trials* for the RMP. During the survey 24 sightings of minke whales were made in primary survey mode in 772 n.miles of trackline. A corresponding Japanese survey was conducted, but no report was yet available. It was reported that some minke whales were sighted this year in nearshore waters.

The Committee was informed of plans for whale sightings surveys, similar to previous surveys, to be conducted in September 2000 in the same area. These surveys were also

designed to provide information for the *Implementation Simulation Trials* under the RMP. Biopsy sampling had been intended in previous surveys but has proved difficult and such sampling is not planned to be conducted in this survey. Kim stated that abundance estimation of data from the two surveys conducted in June 1999 and May 2000 will be undertaken and presented to next year's meeting.

The Committee was also informed of plans for two additional whale sightings surveys to be conducted in April and September 2001 in western waters of Korea, in the Yellow Sea. The Committee welcomed this proposal and the intention noted by Kim that it is hoped that these surveys would continue.

Kim introduced Annex S2, a plan for a whale sightings survey in western waters of Korea in 2001 that is intended to provide an abundance estimate that could be used in the RMP. He stated that this information would be valuable to investigate the status of the stock and for a future Comprehensive Assessment in this region. The Committee welcomed this voluntary offer to provide this information and recalled its requirements and guidelines for conducting surveys and analysing data within the RMS (IWC, 1997e, pp.227-235). The Committee considered that the proposal had adequately addressed the appropriate guidelines and requested Miyashita to provide Committee oversight on the cruise, including participation in the pre-cruise meeting. It noted that there were no implications for the Committee's workplan, nor would this entail any cost or time for the Committee. The Committee **agreed** that the collection of biopsy samples would provide valuable information for the *Implementation Simulation Trials* for North Pacific minke whales, and asked that Miyashita convey this message at the pre-cruise meeting.

### 7.2 Western North Pacific Bryde's whales

*7.2.1 Review progress towards initial Implementation Simulation Trials*

The Committee noted that the RMP *Implementation Simulation Trials* had been given low priority last year; no progress had been made. Hatanaka regretted this, and asked that this task be given higher priority over the coming year. It was noted that this would need to be taken up in the Committee's work plan.

SC/52/RMP8 described a detailed analysis to address a question raised last year (IWC, 2000g, p.88) about the validity of species identification of Bryde's and sei whales in commercial catches in Japanese pelagic whaling in 1973 and 1974. The analyses of individual allozyme and operational information implied that the species identification was correct. The Committee welcomed this thorough analysis, and **agreed** that it resolved the uncertainties raised last year.

*7.2.2 Review reports of sightings surveys*

The Committee received a report of a three vessel sightings survey conducted in August-September 1999 as part of a multi-year survey schedule aimed at providing abundance estimates for use in the RMP (SC/52/RMP9). In 6,634 n.miles of trackline, 167 sightings of Bryde's whales were made, of which 11 included a mother-calf pair. The survey was conducted in the region 165°E to 180° and 10° to 43°N. Pastene and Nishiwaki provided Committee oversight, and the Committee **agreed** that the survey had been conducted acceptably for use in the RMP.

Biopsy sampling was attempted using both a compound crossbow and an airgun for 19 sighted schools, with five samples being obtained from 39 shooting attempts. The Committee welcomed the information on successful biopsy sampling.

The Committee agreed that it would be useful to include information on the sighting angles and distances and on the experiments conducted as discussed above for minke whale surveys.

The reporting requirements for sightings data to be used in the RMP are given in IWC (1997e, pp.277-235). It was suggested that earlier access to these data may be useful in allowing the Committee the opportunity to identify any data collection issues that may need to be addressed. The use of DESS for such data was raised, but there are workload and timing issues that need to be addressed relative to including them in DESS in the near future (see Item 18).

The Committee received SC/52/RMP10 describing the next in this series of sightings surveys. This survey will be conducted using one vessel instead of two, resulting in an extension in the planned completion of the series from four years to five. The survey will be conducted in August and September in the band from 137°30'-145°E, again from 10°-43°N. The Committee asked Shimada to provide oversight on its behalf.

The design of the northern portion of the planned trackline was parallel to the Japanese coastline and to the prevailing Kuroshio current. The Committee noted that such survey design was not ideal, and **recommends** that this portion be restructured to work on and off shore to the degree possible.

The Committee **recommends** that the Commission request the relevant authorities of the Federated States of Micronesia, the Commonwealth of the Northern Mariana Islands, and the USA to grant permission in a timely fashion for Japanese vessels to survey in their respective EEZ waters.

### 7.3 North Atlantic minke whales

*7.3.1 Report of sightings surveys*

SC/52/RMP13 reported on the Norwegian 1999 sightings survey for minke whales. This was the fourth survey year in a six-year programme over the period 1996-2001 to cover the northeastern Atlantic to obtain abundance estimates for *Small Areas* EB, EC, ES, EN and CM to be used for calculating catch limits by the RMP at the end of the survey period. One humpback whale, two fin whales, one blue whale and two minke whales were instrumented with satellite tags. Further details are given in Annex D, item 11.1.

The Committee **agreed** that the surveys continued to be conducted in a manner suitable for use in the RMP, and asked Øien to continue in his oversight role. As discussed above, the cruise report could usefully be augmented with displays of the sighting angle and distance data, as well as more details about the experimental data. The need for additional data on dive times for use in analyses of these types of surveys was reiterated. The Committee welcomed the new satellite tagging data collected during this survey.

Noting that the next survey is planned for the *Small Area* that includes Russian Federation EEZ waters, and that a previous attempt to survey this area had been made, the Committee **recommends** that the Commission request the

relevant authorities of the Russian Federation to grant permission in a timely fashion for Norwegian research vessels to survey in its EEZ waters.

*7.3.2 Other*

A project to explore the relationship of West and East Greenland minke whale stocks had been conducted by the Greenland Institute of Natural Resources, and preliminary results are presented in four papers (SC/52/AS8, 9, 10 and 11). Techniques used were genetics (mtDNA, microsatellites), fatty acid composition in blubber, persistent organochlorine levels and stable Pb isotope composition of kidney, liver and muscle tissue. The genetics study concluded that minke whales sampled in the North Sea area differed from those sampled at Greenland and in the remaining Northeast Atlantic region, and whales in the two latter areas do not differ. This conclusion is partly confirmed by the other analyses. It is expected that the analyses will be finalised next year and thus be available for a re-evaluation of North Atlantic minke whale stock structure in one or two years time.

In response to a suggestion by Walløe, the Committee proposed that an RMP *implementation review* for North Atlantic minke whales be conducted in 2002, when a new estimate of abundance from Norway's series of annual surveys (SC/52/RMP13) and analyses of samples collected over the last five years would be available.

### 7.4 Work plan

The Committee agreed that the following items should be part of its work plan.

(1) Code and run *Implementation Simulation Trials* for North Pacific minke whales, including resolving any inconsistencies remaining as specified in Annex D, Appendix 10 (see Item 7.1.1.2). This work will be undertaken by the Secretariat under the guidance of an Intersessional Steering Group established under Item 7.1.1.2.
(2) Begin coding *Implementation Simulation Trials* for western North Pacific Bryde's whales as specified in IWC (2000h, pp.118-123) (see Item 7.2.1). The Committee re-established the intersessional steering group established last year (IWC, 2000f, p.13) to oversee this work.
(3) Plan for an *implementation review* for North Atlantic minke whales in 2002.

The Committee gave priority during the year to completing points (1) and (2) under Item 6.5 and then to point (1) above. It noted the importance of completing work on the *Implementation Simulation Trials* for North Pacific minke whales and that the workload of the Secretariat should allow the completion of this work during the intersessional period.

## 8. ABORIGINAL SUBSISTENCE WHALING MANAGEMENT PROCEDURE (AWMP) – (SEE ANNEX E)

This Item continues to be discussed as a result of Resolution 1994-4 of the Commission (IWC, 1995a, pp.42-3). The report of the Standing Working Group (SWG) on the Development of an Aboriginal Whaling Management Procedure is given as Annex E. The Committee's deliberations, as reported below, are largely a summary of that Annex, and the interested reader is referred to it for a more detailed discussion. A glossary of terms is given in Annex E, Appendix 2. For ease of reading, 'last year' refers to the intersessional meeting held in Seattle in November 1999 (SC/52/Rep3).

### 8.1 Outcomes of Intersessional Workshop

The Intersessional Workshop continued the work of the SWG as given in table 6 of IWC (2000f, p.20). The main topics discussed were: stock structure of bowhead whales and gray whales; *Implementation Trial* structure and specification; performance statistics; *SLA* optimisation; and workplan. Discussion of these items is part of the ongoing process and such discussions are referred to throughout this report where appropriate. A number of computing and other tasks were agreed at the Workshop and good progress was made with these.

### 8.2 Description of potential procedures

*8.2.1 Bering-Chukchi-Beaufort Seas bowhead whales*

The Committee was pleased to receive three papers presenting potential *SLA*s for this stock.

SC/52/AWMP5 developed a family of *SLA*s for the B-C-B Seas stock of bowhead whales based on a 'pseudo-Bayesian' estimator and the catch control law introduced by Punt and Butterworth (1997). A piecewise linear 'prior' distribution is assumed for *MSYR*, the data included in the likelihood function are downweighted relative to the 'prior' for *MSYR*, and historical estimates of absolute abundance are downweighted compared to more recent information. Two variants of this family based on attempting to match the median final depletions and the median need satisfactions achieved by the ideal *H* were selected. Results for an *H-optimised* variant of this *SLA* were also presented.

The results for the *H-optimised* variant generally achieved a performance balance intermediate between those for the other two variants. The overall performance for the *H-optimised* variant tended to be better than that of either original variant. In addition, the *H-optimised* variant often achieved tighter 90% performance intervals than the other variants.

SC/52/AWMP6 presented an alternative refinement of the Punt-Butterworth *SLA* (Punt and Butterworth, 1997). This involves replacement of the Bayesian estimation procedure by one based upon maximising a penalised likelihood, where the penalty function related to the intrinsic growth rate parameter and incorporated two control parameters for the procedure. A further control parameter was introduced into the rule to determine whether or not catch was reduced below need. Initial suggestions were made for appropriate choices for values for these control parameters, and results presented for some deterministic *Evaluation Trials*.

SC/52/AWMP7 used Adaptive Kalman Filters (AKF) to obtain conditional stock estimates and posterior probability distributions for the *MSYR* parameter and the bias factor. A set of catch control laws (one CCL corresponding to each filter) is then used on these conditional estimates, which together with the posterior distributions of *MSYR* gives a cumulative distribution function for the catch limit. The eventual catch limit is then determined as a pre-specified quantile of this distribution.

The Committee welcomed the *SLA* outlined in SC/52/AWMP7 as it differed substantially in approach from those in SC/52/AWMP5 and SC/52/AWMP6. Noting the preliminary nature of the *SLA*, several suggestions were made on how the approach outlined in SC/52/AWMP7 could be developed further. Givens noted that the *H-optimisation*

and merging approach was likely to be effective when merging diverse, independent *SLA*s, so the *SLA* introduced in SC/52/AWMP7 was particularly welcome.

*8.2.2 Eastern North Pacific gray whales*

No *SLA*s designed for the eastern North Pacific gray whale were presented to the SWG. However, it may be possible to modify the *SLA*s currently being evaluated for the Bering-Chukchi-Beaufort bowheads for the gray whale, although the inability to find a model that can reconcile the historical catches and the recent trend in estimates of absolute abundance may necessitate a different approach to *SLA* design for this population.

*8.2.3 Greenland fisheries*

No *SLA*s for the Greenland fisheries were presented. Progress towards this is discussed under Item 8.6.

**8.3 General trial structure issues**

*8.3.1 Classes of trials, their identification, and relationships between them*

SC/52/AWMP4 described how to characterise groups of simulation trial scenarios designed for testing AWMP *SLA*s. The paper focused on using population trajectory shape to identify unusual or redundant trials because the trials are specified by a very high-dimensional parameter vector with many potential interactions among its elements that may obscure outlying or redundant trials. Suggestions were made for reducing redundancy and improving balance (across the need level and *MSYR* factors) for the bowhead *Evaluation Trials* and these are discussed under Item 8.4.1.1.

The Committee welcomed this analysis that had been presented in response to discussions at the last meeting. However, it was noted that the redundancy analysis had not been based on trajectories reflecting the catches allowed by an *SLA* that attempts to estimate *MSYR*. It is therefore possible that some trials may have mistakenly been flagged as redundant which may not have been if trajectories from the latter had been examined. For example, an ordinary trial and its variant with severe data bias might produce similar trajectories if strike limits are set by an unresponsive *SLA* but notably different trajectories under an *SLA* which makes greater use of the data. This issue was also taken into account when reviewing the trial structure in Item 8.4.1.1.

In conclusion, the Committee reconfirmed that *Robustness Trials* should be used to examine *SLA* performance for the full range of plausible scenarios in order to identify whether it behaves as expected, and not necessarily to see whether the *SLA* provides satisfactory strike limits. It also reaffirmed that *Cross-validation Trials* within the *Evaluation Trial* space are highly desirable and that each *Robustness Trial* also serves as a *Cross-validation Trial* in the sense of protecting against unpredictable *SLA* behaviour in regions of parameter space outside that tested by *Evaluation Trials*.

*8.3.2 Model structure*

SC/53/AS12 noted that the calculation of replacement yield for the stochastic model underlying the trials for the bowhead population was problematic because it is dominated by random fluctuations in the yearly outcomes of the stochastic birth/calf survival and death processes. The calculation of *H* is affected similarly. The Committee **agreed** that the expected replacement yield should be calculated and used for the calculation of *H*. A small Working Group was established to provide technical details regarding appropriate amendments to the simulation code and the revised specifications for replacement yield and *H* are given in Annex E, Appendix 3.

SC/52/AS12 also presented an improved method for estimating values for $\sigma_q^2$ and $\rho$ for use in the bowhead stochastic model. The values given in SC/52/Rep3 were argued to lead to excess variation because they were obtained without first eliminating quantifiable variation attributable to other sources. The Committee **agreed** that the new values (see Adjunct 1 of Annex E, Appendix 3) should be adopted for the bowhead *Evaluation Trials* but that the old values should be retained for possible use in *Robustness Trials*.

The trajectories of calves resulting from the stochastic model exhibited some unusual features including long-term periodicity and cyclic shifts in amplitude. It was **agreed** that this should be studied intersessionally in order to obtain a better understanding of what processes lead to such features. It is important to elucidate the causes of these features, not only to better understand and validate the simulation model but also to ensure that *SLA*s using simulated calf data would be given information with a realistic amount of variation.

Finally, the SWG noted that the model structure for the Type 1 fishery would need to be sufficiently general to simulate diverse hypotheses about stock structure and data collection.

*8.3.3 Design of trials*

The Committee reaffirmed that only plausible trials should be considered during AWMP development and testing. It discussed the issue of balance with respect to *MSYR* and need satisfaction because SC/52/AWMP4 had noted that the bowhead *Evaluation Trials* were skewed towards investigation of performance under high need and low *MSYR*. The principal issue was whether results for diverse trials could be inferred from results for trials with low *MSYR* and high need. In other words, did 'worst case scenarios' alone suffice or was it also important to focus consideration on scenarios where the stock can easily sustain need while holding a very high standard for need satisfaction performance. The Committee **agreed** that trials should be designed to achieve an appropriate balance across the factors of *MSYR* and need.

A related issue was whether some less plausible *Evaluation Trials* might tend to have undue influence on the informal tuning an *SLA* receives during development, at the expense of performance on more central trials. It was noted that in the bowhead case, the SWG had earmarked certain central trials explicitly for tuning and that it intended to provide explicit tuning advice to *SLA* developers so that they would not be forced to guess which trials were most relevant.

Item 4.3 of SC/52/Rep3 summarised some concerns expressed about model uncertainty. For example, the population dynamics model used by the SWG represents a single simplified view of how whale dynamics may actually occur. It would be appropriate to examine performance under a number of fundamentally different models. The Committee **reaffirms** its view given in SC/52/Rep3 that one primary substitute for direct consideration of different models was the manipulation of certain biological parameters and modelling assumptions. This is reflected, for example, in bowhead *Robustness Trials* BR10, BR11 and BR14. In addition, the Committee was pleased to note that some members intended to submit different population dynamics models during the intersessional period.

*8.3.4 Review of performance statistics*

Annex E, Appendix 4 provides an example of a graphical approach to contrast the performances of five *SLA*s in terms of the mandatory statistics identified at the last meeting. The median performance of *H* is shown on the performance plots. *SLA*s are unlikely to be able to match the performance of *H* because *H* is based on perfect information. However, performance relative to *H* provides a reference point for comparison of the performance of candidate *SLA*s. The SWG noted that *H* had been defined taking account of the Commission's objectives as reflected in Schedule Paragraph 13(a)[1]. However, use of *H* does not reflect the belief that *H* was the only or the best possible goal for an AWMP *SLA*.

The Committee also **agreed** that the performance plots would be modified to include panels that illustrate the trade-off between satisfaction of need (the N9 statistic) and resource status (the D1 statistic). This panel would also show the trade-off between these statistics achieved by *H*. Breiwick volunteered to make the changes to the S-plus function and to distribute the revised version for comments through the intersessional e-mail group. This is discussed further under Item 8.4.2. A full list of performance statistics is given in Table 2.

*8.3.5 SLA Tuning*

The Committee reaffirmed its previous advice on tuning methods given in SC/52/Rep3 (items 4.5 and Section E of Annex D), notwithstanding the additional considerations noted above.

*8.3.6 SLA Optimisation*

SC/52/Rep3 and previous reports contain detailed consideration of various quantitative methods for optimising *SLA*s including the *H-optimisation* approach (Givens, 1997; Givens, 1999) specified in IWC (2000n, p.149). The SWG has repeatedly emphasised that a developer may optimise *SLA* performance using any method. However, SC/52/Rep3 and past work considered by the SWG have shown that *H-optimisation* can produce improved results compared to a nominal *SLA*. The SWG noted that results in SC/52/AWMP5 provided another example where *H-optimisation* appeared to have improved *SLA* performance.

[1] Paragraph 13(a) states that catch limits for aboriginal whaling should be established in accordance with three principles, two of which state that: (1) for stocks at or above the MSY level, aboriginal subsistence catches shall be permitted so long as total removals do not exceed 90 percent of MSY; and (2) for stocks below the MSY level, aboriginal subsistence catches shall be permitted so long as they are set at levels which will allow whale stocks to move to the MSY level.

## 8.4 Implementation trial structure for bowhead whales

At the last meeting, it was agreed that the factors listed in Table 3 should be considered in the bowhead whales trials.

*8.4.1 Specification of trials*

The SWG noted its earlier discussions regarding changes to the definition of replacement yield and *H* for the stochastic trials, and to the values of the parameters that control stochastic dynamics model variation.

**8.4.1.1 EVALUATION TRIALS**

The SWG reviewed the set of *Evaluation Trials* and proposed a number of changes as discussed in Annex E, based, in part, on the suggestions in SC/52/AWMP4.

These changes are reflected in Table 4. The complete collection of revised bowhead *Evaluation Trials* considered by the SWG is given in Annex E. The Committee **endorsed** these changes.

**8.4.1.2 ROBUSTNESS TRIALS**

The Committee **agreed** that the task of amending the specifications of the *Robustness Trials* (Annex E, Appendix 3) should be continued intersessionally through the e-mail Correspondence Group and finalised at the proposed Intersessional Workshop. When selecting *Robustness Trials*, a range of final need levels should be considered but emphasis should be placed on a final need level of 201. It was **agreed** to include *Robustness Trials* based on: (1) $MSYL_{1+} = 0.9$; and (2) a negative correlation in the extent of

Table 2

Performance statistics.

| ID | Mandatory | Optional | Time Periods | Can be shown using Zeh graph program | Used to explain performance to layperson | Used to evaluate performance for Scientific Committee | Name | Comment |
|---|---|---|---|---|---|---|---|---|
| D1 | 1+, mature | | 100, ~~50, 20~~ | Yes | Yes | Yes | Final Depletion | Delete 20, 50 years (1999) |
| D2 | ~~1+~~, mature | | 100, ~~50, 20~~ | Yes | Yes | Yes | Lowest Depletion | Delete 1+ and 20, 50 years (1999) |
| D6 | | 1+, mature | 100 | Yes | Yes | No | Trajectories 1 and 2 | Demote to optional (1999) |
| D7 | | 1+, mature | 100 | Yes | Yes | No | Pointwise Quantile Trajectories | Demote to optional (1999) |
| D8 | BR9, 10, 11 | 1+, mature | 100 | Will be | | Yes | Rescaled Final Depletion | Defined at 1999 workshop |
| D9 | | 1+, mature | 100 | Yes | | Yes | Minimum number of whales | Defined at 1999 workshop |
| N1 | | Yes | 20, ~~50,~~ 100 | Yes | Yes | Yes | Total Need Satisfaction | Delete 50 years (1999) |
| N2 | | Yes | 20, ~~50,~~ 100 | Yes | Yes, after rescaling | Yes | Longest Shortfall | Delete 50 years (1999) |
| N4 | | Yes | 20, ~~50,~~ 100 | No | Yes | Yes | Shortfall Frequency | Delete 50 years (1999) |
| N7 | | Yes | 100 | Yes | No | Yes | Percent Need Satisfaction Pointwise Quantile Trajectory Plot | 1996. Redefined in 1997 |
| N8 | | Yes | 100 | Yes | No | Yes | Percent Need Satisfaction Trajectories 1 and 2 Plot | 1996 |
| N9 | Yes | | 20, ~~50,~~ 100 | Will be | Yes | Yes | Average Need Satisfaction | Delete 50 years (1999) |
| N10 | Yes | | 100 | Will be | No | Yes | Average Annual Variation in Catch | Modified at 1999 workshop |
| N11 | ~~Yes~~ | Yes | 100 | No | No | Yes | Anti-curvature Catch Variation Statistic | Modified at 1999 workshop Demote SC2000 |
| R1 | 1+, mature | | 100 | Yes | Yes | Yes | Relative Recovery | Redefined in 1997 |
| R3 | | 1+, mature | 100, ~~50, 20~~ | No | Yes | Yes | Time Frequency in Recovered State after Recovery | Delete 20, 50 years (1999) |
| R4 | | 1+, mature | 100, ~~50, 20~~ | No | Yes | Yes | Relative Time to Recovery | Delete 20, 50 years (1999) |

Table 3
Factors used in bowhead trials.

| Symbol | Varying Factors | Other Levels (Reference levels shown **bold and underlined**) |
|---|---|---|
| | *MSYR* $_{1+}$ | 1%, **<u>2.5%</u>**, 4% |
| | *MSYL* | 0.4, **<u>0.6</u>**, 0.8, 0.9 |
| A | Density-dependent component | **<u>1+</u>**, mature |
| B1 | Population dynamics model | **<u>Deterministic</u>**, stochastic (demographic), **<u>Stochastic (demographic + serially corr. env. var.)</u>** |
| B2 | Stochastic parameters | $S_D$: **($\rho$=0, $\sigma_\varepsilon^2$ =0)**, $S_E$: **($\rho$=.752, $\sigma_\varepsilon^2$ =0.0254)**[1], Negative correlation: ($\rho$=-7.52) |
| C | Need in final year | **<u>67</u>**, **<u>134</u>**, **<u>201</u>** |
| D | Form of need time dependence | **<u>Linear</u>**, step function (changing from 67 to final need level in year 2053) |
| E | Survey frequency | **<u>5yr</u>**, 10 yr, 15 yr |
| F | Strategic surveys | **<u>No</u>**, yes – see details in Appendix 3b Section Di |
| | Survey bias (i) constant | 0.67, **<u>1.0</u>**, 1.5 (see note[2] below) |
| G1 | (ii) historical time dependence | **<u>None</u>**, increase by 50% from 1978 to 2002 (0.67→1, 1→1.5) |
| G2 | (iii) future time dependence | **<u>None</u>**, decrease by 50% from year 0 to year 100, increase by 50% from year 0 to year 100, Sinusoidal |
| H | Survey CV: (true, estimated) | (0.1, 0.1), (0.25, 0.1); (**<u>0.25, 0.25</u>**); (0.34, 0.25) |
| | Age data: bias and *CV* | **<u>Good (no bias or extra variance:</u> $\gamma_{12.9}$=0, $\lambda_{12.9}$=1)**, Poor ($\gamma_{12.9}$=2, $\lambda_{12.9}$=1.5) |
| I | Historic (1848-1914) catch bias | 0.5, **<u>1.0</u>**, 1.5 |
| J | Carryover strategy | **<u>None</u>**, to be specified later |
| K | Time dependence in *K* * | **<u>Constant</u>**, halve linearly over 100yr, Double linearly over 100yr, Sinusoidal from a base value in year 0 increasing to a maximum of 150% in year 40. |
| L | Time dependence in resilience * | **<u>Constant,</u>** halve linearly over 100yr (initially 4% / 2.5% *MSYR* only), Double linearly over 100yr (initially 1% / 2.5% *MSYR* only), Step *MSYR* 2½%→1%→2½% every 33 yrs, alone or in sync with halving/doubling *M* |
| M | Time dependence in natural mortality, *M* * | **<u>Constant,</u>** halve linearly over 100yr, Double linearly over 100yr. |
| N | Episodic events * | **<u>None</u>**, 1% probability each year that 50% of animals die |
| O | Integrated | **<u>NA</u>**, priors for *MSYR*, *MSYL*, historical catch bias, extent of environmental variation in the probability of birth. |
| P | Initial year of population projection | **<u>1848</u>**, 1940 |
| | **Factors held fixed** | |
| | Length of simulation | |
| | Priors for conditioning: $S_{adult}$ | |
| | Abundance estimates (i) contain calves? | |
| | (ii) correlation in estimates | |
| | (iii) delays in using results | |
| | Density-dependence in *M* | |

*Effects of factors K, L, M and N begin in year 2003 (i.e. at start of management). [1]Values changed from that specified at Seattle workshop (1999): $S_E$: ($\rho$=0.756, $\sigma_\varepsilon^2$ =0.139) as these assumed the observed variance in calf counts was solely due to environmental effects (Poole and Givens, 2000).

[2]If the historical survey bias in year 2002 is not equal to the value of the future bias, then the bias changes linearly between years 0 and 25 to the new value, and is constant thereafter.

environmental variation in births. The Committee also reaffirmed that the population components (mature, 1+) to which MSYL and density-dependence relate should be linked for the *Robustness Trials* based on factor A (Table 3). There will also be a need to review these trials in the light of information from the Commission regarding carryover provisions (see Item 8.8). Changes to *Robustness Trials* initiated at this meeting are reflected in Table 4. The full list of robustness trials is given in Annex E, Appendix 3.

#### 8.4.1.3 CROSS-VALIDATION TRIALS

*Cross-validation Trials* are case-specific trials to be held aside from *SLA* development so that resulting *SLA*s can be subjected to a subsequent independent test. Cross validation is a final check for whether the selected *SLA* performs roughly as expected, and is conducted subsequent to the primary selection process. *Cross-validation Trials* are intended to examine two types of concerns: (1) unpredictable behaviour in the interior of a tested region of parameter space due to over-fitting; and (2) unpredictable behaviour somewhat outside a tested region of parameter space due to extrapolation.

The Committee agreed that only *SLA*(s) selected for presentation to the Commission would have to be subjected to cross-validation. It also agreed that if an *H-optimised SLA* is selected, any *SLA*s used in its construction should also be subjected to the *Cross-validation Trials.*

It is planned to develop *Cross-validation Trials* at the intersessional workshop referred to under Item 8.9. In discussion of how it might interpret the results of *Cross-validation Trials*, particularly any that involve extrapolation outside the *Evaluation Trial* space, the Committee **agreed** that if unexpected behaviour was observed for one of the *Cross-validation Trials*, it would examine both the trial in detail and the causes for this behaviour. If necessary, this might require some modifications to the selected *SLA*, or in the extreme, to a change in the selected *SLA*, in which case, the entire cross-validation process would have to be repeated.

### *8.4.2 Review of performance statistics*

The Committee agreed that the performance plots should be modified to include all of the mandatory statistics listed in Table 2. The values for statistics N10 (AAV) and N11 (anti-curvature statistic) are highly correlated (Annex E, Appendix 4). It was agreed that N10 would be retained as mandatory and N11 would be designated as optional. Givens suggested that the trade-off between N9 and D1 should be

Table 4

Revised list of bowhead whale *Evaluation Trials* and additional bowhead *Robustness Trials*. Changes from last meeting given in *italics*. Changes from the base-case are highlighted in **bold**.

| Trial No. | Description | Model | $MSYR_{1+}$ | $MSYL_{1+}$ | Final need | Survey frequency | Historical survey bias | Future survey bias | Survey CV (true, est.) |
|---|---|---|---|---|---|---|---|---|---|
| BE01* | Base-case | $D,S_D,S_E$ | 2.5% | 0.6 | *134* | 5 | 1 | 1 | 0.25, 0.25 |
| BE02 | Constant need | D | 2.5% | 0.6 | **67** | 5 | 1 | 1 | 0.25, 0.25 |
| BE03 | Future +ve bias | $D,S_E$ | 2.5% | 0.6 | *134* | 5 | 1 | ***1→1.5 in yr 25*** | 0.25, 0.25 |
| BE04 | Future -ve bias | D | 2.5% | 0.6 | *134* | 5 | 1 | ***1→0.67 in yr 25*** | 0.25, 0.25 |
| BE05 | Underestimated *CV*s | D | 2.5% | 0.6 | *134* | 5 | 1 | 1 | **0.25, 0.10** |
| BE07* | $MSYL_{1+} = 0.8$ | $D,S_E$ | 2.5% | **0.8** | *134* | 5 | 1 | 1 | 0.25, 0.25 |
| BE08 | 10yr surveys | D | 2.5% | 0.6 | *134* | **10** | 1 | 1 | 0.25, 0.25 |
| BE09* | $MSYR_{1+} = 1\%$ | $D,S_E$ | **1%** | 0.6 | *134* | 5 | **0.67 → 1** | 1 | 0.25, 0.25 |
| BE10* | $MSYR_{1+} = 4\%$ | D | **4%** | **0.8** | *134* | 5 | 1 | 1 | 0.25, 0.25 |
| BE11 | Bad data | D | 2.5% | 0.6 | *134* | 5 | 1 | ***1→1.5 in yr 25*** | **0.25, 0.10** |
| BE12* | Difficult 1% | $D,S_E$ | **1%** | 0.6 | 134 | 5 | **1 → 1.5** | **1.5** | **0.25, 0.10** |
| BE13 | Difficult 1%; constant need | D | **1%** | 0.6 | **67** | 5 | **1 → 1.5** | **1.5** | **0.25, 0.10** |
| BE14 | Need increases to 201 | D | 2.5% | 0.6 | ***201*** | 5 | 1 | 1 | 0.25, 0.25 |
| BE15 | Future +ve bias; 201 need | D | 2.5% | 0.6 | ***201*** | 5 | 1 | ***1→1.5 in yr 25*** | 0.25, 0.25 |
| BE16 | $MSYR_{1+} = 1\%$; 201 need | $D,S_E$ | **1%** | 0.6 | ***201*** | 5 | **0.67 → 1** | 1 | 0.25, 0.25 |
| BE20* | $MSYR_{1+} = 4\%$; 201 need | D | **4%** | **0.8** | **201** | 5 | 1 | 1 | 0.25, 0.25 |
| BE21* | Integrated | D | **U[1-4]** | **U[0.4-0.8]** | 134 | 5 | 1 | 1 | 0.25, 0.25 |
| **Additional BR trials** | | | | | | | | | |
| *BR04b-10* | *$MSYR_{1+} = 4\%$; 10yr surveys* | *D* | ***4%*** | ***0.8*** | ***201*** | ***10*** | *1* | *1* | *0.25, 0.25* |
| *BR04b-9* | *$MSYR_{1+} = 1\%$; 10yr surveys* | *D* | ***1%*** | *0.6* | ***201*** | ***10*** | ***0.67 → 1*** | *1* | *0.25, 0.25* |
| *BR04b-13* | *Hard 1%; 10yr surveys* | *D* | ***1%*** | *0.6* | ***67*** | ***10*** | ***1 → 1.5*** | ***1.5*** | ***0.25, 0.10*** |
| *BR15* | *$MSYL_{1+} = 0.9$* | | | | | | | | |
| *BR16* | *$\rho = -0.75$* | *$S_E$* | | | | | | | |

presented in a single plot for multiple trials. The Committee welcomed his offer to develop such a plot further intersessionally.

## 8.5 Implementation trial structure for gray whales

SC/52/AWMP1 provided specifications related to how density-dependence impacts the mortality of calves so that calf count data can be used in the process of conditioning trials for the eastern North Pacific gray whales. The choice among these specifications is less important if the calf counts are assumed to provide a relative rather than an absolute index of the number of calves. The results of the conditioning process are insensitive to assumptions regarding the age-at-recruitment. The results for trials based on $MSYR_{1+} = 1.5\%$ indicate a need to combine the assumption of an *MSYR* of this magnitude with an increase in survey bias of 2-2.5% per annum.

Following discussions last year on stock structure, SC/52/AWMP2 calculated population projections from 1968 for eastern North Pacific gray whales based on a two sub-stock model with mixing. It considered the case of a single breeding stock that splits into two feeding sub-stocks. A conservative approach was used to remove animals due to harvesting in that the entire annual catch was assumed to have come from the smaller sub-stock and zero catches were assumed for the other sub-stock. The known catch history was used from 1968-1999 and an annual removal of 140 animals was assumed for 2000 onwards. Results for the 1968 sub-stock 1 fraction of 20% indicated extinction (of sub-stock 1) only for the case where the mixing rate of sub-stock 1 was 1%. For a 1968 fraction of 15%, extinction occurred for mixing rates of 1% and 2%. No extinctions occurred if half the annual total harvest was allocated to each sub-stock. Small catches taken from sub-stock 1 ($\leq 5$) did not result in any projections going extinct. The results are dependent, however, on the 1968 population size of sub-stock 1 and the mixing rates used, and highlight the importance of knowledge about these parameters.

### *8.5.1 Specification of trials*

The Committee **agreed** that at present, the assumption of a single stock is the most likely scenario for gray whales, particularly as the vast majority of the catch is taken from the northern feeding range. It therefore **agreed** to give highest priority to single stock trials, noting that there is a possibility that there may be site fidelity for animals in the southern feeding range (SC/52/Rep3; Annex I). Consideration of such options will be given a lower priority pending further information.

#### 8.5.1.1 EVALUATION TRIALS

A preliminary set of *Initial Exploration Trials* for the gray whale was developed at the last meeting (items 5.2 and 5.3 of SC/52/Rep3). The Committee welcomed the work conducted intersessionally which responded to questions raised at the last meeting. It encouraged members of the SWG to collaborate to finalise the specifications and coding of the trials for the gray whale for presentation at the Intersessional Workshop through the e-mail Correspondence Group. Punt indicated that he would attempt to apply an *SLA* to the trials for presentation at the Intersessional Workshop.

#### 8.5.1.2 ROBUSTNESS AND CROSS-VALIDATION TRIALS

The SWG was not in a position to specify *Robustness* or *Cross-validation Trials* at the current meeting.

#### 8.5.1.3 REVIEW OF PERFORMANCE STATISTICS

The SWG noted its previous deliberations on this issue (SC/52/Rep3, item 5.4) and reaffirmed its intention to use the same performance statistics in the AWMP development of each aboriginal fishery.

## 8.6 Trial structure for the Greenland fisheries

In 1998, the Scientific Committee had informed the Commission that with currently available data, it would be extremely difficult, if not impossible, to develop an *SLA* that

will satisfy all the Commission's objectives for the Greenland fisheries. To that end, the Committee recommended, and the Commission accepted, the need to develop a cooperative research programme that will enable the Committee to provide satisfactory advice to the Commission. The SWG noted that Committee consideration of such a research programme had begun last year and had been a major topic at this year's meeting (see Annex F). Several members of the SWG had participated in the discussion of this programme.

The SWG noted that *SLA* development for these fisheries was still in the exploratory stage. It was pleased to note that several members planned to develop a potentially suitable *SLA* in the coming intersessional period, taking into account the discussion of the type of data that might become available from the Greenland research programme. Considering likely progress of this, the SWG **agreed** that *SLA* development for Greenland fisheries remains at the stage of *Initial Exploration Trials* until 2002, at which time results from the Greenland research programme could begin to be used to advance *SLA* development and testing further. This recommendation does not preclude revision of the *Initial Exploration Trials* specified in Annex E, Appendix 3 or other progress believed appropriate by the SWG in the interim.

### 8.7 Planning for the selection of *SLA*s

The Committee noted that its discussions had focused on statistics that would be used during *SLA* selection. It agreed that it was important to begin to discuss the principles and concepts involved in any selection process.

After some discussion, the Committee **agreed** that greater emphasis should be placed on the use of multivariate graphical comparisons and descriptive multivariate statistical analyses than was used in the selection of the *RMP CLA*. Members will bring suggestions of such methods for consideration at its intersessional meeting. It was also **agreed** that no quantitative analysis method for generating an automatic *SLA* selection should be employed, as such strategies had not been useful during selection of the RMP.

Finally, the Committee noted that it was focussing on statistics and summaries relevant for development and selection of an *SLA*, and that the methods used to present the results to the Commission might be somewhat different. Some distinctions have already been made; see Table 2.

### 8.8 Aboriginal Whaling Scheme

*8.8.1 Scientific aspects*

The Committee considered Annex E, Appendix 5, which was written to promote discussion of the scientific aspects of an Aboriginal Whaling Scheme. The SWG agreed with the general ideas expressed, but did not have time to consider most relevant matters in any detail. The ideas will be developed further and specific proposals considered at next year's meeting.

One element that was discussed related to the potential long-term change in the types and nature of data obtained for a fishery. Over time, data might change from relative abundance indices on an unknown portion of the stock to absolute abundance estimates on all (or a known portion) of a clearly delineated stock. The Committee **agreed** that methods for ensuring that any Aboriginal Whaling Scheme was sufficiently flexible to adjust for such transitions would be an important topic for future discussion.

The SWG also discussed issues related to the treatment of unused strikes between years. The Commission has indicated that it would like the concept of carrying over unused strikes from one year to the next to be included as a design feature of an *SLA*. The SWG had agreed last year that strike limits would be modelled as being provided in multi-year blocks. The Committee **agreed** that the following scheme should be presented to the Commission and hunters for comment.

For the purposes of illustration only, it is assumed that the block is 5 years, that the total strike limit over the 5-year period is 500 and that an inter-annual carryover allowance of 50% is permitted. The block length and the percentage inter-annual carryover allowance are numbers for which explicit advice is required from the Commission. The total block quota is then divided by the number of years to provide an average annual quota. The strike limit set for any one year should normally be allowed to exceed this average annual quota by 50%, provided that the total strikes allowed during a block do not exceed the block limit (plus any carryover brought into the block). The same 50% allowance may be carried over between the last year of one block and the first year of the next block; it does not impact the overall block limit. A hypothetical example is given in Table 5.

Table 5

Example of a system to allow unused strikes to be used in subsequent years.

| Year | Block limit | Maximum strikes in year | Actual strikes | Strikes remaining |
|---|---|---|---|---|
| 1 | 500 | 150 | 100 | 400 |
| 2 | 500 | 150 | 120 | 280 |
| 3 | 500 | 150 | 95 | 185 |
| 4 | 500 | 150 | 95 | 90 |
| 5 | 500 | 90 | 30 | 60 |
| **Total** | | | **440** | **60** |
| 6 | 500 | 150 | 130 | 420 |
| 7 | 500 | 150 | 90 | 330 |
| 8 | 500 | 150 | 60 | 270 |
| 9 | 500 | 150 | 40 | 230 |
| 10 | 500 | 150 | 150 | 80 |
| **Total** | | | 470 | 80 |

*8.8.2 Dialogue with Commission and hunters*

The Committee reiterated the importance it attached to continuing dialogue with the Commission and hunters throughout the development process. It referred to Item 8.8.1 and **recommends**, as in previous years: (1) a presentation by the Chairman of the SWG of its report and a less technical Chairman's discussion paper; and (2) informal discussions among the SWG Chairman and interested Commissioners.

### 8.9 Work plan and priority tasks

The Committee recognised the need to ensure that as rapid progress as possible is made towards providing the Commission with recommendations that satisfy the specified management objectives to the greatest extent possible. It noted that speed and efficiency of the SWG's progress depended on several factors including the diversity, expertise and continuity of its members, and suitable levels of resources supporting its efforts. Referring to its work plan given in table 6 of IWC (2000f, p.20), it noted that progress had fallen somewhat behind the column labelled 'faster'. However, it believed that it should be possible to catch up at the 2001 annual meeting. It intended to make every effort to

do so, and **agreed** that an Intersessional Workshop in late 2000 was absolutely essential for it to make the fastest possible progress.

The following topics were identified for consideration at a 2000 Intersessional Workshop: bowhead *Robustness Trial* specifications, bowhead *Cross-validation Trial* specifications, Eastern North Pacific gray whale *Evaluation Trial* specifications, methods for selecting *SLA*s, and a protocol for how and when final versions of *SLA* code could be distributed among members for evaluation and/or optimisation. A sum of £12,000 is required as last year.

The Commission has established an AWMP developers fund (IWC, 1999d, p.165) of £5,000. This has proved invaluable in ensuring progress in the work of the SWG. Given the increasing number of developers and the need to follow the 'faster' progress option, the Committee **recommends** that this be increased to £8,000.

For the 2001 annual meeting, priority topics would be decided at the Intersessional Workshop, however the SWG noted that for bowheads it intended to address all items in the 'faster' timeline in table 6 of IWC (2000f, p.20) corresponding to dates indicated there up to and including the '2001 meeting' entries. A revised timetable is given in Table 6 for the 'faster' plan. With respect to gray whales, the Committee re-affirmed that for the single stock scenario, the timetable and Workplan will attempt to mirror that for the bowhead whale to the extent possible. With respect to the other fisheries, the situation remains as last year (IWC, 2000f, pp.19-21). In particular, the Committee reiterates that it will be in a stronger position to provide advice on a timetable for the Greenland fisheries when the results of the research programme discussed under Item 9.3 become available.

*8.9.1 Computing tasks*

The Committee identified the tasks in Table 7 as requiring completion intersessionally. Some of these tasks involve conditioning trials. The SWG thanked members who offered to conduct some conditioning work on their own computers to reduce the computing load for the Secretariat.

The Committee noted that if progress on a bowhead *SLA* progressed as planned for the 2001 annual meeting, then the Secretariat would have a potentially large task of validating one or more bowhead *SLA*s in 2002. It noted that this validation process and subsequent coding/computing concerns had been very time-consuming for the Secretariat in the case of the RMP. Therefore, it **agrees** that planning should begin now for this eventuality, taking into account the other computing requirements of the Committee and the possibility that such work could perhaps be the subject of a contract.

## 9. ABORIGINAL SUBSISTENCE WHALING STOCK ASSESSMENTS (AS) – (SEE ANNEX F)

### 9.1 Annual review of catches and catch limits

*9.1.1 Bering-Chukchi-Beaufort Seas stock of bowhead whales*

**9.1.1.1 ASSESSMENT MODEL REVISIONS**

A thorough assessment of this stock of bowhead whales was carried out in 1998 and a new one is planned for 2004. This year the Committee reviewed eight reports on the biology of bowhead whales from the B-C-B stock and on methods for estimating its stock size and status. Detailed discussions are given in Annex F.

All assessments of the B-C-B stock of bowhead whales rely on likelihood functions derived from almost identical data and a particular family of population dynamics models.

SC/52/AS15 examined how the likelihood surface created by such models exhibits a narrow, cusp-shaped, flat-topped, steep-edged ridge of strong non-linear dependency between key model parameters. Such features generally make statistical inference and interpretation difficult. Using examples, the authors examined some of the implications for maximum-likelihood estimation, Bayesian estimation and bootstrapping. The examples showed that small changes in the early portion of the trajectory cause large changes in recent years where the only available data lie. The authors argued that it is a poor model from which to generate

Table 6

Approximate timetable for developing a *SLA* for the Bering-Chukchi-Beaufort bowhead whale following the 'faster' option.

| Time | 'Faster' |
|---|---|
| Intersessional Workshop, late 2000 | Consider results from *Evaluation Trials* for candidate *SLA*s. Finalise *Robustness Trials* and specify *Cross-validation Trials.* Code *Robustness Trials* and *Cross-validation Trials.* |
| 2001 meeting | Examine *Evaluation Trial* results for candidate *SLA*s. Narrow choice to preferred *SLA(*s) upon which to run *Robustness Trials* and *Cross-validation Trials*. Examine results and finalise preferred *SLA*. Determine tunings for presentation to the Commission and begin to prepare explanation for Commission. Make recommendation to Commission with suggested tuning options. Receive feedback from Commission. Revise *Cross-validation Trials* if necessary. Propose scientific aspects of Aboriginal Whaling Scheme to the Commission. |
| Post 2001 meeting | Incorporate feedback from Commission. Run any necessary additional or revised trials. |
| 2002 | Formally present recommendation on all scientific aspects to the Commission. |

Table 7

Computing tasks for the coming year.

| Task | Estimated time | Target deadline |
|---|---|---|
| Coding changes to the calculation of *RY* and *H* for the stochastic dynamics model | 1 week | 27 July 2000 |
| Modifying the parameter values for the stochastic model | 1 week | 27 July 2000 |
| Run bowhead *Robustness Trials* on any *SLA*s provided to the Secretariat intersessionally | 1 week per *SLA* | 1 July 2001 |
| Coding bowhead *Cross-Validation Trials* | 1.5 weeks to 1 month, depending on final specifications | 1 July 2001 |
| Coding bowhead *Robustness Trials* | 1 month | 1 July 2001 |
| Coding Eastern North Pacific gray whale *Initial Exploration Trials* | 1 month | 1 July 2001 |
| Investigate unusual aspects of calf production trajectories generated by the stochastic dynamics model | Intersessional correspondence | 1 July 2001 |

likelihood functions for bowhead assessment. Other members concurred with this and discussed different aspects of the model behaviour.

The Committee agreed that whilst the population model itself was not problematic, the instability of its behaviour in the bowhead case was troubling and may be indicative of questions being asked that were more demanding than the data would allow. In particular, the calculation of confidence intervals requires particular care.

The question of why Bayesian and maximum-likelihood assessments of the bowhead population differed was also discussed, without consensus.

SC/52/AS19 presented new estimates of annual bowhead survival rate based on more photo-identification data (1981-98) than were available to Whitcher *et al.* (1996), and an improved system for scoring photographic quality and whale identifiability that permitted selection of photographs suitable for use in capture-recapture analyses. The maximum-likelihood estimate was 1, with 95% profile likelihood confidence interval 0.96 to 1. The validity of the confidence interval was uncertain, as the estimate was at the boundary of the parameter space. The authors believed that one or two more aerial photographic studies during the spring migration could narrow confidence intervals as well as provide other useful information, including an estimate of current abundance. The Bayesian estimates were 0.980 with 95% probability interval 0.898-0.998 (using a uniform prior) and 0.987 with 95% probability interval 0.946-0.996 (using the prior from the 1998 bowhead assessment).

The Committee encouraged the collection of further photo-identification data and continuation of the work on survival/mortality rate estimation.

Zeh presented an estimate for the 1985-86 abundance based on the data from marked and unmarked bowheads used in SC/52/AS19. The estimate, corrected for unmarked whales with the proportion of marked whales estimated from photographs of high quality, was 6,319 (SE = 1,212 and 95% CI = 4,354-9,173). This estimate lay between the abundance estimates for 1985 and 1986 obtained from the ice-based acoustic and visual census and was more precise than either.

SC/52/AS14 re-examined the photo-identification data analysed by Da Silva *et al.* (2000) by maximum-likelihood methods. The results were similar to those obtained by Da Silva *et al.* (2000). The paper also considered some issues of basic statistical methodology.

SC/52/AS13 was a continuation of an incomplete frequentist assessment of B-C-B bowhead whales presented last year. It included newly-available photo-identification and age data. A bootstrap experiment was carried out to find a pivot for the parameter replacement yield in 1998. A negative bias was found to be present in the maximum-likelihood estimate of this parameter, and simple bias correction was employed to obtain a confidence distribution.

SC/52/AS12 examined the use of a stochastic population dynamics model for B-C-B Seas bowhead stock assessment. This is one of the models currently used by the AWMP SWG in the context of catch limit trials. Two stochastic variants were considered: (1) demographic stochasticity only; and (2) demographic stochasticity plus temporally correlated environmental variation in the birthing/calf survival process. Results were very similar to those of the deterministic model, although the stochastic models produced greater posterior variance in certain management-related quantities. The stochastic models were also slightly less successful in matching the observed abundance estimates. Both stochastic models produced lower bounds on the catch limit that exceed the current strike limit, and these results thus support the existing Committee inference that the stock will continue to increase under the current hunting levels. SC/52/AS12 advised the use of expected replacement yield and a revised $Q_0$ statistic when using stochastic assessment models. These changes were agreed (see Item 8.4.1).

SC/52/AS24 summarised the subsistence harvest of bowhead whales by Alaskan Eskimos during 1999. A total of 47 whales was struck during the 1999 hunt resulting in 42 animals landed - an efficiency rate of 89%, which is the highest recorded since records began in 1974. Based on new data from 1993 to the present, the average length of the five smallest pregnant whales examined was 13.7m which is less than earlier analysis from the harvested animals. Since 1980, 29% of the landed mature females (for which we have records) > 14.2m were pregnant. Using 13.7m for the length at sexual maturity, 27% of the harvested mature females were pregnant. This rate is consistent with the currently accepted calving interval of four years. Borodin reported that in 1999, a single (male) bowhead was taken in the subsistence hunt by Chukotka natives. Therefore, a total of 48 whales was struck and 43 landed from this stock.

SC/52/AS25 gave preliminary findings from census activities for the stock at Point Barrow, Alaska during 1999 and 2000. Due to ice conditions, a census was not carried out in Spring 1999 but instead an independent observer experiment was conducted. In Spring 2000, a full census was attempted. A total of 1,606 new and 348 whales about which observers were uncertain as to whether they had already been seen were counted in 473 hours of watch between 7 April and 12 May. Visibility conditions deteriorated in May due to closed leads caused by westerly winds. Leads remained closed and on 21 May the census was terminated because it was considered that too much unmonitored time had occurred to make a useful population estimate. The authors discussed a possible methodology for estimating population trend using partial census data.

SC/52/AS26 presented an acoustic study conducted as part of the bowhead census off Pt. Barrow, Alaska. Acoustic field methods and post-processing location methods were the same as those used in previous years (Clark and Ellison, 2000). A new acoustic location method was used to locate vocalising whales in real-time while recording whales. In 2000, arrays were maintained along the nearshore ice-edge from 18 April through 22 May for a total of *ca* 660 hours. In addition, two autonomous seafloor recording units were deployed *ca* 8 miles offshore of the array. Results of the location analysis for the three samples show changes in the whales' distribution throughout the season, with the distribution shifting from inshore to offshore. Early in the season when there was some open water and a lead along the nearshore ice-edge, most whales were migrating within a narrow corridor close to the lead edge. As the season progressed and the offshore ice moved in, whales were migrating in a wider corridor and displaced offshore by several kilometres.

#### 9.1.1.2 MANAGEMENT ADVICE

The last major assessment of this stock of bowhead whales was carried out in 1998, and the next is planned for 2004.

The Committee agreed that there was no reason to change the management advice given previously (IWC, 1999e, p.185), that is, that it is very likely that a catch limit of 102 whales or less would be consistent with the requirements of the Schedule.

The Committee noted that it had not yet provided advice on the effect of aboriginal catches for the period 1998-2002. Population trajectories were calculated under three different catch assumptions. These assumptions and the accompanying methodology are described in Appendix 2 of Annex F. The results are shown in Table 8.

The Committee noted that the quotas will be reviewed by the Commission in 2002. The Committee **strongly recommends** that a full census should be attempted in 2001, since the last census was carried out in 1993.

### *9.1.2 Eastern North Pacific stock of gray whales*

#### 9.1.2.1 CATCH AND STRANDING INFORMATION

SC/52/AS5 reported on 273 gray whales stranded in 1999 along the west coast of North America from Baja California, Mexico to Alaska. This number was 5-13 times higher than annual counts from 1995-98. Most stranded whales were reported along remote shorelines of Mexico ($n = 118$; 43%) and Alaska ($n = 73$; 27%) and so were difficult to reach for examination. Of the 115 whales where sex was determined, 76 (66%) were female and 39 (34%) were male. Of the 133 whales where age or body length (proxy age), was reported, 51 (38%) were adults, 38 (29%) were juveniles, 30 (23%) were yearlings and 14 (11%) were calves. Potential causal factors investigated for the 1999 strandings included: (1) starvation; (2) chemical contaminants; (3) biotoxins; (4) disease; (5) fishery interactions; and (6) the effect of local winds on carcass deposition. Of these, ship strikes and fishery interactions were ruled out. Contaminant levels were not higher in the 1999 stranded whales than in whales stranded in previous years, and wind conditions not significantly different than in earlier years, leaving starvation, biotoxins and disease as the most likely causal factors.

From 1 January to 10 June 2000, 84 gray whale strandings have been reported in the US from California to Alaska. Stranding numbers in California are even higher during this time period ($n = 54$) than for the full year in 1999 ($n = 42$). The California strandings have centred around San Francisco Bay. Similar to 1999, the overall strandings have consisted of a predominance of adults and subadults. However, in contrast to those reported in 1999, there were more males ($n = 42$) than females ($n = 13$). The cause of these strandings is still unknown, and efforts will continue to examine carcasses, collect tissues and analyse samples. Since this is the beginning of the stranding season for Alaska, it is expected that these stranding numbers will continue to rise.

SC/52/AS16 reported on the high gray whale mortality recorded in the Mexican State of Baja California Sur. Although strandings of this species are normally recorded along its range and are more abundant in the wintering grounds where the whales tend to be more congregated, the count of 207 dead whales during the 2000 season (December 1999 to March 2000) was the highest ever recorded. The search effort for stranded or floating whales in the breeding lagoons and along the coastline was the same as in the previous season. There was a notably high number of adults (128) and a higher percentage of males than in the 1999 winter season when the majority of the adult dead gray whales were females. Most dead whales were found inside or around the breeding lagoons. Although more than half of those recorded were reported as at the Pacific Coast, most were recorded close to and around the breeding lagoons. The poor body condition of some stranded and living whales in San Ignacio and Ojo de Liebre lagoons may indicate poor nutrition. Several causes have been suggested, the most likely being the depletion of prey in some of the summer feeding grounds. The authors believed that the observations of whales searching for food at uncommon locations did not appear to be a response to disease or the other causes suggested elsewhere. They suggested that the cause of these high mortalities was related to nutritional deficiencies, probably the depletion of at least some feeding grounds. In discussion, attention was drawn to the fact that there has been a shift in age composition of the gray whales, in particular in the calving lagoons where previously the strandings were primarily calves.

SC/52/AS17 noted that the Magdalena Bay complex is the southernmost lagoon utilised by the gray whale during the winter on a regular basis. This body of water is divided into two large bays, with a chain of estuaries and channels. It has been suggested that the use of Magdalena Bay by the gray whale prior to its exploitation was much more important than it is today. The study consisted of conducting censuses from small boats during four winter seasons starting in 1997. Variations in the numbers and use pattern of the area were presented.

SC/52/AS18 presented a study of annual calf production for the California stock of gray whales based on a shore-based sightings survey to estimate the number of northbound migrating gray whale calves passing Piedras Blancas, California for seven consecutive years. The authors also conducted aerial surveys to determine offshore distribution of the migration in 1994 and 1995, measured day/night migration rates with thermal sensors in 1994-1996. Calf production indices (calf estimate/total population estimate) were 4.0%, 2.7%, 5.1%. 6.8%, 5.0%, 1.6% and 1.0% for the years 1994-2000 respectively.

Schweder drew attention to the dramatic drop in calf production and the shift in strandings from calves to adults in 1999 and 2000. These appeared to be poor years with both more strandings and less calving. George commented that similar changes in recruitment have been observed in bowhead surveys and this may be related to ice density.

Table 8

Population growth and percentage annual rate of increase (ROI) under three removal schedules. Shown are the posterior medians and lower bounds (5$^{th}$ percentiles) for 1+ population size at the start of each year, based on the 1998 assessment.

| Year | Rem. | 5% | Median | Rem. | 5% | Median | Rem. | 5% | Median |
|---|---|---|---|---|---|---|---|---|---|
| 1998 | 49 | 7,636 | 8,598 | 49 | 7,636 | 8,598 | 49 | 7,636 | 8,598 |
| 1999 | 47 | 7,725 | 8,743 | 47 | 7,725 | 8,743 | 47 | 7,725 | 8,743 |
| 2000 | 67 | 7,820 | 8,885 | 67 | 7,820 | 8,885 | 67 | 7,820 | 8,885 |
| 2001 | 0 | 7,890 | 9,008 | 67 | 7,890 | 9,008 | 102 | 7,890 | 9,008 |
| 2002 | 0 | 8,016 | 9,193 | 67 | 7,951 | 9,128 | 102 | 7,917 | 9,094 |
| 2003 | 0 | 8,148 | 9,369 | 67 | 8,018 | 9,243 | 102 | 7,950 | 9,177 |
| 2004 | 0 | 8,280 | 9,531 | 67 | 8,085 | 9,349 | 102 | 7,983 | 9,255 |
| ROI | | 1.01% | 1.67% | | 0.67% | 1.33% | | 0.48% | 1.16% |

A study of gray whale calves found dead in Mexican lagoons between 1954 and 1999 was considered. There were records for 381 gray whale calves in Mexico during this period with the highest number of calves stranded in the early 1980s. Annual strandings before and after this period were much lower. The author noted that the data do not seem to be related to El Niño events. In addition, the number of dead calves does not appear to be related to total calf production.

A retrospective summary of gray whale and benthic fauna distribution and abundance in the Chirikov Basin during the early 1980s was presented in SC/52/E3. The north-central position of the basin was the area of highest relative abundance of both whales and benthic fauna. Although a 30% decline in benthic biomass was reported for the Chirikov Basin in the late 1980s, the eastern North Pacific stock continued to increase to an estimated 26,635 (CV = 10.06%) whales by the late 1990s. This observation, as well as the comparatively high abundance of feeding gray whales in the Chirikov Basin in 1983 (an El Niño year), confounds simple explanations of the potential cause of the high gray whale mortalities reported in 1999 through 2000.

The combination of increases in the number of stranded animals reported in 1999 and 2000, which may indicate an increase in the *per capita* mortality rate, and decreases in calf production in 1999 and 2000, could have caused an overall decrease in the abundance of this population. However, without new survey data to directly assess abundance, it is not possible to make conclusions regarding any changes in the status of this stock relative to the last assessment made by the Committee in 1997.

The Committee commends the governments of Mexico and the USA for supporting research on gray whales in 1999 and 2000 and **recommends** that:

(1) both countries continue to monitor the number of stranded gray whales in 2001 and increase efforts to examine the carcasses to determine the cause of death;
(2) Mexico continues to monitor the habitat use patterns of the whales in the breeding lagoons;
(3) the USA continues to (a) assess calf production of the eastern North Pacific gray whale to determine whether it remains reduced or returns to levels considered 'normal' for this population, and (b) conducts a survey of southbound migrating gray whales in 2001, that can be used to generate a new estimate of total abundance - these data are critical to understanding the dynamics of this population as it moves towards carrying capacity;
(4) additional research is undertaken concerning the cause or causes of increased gray whale mortality and a better assessment of the quality and quantity of forage currently on the feeding grounds of this population of gray whales.

Borodin reported that in 1999, 121 gray whales were landed in the subsistence hunt by Chukotka natives. Of the landed whales, 68 were male and 53 were female. In addition, two animals were struck-and-lost in the same fishery. One female gray whale was landed in the Makah subsistence hunt (Washington State, USA) in 1999. None were struck-and-lost.

The Committee recognised the need for better understanding of site fidelity and potential population sub-division in this stock, and the Committee **recommends** that additional information relevant to these questions be collected from the gray whales landed in the subsistence hunt by Chukotka natives.

#### 9.1.2.2 MANAGEMENT ADVICE

The recent information from 1999 and 2000 on increases in the number of eastern North Pacific gray whales that were reported stranded and the reported decreases in calf production in 1999 and 2000 cannot be interpreted to necessarily indicate that the abundance of the population has declined since the most recent survey in 1997/1998 or that increased caution is necessary for management at this time. In fact, increases in the *per capita* mortality rate and decreases in net production may be related to the population approaching its carrying capacity. Therefore, pending additional information on calf production, the number of stranded animals and a new estimate of abundance, the Committee **agreed** that it had no reason to change the advice given previously that a take of up to 482 whales per year is sustainable, and is likely to allow the population to stabilise above the *MSYL*.

### *9.1.3 Minke whales and fin whales off Greenland*

#### 9.1.3.1 CATCH INFORMATION

SC/52/ProgRepDenmark reported that in 1999 a total of 165 minke whales (123 females, 34 males, 8 sex undetermined) was landed in West Greenland and that there were five struck-and-lost. A total of 14 minke whales (13 females, 1 male) was landed in East Greenland. It also reported that in 1999 a total of seven fin whales (4 females, 3 males) was landed and two were struck-and-lost.

#### 9.1.3.2 MANAGEMENT ADVICE

The Committee again noted that it has never been able to provide satisfactory scientific advice on either fin or minke whales off Greenland. It **strongly recommends** the establishment of the research programme for fin and minke whales off Greenland discussed under Item 9.3. Results from this research programme and the major assessment of fin and minke whales off Greenland planned for 2003, should allow a substantial improvement in the quality of the Committee's advice in the future.

### *9.1.4 Humpback whales off St. Vincent and the Grenadines*

#### 9.1.4.1 REVIEW COMMISSION DEFINITION OF LENGTH OF HUMPBACK CALF

Last year the Commission added to the Schedule the provision that 'It is forbidden to strike, take or kill calves or any humpback whale accompanied by a calf.' A humpback whale calf was defined as 'an animal less than 8m in length, subject to review by the Scientific Committee next year'. This length had been adopted as a result of the Committee's discussions last year (IWC, 2000f, p.24). Although no new papers were presented on this topic there was considerable discussion on this agenda item.

Hester believed that there are a number of difficulties associated with the adoption of this length definition for a humpback whale calf. It presumes that calves less than 8m are dependent on the female and cannot survive alone. In his opinion there are insufficient data to support this view. He noted that the Bequia hunt occurs in coastal waters near the southwest North Atlantic breeding grounds. Females and cow-calf pairs are present, and Hester claimed that large male humpback whales are rarely, if ever encountered. He also believed that a length definition provides practical difficulties in this fishery. The boats, which are small and work in fairly rough seas, have difficulty determining if the females are accompanied by a calf, let alone the absolute or relative size of a small animal.

Clapham and Brownell reiterated that there was no new information to alter the length definition accepted by the Committee last year, and that there should be no difficulty identifying calves of the year, which are clearly dependent and which maintain close association with the mother; indeed, such identification is routinely accomplished by scientists in similar boats and conditions in many other humpback whale breeding grounds worldwide. They further noted that, at 8.5m, the boats used by Bequia whalers were of an almost ideal length to use as a standard for assessing the length of a whale less than 8m, particularly since calves of the year would be considerably smaller than this.

There was some discussion over the question as to whether male humpback whales are regularly found in the hunting area and whether the area represented part of the migratory route rather than a breeding area. Ryan commented that the information available came from the fishermen who had many years of experience of both hunting and observing whales. It was their belief that males seldom used the passage and that the area was part of a migratory route. In addition, Hester observed that after more than a decade of hunting under IWC regulations, no adult male humpback whales were taken, although, curiously, all the small whales landed were males. There is no evidence at this time to indicate that the selectivity pattern of this hunt will change other than to primarily large females if the taking of small whales is prohibited. With respect to the question of this being a migratory area, Clapham commented that if so, it would be unique among humpback groups throughout the world.

In conclusion, the Committee **reiterates** its view that there is a high probability that any humpback whale less than 8m in the breeding area during the winter season is a calf.

#### 9.1.4.2 CATCH INFORMATION

Two humpback whales were taken on 6 March 2000 off the southeastern coast of Bequia. A male calf was taken at around 08:30 at 12°56'37''N and 61°13'34''W, and a large female whale was taken around 11:55 at 12°56'37''N and 61°12'34''W. The method of killing was a harpoon hand thrown from a small open whaling boat. The whales were taken to the landing station at Petit Nevis (Whale Cay).

The large female humpback whale was 50ft (15.2m) in length, 13ft (4.0m) in diameter with a girth of 30ft (9.1m). The tail fluke was 13ft wide. The male calf was 20ft (6.1m) in length with a girth of 13.7 ft (4.2m) (at flipper) and a tail span of 6.6ft (2m). There was milk present in the stomach of the calf, which suggests that the large female was lactating. No results for DNA analysis are available at this time.

#### 9.1.4.3 MANAGEMENT ADVICE

The Committee **reiterates** its view of last year that a catch of up to three whales taken annually would be unlikely to harm this stock.

The Committee noted that the results from the recently completed multinational survey in the Eastern Caribbean and surveys conducted in St. Vincent and the Grenadines and St. Lucia and the Comprehensive Assessment of North Atlantic humpback whales planned for 2001, should allow a substantial improvement in the quality of its advice in the future. However, pending these, the question of the abundance and population identity of humpback whales in the Southeast Caribbean remains unresolved.

Further research that would provide data on the fine-scale distribution by sex in the area of the subsistence hunt would be relevant to considerations of the effects of regulations on the hunt.

### 9.2 Effect on a stock of taking calves

The Committee agreed that although examples from existing fisheries would be relevant, the aim of this agenda item was to consider the general issue of the effect on a stock of taking calves.

SC/52/AS20 addressed this question by directly assessing the effect on the stock of North Atlantic humpback whales of taking calves, small whales and lactating females in the Bequia fishery. The authors assumed that females and calves both occur on the grounds but that large males do not and took operational factors into account. On this basis, the authors assumed that the allowed take of two whales each season will probably be either a cow-calf pair, or two adult females. Because of the higher rate of natural mortality for calves and the expected sex ratio for calves of near 1:1, the authors noted that the impact on the population is less if the catch comprises a cow-calf pair rather than two adult females.

Smith believed that substantially more factual information than was used in SC/52/AS20 would be necessary for a thorough review of the implications of prohibiting taking females accompanied by whales less than 8m long in the St. Vincent and the Grenadines fishery. Relevant considerations include issues of need, humpback whale use of the area, presence of males and operational factors, many of which are discussed under Item 9.1.4.1.

SC/52/AS22 dealt with harvest selectivity patterns. The Schedule has always included provisions to prohibit the taking of calves and females accompanied by calves. There are a number of baleen whale species where the sex and age composition of the harvest could be controlled by utilising differences in behaviour and spatial distribution, as well as examples of where such differences have been used by whalers. The implications of age and sex specific regulations for whaling were explored by examining the relative effects of harvests of baleen whales with different age and sex selectivity patterns using as an example a Leslie matrix population model developed for North Atlantic humpback whales. The effects of eleven selectivity patterns were measured by computing the fraction of the population that would have to be killed (harvest fraction) to reduce the growth rate of the population model to zero. The harvest fraction expressed as a percentage difference between the value for a given selectivity pattern and the value for a random harvest reflects the relative *per capita* impact of that pattern, and ranged from 66% to −15%.

The harvest pattern with the lowest impact (15% less than random) was consistent with the protection of calves and females accompanied by calves. Patterns that targeted females accompanied by calves had greater impact per whale harvested. Harvest of only calves outperformed random harvest, but had greater impact than the prohibition of cows and calves. A summary of the results is given in Table 9. Although the calculations were made using a published model for humpback whales, the effects identified would be similar for other species of large baleen whales with similar life histories.

The paper also addressed the implications of age and sex specific targeting by commercial whaling operations if managed under the RMP. The regulations there would reduce catch limits according to the proportion of females in the landings in excess of 50%. It was shown that catch limit adjustments in the RMP that are based on the sex ratio of the landings were more extreme for selectivity patterns that had greater *per capita* impact, and served to offset some of the effects of such selectivity. The authors suggested that similar provisions should be explored in the development of the AWMP.

Table 9

The percent *per capita* impact (relative to a random harvest) for a selected range of harvest selectivity patterns computed using a simple model of population dynamics and expressed in terms of numbers of whales. The harvest patterns presented involved simple selection of or protection of cows (females accompanied by calves), and represent the range of effects that such patterns could have; evaluation of specific cases would require including more information than is included in the present model. The percent *per capita* impact reflects the effect of each selectivity pattern relative to a random pattern.

| Harvest selectivity pattern | % *Per capita* impact |
|---|---|
| Cows only | 65.6 |
| Cows and calves only | 31.3 |
| Random harvest | 0.0 |
| Calves only | -11.2 |
| Males and females, protecting cows and calves | -15.3 |

The Committee noted that SC/52/AS20 and SC/52/AS22 agreed in showing that harvests of cow-calf pairs would have less impact than harvest of cows only (for the same total number of takes). However, other harvest patterns, for example of males only, would have even less impact. Operational and biological factors will probably restrict the range of harvest patterns that can be achieved in any practical case.

### 9.3 Development of a Research Programme for Greenland fin and minke whales

Last year, the Committee had **strongly endorsed** the establishment of a research programme for fin and minke whales off Greenland and outlined plans for such research (IWC, 2000f, p.23). A major feature of the outline plans developed last year was the potential use of a large-scale biopsy sampling programme to address questions of stock identity, movements, site fidelity and the abundance of animals to the fishery. However, it was recognised that before such plans should be developed it was essential to investigate the feasibility of obtaining large numbers of biopsy samples. To this end, the Commission approved the purchase of the recently developed *Larsen* gun.

#### *9.3.1 Outline of the programme proposed by the Greenland Institute of Natural Resources*

SC/52/AS3, 4, 6, 7, and 21 described aspects of a proposed research programme developed by the Greenland Institute of Natural Resources since last year's meeting.

SC/52/AS1 reported on a feasibility study on biopsy sampling undertaken in the archipelago outside Nuuk in autumn 1999. Over a five-day period the authors obtained one biopsy sample from three shots fired. An inflatable was used. The authors concluded that due to the evasive behaviour of the whales, these trials were unsuccessful, and they therefore decided that biopsy abundance estimates would be at least as difficult to obtain as survey estimates. On this basis, the Institute decided to proceed with the development of a monitoring programme based on surveys, as discussed in the remaining documents.

The programme aims at obtaining a time series of relative and/or absolute abundance estimates for minke, fin and humpback whales in the Greenland area (using RMP minke whale terminology, these would be *Small Areas* WG and CG). The programme includes West Greenland Inshore Sighting Surveys (SC/52/AS6) that can be run by the Greenland Institute of Natural Resources largely independent of external funding. At least during the initial phase of the programme, these surveys are planned to occur on a yearly basis, with a feasibility study being undertaken this year. The programme also includes West Greenland Offshore and East Greenland Sighting Surveys (SC/52/AS7, AS21) so that a complete coverage of the Greenland management areas can be obtained if this is considered useful for an AWMP. These latter surveys are envisioned to occur with larger intervals, and will only be possible if external funding is available.

All proposed surveys are based on double platform observations targeted for minke whales. The West Greenland Inshore and Offshore Surveys are planned as shipboard line-transect surveys. The authors considered that shipboard surveys were preferable to aerial surveys. While the offshore survey is planned as a dedicated survey involving two ships, this year's inshore feasibility study examines if inshore surveys can be conducted by combining a limited dedicated survey with opportunistic two-hour transects. An East Greenland survey was planned as an aerial cue-counting survey, owing to the difficult ice conditions off East Greenland.

There was considerable discussion on the biopsy feasibility study described in SC/52/AS1.

Attention was drawn to SC/52/O5 that summarised feasibility biopsy trials for minke whales using the Institute of Cetacean Research (Tokyo) air gun during the JARPN and JARPA surveys using large vessels. The authors concluded that it was more difficult to approach and attempt to biopsy minke whales in offshore rather than coastal waters.

Donovan and Larsen believed that it was somewhat premature to conclude that biopsy sampling was not feasible off Greenland and they made a number of suggestions for a further feasibility study, as noted in Annex F, Appendix 4.

On the general issue, Cawthorn stated that from his experience, it was feasible to biopsy sample minke whales. Nishiwaki commented that it was impractical to use crossbows from large vessels and that *Larsen* guns were more suitable.

A Working Group was established to make detailed recommendations for a research programme. This is given as Annex T. The Committee **strongly recommends** this programme.

#### *9.3.2 Other information on Greenlandic stocks*

SC/52/AS2 and AS3 provided background information on the minke and fin whales caught in Greenland from 1988-99. SC/52/AS2 showed that fin whales are caught on the West Greenland banks and in the Disko Bay area. Minke whales are taken closer to shore from Kap Farvel in the south to Upernavik in the north.

SC/52/AS3 provided estimates of biological parameters calculated from caught whales. For all parameters the reporting rate has increased during the period 1988-99, with approximately 90% of today's reports giving information on the sex and length of caught minke whales.

Stock identity questions have been identified as important in terms of the development of *Strike Limit Algorithms* for the Greenlandic stocks (e.g. IWC, 2000i, p.133). Øien introduced four papers (SC/52/AS8-11) which explored the population structure of minke whales (*Balaenoptera acutorostrata*) in Greenland waters, the Northeast Atlantic region and the North Sea using four different approaches. The tissue samples analysed were obtained from the Greenland and the Norwegian catches between 6 May and 31 October 1998. Samples from a total of seven *Small Areas* were used in each analysis.

SC/52/AS8 reported genetic studies of the minke whale tissues. In contrast to previous studies, the samples analysed ($n = 192$) were collected during one summer season to eliminate inter-annual variation. Samples were analysed by

sequencing the D-loop in mtDNA and by analysing 16 polymorphic nuclear microsatellite markers. The authors concluded that minke whales sampled in Greenland and in the Northeast Atlantic region do not differ genetically. They recommended that future genetic studies of minke whale population structure include samples taken in the same year from all areas of the species range in the North Atlantic including Canadian and Icelandic waters.

SC/52/AS9 presented information on the variation in fatty acid composition in blubber from 168 minke whales. A total of 45 fatty acids were identified making up 93-98% of the total fatty acids. A stratification of individual fatty acids was identified in the blubber: diet-related fatty acids (i.e. long-chained unsaturated) dominated the inner layer that reflected a 'short'-term dietary signal whilst the outer layer represented a 'long-term' exposure or average diet. Multivariate analyses distinguished between animals from different regions. The authors recommended that future studies of fatty acid profiles in minke whales include samples from their entire North Atlantic range (including Canadian and Icelandic waters) and that samples be collected within a narrow time-window during the same year.

SC/52/AS10 examined persistent organochlorine levels and patterns. The authors tentatively concluded that minke whales from widely separated regions in the North Atlantic do not show major geographic differences in levels and patterns of PCBs and OC pesticides. Regional differences which occurred in the more polar, rapidly cleared compounds suggested that at least over the short-term, these OCs can be useful in determining regions used by minke whales.

SC/52/AS11 examined elemental and stable Pb isotope composition of minke whale soft tissues (kidney, liver, muscle). Significant multi-element differences were found between whales taken from each of the *Small Areas*, indicating that each contained a group of animals that was distinctly different in terms of range or feeding area from all the others. Further work is planned on the elemental composition of baleen, a non-resorbed tissue, that may provide an alternative, long-term perspective on stock structure to the soft tissues.

The Committee welcomed this information but did not attempt to review and synthesise it during the meeting.

### 9.4 Baffin Bay, Davis Strait and Hudson Bay stocks of bowhead whales

SC/52/OS7 presented abundance estimates of bowhead whales from the Hudson Bay-Foxe Basin stock from aerial surveys carried out on the summer range. Two strip surveys estimated 256+31 and 284+49 whales to be aggregating in northern Foxe Basin in 1994. A line-transect survey estimated 75+28 whales to be summering in northwestern Hudson Bay in 1995. Taken together, these estimates suggest that there are a minimum of about 345 whales in the Hudson Bay-Foxe Basin stock. There was no attempt to adjust for animals not at the surface, and given the limited coverage of the surveys the author did not consider these numbers to be an estimate of total stock size. Attempts were made to use photo-identification to estimate abundance, but the low number of well-marked animals precluded this effort. Aerial surveys are planned for Peel Sound and Prince Regent Inlet to determine whether these areas, thought to be calf-rearing areas, are occupied.

Finley reviewed information on distribution, movements, population size, general biology, recruitment, mortality and behaviour of bowhead whales in the northwestern Atlantic. He noted that both the Baffin Bay and Hudson Bay stocks numbered in the low hundreds, and were structured into isolated age- and sex-segregated groups with strong fidelity to particular habitats.

Givens referred to discussions in Annex I regarding the vulnerability of small populations to even low levels of persistent take, and related this to the subsistence harvest on this stock. Cosens replied that the average annual Total Allowable Removals recommended by Canada for these stocks represents 0.2% of the estimated Hudson Bay-Foxe Basin stock and 0.02% of the estimated Baffin Bay-Davis Strait stock (one whale in thirteen years). George noted that killer whale predation on the B-C-B stock of bowheads appeared to be much lower than in the Baffin Bay stock, which may partly account for the lack of recovery of the latter.

The Committee welcomed information from Canada on surveys carried out in Foxe Basin and Hudson Bay and **agreed** that more information about the Davis Strait stock is urgently needed.

### 9.5 Review preparations for North Atlantic humpback whales assessment in 2001

A sightings survey in St. Vincent and the Grenadines was conducted from 7-11 March 2000 (SC/52/ProgRep StVincent) but no humpback whales were sighted. Similarly, a sightings survey was conducted in St. Lucia from 14-18 February 2000 (SC/52/ProgRepStLucia) and again no humpback whales were seen. Weather conditions were poor during the survey.

The Committee welcomed the initiation of sightings surveys in these waters. It suggested that the benefits of collaborative studies with other programmes such as that described in SC/52/AS23 should be explored.

SC/52/AS23 described a visual and acoustic survey that was conducted in the eastern and southern Caribbean Sea to assess the current distribution and status of humpback whales in areas where they were previously exploited to commercial extinction and to evaluate the effectiveness of using visual and passive acoustic survey methods to assess abundance. This had been discussed by the Committee last year and an Intersessional Working Group had been established to assist in its planning (IWC, 2000f, pp.32-3).

The survey was conducted from the 75m NOAA research ship *Gordon Gunter*, and included the islands in the Lesser Antilles, Trinidad, Tobago, Barbados and the north coast of Venezuela. It did not include the waters of Antigua-Barbuda, Dominica and St. Vincent and the Grenadines, who would not provide the necessary permits. Approximately 10,900km of trackline was surveyed between 16 February and 29 March 2000 which corresponded with the peak breeding season of humpback whales in the West Indies. A total of 33 visual sightings of humpbacks ($n = 46$, including three calves) was made during both the 'on-effort' and 'off-effort' visual survey modes combined. Directional sonobuoys were used to detect calling humpback whales in the survey area. Humpback whale song was detected throughout the entire survey area, indicating that some humpback whales currently occupy areas where they were historically hunted by commercial whalers. A total of 74 acoustic detections of singing humpback whales was obtained from approximately 350 hours of monitoring of 176 sonobuoys deployed throughout the study area. Observations of female-calf pairs confirm that the Lesser Antilles and the Caribbean coast of Venezuela serve as nursing, mating and possibly calving grounds for this species. The observations confirm that humpback whales continue to utilise this region following

their commercial extinction. Although the observed low density of whales was partly attributable to the effect of strong trade winds and high sea states on visual survey conditions, the results of this survey suggest that the abundance of humpbacks in the eastern and southern Caribbean Sea may be lower than it was during the 19th century. The acoustic detection methodology proved more useful for detecting and enumerating singing humpback whales than traditional visual surveys. It is hoped that further development of analyses for acoustic data along with other information will lead to an improved approach for assessing whale abundance in this region. In the future it is hoped that all nations in the region will provide clearance for and/or collaborate to conduct surveys in their waters to enable more complete coverage of this portion of the species' range.

Palazzo and Smith regretted that the cruise had not been allowed to cover some important waters and hoped that broader international cooperation could be secured for the continuation of this effort.

Rambally expressed caution over comparisons of humpback population distribution in the islands of the Eastern Caribbean to the distribution of these whales in the congregation areas of Navidad and Silver Banks in the Dominican Republic. She noted that whaling did occur in the northern region of the Caribbean and therefore it may not be justified to use the argument that whaling is the sole reason for assumed low stock abundance in the Eastern and Southern Caribbean. She also commented that historically, whaling vessels may have utilised the Eastern Caribbean primarily because of the prevailing political status of the islands rather than because of large congregations of whales. She therefore felt that the argument that these islands were major congregation areas for humpbacks during the 19th Century may not necessarily be valid.

Clapham responded that there was no evidence that humpbacks had ever been 'significantly exploited' in the northern West Indies. Numerous whaling logs had been examined, and showed that considerable sperm whaling and blackfishing had occurred in the region, but few humpback catches. Much discussion followed these interventions.

In conclusion, the Committee **recommends** that these research programmes should continue and that the Commission should endorse and support these efforts and encourage cooperative ventures. Particular consideration should be given to collecting information relative to the fine scale distribution by sex in the area of the subsistence hunt. It also **recommends** that the coordination of such future work should be undertaken by an Intersessional Steering Group.

Smith presented a proposal for the conduct of the planned Comprehensive Assessment of North Atlantic humpback whales. Significant intersessional work will be required if this assessment is to be conducted during or just prior to the annual meeting. A Steering Group was appointed for the assessment with Hammond as the convenor and with Clapham, Hester (or Ryan), Øien, Rambally, Smith, Wallløe and Witting as the other members. It was also **agreed** that Hammond would Chair the assessment meeting next year.

In addition to the costs of Invited Participants, three intersessional tasks that may require funding were identified.

(1) Scientists involved in the YoNAH project propose to prepare a document summarising the results of (completed and in preparation) YoNAH analyses. This will be relevant to agenda items on stock identity, abundance and biological parameters. It would require a several-day Workshop of YoNAH principals, probably in Autumn 2000, and would result in a document that could be circulated for preliminary Scientific Committee review in early 2001.
(2) Consideration should be given to asking Reeves to undertake a contract study to organise and improve estimates of historical catches by area and year. This would draw on Mitchell and Reeves (1983), information developed subsequently in other studies, and additional historical records, such as Colonial Blue Books, not previously analysed.
(3) YoNAH investigations have confirmed a complex matrilineal social and spatial structure in North Atlantic humpbacks, including potentially several historically important breeding and feeding grounds. Because exploitation has been differential across the feeding and breeding grounds, and because the population cannot be assumed to be randomly mixing, more complex population modelling approaches will likely be required. A contract study to address this may be useful.

As noted above, the Steering Group should also consider relevant aspects of survey work. Funding is considered under Item 21.

### 9.6 Work plan

The Committee **reaffirmed** that at its meeting in 2001 it would give high priority to a Comprehensive Assessment of the North Atlantic humpback whale. A second priority topic would be further planning and review of preliminary results from the Greenland Research Programme.

It was noted that calf production and strandings data from 1999 and 2000 for eastern North Pacific gray whales were substantially different from previous years. In addition, there was little immediacy in the need to conduct a status review of fin and minke whales off Greenland until more data become available on these two species in 2003. Therefore, the Committee **recommends** that an assessment of eastern North Pacific gray whales be conducted at the 2002 meeting of the Committee and the Greenland fin and minke whale agenda item be scheduled to be addressed at the 2003 Committee meeting.

The Committee agreed to the timetable for stock assessment at Annual Meetings given in Table 10.

Table 10

Future assessments of stocks subject to aboriginal subsistence whaling.

| Year | Items to be considered |
|---|---|
| 2001 | North Atlantic humpback whales |
| 2002 | Eastern North Pacific gray whales |
| 2003 | Fin and minke whales off Greenland |
| 2004 | B-C-B Seas bowhead whales |

## 10. COMPREHENSIVE ASSESSMENT OF WHALE STOCKS – IN-DEPTH ASSESSMENTS (SEE ANNEX G)

### 10.1 Southern Hemisphere humpback whales – preliminary assessment

*10.1.1 Report of IWG on Southern Hemisphere humpback assessment*

Last year the Committee agreed that a preliminary assessment of Southern Hemisphere humpback whales be placed on the agenda for its 2000 meeting, and asked that

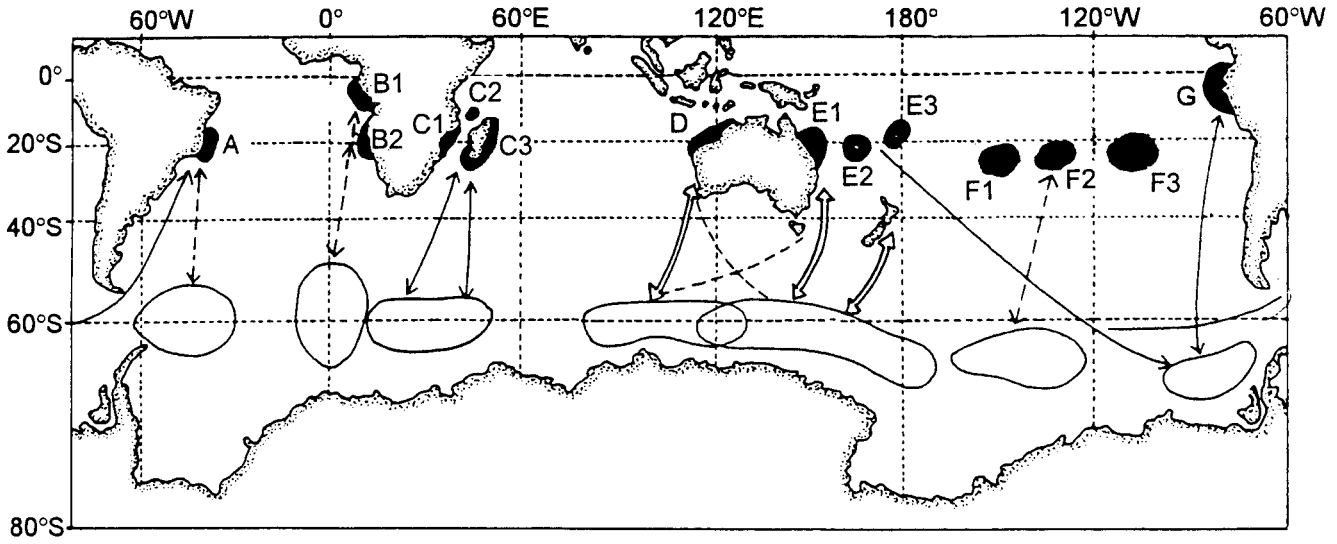


Fig.1. Putative breeding grounds, feeding grounds and migratory routes for Southern Hemisphere humpback whales (updated from fig.1, IWC, 1997b, p.136). Putative stocks and sub-stocks are as follows: A: East South American stock; B1: Gabon sub-stock; B2: Angolan sub-stock; C1: Mozambique sub-stock; C2: Comoros sub-stock; C3: Madagascar sub-stock; D: Western Australia stock; E1: Eastern Australia sub-stock; E2: New Caledonia sub-stock; E3: Tonga sub-stock; F1: Cook Islands sub-stock; F2: French Polynesia sub-stock; F3: Easter Island sub-stock; G: West South American stock.

preparations for this work be made intersessionally (IWC, 2000f, p.34). A first step towards this review is reported in SC/52/IA5. This was supplemented by results generated after comments on the paper were received.

Estimates of population trajectories, carrying capacity and intrinsic growth rates were obtained in SC/52/IA5 by fitting the 'lumped' (sex- and age-aggregated) model used in the Catch Limit Algorithm to: (a) a single estimate of current abundance; and (b) an estimate of rate of increase (ROI) for each putative humpback stock for which these estimates are available. The model also takes as inputs; (c) definitions of stock boundaries on the feeding grounds; and (d) data on historic catch sizes and locations.

Putative breeding grounds, feeding grounds and migratory routes for Southern Hemisphere humpback whales are shown in Fig. 1.

Abundance estimates were available for the Mozambique/Comoros/Madagascar stock (C), the West Australian stock (D) and the East Australian stock (E) only. Rate of increase (ROI) estimates were available only for stocks D and E. The fit for stock C used an ROI equal to the average of that for stocks D and E. A model which treats all seven Southern Hemisphere stocks (A to G) as a homogeneous, rapidly mixing stock, with this average ROI, was also investigated. This was subsequently rejected as implausible and likely to lead to biased inference. The model was also fitted to the West South American stock (G) and the East South American stock (A), using a recent population estimate and (in the case of A) the mean ROI from stocks D and E. For stock G, the ROI used was substantially less than that from stocks D and E, as higher values were incompatible with the historic catch series and current abundance.

The location of a proportion of the catch data was not known, but results were found to be surprisingly insensitive to allocation of catches to stocks. Results were found to be sensitive to estimates of ROI and current abundance.

The Committee **agreed** that the first step at a preliminary assessment of Southern Hemisphere humpback whales contained in SC/52/IA5 was useful, and had focussed attention on what information and additional work was necessary for a fuller assessment. There were some aspects of the results from this paper which seemed implausible and the Committee further **agreed** that it was premature to draw strong conclusions about stock status and trajectories on the basis of these results. It considered what revisions of these analyses might usefully be conducted, including:

(1) revised stock structure;
(2) alternate population dynamics models and fitting procedures;
(3) new or different catch data;
(4) revised and/or new abundance estimates; and
(5) revised and/or new ROI estimates.

This is discussed further under Item 10.1.8, after describing the new data and results that were presented at this meeting.

*10.1.2 Report on calibration of humpback whale earplug readings*

Last year, it was agreed to attempt to calibrate readings of humpback whale earplugs intersessionally. This calibration was to involve a number of researchers undertaking blind test readings of earplugs from animals of a range of ages. Despite a number of potential sources being identified, 27 earplugs were only recently obtained, these being supplied by the Institute of Cetacean Research, Japan. The Committee **recommends** that the exercise should still be carried out, including the provision of photographs to participants for indication of layers counted.

*10.1.3 Update of Antarctic Catalogue*

The progress of the IWC Antarctic Humpback Whale Catalogue was reported in SC/52/IA17, including the cataloguing of 249 photographs in the last year. Further photographs have been received from the Antarctic, migration corridors and breeding grounds. The Committee welcomed the development of an Antarctic Catalogue web page under this proposal. The report included an application for some maintenance funds for the forthcoming year, and the Committee **recommends** that this work be continued.

*10.1.4 Estimates of abundance and rate of increase*

Estimates of population size and ROI were reported in SC/52/IA2, for humpback whales in Area IV, using data collected on JARPA surveys between 1989/90 and

1999/2000. Estimated densities increased over the period 1989/90 to 1999/2000 at a statistically significant rate of 13.4% per annum. Reservations were expressed about the plausibility of this estimate, although the estimate has a high CV (29%). It was noted that estimates of humpback abundance from JARPA surveys would not be subject to the same bias as those of minke whales if humpback and minke distributions were uncorrelated. Insufficient information was available at this meeting to reach a conclusion on this issue. The Committee **recommends** that this be investigated intersessionally.

DESS-based analyses used to estimate the abundance of nine cetacean species from IDCR-SOWER cruises were reported in SC/52/O30. Separate abundance estimates were calculated for each set of circumpolar surveys. The Committee discussed the appropriateness of pooling data across circumpolar surveys to estimate: (a) a common effective strip width (esw); and (b) a common mean school size. The sensitivity of the estimates in SC/52/O30 to a number of factors was discussed in SC/52/O32. Truncation distance for estimation of estimated search width appeared to have little impact in relation to variance estimation, apart from better precision obtained in estimates of blue whale abundance using higher truncation distance. The incorporation of 'like-species' was also investigated.

*10.1.5 Information from the 1999/2000 SOWER circumpolar survey*

Despite poor weather in Area I, trackline coverage was good. A total of 83 sightings of 178 humpback whales was made, and biopsies were obtained from 37 animals. More samples could have been obtained if logistical difficulties had not led to the correct ammunition for the biopsy guns being unavailable. The Committee expressed its gratitude to the Japanese government for providing the *Shonan Maru* and the *Shonan Maru No. 2* to conduct the research.

*10.1.6 Stock structure*

SC/52/IA4 used mtDNA and nuclear DNA to examine genetic diversity in humpback whales from feeding grounds of Areas I (stock G), III (stocks B and C), IV (stock D), V (stock E) and VI (stock F). The level of genetic diversity in the Antarctic was high for both genomes. The nucleotide diversity of the mtDNA and the mean expected heterozygosity of the nuclear loci were estimated to be 0.026 and 0.81 respectively. Sex was determined for all samples. A female from which a biopsy was taken in Area IVE in 2000, was recognised genetically as having been first sampled in Area VW in 1995. It was agreed that the results from this analysis were generally compatible with the feeding/breeding stock scenario given in SC/52/IA5.

SC/52/IA6 reported results of photo-identification comparisons from Oceania (New Caledonia, Tonga, New Zealand – in putative stock E, and the Cook Islands and French Polynesia – in putative stock F). Matches indicated limited movement among these breeding areas (including between breeding grounds E and F). Comparisons with photographs from western South America and the Antarctic Peninsula confirmed the apparent separation between Areas V/VI and Area I, a result that was supported by genetic analysis in SC/52/IA14. The authors suggested that abundance of humpbacks in Oceania appears to remain low.

Genetic analysis of humpbacks from breeding/migratory areas of the southwestern Atlantic, southeastern Atlantic and southwestern Indian Oceans was summarised in SC/52/IA11. High haplotype and nucleotide diversities suggested no substantial loss of genetic variation as a result of exploitation. Conclusions regarding separation or connection between the areas studied were complicated by small sample sizes and questions regarding analytical methods. The Committee **recommends** that this work continue with expanded biopsy sampling, collection of data and additional analyses from the breeding stocks concerned, and with comparisons to the high-latitude feeding areas of the putative stocks.

SC/52/IA14 and SC/52/IA15 reported the results of genetic analyses of humpback whales from the Colombian wintering grounds and the Antarctic Peninsula, respectively. The former found two shared mtDNA haplotypes with the North Pacific, indicating a past or current migratory connection between hemispheres. Comparisons (SC/52/IA15) between the Antarctic Peninsula and wintering grounds of Areas I, III, IV and V, as well as with the North Pacific and North Atlantic, revealed historic interchange between hemispheres and limited connections with other areas of the Southern Hemisphere; the data also supported the known migratory connection between the Antarctic Peninsula and Colombia. Modification of the eastern boundary of the Area I feeding ground from 60°W to at least 58°W was recommended. Overall, the Committee concluded that these genetic results broadly supported the feeding/breeding stock scenario given in SC/52/IA5.

A review of recent and historical evidence for population sub-divisions among humpback whales in Area V and Area VI (corresponding to the boundaries of the proposed South Pacific Sanctuary) was given in SC/52/IA20. Discovery marking and recent mtDNA analysis showed that two wintering grounds in Area V are differentiated genetically and isolated demographically from each other and from Areas VI and I. No historical evidence is available for Area VI wintering grounds, and genetic analysis is incomplete. Analysis of resightings data on individually identified whales from five wintering grounds (three in Area V and two in Area VI) provided preliminary evidence that each is demographically independent, and at least two are genetically differentiated. The paper concluded that these five wintering grounds should be considered individual stocks. The Committee agreed that the sensitivity of the model in SC/52/IA5 to sub-divisions of the E stock should be tested.

SC/52/IA12 presented further details of Soviet catches of humpback whales, noting that two whaling fleets had taken 12,945 humpbacks in 1959/60, most from Area V and Area VI West. Data on location of catch, whale length, sex ratio, sexual maturity and reproductive condition were given. Newly reported Discovery mark recoveries indicate little mixing between stocks D and E (with delineation at 120-130°E), and a probable delineation between eastern Australia and New Zealand stocks at 170-180°E.

The Committee noted that the catches referred to in SC/52/IA12 had already been reported at the 1994 meeting (IWC, 1995c). The new information provided at this meeting relates to the location of catches within Antarctic Area V. The Committee expressed its appreciation to those responsible for gathering these data, which are so important to the Committee's assessment of Southern Hemisphere humpback stocks. The Russian delegation reiterated a statement made in each of the last few years, that the catch data should undergo expert review at a national level, and that this had not been done in this case.

In conclusion, the Committee agreed that reruns of the model used in SC/52/IA5 should: (a) move the boundary between feeding grounds for G and A stocks 10-15° to the

east; (b) split stock E into three sub-populations (Eastern Australia, New Caledonia and Tonga); and (c) split stock F into two or three sub-stocks (Cook Islands, French Polynesia and possibly Easter Island). Although quantitative evidence of the existence of sub-stocks with stocks B and C was limited, there was some evidence to suggest that stock B might comprise two sub-stocks (Gabon and Angola), and stock C, three (Mozambique, Comores, Madagascar). These possibilities should be included in any further analyses.

*10.1.7 Other new information*

Several papers reported on research on humpback whales carried out in the South Pacific region. SC/52/IA7 focussed on the Cook Islands, reporting on sightings, biopsy sampling and natural marking studies. SC/52/IA9 reported preliminary results from a survey on wintering distribution of humpback whales in French Polynesia between 1997 and 1999. Incidental sightings of humpback whales around New Zealand and in the Tasman Sea were reviewed. Given that few reports of humpback whales had previously been received from this region, further work was encouraged.

SC/52/O9 described sightings survey data collected in Areas III and IV over the austral summer of 1999/2000, including photo-identification studies.

SC/52/O20 reported on humpback whale research conducted during the 1999/2000 JARPA survey, in Areas IIIE and IV. A total of 661 schools of 1,269 humpbacks whales was recorded during primary searching. Of these, 78 individuals were photographed for natural marking studies and 42 biopsy samples were collected.

Clapham summarised a proposed assessment of humpback whale populations in the wintering grounds of Areas V and VI. This study is to include photo-identification and genetic sampling components. The Committee recognised the value of this work and similar work planned within breeding stocks off Brazil and the west and east coasts of Africa (stocks A, B and C respectively).

Best noted that humpback sightings data may be available from commercial whaling operations for a period after the species was protected. Reports currently held by the Secretariat may, together with the new Soviet catch data (as reported in SC/52/IA12), assist in providing a more reliable assessment of past humpback whale status than was possible in SC/52/IA5.

*10.1.8 Data and analyses needed to refine the assessment*

The Committee agreed that further analyses of the type presented in SC/52/IA5 will continue to be useful in identifying future information needs, and in developing an assessment of Southern Hemisphere humpback whales. It was also suggested that it would be beneficial if other research groups became involved in doing preliminary assessments.

The aggregated model used in SC/52/IA5 was considered appropriate for this preliminary work. However, more complex models should be investigated in the future, when suitable new data become available. The use of dis-aggregated models (e.g. age-structured) was suggested, as was consideration of the spatial location at which density-dependence takes place (on feeding grounds or breeding grounds), and possible use of models which incorporate depensation.

In conclusion, the Committee **agreed** that further runs of the model used in SC/52/IA5 that take into account the new information presented on stock structure, ROI, abundance and catch data would be useful to its deliberations. These should include the factors given here.

*(a) Stock structure*

New runs assuming a single circumpolar stock were not considered useful. Stock-specific runs would not be possible for stocks B and F because no suitable abundance estimates are available. Decisions on the most appropriate sub-division of stocks need to be addressed in order to use the new information on stock structure and catch in runs of the model of SC/52/IA5. An Intersessional e-mail Group convened by Bannister was established to address this issue before the 2001 Committee meeting.

*(b) Catch data*

It was noted that additional catch data to those used in SC/52/IA5 are available, and should be used in future analyses. The Committee **recommends** that CPUE data be used to investigate the validity of the modelled population trajectory. Similarly, abundance estimates from feeding ground surveys might be used as a check of model runs which use breeding ground surveys as input, as previously suggested in IWC (1998d). In order to use the new information on catch data, it was noted that the catch record should be updated intersessionally. The Committee **agrees** that Findlay should be responsible for collating and making available the latest catch series, and requests that any revisions to the catch history be sent to him.

*(c) ROI and abundance estimates*

Estimates of ROI are available for only two of the seven putative stocks (D and E). Concern was expressed that using the ROI estimates from these two stocks for other stocks may not be appropriate.

Several breeding areas currently lack estimates of ROI and abundance. It was noted that photo-identification studies were being conducted in some of these, and it may therefore be possible to get estimates for these areas from existing data. It was further noted that a shore-based survey was planned for stock C (or at least its Mozambique component), subject to obtaining funding. The Committee **recommends** that ROI and abundance estimates be obtained in both these cases and for other stocks, in particular those for which none was currently available. It was noted that an additional survey was being conducted off East Australia this year. The Committee **recommends** that this work be completed.

Concern was expressed that the range of values used for ROI might not reflect population growth rates that are biologically plausible. In particular, the upper confidence limits used (14.4-16.9%) were thought to be implausible given humpback whale life history. The Committee agreed that the range of values used for future analyses should be reconsidered. A review of humpback life history literature and suggested plausible range of population growth rates are contained in Appendix 5 of Annex G.

A revised table of available abundance estimates, together with a summary of the new ROI estimates presented at the meeting was created, and is contained in Appendix 6 of Annex G, although many of these may be biased.

**10.2. Southern Hemisphere minke whales – prepare for review of abundance estimates in 2001**

*10.2.1 Report of Intersessional Steering Group*

Due to lack of time at the 1999 meeting of the Committee, the terms of reference of the review were not well specified. An Intersessional Steering Group developed the following list of topics that could usefully be incorporated into the review.

(1) Consider the most appropriate estimation methods and the resulting estimates of abundance for the areas

surveyed on individual surveys, based on standard line-transect methods.
(2) Consider alternative estimation methods and the resulting estimates of abundance.
(3) Integrate IWC/IDCR-SOWER, JARPA, JSV and other data to provide time series of abundance estimates at a circumpolar level, and in smaller areas of interest.
(4) Estimate trend over the period covered by the IWC/IDCR-SOWER surveys, building on (1) to (3) above.
(5) Integrate the results from (1) to (4) above, together with biological information, in population dynamics models to provide an assessment of Southern Hemisphere minke whales.

A central issue relating to the scope of the review is whether or not it should include point (5) above. It was noted that it has been 10 years since the Comprehensive Assessment of minke whales and that an assessment of this nature would be timely. While recognising that it involved a considerable workload, the Committee agreed that this work should be undertaken, and that planning for an in-depth assessment of Southern Hemisphere minke whales should begin.

It was recognised that even without point (5) above, the review would take more than one year to complete. Details of tasks and approaches relevant to points (1) to (4) of the review are considered under Item 10.2.7, while priorities are considered under Item 10.3.

*10.2.2 Report on relevant DESS work*

All changes to the IWC Database and Estimation Software System (DESS) requested at the 1999 meeting of the Committee have been made. Details are given under item 6.2.1 of Annex G.

Changes included updating definitions of species codes in response to recommendations made by a Working Group Chaired by Bannister to address the issue. The Working Group met again at this year's Committee meeting to finalise its proposals regarding standardising codes for most comparable estimation across years. These are contained in Appendix 8 of Annex G. The Committee **recommends** that these proposals be adopted. The Committee also endorsed a **recommendation** of the Working Group that data from JARPA be analysed to determine the proportion of dwarf minke whales, both in the minke whale catch data and in sightings by 10° longitude and 1° latitude sector in the area covered by JARPA.

A proposal from an Intersessional e-mail Group under Hammond to address the issue of how to deal with the first five IWC/IDCR surveys (1978/79-1982/83) in the IWC/IDCR-SOWER series, which used a different design from subsequent surveys, was circulated. Proposals relating to including in DESS an option for treating stratified estimation from these surveys in a manner which is consistent with previous decisions by the Committee about these surveys, but is different from later surveys, was agreed. Furthermore a proposal that an option also be included for RMP *Small Area* abundance estimation that is based upon pre-specified 2.5° longitude sectors was also agreed. These issues will be considered further in the review of minke abundance estimates.

*10.2.3 1999/2000 IWC/SOWER cruise and other new information*

Relatively few minke whales were sighted on the 1999/2000 IWC/SOWER Antarctic survey, conducted in Areas I and II. Similar results were obtained on the CCAMLR survey, and it was noted that low numbers of sightings of minke whales in this area had been found on previous IWC/IDCR surveys. Minke whale biopsy sampling was included in the survey protocol for the first time, but due to the generally poor weather on the survey, only one minke biopsy was attempted, and this was not successful.

Comparison with the results from the 1997/98 IWC/SOWER survey (SC/52/IA13) revealed an inconsistency in the way the sightings code 'undetermined minke' had been used on the two surveys. While the reasons for this are now clear, this should be considered during the review. Two further such issues arose from SC/52/IA13. Firstly, the dynamic ice-edge in Area II resulted in very little overlap with areas covered on previous surveys and this highlighted a need for versatile general methodology for comparing abundance estimates between surveys. The possibility of consistent differences between the detection function shapes in closing and IO mode was raised. This and other issues relating to trends in detection function estimates also require investigation in the review.

SC/52/IA18 reported on an ongoing project started in 1998 with support from the Brazilian Environmental Agency and the Brazilian Navy. This involved sightings surveys on the former whaling grounds off northeastern Brazil. The Committee **recommends** that surveys be expanded to include the entire breeding ground, and that consideration be given to estimation of $g(0)$. There are plans to expand the surveys to include photo-identification and biopsy work in the future. The Committee looked forward to seeing results of this further work in due course.

Results relating to minke whales from the 1999/2000 JARPA survey in Area IV and the eastern part of Area III were also presented (SC/52/O20). Minke whales were the most frequently sighted species, and no dwarf form minke whales were sighted. Nishiwaki reported that the sighting rate on this survey was higher than that on any previous JARPA survey in Area IV.

*10.2.4 Progress on GAM-based estimators for JARPA and closing mode data*

With a view to estimating relative or absolute minke whale abundance from JARPA surveys, the performance of abundance estimators, and estimators based on generalised additive models (GAMs) in particular, were tested by simulation (SC/52/IA19). There was some improvement in the performance of a GAM-based estimator over that previously reported, and the method performed consistently better than a conventional line-transect estimator, but bias remained somewhat sensitive to the degree of clustering of minke schools. In the light of the simulation results, and the similarity of closing mode on IWC/IDCR-SOWER surveys and JARPA SV mode, there was agreement that estimates from these two modes could be used in the same way. However, it was pointed out that the simulations indicate that the bias in closing mode depends on the degree of clustering, and that there was a need to re-evaluate the use of closing mode as an index of relative abundance. This was noted for the review of minke abundance estimates. It was also noted that since IWC/IDCR-SOWER surveys alternate between closing and passing modes, it is in principle possible to calculate a correction factor that accommodates the variable bias in closing mode estimates due to clustering.

The Committee **recommends** that spatial modelling methods which are able to estimate the degree of clustering reliably without strong assumptions about its nature or degree should be investigated. These have the prospect of

providing objective estimates of the degree of clustering on real surveys, of being able to accommodate clustering which varies in degree within a single survey, and of providing unbiased GAM-based estimators.

*10.2.5 Testing and accounting for responsive movement*
No new information was available to the Committee on this topic.

*10.2.6 Stock structure*
SC/52/IA3 presented a Restriction Fragmental Length Polymorphism (RFLP) analysis of mtDNA in the ordinary form minke whales from Antarctic Areas V and VIW, using samples from the 1988/89-1998/99 JARPA surveys. Within Areas V and VIW some preliminary evidence was found of genetic differentiation of group VW, which seem to be differentiated from both the 'western stock' and from the rest of the groups examined in Areas V and VIW. This preliminary finding requires further investigation.

Information on 78 whale tags recovered on the factory ship *Sovietskaya Ukraina* from 1972 until 1986 was presented. Best, Kato and Mikhalev reported than in the case of minke whales, all but one of the Discovery marks had previously been reported to the IWC Secretariat, but none of the Soviet tags had.

The Committee appreciated receiving these data and would welcome new data in the future.

*10.2.7 Finalise plans for review*
The Committee agreed that high priority be given to the validation and incorporation of existing IWC/SOWER survey data into DESS. The data from the 2000/01 survey, if it goes ahead, should also be incorporated as soon as possible. The Committee recognised the value of previous analyses and noted that it was important to have as long a series of estimates as possible in order to address the issue of trend most effectively.

While the estimates of Southern Hemisphere minke population sizes accepted in the Comprehensive Assessment[2], totalling 760,000, which were obtained using IWC/IDCR data from 1982/83 to 1989/90, were the best available at the time for the years surveyed, they are no longer appropriate estimates of current minke whale abundance. Some initial crude extrapolations of the incomplete third circumpolar set of surveys led to a point estimate that was appreciably lower than the total of the previously agreed point estimates by Area from the Comprehensive Assessment[2]. However, there are a number of factors that make interpretation difficult, including:

(a) differences in survey area coverage;
(b) changes in position and configuration of the ice edge; and
(c) changes in the proportion of sightings classified as 'like-minke'.

In addition, without calculation of confidence limits for the crude point estimate, it was not possible to conclude whether the appreciable difference noted above was statistically significant. Although there are plans to address these difficulties, the Committee is unable to provide reliable estimates of current minke whale abundance at this time. Some considerations that are likely to be pertinent to the resolution of these issues are given in Appendix 10 of Annex G.

Butterworth noted that analyses of minke whale catch-at-age data in Butterworth and Punt (1999b) indicated that somewhat lower recent estimates were to be expected, *inter alia* as the natural consequence of a fast growing resource over-shooting and then returning to a new carrying capacity, and that this had to be taken into account in interpreting the results reported above. In response, Smith believed that the rough extrapolations, while raising concerns about possible declines in minke whale abundance are an insufficient basis for discussing trends in abundance at this time. He also noted that Butterworth and Punt (1999a) involved fitting a simple single species density-dependent model to the results of VPA analyses, and suggested that a broader range of models would need to be examined to interpret possible changes in abundance. These models might include the observed changes in the Antarctic physical and biological environment, for example, changes in krill abundance, and interactions with other cetacean populations. There was insufficient time to discuss these issues in detail.

Ohsumi noted that the minke abundance estimates in Areas IV and V from the JARPA surveys from the 1989/90 to 1995/96 surveys contained in Nishiwaki *et al.* (1997), presented to the JARPA Review meeting, do not indicate that comparable estimates of current abundance may prove to be lower. Interpretation of these results is difficult for the same reasons that interpretation of the IWC/IDCR-SOWER results is difficult.

The Committee **agreed** that there was an urgent need to address trend-related issues, and to provide up-to-date estimates of minke whale abundance.

Some members expressed concern that the results of abundance estimation analyses from IWC/IDCR-SOWER surveys had been reported in different ways for Southern Hemisphere blue and minke whales. For blue whales, though crude extrapolated point estimates of abundance would be higher than those for the second circumpolar survey, the sub-committee responsible (see Annex H, item 5.2) decided not to report this, arguing on scientific grounds that further analyses were first needed. Yet subsequently in another sub-committee (see Annex G, item 6.7.2), given essentially the same comparison of crude extrapolated point estimates of abundance for minke whales, similarly derived, the fact that the later estimate was lower was reported on argued scientific grounds. Although the minke whale estimates concerned would be more precise than those for the blue whales, this is more than offset by the fact that, in relative terms, the extent to which the later blue whale estimate is higher is an order of magnitude greater than that by which the later minke whale estimate is lower. In these circumstances, they considered that the Committee had no scientifically defensible option other than to proceed consistently and either report both differences, or report neither. They preferred that both differences be reported.

Others did not agree that there were inconsistencies in the reporting of results for Antarctic minke whales and Antarctic blue whales between different sub-committees. They felt that the need for current estimates of abundance for Antarctic minke whales is substantially different from that of Antarctic blue whales. They argued that for good reasons, primarily a lack of information, no Comprehensive Assessment of Southern Hemisphere blue whales has been conducted. Further, that there is no management need for the Committee to provide scientific advice on the current abundance of blue

[2] IWC, 1991b, p.117 table 1, with a minor correction in IWC, 1993a, p.114, table 1.

whales. Therefore, the Committee simply reported a range of abundance estimates for Antarctic blue whales, pending further analysis to address those issues identified last year that had not yet been addressed.

In contrast, they noted that in 1990, the Committee conducted a Comprehensive Assessment of Southern Hemisphere minke whales, and this year agreed that they are no longer appropriate estimates of current minke whale abundance. Unlike the blue whale case, these members believed that there is a clear need for scientific advice regarding the current abundance of Antarctic minke whales. Finally, they believed that the reason the Committee noted that the total of estimates from initial crude extrapolations of the incomplete third circumpolar set of surveys was appreciably lower than the total of the previously agreed point estimates by Area, was to emphasise the need to use up-to-date estimates of abundance when evaluating the effect of scientific catches on stocks of minke whales in the Antarctic.

Morishita associated himself with the views of those who felt there was an inconsistency in the way Antarctic blue and minke whales had been dealt with. He further stated, in response to the views expressed above, that the management needs for blue whales are much greater than those for minke whales because the size of the blue whale stock is much smaller than that of minke whales. In Morishita's view there were more than half a million minke whales and the research take of 400 animals will have negligible effect on the stock.

### 10.3 Work plan

*10.3.1 Southern Hemisphere humpback whales - preliminary assessment*

The Committee felt that new data gathering activities and work that would generate information on stock structure, rates of increase, and abundance, particularly for stocks where these were not currently available, should take highest priority. It **recommends** that work to this end take place at the earliest opportunity. Specific tasks in this regard are listed under 'Southern Hemisphere humpback whales' (1) to (4) in Annex G, Appendix 11.

Revising the results from SC/52/IA5 in the light of new data was also considered important for the Committee's deliberations at its next meeting. The Committee **recommends** that the work detailed in this regard under item 5.8 of Annex G be completed.

It further **recommends** that the work of maintaining the Antarctic photo-catalogue and earplug calibration continue.

Specific other tasks identified as important for improving the preliminary assessment are listed in Annex G, Appendix 11.

*10.3.2 Southern Hemisphere minke whales – preparation for review of abundance estimates*

At its 1998 meeting, the Committee recommended that the third circumpolar set of surveys should be completed as soon as possible. Last year it agreed to delay by one year its work towards that objective, given the opportunity to collaborate with SO-GLOBEC in the SOWER 2000 research programme (IWC, 2000f, pp.31-34). This year the Committee found itself in the position of being unable to undertake that cooperative work. It therefore **agreed** with the sub-committee's recommendation for participation in the 2000/01 Antarctic minke whale survey, recognising, however, that a final decision would be made during its consideration of the budget for 2000/01 and its overall work priorities under Agenda Items 21 and 24. Details of the proposed survey are contained in Appendix 12 of Annex G.

The Committee considered that it was unlikely that all the methodological development and analyses necessary for a proper review of Southern Hemisphere minke whale abundance estimates could be completed in one year. While the value of the analyses of IWC/IDCR-SOWER data conducted to date was recognised, an integrated approach to the future analysis of IWC/IDCR-SOWER data was proposed. In the light of recent methodological advances, and the diversity of expertise represented in the Committee, it believed that this approach would make best possible use of these data and best capitalise on the substantial investment in gathering the data. The Committee strongly supported this proposal (contained in Annex G, Appendix 13). It believed that the most effective way forward was to hold an intersessional workshop involving participants with a broad range of relevant experience and expertise, in order to review results and methods, develop a collaborative research plan for the minke abundance review, and initiate work to this end.

The Committee also considered it important that results that will facilitate the review be presented at its next meeting. In this regard, it **recommends** that the following tasks be assigned high priority.

(a) Enter existing sightings datasets (IWC/CCAMLR and IWC/SOWER datasets) into DESS, update DESS to allow use of a fuller complement of the analysis options available in the programme Distance.
(b) Complete a conventional line transect analysis of all surveys in IWC/IDCR-SOWER series using consistent methodology.
(c) Complete some methodological development and associated analyses necessary to estimate trend, and address the issue of inter-survey comparability of abundance estimates.
(d) In the light of the proposal referred to above, the Committee **recommends** than an intersessional workshop be held to address the topics identified in Annex G, Appendix 7, to facilitate work on items (b) and (c) above, and to develop a research plan for the completion of this work over the next few years.

The Committee agreed that it was important to make substantial progress on items (a) to (c) by its next meeting. To this end, a sub-group was established to develop plans for an intersessional workshop.

When preparing for and conducting the Intersessional Workshop and subsequent thorough review of abundance estimation, Reilly reminded the Committee that many of the relevant issues had been addressed in previous meetings, for example, the possible use of JSV data to extrapolate abundance to areas not covered by the IWC/IDCR-SOWER surveys for minke whales and other species (Bloch and Desportes, 1991, p.117; IWC, 1993a, p.107; IWC, 1995c, pp.122-123; IWC, 1996b, p.117, 121). Reilly noted his particular concerns about using now dated information from JSV data collected concurrent with only the first circumpolar surveys to extrapolate patterns for the second and third circumpolar surveys, which were conducted many years later. This use would require the un-testable and, in Reilly's view, unlikely assumption that patterns of relative abundance among latitudinal bands remain unchanged across decades.

## 11. COMPREHENSIVE ASSESSMENT OF WHALE STOCKS – OTHER STOCKS (CA/OS) – (SEE ANNEX H)

### 11.1 Western North Atlantic right whales

*11.1.1 Review report of Intersessional Workshop on Status and Trends*

The Workshop proposed last year (IWC, 2000f, p.30) was held at Woods Hole, USA 24-27 October 1999. Its report is given as SC/52/Rep1. It was held in the context of the Committee's serious concerns over the status of the stock, and last year's strong recommendation that the Comprehensive Assessment of this stock should remain of high priority. Its terms of reference, as carried forward from the 1998 meeting, had been determined as:

> 'the Comprehensive Assessment of the western North Atlantic right whale should be a priority topic... with its objectives being to establish the current status and dynamics of the population'.

The Workshop reviewed the available data, available population models, status and trends. The latter included discussion of factors affecting trends and a comparison with other populations, particularly those in the Southern Hemisphere which, in contrast with those in the North Atlantic, are showing higher reproductive rates and population increase.

A summary of the Workshop's discussions, conclusions and recommendations is given in Annex H, item 4.1.1.

The Committee commended the meeting organisers and considered its recommendations, which are discussed further in Item 11.1.3.

The Committee also received the report of a Workshop on the Causes of Reproductive Failure in North Atlantic Right Whales and New Avenues of Research held at Falmouth, Massachusetts, 26-28 April 2000 under the auspices of the US National Marine Fisheries Service (SC/52/OS14). The Workshop had been prompted by evidence that reproductive dysfunction may be a contributory factor in the population's failure to recover. Its goal was to identify factors potentially affecting reproduction and to develop an appropriate and feasible research strategy to investigate them. A summary of its discussions and conclusions is given in Annex H, item 4.1.2. The Committee's consideration of its recommendations is reported in Item 11.1.3.

*11.1.2 Review report on long-term effects of tag implantation*

The Committee was provided with the report of a Workshop on the Effects of Tagging on North Atlantic Right Whales (Kraus *et al*., 2000) which had gathered together experts from a variety of relevant disciplines, including veterinary practitioners, to review documentation and photographs of individual animals before and after tagging. Some of the fifty-five individuals tagged between 1988 and 1997 had developed swelling at the implantation site. However, the report was inconclusive as no evidence had been provided to definitively evaluate the effects of tagging on right whales. Some participants believed that the swellings were of an expected nature for the level of trauma induced, and that the individuals had elicited a physiological response to a penetrating injury and open wound. Normal healing response would involve a decrease in local and regional swelling over time. There was no evidence to suggest that the tagging had induced any incidents of mortality. The Committee recognised that time scale information on the effects of tagging would be useful, notably the timing and type of tissue response at the site of implantation; it **recommends** that such an analysis be conducted.

In discussion of a request for a more precautionary approach, particularly in regard to the possible effects of stress, the Committee noted that an analysis had found no differences in survival of tagged and non-tagged whales. Some concerns were expressed regarding tagging mature females with calves and the possible negative effect this could have on their reproductive success. However, it was suggested that the risks of tagging must be balanced against the benefits of the information derived. The Committee **recommends** that a further analysis of the risks of using implantable tags with this species be undertaken, paying particular attention to possible differences in reproductive success in tagged versus non-tagged females.

In view of the ready access of scientists to subsistence harvested bowheads at Barrow, Alaska, the Committee **recommends** that implantable tags proposed for use on the North Atlantic right whale be tested on harvested bowhead whales. Appropriate tests could include assessing depth and nature of the wound, extent to which epidermal material is carried into the wound, and the holding strength of attachment devices.

*11.1.3 Action arising*

The Committee **endorses** all the recommendations from the Workshop on Status and Trends (SC/52/Rep1), and from the Workshop on Causes of Reproductive Failure (SC/52/OS14).

In discussion of the recommendations from the Workshop on Status and Trends, the Committee noted that the Workshop had agreed that at least two aspects should be separated out when future research strategy is decided, i.e.

(1) research permitting documentation and scientific insights into population dynamics and ecology of a whale population that has been reduced both to very low absolute numbers as well as to a small fraction of its original population size;
(2) research permitting implementation of appropriate management actions and evaluation of their performance.

The Committee confirmed that whilst both are important, and recommendations for both have been developed, the highest priority must be accorded to category (2). Despite the improvements that can and should be made in terms of refining the modelling of this population, it is clear that none of those refinements will lead to a change in the conclusion that:

> *by any management criteria applied by the IWC in terms of either commercial whaling or aboriginal subsistence whaling, there should be no direct anthropogenic removals from this stock.*

The evidence that this population (possibly the only potentially viable population of this species) is in serious danger is compelling, and the need for further research under category (1) above should not be seen as a reason for delaying immediate and highest priority action under (2). In short, the population:

(a) is at very low absolute abundance and thus highly vulnerable to stochastic variation in population dynamic processes;
(b) is, unlike a number of Southern Hemisphere populations, not recovering despite protection from whaling since the 1930s;

(c) appears to be decreasing at present as a result of:

(i) a decreased rate of survival in the 1990s versus the 1980s;
(ii) an increase in effective calving interval in the 1990s; and

(d) is subject to known direct anthropogenic removals (ship strikes and entanglements in fishing gear) that have been increasing in recent years.

In addition, there is some evidence (e.g. from skin lesions) that the overall health of the population has decreased since the 1980s.

*(a) Research recommendations*

The Committee noted the priorities applied by the Workshop to the research proposals it had developed, as in table 1 of Annex H, which also includes a summary of progress made since the Workshop. In particular it regarded the proposed Genetics Workshop (SC/52/Rep1, item 6.1.1 and Annex E) as especially important.

The Committee **recommends** that the highest priority be assigned to research into means of reducing mortality from entanglements and vessel collisions. It further **recommends** that an international multi-disciplinary Workshop be held to review progress and to identify priorities for further work and the most promising approaches to management action to reduce mortality, as detailed in SC/52/Rep1, item 8.1.2.

It is essential that every effort be made to ensure that requisite data are available. At a minimum this must include, for the entire east coast of North America, good temporal and geographical information on vessel traffic, fishing gear effort and distribution. The Committee **recommends** that the Commission urges the relevant governments to ensure that such data are recorded, collated and made available. In this context, the Committee **recommends** that a Geographic Information System (GIS) project be conducted to overlay effort data on to information on right whale distribution together with that of fishing gear, shipping activity and other threats.

For the multidisciplinary Workshop to be successful it is important that relevant national and international organisations are invited as well as experts, e.g. in right whale biology, shipping technology, fishing gear. A steering group had been established with responsibilities as in SC/52/Rep1, item 8.1.2.

Notwithstanding that research into reduction of mortality should be given highest priority, the Committee also recognised that reduced calving success may reflect the impact of a variety of human activities that alter coastal habitats. It **recommends** that research on these and other habitat quality issues be intensified and that the proposed Workshop evaluate the impact and mitigation of habitat stressors.

*(b) Management recommendations*

The Committee concurred with the Workshop in **reiterating that it is a matter of absolute urgency** that every effort be made to reduce anthropogenic mortality in the population to zero. This is perhaps the only way in which its chances of survival can be directly improved. There is no need to wait for further research before implementing any currently available management actions that can reduce anthropogenic mortalities.

It is **recommended** that the Secretary write to the International Maritime Organisation (IMO) to underscore the severity of the current status of North Atlantic right whales, and to request that organisation's assistance with implementing measures within the international maritime community for the conservation of this critically endangered population.

It is further **recommended** that the data on the number of ships entering the area and the speeds at which they are travelling be investigated, and that whale distribution be overlaid with traffic distribution and shipping lanes to assess the need and feasibility of further regulatory actions related to ship routing and reduction of ship speed.

In addition to the above, arising directly from the Workshop, the Committee **recommends** that, for the immediate future, and given the important management implications of the estimate of survival rate, annual updates of survival rate estimates be presented to, and considered by, the Committee. That would have the further benefit of taking advantage of data now available from a major offshore area poorly sampled during the early 1990s. It also **recommends** that it would be useful to include other right whale populations in a comparative analysis of genetic diversity and reproductive rates.

The Committee draws the Commission's attention to concerns expressed at the Workshop over transfer of biological samples under CITES regulations (SC/52/Rep1, item 6.1.1). Transfer of samples is still in certain cases very difficult and can constitute a major impediment to research on critically endangered species such as northern right whales. It **reiterates** its earlier **recommendation** that the Commission should strongly urge member nations to facilitate the transfer of such samples, and that the IWC Secretariat approach the CITES Secretariat to consider ways of expediting permits for *bona fide* institutions conducting conservation-related research on endangered species.

*(c) Workshop on Reproductive Failure*

In considering the results of the Workshop on Reproductive Failure, the Committee **agreed** that if every effort is going to be made to improve the status of the North Atlantic right whale, it is important that the reasons for the reproductive dysfunction be established as soon as possible. If calf production does not recover from the very low levels observed over the last three years, even the complete removal of anthropogenic mortality might be insufficient to permit the population to increase. The Committee therefore **strongly recommends** that the programme of research discussed in SC/52/OS14 be supported to the fullest extent possible.

The Committee **agrees** that none of the five possible factors considered can be discounted as a possible cause of the reproductive dysfunction observed in the North Atlantic right whale. It is likely in fact that no one factor is entirely responsible, and two or more factors could be interacting, possibly over different time scales. It is therefore important that the proposed research programme consider all possible factors and be interactive and multi-disciplinary in nature. For such a programme to be successful, there needs to be strong central coordination. The Committee therefore **endorses the recommendation** that a steering committee be established to develop protocols, review results and progress, and recommend revisions to the research programme recommended in the report.

The Committee also **recommends**:

(i) the development of a comprehensive database (coordinated through the North Atlantic Right Whale Catalogue) linked for all whales across all research programmes, which would allow for multivariate analyses using data from photo-identification studies,

health assessment, genetics, pathology, contaminant and biomarker studies, biotoxins, and blubber thickness/composition;

(ii) full support for continuation of the photo-identification programme, as the catalogue and database must be integral components of the proposed research programme, and continuity of the time series of sightings data will be essential for determining whether reproductive performance continues to decline or improves.

The Committee **agrees** that the Secretary should be asked to write to the US National Marine Fisheries Service (NMFS) and the Canadian Department of Fisheries and Oceans, informing them of the Committee's serious concerns over the status of this stock, and seeking their support for implementation of the various actions recommended.

### 11.2 Southern Hemisphere blue whales

*11.2.1 Differentiation of sub-species*

On the 1999/2000 IWC/SOWER cruise only one blue whale was recorded. It had been identified as a true blue whale by the topman but no identification photographs or biopsy sample could be obtained because of bad weather conditions.

The Committee reiterates the importance of resolving the issue of the proportion of pygmy blue whales south of 60°S in relation to interpretation and possible correction of abundance estimates for true blue whales in this region. It noted that it was still not possible to genetically distinguish true blue (*Balaenoptera musculus intermedia*) and pygmy blue whales (*Balaenoptera musculus brevicauda*), but that work was ongoing. The Committee **renews its request** that additional material, especially from known true blue whales, should continue to be sought for genetic analysis to assist in the resolution of this issue.

Acoustic studies on blue whales during the 1999/2000 SOWER cruise using sonobuoys and hydrophones from two vessels had resulted in recordings of sounds similar in frequency range, but different in other characteristics, from those made by true blue whales.

The Committee **agrees** that, ideally, dedicated cruises should be undertaken to areas of known concentration of true blue whales although opportunities should also be taken to take advantage of 'piggy backing' on other operations, for example, Antarctic surveys for other purposes e.g. krill. While more rapid progress with the acoustic work is desirable, that would depend on more frequent contacts with blue whales. As the population is still small and scattered around the Antarctic, the probability of encounters is low. The current survey design, which allocated a sizeable proportion (25%) of the IWC/SOWER cruise to blue whale research, and which allowed this to be flexible in nature to take advantage of blue whale encounters, was probably the best that could be achieved at present, until areas of consistent blue whale abundance were discovered.

The Committee also reviewed proposals for analysis of existing recordings from SOWER and IWC research cruises and **agrees** that the work detailed in Annex H, Appendix 2 should be undertaken.

Two studies had attempted to determine from catch data the proportion of pygmy blue whales likely to be present in waters south of 60°S. SC/52/OS4, using biological data from Japanese commercial catches in the Antarctic, 1950/51-1962/63, suggested that the two sub-species might be geographically separated in mid-summer, but it was likely that a few pygmy blue whales could be found south of 55°S and the Antarctic Convergence. SC/52/OS15 examined the possible occurrence of pygmy blue whales in catch records of purportedly true blue whales. The analysis focused on pregnant or lactating females less than 75ft (23m) in length on the assumption that sexually mature animals in this category would be too small to be true blue whales. Uncertainties in the catch records made detailed statistical analysis inappropriate; nonetheless, the results indicated that the southern margin of the pygmy blue whale's range extends south of 60°S in low numbers compared to true blue whales.

Noting that the length distributions of pregnant true and pygmy blue whales appeared to overlap, and that only 2% of the pregnant blue whales in the historic Antarctic catch south of 60°S were less than 75ft, the Committee agreed that the data presented in SC/52/OS15 provided no unequivocal evidence of the presence of pygmy blue whales in the catch south of 60°S, and that if pygmy blue whales were present they were unlikely to constitute more than 5% of the catch.

The Committee noted that on the 1999/2000 JARPA cruise in Antarctic Areas IV and IIIE there had been 53 primary sightings of blue whales, in 25 schools.

*11.2.2 Review abundance estimates*

The Committee considered the abundance estimates of blue whales derived from the three IWC/IDCR/SOWER circumpolar cruises, as presented in SC/52/O30.

The Committee **agrees** that the effective strip width and mean school size were better estimated on a circumpolar-specific basis rather than pooling over the three circumpolar cruises. Based on an adjustment of the estimates of SC/52/O30 in this manner, the Committee **agrees** that an abundance estimate for blue whales (not designated by sub-species, see penultimate paragraph of Item 11.2.1) south of 60°S over the last two decades of the 20$^{th}$ century was in the range of 400 (CV = 0.4) to 1,100 (CV = 0.4). The estimate is negatively biased because the areas south of 60°S were incompletely surveyed.

The Committee also **agrees** that inferences about trends and their statistical significance could not be made at this time using the above estimates for a number of reasons:

(1) different areal coverage between the ice-edge and 60°S during the three circumpolar surveys;
(2) classification over time of 'blue whale', 'like blue whale', 'unidentified large whale blue' and the other identified whale species codes;
(3) differential amounts of closing and passing modes over the years;
(4) other sources of variance not accounted for in the estimated sampling variances; and
(5) the possible effect on the estimation of trends of increasing estimates of effective search half-width and change in school size over time.

In reviewing progress on the additional analyses recommended last year (IWC, 2000f, p.29) the Committee noted the following.

*(1) Extrapolation using the JSV data*

It had not yet been possible to undertake the work proposed. A number of different views were expressed concerning the value of continuing as recommended last year. The Committee agreed that there needed to be further consideration of the use of these data, particularly in light of discussions in Annex G.

The Committee noted that conditions for using JSV data had been agreed previously as follows. The data now stored in the DESS system can be accessed following requests:

(a) from the Committee for the Comprehensive Assessment of whale stocks;
(b) from the Committee for the specific study of the species listed in the nomenclature of the IWC;
(c) for collaborative research with the data holder (Kato) and relevant Japanese scientists.

*(2) Examination of the most appropriate truncation distance*
The Committee agreed that this issue had been addressed satisfactorily in the assessments presented.

*(3) Standardisation on common northern boundaries for estimating rate of increase*
This had not been done. The Committee agreed that alternatives should also be considered but noted that the matter was being considered under Item 10.2.

*(4) Investigation of issues regarding sub-species identification*
This issue is addressed under Item 11.2.1.

*11.2.3 Identify potential areas of concentration for future study*
During the 1997/1998 IWC/SOWER blue whale cruise off the coast of Chile, a total of 39 sightings of 47 blue whales (tentatively identified as pygmy blue whales) was made by the two vessels, and en route to this and other cruises, researchers made incidental sightings of blue whales within the sheltered waters of the Chilean fjord system. There were up to 60 sightings per day; some feeding association with glacial melt waters was noted. It was suggested that if future IWC SOWER cruises were to cover this area, the possibility of surveying Chilean territorial waters (within 12 n.miles) be investigated. The Committee **recommends** future investigations of this potential area of concentration.

Attention was drawn to the areas of high euphausiid concentration used by blue whales as wintering grounds in the eastern tropical Pacific (Costa Rica, Mexico). The Committee **agrees** that when considering possible blue whale wintering areas in the Southwest Pacific, it may be useful to identify areas of warm water euphausiid concentrations.

The Committee encouraged satellite tagging of pygmy blue whales before migration, especially in areas where photogrammetry and biopsy sampling are also possible. Tagging individuals of known length may contribute to clarification of the question of sub-species separation south of 60°S.

SC/50/CAWS14 described a wintering ground for true blue whales off Namibia that had been exploited in the 1920s.

*11.2.4 Other*
SC/52/OS9 documented a localised aggregation of blue whales (sub-species uncertain) occurring in southeastern Australian waters during austral summer and autumn. This appears to be a previously undescribed blue whale feeding area, where whales feed on neritic krill (*Nyctiphanes australis*), aggregating in response to seasonally predictable cool water upwelling. Aerial surveys have found up to 32 blue whales, with feeding behaviour in about 35% of all sightings. It was suggested that as long as the weather patterns and oceanography which drive the seasonal upwelling remain relatively stable, blue whales will continue to feed there. An ongoing ecological study will focus on links between whales, krill, oceanography, bathymetry and climate, with additional focus on numbers and individual identity of blue whales using this area, and on the potential threats to their recovery. Satellite tracking is planned to determine seasonal migratory movements, and analysis of faecal and krill samples has yet to be undertaken.

### 11.3 Other small stocks – review information on status and trends

*11.3.1 Sea of Okhotsk, Baffin Bay/Davis Strait and Hudson Bay stocks of bowheads*
Information on bowhead whales from Hudson Bay/Foxe Basin and Baffin Bay/Davis Straits stocks (SC/52/OS7) indicated from mtDNA analysis that Foxe Basin and Repulse Bay animals are more similar to those in the Beaufort Sea than to those from Cumberland Sound. Aerial photogrammetry suggests northern Foxe Basin is a nursery area. Most stranded animals are juveniles. Habitat preference research has been undertaken.

Finley (2001) reviewed the status of the northwestern Atlantic bowhead, including distribution, movements, population size, general biology, recruitment, mortality and behaviour. The Baffin Bay and Hudson Bay stocks both number in the low hundreds with isolated age- and sex-structured groups showing strong fidelity to particular habitats. The Hudson Bay population's potentially larger size may be due to its nursery ground in Foxe Basin never having been commercially exploited. Killer whales may be a significant source of mortality in the Baffin Bay region, particularly on calves and juveniles during the autumn migration.

Norwegian whalers had seen several bowheads on the west coast of Spitzbergen (at *ca* 80°N) in late May-early June 2000. Some had also been seen there two years ago. In recent years there have been sightings in pack ice east of Spitzbergen, among and south of the Franz Josef Islands and along the west coast of Novaya Zemlya in the eastern Barents Sea. Additional sightings have been reported by Russian aerial surveys in other Arctic regions. The population identity of all these whales is currently unknown.

Work on the Okhotsk Sea bowhead population will continue in summer 2000. A recent publication (Doroshenko, 2000) gives details of North Pacific pelagic Soviet whaling, including 133 animals taken in 1968 in the Shantar area of the Okhotsk Sea, where the present field work is located.

*11.3.2 Western North Pacific gray whales*
In the fourth field season of joint Russian-American research on the gray whale summer feeding ground off northeastern Sakhalin Island, 1999, 88 individuals had been photo-identified and 42 animals biopsied. Genetic analysis so far showed no fixed or diagnostic mtDNA differences between that population and eastern gray whales, although there were statistically significant differences between the two populations in terms of haplotype frequencies. Last year for the first time apparently thin whales had been seen (as elsewhere in the North Pacific), although there were no data on food limitation off Sakhalin Island. Field work will continue in summer 2000; it is anticipated that few new individuals will be identified, indicating that the total population size is perhaps about one hundred whales.

SC/52/SD1 reported molecular analysis of a gray whale sample from a market in Japan, with a mtDNA haplotype identical to a haplotype from the eastern North Pacific population. The high number of haplotypes shared between the western and eastern gray whale populations was noted. From the analysis presented in SC/52/SD16, one author commented that it was very hard to believe that the whale concerned was anything except a western animal. Lento and Brownell noted that the question of the market sample's identity could be resolved by genotype comparison with tissue from the gray whale killed off Hokkaido in 1996.

*11.3.3 Other stocks*

Annex H, item 6.3 gives information on North Atlantic blue whale sightings and biopsy sampling during NILS 1999; satellite tracking of one individual showed deep water movement from the east coast of Greenland to northern Denmark Strait.

SC/52/OS2 gave details of minke whale movements in relation to ice conditions off the Chukotka Peninsula, and reported that large groups, unusual for this species, are often found there.

SC/52/OS13 summarised a two-week ship and aerial survey for right whales in the southeastern Bering Sea in July 1999. Five males were seen and one photo-identified individual was matched with one seen in 1998; photogrammetry and acoustic studies were undertaken. Catches in the Gulf of Alaska and southeastern Bering Sea between 1963 and 1967 (Doroshenko, 2000), as well as off Sakhalin Island in 1967, largely explain why the populations concerned have failed to recover.

Whale observations from Bering Sea fisheries surveys in July 1999 (SC/52/O4) provided uncorrected abundance estimates for fin (the most abundant species), humpback and minke whales. A pair of right whales was reported.

Current knowledge of western North Pacific humpback whales is summarised in Annex H, item 6.3, with information on stock separation, abundance and bycatch. Surveys have been undertaken in conjunction with humpback whalewatching in southern Japan.

Three papers on southern right whales are summarised in Annex H, item 7. SC/52/OS11 compared the distribution of 19th century whaling effort with 20th century sightings of right whales on the coast of southern Africa, and the distribution of 19th century American catches in the corresponding sector of the Antarctic in summer with 20th century catches and sightings. Right whales currently do not seem to migrate as far north in winter as in the last century, possibly because of range contraction or extirpation of one or more local stocks. The absence of 19th century catches in high latitudes of the Antarctic seems to be due to operational rather than biological factors. SC/52/O12 detailed the results of an ongoing project to monitor population and behaviour of the Australian population at Head of the Bight, South Australia. Information is being obtained on reproduction, site use, coastal movements and population size, with an estimate for the latter of 982 for the Australian population, assuming an equal sex ratio and 40% immature. Upper and lower bounds of 1,178 and 841 were obtained with 50% and 30% immature, respectively. Shark predation seems to occur, with neonates especially vulnerable. SC/O99/RW1, presented to the Woods Hole Right Whale Workshop, analysed calving rate variability in southwest and northwest Atlantic right whales. Based on photo-identification data, the method provides a way of determining the difference between estimated calf production each year and that expected from the model estimates of the number of females in each stage of the reproductive cycle. It also provides a means of examining correlations between right whale reproductive success and relevant environmental indices from feeding areas.

Abundance estimates of fin, sei and sperm whales south of 60°S from the three sets of IWC/SOWER circumpolar cruises were given in SC/52/O30. All cruises had been pooled to estimate effective search half-width and school size for fin and sei whales, but sightings were pooled separately for each circumpolar set of data for sperm whales. For blue whales, it had been agreed that circumpolar-specific pooling provided a better estimate. The fin whale estimates were therefore adjusted in the same manner, but there were insufficient sightings of sei whales to pool in this way. A range of estimates was obtained for each species over the last two decades of the 20th century. The estimated abundance of fin whales was in the range 2,100 (CV = 0.36) to 7,000 (CV = 0.55), sei whales from 300 (CV = 0.84) to 900 (CV = 0.51) and sperm whales from 5,400 (CV = 0.38) to 10,500 (CV = 0.15). The estimates are negatively biased since the area south of 60°S was incompletely surveyed. The reservations expressed in Item 11.2.2 concerning inferences of trend also apply to these estimates. In addition, for these three species, it should be noted that the estimates apply only to the southern extremity of their distribution, and hence represent only a fraction of their abundance. Furthermore, for sperm whales, the estimates are additionally downwardly biased since the estimates assume $g(0) = 1$; sperm whales are usually encountered singly, and have long dive times, and hence some schools on the trackline were probably missed.

The 1999/2000 JARPA survey provided further information for fin whales (356 animals (66 schools) in Areas IV and IIIE); sperm whales (206 animals (197 schools) in Areas IV and IIIE) and sei whales (no sightings).

**11.4 Nomenclature**

The Committee noted that under this Item all cetacean species were to be included so as to provide the appropriate naming and classification for relevant Commission publications or documentation.

The Committee **recommends** the revised list of names given in Annex U to the Commission.

The Committee draws particular attention to its decision to retain the generic name *Eubalaena* for right whales, and to recognise the three species *E. glacialis*, the North Atlantic right whale, *E. australis*, the southern right whale, and *E. japonica*, the North Pacific right whale. It also agreed to retain one species of Bryde's whale, *Balaenoptera edeni*, pending resolution of a nomenclatural uncertainty but recognising that more than one species is involved.

In response to a proposal that the Schedule's definition of 'minke whale' should be amended to take account of the recognition that there are two species of minke whale, the Committee agreed to **recommend** that in Schedule section I. Interpretation, paragraph 1A Baleen Whales, the entry 'minke whale (*Balaenoptera acutorostrata, B. bonaerensis*)' should list two species, i.e. the common minke whale, *B. acutorostrata*, and the Antarctic minke whale, *B. bonaerensis*, separately. For right whales (*Eubalaena* spp) the specific name *E. japonica* should be added in the parenthesis. The Secretary advised that as this will require 60 days' notice prior to next year's meeting, these amendments should be included in the Commission's agenda for IWC 53.

**11.5 Work plan**

The Committee considered this Item in the context of this year's agenda, and the priority items recommended two years ago (IWC, 1999b, p.33) taking into account the need for intersessional work where appropriate. The following items will be **considered** for inclusion in next year's agenda (see Item 24).

(1) Western North Atlantic right whales:

  (a) review results of the Genetics Workshop;
  (b) review progress in implementing recommendations in Annex H, table 1.

In respect of item (a) the Committee **recommends** that the Workshop should be strongly supported.

(2) Southern Hemisphere blue whales:

  (a) review progress in sub-species differentiation, including acoustic analysis;
  (b) prepare for stock assessment of Southern Hemisphere blue whales including pygmy blues.

In respect of item (a) the Committee **recommends** that the work detailed in Annex H, Appendix 2 at a cost of US$7,000, be undertaken.

(3) Other small stocks - review available information on status and trends:

  (a) Sea of Okhotsk, Baffin Bay/Davis Strait and Hudson Bay stocks of bowheads;
  (b) Western North Pacific gray whales;

(4) Other stocks:

  (a) southern right whales - review research progress;
  (b) Southern Hemisphere fin whales- review available information on stock status;
  (c) sperm whales - review available information on stock structure.

## 12. STOCK DEFINITION (SEE ANNEX I)

*A note on terminology*

The Committee recognised that 'stock definition' is a succinct but inexact title for this agenda item and Working Group. In order to fulfil its tasks, the Working Group needs to consider *biological* stocks, biological sub-structure *within* stocks, and *management* stocks. The phrase 'stock definition' therefore needs to be understood in the wider context of biology and management.

Historically, the term 'stock' has been used to describe all three aspects above, both within and outside the IWC, and there is no standard definition even of 'biological stock'. In view of this, this item of the report and Annex I use a simplified terminology ('stock', '(sub)stock', 'management stock') but without explicit definitions. It should therefore be noted that the terms used may not correspond exactly to those used elsewhere, for example in the RMP. The Committee noted the desirability of clear and consistent terminology in future.

A minority statement on this matter, given by Butterworth and supported by some others, is given as Annex V.

**12.1 Case studies**

*12.1.1 Review of stock structure in bowhead whales*

Bowhead whale stock structure was reviewed in paper SC/52/SD4. The five unambiguous stocks are: Spitzbergen, Davis Strait, Hudson Bay, Okhotsk Sea, and Bering-Chukchi-Beaufort (B-C-B) Seas. Further substructure may be present in some places at certain times of year. Of the five stocks, the B-C-B, which has been reviewed many times by the Committee, is by far the most abundant, and receives the most management attention as it is subject to a regular aboriginal harvest. This stock migrates north out of the Bering Sea from April to June, past the northern Alaskan coast in spring (when 90% of the native harvest occurs), through the Chukchi Sea, and then further east to the Beaufort Sea. From mid-September to October they migrate west out of the Beaufort Sea, head towards Wrangel Island, and then move southeast along the Siberian coast (October to November) to the Bering Strait. LeDuc *et al.* (1998) found genetic frequency differences between the B-C-B and Sea of Okhotsk stocks, using both mitochondrial DNA (mtDNA) and microsatellites. However, there were no haplotypes known to be unique to the small Okhotsk stock.

A few tens of animals have been seen in the Chukchi Sea in summer. It is not known whether these animals constitute a (sub)stock within B-C-B bowheads. More data from Chukchi Sea summer animals would be needed to investigate this issue.

In developing a management plan for B-C-B bowheads, the AWMP treats them as a single management stock. The Committee **agrees** that this is appropriate. Even if there is separation of (sub)stocks after migration, for instance between the Chukchi and Beaufort Seas, there is little risk of differential local depletion, because harvesting occurs almost entirely during migration, and is spread in time across the duration of migration periods.

In the eastern Canadian Arctic, analyses of mtDNA and microsatellites indicate that bowheads from the Hudson Bay-Foxe Basin stock are genetically more similar to bowheads from the B-C-B stock than they are to bowheads from the much closer Baffin Bay-Davis Strait stock (SC/52/OS7). Aerial photogrammetry indicates sex and age segregation between Hudson Bay and Foxe Basin in summer. More genetic sampling, abundance estimates and photogrammetry is planned for both these eastern Canadian Arctic stocks.

The results in SC/52/OS7 are the first example of shared haplotypes between ocean basins in the Northern Hemisphere for baleen whales. Based on mtDNA, individual bowheads cannot be assigned with certainty even to ocean basin, much less to stock. However, analyses of mtDNA and nuclear DNA do indicate genetic separation within ocean basins (in breeding areas as well as in feeding areas), both between the Okhotsk Sea and B-C-B pair of stocks, and between the two eastern Canadian Arctic stocks. At least one potential criterion for stock definition, the phylogeographic definition of Evolutionarily Significant Units (explained in Item 12.2) would fail to separate the Hudson Bay and B-C-B stocks, despite their near-total geographic isolation for probably thousands of years.

*12.1.2 Review of stock structure in gray whales*

Gray whale stock structure was reviewed in SC/52/SD3. There are two clearly separate stocks, in the eastern and western North Pacific, with a large distributional gap and no reason to expect significant interchange nowadays. However, contact may have occurred as recently as 400 years ago. Both stocks have a long history of exploitation, with the eastern stock reduced to a few thousand animals and the western stock nearly extirpated. Only the eastern stock has recovered significantly since exploitation rates were reduced. The western stock is estimated to number around only 100 animals, all occupying the one known feeding area

off Sakhalin Island. There are no data on the existence or otherwise of sub-structure within the current western stock, although several different migration corridors are known to have been used in the past.

The abundant eastern stock migrates between winter assembly/calving grounds along the coast of Baja California and the southwestern USA, and feeding grounds to the north. Their promiscuous breeding behaviour leaves little opportunity for evolutionary differences, but there is nevertheless detectable site fidelity at various times of year. In summer, most animals feed in the Bering and Chukchi Seas, but some animals are found along the Pacific coast between California and southeast Alaska. The number of Pacific-coast-summering whales is unknown, but may be in the low- to mid-hundreds. Some of these animals are 'residents' that return annually to the same areas, with some 'residents' using several areas within a single year and others staying in one area. Appropriate photo-identification data has only been collected from a few areas to date, so the ratio of 'transient' to 'resident' animals is unknown. A small-sample-size genetic study from a single summering area found no evidence of genetic differentiation between local residents and transients.

Photo-id studies reveal a similar pattern of partial fidelity on the wintering grounds. Although whale numbers were severely reduced in many wintering lagoons during the 19$^{th}$ and early 20$^{th}$ centuries, abundance in all these sites has since increased.

SC/52/SD3 also noted that the mechanism for selecting feeding grounds is unknown. If females learn their preferred feeding areas from their mothers and if a localised summer hunt was regulated using an inappropriate stock definition, it could lead to local depletion or extirpation of resident animals.

SC/52/SD16 examined genetic differences between western and eastern stocks of gray whales. Although there were no fixed (diagnostic) differences between the eastern and western stocks, they were significantly different according to a variety of standard genetic measures of stock differentiation. The lack of diagnostic differences means that tissue from any given individual whale cannot be reliably assigned to stock. Baker reported that this is supported by analyses in SC/52/SD1.

SC/52/SD12 used simulations to investigate the chances of correctly determining whether animals on a coastal summering ground form a distinct sub-stock if a hypothesis test on mtDNA samples is used. It was concluded that a hypothesis test was indeed likely to correctly indicate the presence or absence of stock substructure, although more modelling is required to be sure that a negative test result really is a safe basis for single-stock management. The reason that a hypothesis-test approach to (sub)stock definition may work for gray whales is that the size of the population unit is very small.

Recently, Makah Indians were granted a harvest quota to take up to five gray whales per year in Washington State waters. In 1999 and 2000, the Makah agreed to take only migrating whales in the spring and autumn. However, managers may still wish to know, for future management, whether local summer residents could be depleted if harvested. The Committee agreed that there are important issues of management objectives to be addressed, concerning the size of the unit to be conserved and the appropriate level of precaution; if most animals in an area are transient, a resident group may comprise only a small proportion of abundance, but it may still be deemed worthy of protection.

The Committee agreed that there is a need for a better understanding of site fidelity and potential stock sub-structure in eastern gray whales, to improve advice on management. The requisite information could be gained through continuation and expansion of photo-identification, satellite tagging, genetic and pollutant/chemical research from animals on the feeding grounds. The Committee **recommends** appropriate studies.

### 12.2 Review of stock concepts used in management of species other than whales

The Committee considered stock concepts used in land mammal management, as reviewed in SC/52/SD9. Most approaches are not suitable for cetaceans. Theoretical genetic definitions such as ESU and MU (Moritz, 1994), often fail in important practical management cases. The risks of inappropriate stock definition for terrestrial game management are often less than for cetaceans, because on land there is the possibility of re-stocking. The Committee agreed that the existing approach with the most promise is *metapopulation analysis.* Models incorporating features of this are already being used in cetacean studies (e.g. SC/F2K/J3), and the Committee **recommends** further development of such models.

The Committee briefly discussed stock definitions as applied to tuna. Stock areas for management have often been defined on a very large scale, and concerns have been raised about localised depletions. Where stock definitions have made use of biological considerations, morphometric and tagging data have been more significant than genetic studies. Because of differences in population size, and differences in life history, the Committee recognised that direct application of tuna stock definition concepts to whales is unlikely to be fruitful.

### 12.3 Review statistical considerations

The Committee discussed a range of analytical and statistical issues relevant to stock definition, including: the role of hypothesis testing; choice of test statistics; Bonferroni correction; power calculation; sample size estimation; estimation of dispersal rates; effects of limited dispersal in management (SC/F2K/J3,4,5,7 and addenda; SC/52/SD10, 15). Much of the work was based on North Pacific minke whale data, or designed around hypothetical 'minke-like' populations.

SC/F2K/J7 pointed out the potential asymmetry between type-1 and type-2 errors if standard hypothesis tests are applied to several plausible O/W stock structures for North Pacific minke whales. In the simulations used, the risk of not finding stock structure when it was present was several times greater than the risk of finding structure when absent. The paper also provided a method for estimating dispersal rate. The Committee agreed that this was a significant step forward. Despite uncertainties about model choice, confidence intervals on dispersal, such as in SC/F2K/J7, would be useful in the development of *Implementation Simulation Trials*.

The key factor for stock definition is the dispersal rate between population units. If dispersal is very slow, genetic differences are easy to detect and it is unlikely that management stocks will be set too large. If dispersal is very fast, there is no need for separate management stocks. If the dispersal rate is intermediate, i.e. fast enough to prevent detection of stock structure, but slow enough to prevent rapid replenishment of a local depletion, then spatially-aggregated harvesting can sometimes lead to unintentional local extirpation. This danger was illustrated through a simulation

study in SC/52/SD10, with a dispersal rate matching that estimated in SC/F2K/J7, but under a very simplified harvesting and management model.

With issues of stock definition, it is often not clear *a priori* what hypotheses should be tested. In such situations, the Committee agreed that exploratory data analyses are preferable. Multiple hypothesis tests are a poor way of doing exploratory data analysis. Subjective judgment and expert knowledge are critical components of designing suitable formal statistical analyses. The Committee **recommends** that, where hypotheses are not clearly defined beforehand, and where appropriate analytical methods are available, stock definition analyses begin with exploratory analyses and proceed to parameter estimation rather than hypothesis testing.

Despite the many problems associated with hypothesis testing, it remains the *de facto* method presently used by the IWC for genetic analyses of stock structure. If such testing is to be used, it should be accompanied by power analyses. Since power analyses often suggest that there is no basis for excluding alternative hypotheses even when a hypothesis test fails, it was also suggested that consideration be given to ways of assessing the relative plausibility of hypotheses.

Within the hypothesis-testing framework, the Committee had two **technical recommendations** on the presentation of results. The first was to show curves of the trade-off between type-1/type-2 errors. Type-1 and type-2 errors are not equally important to management, and the trade-off between them must be considered in the context of management decisions. The second recommendation was for routine reporting of the $\chi^2$ statistic, which was very often the most powerful of those considered in SC/F2K/J5. It was suggested that the *numerical* values of genetic statistics should be reported, but that tests should normally be based only on the *p*-value of the $\chi^2$ statistic. The Committee also considered the appropriateness of applying Bonferroni corrections when investigating stock structure, and agreed that there are circumstances where Bonferroni corrections are inappropriate.

The Committee **recommends** that failure to obtain significant genetic differences in hypothesis tests should not be taken as evidence against the need to manage as if more than one stock is present, unless power analyses and simulations of the impacts of plausible dispersal rates indicate that there is no need. Confidence intervals on dispersal should be considered rather than point estimates. The Committee also pointed out the difficulty of hypothesis testing when there may be possible mis-specification of putative (sub)stock boundaries, for instance in the absence of obvious spatial structure.

### 12.4 Develop proposals for defining stocks of whale species within an ocean basin

No papers were presented that directly addressed this topic. Instead, the Committee discussed ways in which it could take forward this, its most important agenda item, in the future. There are unresolved and fundamental questions over appropriate ways to analyse and combine genetic and non-genetic information, so as to provide results on movement, dispersal and population structure that are of use to management. There is a risk that fundamental issues will be obscured if attention is restricted purely to existing case studies, because of the complexity of datasets and detailed local issues. It was recognised that decisions about stock definitions in any particular case will of course have to depend on the details of management objectives and available data for that case. However, it was also agreed that it would be fruitful to consider some generic archetypes of underlying stock structure, harvest regime and management objectives, to clarify thinking. Case studies remain of great value in guiding a sensible and useful choice of archetypes.

The Committee did not try to draw up a list of archetypes at this meeting, but did note that a clinal or finely-divided-stepping-stone model might be useful to consider, being of relevance to pelagic whales with continuous distributions in harvest grounds. Another useful archetype might be the case of mixed resident and transient sub-populations along a spatial gradient. To be useful, an archetype needs to describe the harvest regime (e.g. Is the harvest on feeding or breeding grounds? How spatially aggregated is the harvest?) and the management objectives, as well as the population substructure.

Although no universally appropriate way to define cetacean stocks for management has yet been developed, the Committee noted that certain criteria are clearly *not* appropriate. One example of an inappropriate criterion is Moritz's ESU. There is no appreciable interchange between western and eastern Pacific gray whales, so these stocks need separate management; however, the two stocks would not be separated according to Moritz's ESU definition.

The Committee emphasised that specification of management objectives was a necessary precondition for defining management stocks. It was recognised that existing management objectives may not be sufficiently detailed to allow a unique scientific answer to stock definition. The results of simulation studies are in any event useful in drawing managers' attention to the potential implications of different management regimes, and in refining management objectives if necessary.

### 12.5 DNA identification and tracking of whale products (see Annex O)

This item had been added to the agenda in response to IWC Resolution 1999-8 (IWC, 2000d, p.55). A Working Group was established to report to Plenary on this item (Annex O). Morishita stated that Japan had reservations about the scope of the discussions and would participate only on the condition that discussion would exclude matters related to markets and international trade. Walløe stated that Norway took a similar position. Statements from the Governments of Japan and Norway are attached as Appendices 2 and 3, respectively, to Annex I. In view of these concerns, the Chair decided that attention would be given only to scientific matters consonant with the competence of the Committee, including questions of genetics and other aspects of biology but excluding technical matters relating to design, establishment and operations of market monitoring and analysis systems that would be better left to a different, more suitable technical group designated by the Commission (see Item 3). The terms of reference for the Working Group were developed to be consistent with these directions and are given in Appendix 1 of Annex O.

Although a number of relevant documents were forwarded to the Working Group on Stock Definition (see list in Annex Q1), the Chair of the Working Group on DNA Identification and Tracking of Whale Products noted that in accordance with the plenary decision, only material in these documents relevant to the agenda would be discussed.

Several members expressed disappointment at the ruling and the constraints of the agenda, considering that the 'tracking of products derived from whales' necessarily involved market monitoring and analysis systems. While recognising that further expertise would be required on the

issue of how to conduct unbiased market surveys, these members believed that the Committee did have the expertise to develop a list of questions for the Commission's use concerning the range of biological material (i.e. whale products) that market surveys should address to contribute to conservation of whales and the management of whaling. They also believed that the Committee could provide useful information on the technical difficulties that need to be addressed in order to monitor whale-product markets. Some of these difficulties relate to genetic techniques, while other difficulties relate to analytical procedures, such as how to better develop tests to assign individuals to stock origin. Further discussion is included in Annex Q.

The Committee **agreed** that future discussions and preparations for Committee meetings would be facilitated by a review by the Commission of the intent of Resolution 1999-8 (IWC, 2000d). Specifically, it would be useful for the Committee if the Commission would provide detailed objectives of what an identification/tracking scheme would be expected to achieve.

### *12.5.1 Annual report on progress*

Much of the following is drawn from SC/52/SD11, which summarises the report of a Workshop on Forensic Genetics held in La Jolla, California, 14-16 June 1999 (Dizon *et al*., 2000). [Literature references cited below are given in Annex O.] The workshop reviewed the current state of genetic methodologies useful for the identification of species, stocks and individuals, and the tissue and DNA databases held by the participants.

#### 12.5.1.1 METHODS OF GENETIC ANALYSIS

It was emphasised that different markers and databases are needed for different tasks: highly variable markers (nuclear loci, e.g. STRs such as microsatellites) and diagnostic register databases (containing all whales from all legal sources) for identification to individual (genetic profiling) and less variable markers (such as mtDNA sequences) and geographically broad reference libraries for identification to species and stock. However, it was also noted that a single tissue sample or sample of extracted DNA can serve as the source for DNA elements required for all the analyses, i.e. that special or separate samples need not be collected for the different purposes.

There are two approaches to using DNA to test the provenance of tissue samples suspected as being from a cetacean. The first, '*DNA profiling'* is the process of establishing the source of the sample by comparing the meat product's genetic profile with that of a harvested individual. To do so, a '*DNA register'* of the genetic profiles of whale products intended for the market is necessary. For the second, a '*reference library'* is needed for '*lineage testing'*, the process of inferring the species or stock origin of a tissue sample by comparing its DNA to reference DNA from a library of known individuals.

The use and composition of a register of known individuals and a reference library are different. A DNA register as discussed below is a limited database of cetacean DNA profiles for cetacean products that are intended for the market. The reference library is simply an extensive database that strives to catalogue a large and representative collection of cetacean DNA from known species and stocks. The DNA library is used to infer the species or stock of a whale product for which this information is not known, e.g. one that does not match any of the individuals in the DNA register of whales from documented sources.

#### 12.5.1.1.1 IDENTIFICATION OF SPECIES AND STOCKS

The underlying assumption of a DNA register is that the stock (and obviously the species) of the registered animal is known with a high degree of certainty. For stock designation, the sampling position with the date of sampling is usually assumed a reliable determiner of stock membership of a permitted cetacean. If, for a variety of reasons, sampling position and date are unknown, DNA methods can infer the lineage of these samples with varying degrees of success.

Lineage testing at the species level is based on the systematic assumption that a suite of morphological or genetic characters (i.e. fixed differences) unites all members of a *bona fide* species. These characters unambiguously differentiate that species from others. Because such taxa theoretically can be characterised with certainty, an individual from a particular taxon can be assigned with certainty. A number of groups have exploited this operational definition of species to establish species identities of market samples, bycatch and beach-cast cetaceans via the comparison of homologous mtDNA sequences of test and known samples (Dizon *et al*., 2000). In the vast majority of forensic situations, genetic establishment of species is well accepted. For all the baleen whales, all of the common beaked whales and the sperm whale, the IWC can assume that species-level identification based on genetic sequence comparisons can currently be reliably performed. Further developments are needed only to make the process faster and cheaper (for examples of promising new techniques, see Dizon *et al*., 2000).

Lineage testing at the stock level is altogether different. Stocks share a high proportion of genetic markers. Thus, differences between stocks are modal rather than absolute. Generally, the ability to successfully diagnose taxa declines continuously as one moves down the hierarchy from ocean basins or hemispheres, to highly distinct population segments, and, finally to less well-defined local stocks (Dizon *et al*., 2000). And indeed, there are only a few situations of immediate interest to the IWC where stock identifications can be made for an individual with reasonable confidence. Analyses of mtDNA sequences reveal diagnostic differences (i.e. fixed differences) between ocean basin stocks of North Pacific and North Atlantic minke whales (Pastene *et al*., 1996; Hori *et al*., 1994). Diagnostic differences also characterise the dwarf and the other common minke whales (Hori *et al*., 1994; Pastene *et al*., 1994; Pastene *et al*., 1996) and the large- and small-form Bryde's whales (Yoshida and Kato, 1999). However, all three of these situations could arguably have more in common with making species- rather than stock-level inferences. The gene flow between these conspecific pairs has been so low for so long that fixed differences between the pairs have accumulated. The most cited example of within-ocean-basin mtDNA differentiation in whales is that observed in the J and O stocks of minke whales in the North Pacific (Goto and Pastene, 1997; SC/F2K/J28). Genetic differences are dramatic and arguably as high as anything observed between sympatric or partially sympatric stocks within the same hemisphere and ocean basin. Yet, no fixed diagnostic character has been discovered that unambiguously differentiates an *individual* minke whale as being from J or O stock. Perhaps this will be discovered as more of the minke whale genome is examined. For now the stock identity of J and O stock individuals cannot be determined in the same straightforward manner as specifying the species of an unknown individual. If it cannot be done on the highly differentiated J and O taxon pair, it is not likely to be done in other situations of interest to the

IWC. Examples include distinguishing whether a cetacean sample is from a central/northeast Atlantic minke whale or another Atlantic minke whale stock, from an eastern or western Pacific gray whale, or from a pygmy or true blue whale. Not even bowhead whales from different ocean basins can be individually assigned to stock at this point (SC/52/OS7). The reality of the situation is that while lineage testing at the species level involves examining fixed differences, lineage testing at the stock level usually involves examining modal differences, making it difficult to unambiguously assign the individual sample to stock.

Uncertain taxonomy remains a barrier to species identification and determination of relationships for some whales. An example is that of the Bryde's whale complex (SC/52/SD17); resolution of the taxonomic problem and development of the ability to identify these whales to species will depend on availability of more reference sequences from various parts of the ranges of the forms involved.

Attention was drawn to a paper from last year's meeting (SC/51/O9), which contains a review of methodology for high-through-put screening of samples and associated techniques. Note was also taken of a spectrophotometric method in development (by D. Duffield) that may prove to be an alternative to sequence matching for identification to species.

12.5.1.1.2 IDENTIFICATION OF INDIVIDUALS

Although technically demanding, genetically matching a harvested individual, via DNA profiles, to its parts in commerce is straightforward compared with lineage testing. Because matching DNA profiles is now the primary procedure used by criminal forensic laboratories to link a suspect to the crime scene, its chain-of-custody procedures, technician and laboratory certifications, and analytic protocols are well established.

To check for a match between a suspected whale product and a registered-animal sample, the length of the allelic pair (maternal and paternal) in both samples is measured at a number of independent, highly variable nuclear markers, i.e. STR/microsatellite loci (see Dizon *et al*., 2000 for glossary of the genetic terminology). If each sample pair has identical alleles at each locus, the two samples can be assumed to have originated from the same individual. As long as sufficient numbers of sufficiently polymorphic STR loci are used, the probability of a false match due to chance will be vanishingly small (and quantifiable), and if good laboratory practices are followed to avoid contamination, the chance of a false match due to laboratory error can be minimised. The confidence in any discovered matches will likely be more than adequate for IWC management.

Unlike in human forensics, a DNA register of whales from a regulated hunt is intended to allow verification of any sample or collection of samples to all individuals from the hunt. This requires multiple pair-wise matches, where the probability of a match by chance is greatly increased. Further, confidence in probability of identity will differ depending on the population or stock of interest due to differing allelic frequencies (e.g. Paetkau and Strobeck, 1994). This will require an understanding of stock structure for non-target as well as target stocks. These issues may require further development to establish robust statistical methods for individual identification.

For a given species of management interest and in a given trade situation, a DNA register can be considered '*diagnostic*' when all of the registered individuals are defined as permitted and any others are defined as not permitted. This is the preferred system, as it is fully definitive. In the case of a non-diagnostic register, registered individuals would be defined as permitted, but unregistered conspecific individuals would be of uncertain status.

**12.5.1.2 REFERENCE DATABASES AND REGISTERS**

12.5.1.2.1 COLLECTION AND ARCHIVING OF SAMPLES FROM CATCHES AND BYCATCHES

Specific information on techniques and procedures for collection and archiving of samples is given in Dizon *et al.* (1997).

It was agreed that having a large and representative collection of cetacean tissues or DNA from known species and stocks was desirable for purposes of inferring species and stock origins of unknown tissue samples. One example of the need for such broad geographic representation in a reference database is that of lack of available fin whale DNA samples that could contribute to the identification of samples of unknown origin to stock/area (SC/52/SD17). Such data are also necessary to advance current understanding of species taxonomy and stock structure. Institutions within member nations having substantial tissue/DNA holdings should be encouraged to establish publicly accessible databases describing samples they are willing to share for *bona fide* scientific studies relating to lineage testing, species taxonomy and stock structure. Information should be furnished for each individual sample, including the species if known, source of the sample, sampling position and date, availability as tissue or DNA, etc. The Committee welcomed an offer by Dizon to contact interested parties intersessionally to conduct efforts to establish consistent data and web-page formats and to establish terms of exchange regarding use, publication and further distribution of the sample.

Dizon *et al*. (2000) summarised the cetacean tissue archives held, as of June 1999, by the Southwest Fisheries Science Center, USA; Auckland University, NZ; Marine Research Institute, Iceland; and University of Wales, UK. For the future, data needs and formats will have to be developed and agreed upon so that IWC members can present information on an annual basis in a useful and consistent fashion on tissue holdings. Information should be furnished for each individual sample rather than as summaries of species as was done in Dizon *et al*. (2000). The sampling position and date of sampling is usually assumed a reliable determiner of stock membership.

For making recommendations regarding this Commission request, it would also be useful to have a clear statement for whose use the register is intended. If matches are to be sought by laboratories other than the original laboratory, access to the DNA register and calibrating allelic ladders is obviously necessary.

12.5.1.2.2 STATUS OF AND CONDITION FOR ACCESS TO REFERENCE DATABASES

Walløe described the status of the Norwegian DNA register for minke whales (Annex O, Appendix 3), following on a proposal to the Committee made in 1997 (SC/49/NA1). In the development phase, tissue samples from 50 minke whales from the Norwegian catch in 1996 were analysed to identify a set of robust STR markers, to develop a protocol for mitochondrial sequencing and to try to identify Y-chromosome polymorphisms in minke whales. The results (Dupuy and Olaisen, 1998a) were discussed at an international workshop held in Oslo in March 1998 and attended by several members of the Committee. Based on the results of the pilot study and the recommendations of the workshop, 12 STR markers were selected and a protocol for

mtDNA sequencing was finalised (details are given in Dupuy and Olaisen, 1998b). The search for Y-chromosome markers was unsuccessful. A contract was let to a Canadian firm, VITA-Tech, in 1999 (Annex O, Appendix 3). Samples from all whales from the 1996 catch (excluding four) have been analysed by the Department of Forensic Medicine of the University of Oslo. All samples from 1999 have been analysed and quality-checked/validated in Canada and Norway. All samples from the catches in 1997 and 1998 have been analysed by VITA-tech, and quality checking and validation will be completed in a few weeks.

The Norwegian DNA register will be located in the Directorate of Fisheries, Bergen. While called a register, it will actually be a combination of an individual-whale register designed for forensic use and a reference library for both forensic and research use, containing two types of data files, one for STR and gender profiles and one for mtDNA sequences. The data are stored at present as Excel files, where one line represents one whale (Dupuy and Olaisen, 1998b). Database software and software for searching the STR part of the register are available from human forensic laboratories. When the register database has been completed, plans are to make it available in part on the Internet. Planned for the future are archives of tissue samples and extracted DNA. Also planned is sampling and register posting of foetuses from harvested minke whales. Walløe noted that Greenland has approached Norway about the possibility of using the same system for minke whales taken in Greenland, and discussions are being held with Iceland concerning the possible inclusion of data from stored whale products. He also noted that the databases will be used not only for forensic purposes but also for scientific research, including stock-identification problems in the North Atlantic and stock-abundance research. They will possibly include mtDNA from stranded baleen whales and whale data from Japan. In addition, allelic ladders for the loci employed in profiling will be provided on request for purposes of standardisation across laboratories.

The Committee thanked its Norwegian members for the presentation of this information and noted that the Norwegian DNA register is based on standards established for human forensic investigation (Dupuy and Olaisen, 1998a). As such, the technical specifications of the work (as described in the request for proposals for the commercial contract) are of high technical quality. These technical specifications would be a useful model for other countries intending to establish DNA registers.

Goto reported on progress on a system in Japan. It is not yet complete but will be modelled on the Norwegian system and will contain microsatellite, mtDNA and Y-chromosome data. Specifications will be finalised soon. So far, analysis has been completed of 498 northern minke whales (*Balaenoptera acutorostrata*) taken in JARPN and approximately 900 Antarctic minke whales (*B. bonaerensis*) taken in JARPA. Suitable microsatellite loci have been identified for sperm, Bryde's and fin whales. Microsatellite and mtDNA data will be entered for frozen stocks and for strandings and bycatches to the extent possible.

12.5.1.2.3 STANDARDISATION OF ANALYSES

For identification of individuals with STRs, allelic dropout is more likely to occur with very small or degraded samples which contain very little DNA, such as processed market samples. For this reason, size 'binning' of alleles must be standardised across gels and among laboratories. Methods for precise sizing, automated binning of alleles, and reduction of error rates in large-scale genotyping programmes have been standardised for humans after extensive development and cross-laboratory validation using a common set of DNA reference or '*voucher'* samples (Ghosh *et al*., 1997) or '*allelic ladders'* (SC/52/RMP19; Annex O, Appendix 3).

These problems of standardisation are addressed in the Norwegian DNA register with a '*voucher'* set of extracted genomic DNA for individuals with known genotypes (B. Olaisen, pers. comm. to Baker). This solution also provides for some standardisation of PCR conditions, as well as subsequent sizing of the profiles.

12.5.1.2.4 OTHER ISSUES

It was noted that expeditious international transfer of reference samples, DNA extracts, etc., will be important for efficient international cooperation in standardisation of methods. Such transfer requires CITES permitting and certification. The Committee **recommends** that the Commission urge member nations to expedite issuance of CITES permits where appropriate for transfer of samples for scientific research.

*12.5.2 Advice to the Commission*

The Committee **recommends** that the Commission consider the conditions and requirements described above as necessary for useful, reliable and efficient identification of origins of whale products through DNA sampling and analysis. The **recommendation** that a register be fully diagnostic, for whatever trade situation is envisaged, is especially important. Also important is the fact that conditions for access, replication and standardisation must be specified if the system is to be transparent and verifiable.

The Committee could offer further advice, if the Commission would provide detailed objectives of what an identification/tracking scheme would be expected to achieve.

## 12.6 Extirpations or near-extirpations of stocks of large whales

SC/52/SD2 reviewed instances where (sub)stocks of baleen whales were extirpated or rendered commercially extinct by commercial whaling, and where no significant recovery or re-population has occurred since. The instances given were humpback and blue whales off South Georgia, humpback whales off New Zealand, blue whales off Japan, bowhead whales off Spitzbergen, fin whales off Gibraltar, and North Atlantic right whales throughout much of their historic range. The timescale over which recovery has failed to occur ranged from four decades to four centuries. These instances were an unintentional experiment in large-scale removals by the whaling industry that could be informative in discussing appropriate space and time scales for management. Spatial scales associated with the depleted/extirpated (sub)stocks were frequently smaller than those employed in management. For migratory species, management units may cover either breeding or feeding grounds; the author noted that catches on feeding grounds may have more impact on the local persistence of an oceanic stock, because of maternally-directed philopatry (juveniles learning from their mothers where to feed). The cases cited reinforced the view that caution should be employed when analysing genetic data to investigate stock structure, and that a total evidence approach (using data from behavioural, marking, tagging, genetics and acoustic techniques) should be taken to the definition of management units.

In discussion, three factors common to several failures to recover from heavy depletion were suggested: post-depletion abundances of a few hundred animals or less; depletion of neighbouring subpopulations; and continuing low levels of anthropogenic mortality after the end of heavy exploitation. The Committee agreed that it would also be useful to consider cases where population units of cetaceans *had* recovered following heavy exploitation, and decided to review cases next year.

The Committee further agreed that 'stock definition'[3], for management, could be guided by the principle that management units should be defined such that local extirpations are to be avoided, and that local depletions will recover to healthy levels on a management timescale; the scale of 'local' depends on management objectives. This principle is still some way from an operational definition, which would entail refinement both of management objectives and scientific aspects.

A minority statement on this matter, given by Butterworth and supported by some others, is given as Annex V.

### 12.7 Work plan

The Committee agreed that the following items should be discussed at its next meeting.

(1) Case studies of North Atlantic minke whales, and humpback whales worldwide.
(2) Review of recoveries of cetacean (sub)stocks after exploitation.
(3) Develop techniques to combine multiple types of data in stock definition, including genetics, tagging, morphometrics, chemical signatures, and age or sex ratios. Review the utility of non-genetic data for stock definition.
(4) Statistical issues pertaining to stock definition.
(5) Consideration of useful archetypes of cetacean stock structure, harvest regime and management objectives.
(6) Development of ways to define stocks for harvested or potentially harvested cetaceans.

## 13. ENVIRONMENTAL CONCERNS (SEE ANNEX J)

### 13.1 POLLUTION 2000+

*13.1.1 Progress on Phase 1 validation/calibration studies*

The report of the Planning Workshop to Develop a Research Programme to Investigate Pollutant Cause-Effect Relationships in Cetaceans - POLLUTION 2000+, is published in IWC (1999a). The programme was strongly endorsed by the Committee, the Commission, ASCOBANS and the ICES Working Group on Marine Mammal Habitats. Since the discussions and decisions of last year, further refinement of POLLUTION 2000+ has taken place. This has included matters relating to the practical implementation of the project, including: establishing detailed sampling protocols, quality assurance and quality control standards; choice of sampling areas and laboratories; refining the variables to be measured; and organisational matters such as determination of Steering Group members, tasks and fund raising. Financial constraints had a considerable influence on the amount of progress it was possible to achieve.

Last year, the Commission provided £130,000 for the POLLUTION 2000+ and SOWER 2000 programmes. This was considerably less than the figure required for full funding of either programme (£350,000 and £250,000 respectively). After consultation with the Chair of the Scientific Committee it was agreed that £65,000 be allocated to each programme. In addition, The Netherlands indicated at the Commission meeting that it would fund the salary of Reijnders as Project Coordinator and this was greatly appreciated. The need for such a person had been given high priority by the Committee. Unfortunately, this commitment did not materialise until late in the financial year and this greatly hampered the work of the Steering Group, and resulted in a considerable lack of progress.

Other than the core IWC-funding, other potential funding sources were explored. Following contacts with the Nordic Council of Ministers, who had expressed interest in POLLUTION 2000+, a proposal for co-sponsoring to approximately £40,000 was put forward. The proposal was evaluated and considered of high scientific quality, however, due to financial restraints and conflicting requests for funding of Nordic cetacean studies, the Committee had been informed in February that the Council was unable to fund the proposal at that time. Two other possibilities for co-funding the programme are pending. Requests to some Fishermen's Associations are temporarily on-hold pending further discussions on the fieldwork components once the detailed field protocol has been finalised. Another promising possibility is a recently established Joint USA-EU Research Programme, which was scheduled to come into force last year, but has not yet been formally announced. It is expected that a renewed call for proposals will begin this summer.

It was particularly encouraging to note that the USA has contributed $50,000 to the Sarasota Bay fieldwork as part of the bottlenose dolphin sub-project, enabling the extension of the field season in order to collect the samples required for Phase 1 of POLLUTION 2000+. However, it should be noted that despite strong expressions of support during the Commission meeting, no other country has yet taken up the offer to make a special donation to the research fund.

The Committee noted that POLLUTION 2000+, in the form endorsed by the Commission, cannot succeed under the current funding level and with the current funding uncertainty. Although efforts have been and are being made to obtain additional funds, it will probably also require individual member nations to take on responsibility for funding a large component of the sub-projects.

Progress on the two sub-projects under Phase 1 (i.e. harbour porpoise and bottlenose dolphin research) are described in Annex J. It was agreed last year that before embarking on the field work and sampling components of Phase 1, it was essential that agreed protocols were established. These protocols specifically entail the quantity of sample and tissue type required, and establishment of detailed procedures for the different types of samples for collection, storage and shipment to the participating laboratories. To achieve these protocols a contract was established with the FDS-Foundation in Spain. The FDS contacted all the identified potential laboratories involved in the variable analyses; information on the methodologies was collated, and, after taking into account the commonalities and contradictions, the protocols were examined to ensure the feasibility of sampling with the proposed techniques. Alternatives were developed when necessary. The resultant draft 'Unified field protocol for the POLLUTION 2000+ project' has now been circulated for final comments.

Progress towards achieving the overall goals identified for POLLUTION 2000+ had been less than hoped for this year. For the most part, this lack of progress was due to a lack of

[3] See Item 12 under *A note on terminology*.

funding. The Committee **strongly endorses** the continuation of Phase 1 of POLLUTION 2000+. It recognises that additional efforts by the Steering Group to raise outside funding will be necessary. Towards this end, the commitment of The Netherlands to provide salary support for the Chair of the Steering Group for the entire next IWC financial year is an extremely positive development. The Committee **strongly encourages** other IWC member nations to contribute to this research programme.

*13.1.2 Future studies*

The scientific and logistical items to be addressed, and the respective status of POLLUTION 2000+ are given in Table 11.

Table 11

Progress on POLLUTION 2000+.

| Items | Status |
|---|---|
| (a) Scientific | |
| Establish field protocols | Ongoing |
| Given the protocols, examine the implications and allocate priorities | Ongoing |
| Establish quality assurance and quality control standards | To be started |
| Coordinate analyses of sub-projects, review results, synthesise sub-project data | |
| Organise workshops | Started |
| Review, evaluate and complete the final report | In 3-5 years |
| Data storage and access | Started |
| Plan for Phase II | In 2-3 years |
| (b) Logistic | |
| Field logistics, including shipping and archiving samples | Started |
| Funding requirements and accounting | Ongoing |
| Explore sources of funding | Ongoing |
| Draw up a revised budget after establishment of field protocols | Ongoing |

The total funding requirements for POLLUTION 2000+ are similar to those reported in last year's Scientific Committee Report (IWC, 2000j, pp.211-2). A funding shortfall of approximately £150,000 is anticipated. The Committee agreed that if the funding necessary to fully support the endorsed research projects under POLLUTION 2000+ is not available, a sum of £51,000 is the minimum required to continue the programme until additional outside sources of funding can be secured.

## 13.2 SOWER 2000

*13.2.1 Progress on IWC-CCAMLR research*

SC/52/E21 detailed methods and initial results from the first highly successful SOWER 2000 cruise in collaboration with CCAMLR, which was conducted from December 1999 to February 2000 in the Antarctic Peninsula region. The three national vessels (US-chartered: *Yuzhmorgeologiya*, UK: *James Clark Ross*, Japan: *Kaiyo Maru*) involved in the synoptic surveys all used standard methodology. Overall cruise methodology was primarily directed at obtaining estimates of krill biomass. Oceanographic sampling consisted of approximately 35 CTD stations per vessel to a depth of 1,000m twice a day with samples collected at 30m, 150m, 200m, 400m, 600m and 800m. IWC whale observation teams collected visual line-transect data during daylight hours simultaneously with zooplankton sampling. One vessel was also equipped with a passive acoustic system. Six berths for IWC observers were provided on the US vessel, with four on the UK vessel and two on the Japanese vessel. Practical limits on the size of the IWC survey teams meant that adaptations to the preferred double platform methodology had to be made with respect to total effort and the collection of secondary data.

A total of 883 cetacean sightings were recorded along 10,244km of line-transect effort. Humpback whales were the most frequently sighted species (193 sightings), followed by minke (111 sightings) and fin whales (61 sightings). Southern bottlenose whales were the most abundant large odontocetes (53 sightings), while hourglass dolphins were the most frequently sighted small cetaceans (29 sightings).

In addition, a passive acoustic component was implemented, aimed at monitoring odontocete vocalisations. It was conducted from the *James Clark Ross* and funded by the International Fund for Animal Welfare. A simple hydrophone array was towed on a 400m cable astern of the vessel and a total of 353 hours of acoustic effort was achieved along 7,292km (3,937 n.miles) of trackline. Real time monitoring software designed to detect and measure bearings to click type vocalisations was run continuously whenever the hydrophone was deployed. The automated system allowed the equipment to be operated by a member of the visual observation team without the need for any additional personnel.

Satellite and CTD data revealed frontal zones near the South Shetland Islands and in the region of 57-58°S, with cold water representing the Antarctic Circumpolar Current (ACC) most apparent west of the Antarctic Peninsula and South Shetland Islands at a depth of 200m. Reportable results from CCAMLR on krill biomass estimates and distributional patterns are not currently available.

SC/52/E21 represented an initial report, mainly detailing methods and providing preliminary figures and tables on cetacean sightings and indicative oceanographic, primary productivity and krill distribution information. There are many questions to pursue with the data, and some initial areas of interest to CCAMLR and IWC would be comparisons of overall biomass of krill from acoustic data and whale biomass, and the role of the ACC in determining the distribution and abundance of whales and their prey.

The process of full analysis and integration of different datasets will require IWC collaboration at CCAMLR workshops within the framework of that organisation's timetable. It is likely that an analysis workshop of this nature will not occur before August 2001. The integration of data from multi-disciplinary programmes is a time consuming and complex undertaking, and will only succeed if close cooperation and participation between appropriate scientists from both organisations can continue through to the final analysis and write-up stages.

The Committee **agreed** that the collaborative work had been extremely successful and congratulated those who had worked to make this long-discussed cooperation a reality. The combination of cetacean and krill work, alongside oceanographic and other research had achieved much in an initial first attempt at conducting research which will contribute directly to the objectives of both SOWER and CCAMLR. In this collaborative process the IWC gains significant information, at relatively little cost, clearly necessary to the IWC's attempts to determine the possible effects of environmental change on whale stocks. CCAMLR representatives from many nations have been extremely positive regarding the importance to their work of continuing and building on these collaborative ventures on a regular basis.

The Committee **strongly endorses** the continuation of the collaboration on future CCAMLR projects and stressed the

critical need for the IWC to participate in and complete the analysis workshop process with CCAMLR if the full potential of the joint field work is to be realised.

*13.2.2 Future studies*

The Committee was reminded of the overall objective of the SOWER 2000 programme (IWC, 1998c, p.161):

> Define how spatial and temporal variability in the physical and biological environment influence cetacean species in order to determine those processes in the marine ecosystem which best predict long-term changes in cetacean distribution, abundance, stock structure, extent and timing of migrations and fitness.

The first topic of discussion on future studies related to forthcoming opportunities to collaborate with Southern Ocean GLOBEC. The Committee was reminded that the plans for SO-GLOBEC must now be reconsidered given that the two Japanese sighting vessels which were expected to be available for dedicated cetacean survey and tagging work are not able to participate. It was noted that the US SO-GLOBEC portion of the year-round programme will occur in the austral winter. Although this would be a worthwhile opportunity, winter studies (when most baleen whales are not in the Antarctic) are not at present a priority for SOWER 2000, due to the focus on investigating baleen whale feeding ecology. The SO-GLOBEC opportunity does have other benefits in that it will provide a year-round oceanographic and krill sampling survey opportunity from which cetacean sighting and feeding ecology work could still be conducted. Clearly this could not be done at the level outlined in the original plans for SOWER 2000, but a considerable quantity of important data could be obtained through IWC participation. Although the fine scale work is no longer feasible, information on the temporal and spatial distribution of baleen whales at the meso-scale is also of importance.

The Committee **agreed** that it would be extremely useful to obtain cetacean observer berths to further the SOWER 2000 objectives and collaboration with SO-GLOBEC (on sections of the year-round study in the 2001/2 austral summer from October to February, and for the German GLOBEC survey in March-May 2001).

The Committee also considered the analysis phase of the joint IWC-CCAMLR cruises. A detailed budget for SOWER 2000 is reported in IWC (2000j, p.220). Annual costs for 2000/2001 were projected at £386,428. However, this had assumed the availability of the two Japanese research vessels. A revised budget is provided in Annex J, table 1. A minimum budget request of £61,000 is requested to provide support for analysis of the IWC-CCAMLR cruise data from 1999/2000, participation in joint IWC-CCAMLR meetings and workshop, participation in joint IWC/SO-GLOBEC meetings and workshop, and participation in next year's SO-GLOBEC cruises, which would involve placing IWC-supported observers on SO-GLOBEC supported vessels. This is discussed further under Item 21.

**13.3 Arctic initiative**

There are several reasons why the Commission and Scientific Committee are particularly interested in large scale research programmes in the Arctic: the predicted impacts of global climate change are intensified in the sub-areas of the Arctic (and Antarctic) relative to lower latitudes; most aboriginal subsistence harvesting of whales takes place in the Arctic, where access to cetaceans is critical to the subsistence life style of subsistence hunters; and the migratory behaviour of large whales in the Arctic means that international cooperation is essential to carrying out successful research and management programmes on Arctic whales.

There is considerable potential for the IWC to conduct or be involved in synergistic research with existing national and international Arctic research programmes (e.g. US NSF/SBI and SEARCH programmes, AMAP of the Arctic Council), and some cetacean species have already been highlighted as target species for trophic interaction studies (e.g. bowhead, minke, white and gray whales) in these programmes. A number of IWC member nations are already involved in many existing Arctic research programmes that are not focused on whale research.

Given the limits on funding by the IWC, it was agreed not to proceed with the full development of a new Arctic initiative requiring IWC support as recommended last year. Rather, the Committee **strongly encourages** the expansion of existing national and international collaborative research programmes and the provision of advice to the Committee of opportunities to participate.

Several papers concerning research on Arctic issues are discussed in Annex J. These included studies on bowhead, gray, minke and white whales. The Committee continues to benefit from ongoing research by IWC member nations on stock status, impacts of global climate change, impacts of contaminants, human health effects and ecological relationships in the Arctic region.

**13.4 Habitat related issues**

*13.4.1 State of the cetacean environment*

At last year's meeting, the SWG proposed the development of an annual cetacean environment report. This proposal was supported by the Committee on an experimental basis. In response, an Intersessional e-mail Group was established to further refine the concepts outlined in IWC (2000m, p.232). SC/52/E12 reflected much of the efforts of this Intersessional Group. At this year's meeting, a Working Group was formed and given the responsibility of incorporating information contained in SC/52 documents submitted at the meeting to the final report on the environment. The State of the Cetacean Environment Report (SOCER) was organised by regions (the Arctic Ocean; Southern Ocean; Mediterranean and Black Sea; North and South Pacific Ocean; North and South Atlantic Ocean; and Indian Ocean). Information on the eight topics of concern to the Commission were summarised by region. The purpose of SOCER is to provide the Commission a 'user-friendly' update on regional concerns regarding the status of habitats critical to cetacean life history (e.g. breeding and calving, migratory, and feeding habitats). The Committee acknowledged the hard work of Simmonds and Perry in putting together the final report at this year's meeting.

It was agreed to elevate the status of the resultant report to a full Scientific Committee paper, SC/52/E29. The Committee expressed its appreciation to the SWG for its efforts in finalising the SOCER and looks forward to receiving this document annually.

*13.4.2 Workshop on habitat degradation*

The Chair of the SWG summarised previous efforts to convene an Intersessional Workshop on Habitat Degradation (IWC, 2000j, pp.231-2). It was noted that the SWG had hoped in the preceding year to have been able to organise an intersessional scoping meeting to further elaborate the

proposal but that this had not proved possible in the absence of funding. The broad objectives of a workshop on habitat degradation would be to:

(1) determine and estimate the parameters which define cetacean habitat; and
(2) evaluate how changes in these parameters affect cetaceans, particularly with respect to physical and biological degradation.

These are the first steps in a process which is intended to identify and develop objective criteria to measure such changes and develop an approach to assess the significance of habitat degradation including cumulative effects.

The SWG concluded that the idea of a workshop would benefit from further development via a smaller-scale scoping meeting. This would develop appropriate terms of reference and background material for a full workshop. It would consider some of the issues relating to the aims of the workshop that had arisen during discussions in the Committee and also stimulate some of the necessary 'homework' needed to underpin the workshop. The Committee **endorsed** this and **recommends** that the scoping meeting takes place, if funding is available, noting also ICRAM's kind offer to host it. A Steering Group under Simmonds was established to oversee the management of the scoping group meeting. A budget request of £12,000 was proposed by the SWG to support this activity. The details of this request are given in Annex J.

*13.4.3 Competition between cetaceans and fisheries*

The Chair of the SWG reported on the activities of an Intersessional e-mail Correspondence Group (Annex J, Appendix 5) that had been given the responsibility of developing terms of reference for a conference investigating competition between fisheries and marine mammals; final terms of reference are given in Annex J, item 8.3. After some discussion, the Committee **recommends** that such a conference takes place. The Committee noted that there was strong support for this among some IWC member nations.

Considerable preparations are required to convene such a conference. The Committee agreed the conference could not take place before March 2002 at the earliest. This timing of the conference would also allow members of the SWG to participate in an FAO conference organised for September 2001 on fisheries in the ecosystem.

The Committee **agreed** that the foundation for evaluating the impact of fisheries on marine mammal populations and the impact of marine mammal populations on the status of marine fish populations should be based on quantitative models. Given the amount of preparatory work required, the Committee **agreed** to establish an Intersessional Working Group, chaired by Northridge to: (1) identify suitable marine regions where modelling efforts could be focussed; (2) evaluate the extent to which the necessary data are available for modelling; (3) identify, and if possible, contract interested parties to undertake analyses related to the terms of reference; and (4) initiate logistical arrangements. The Committee was pleased to receive a provisional offer to host the conference by the government of St. Lucia.

The primary question to be addressed at the conference was agreed as follows: 'How are changes in abundance of cetaceans likely to be linked (in the short term and the long term) to changes in fishery catches?' The Committee recognised that the quantitative modelling approach would lead to conclusions regarding the effects of fisheries on marine mammals and marine mammals on fisheries. This was considered an advantage of the adopted approach.

*13.4.4 Linking environmental measures and cetacean demographics*

One of the key aspects of evaluating the impact of environmental change on cetacean populations is the ability to ascertain the extent to which environmental change causes predictable changes in the survival and reproductive rates of cetaceans. SC/52/E25 noted that this is an objective commonly encountered in fisheries ecology, where an underlying population model is used to fit specific population data to obtain estimates of recruitment; attempts are then made to correlate the residuals resulting from such an analysis with environmental covariates. Such an approach was applied to Antarctic minke whale catch-at-age data from Area IV. In particular, it was recognised that the reported pattern of alternating good and bad years in table 2 of SC/52/E25 (i.e. highly positive or highly negative residuals) could be used in the future to identify corresponding environmental covariates. The paper concluded that such a process could be used to identify environmental data that are useful for predicting changes in the demographic parameters of cetaceans.

The approach described in SC/52/E25 was dependent on the availability of catch-at-age data and was improved by the availability of reproductive data. Some members responded that photo-identification studies could also be used to address the issue. An example of the use of photo-identification data that could be used in such an analysis was highlighted by Cooke in the context of discussions on southern right whales (Annex H, item 7.1). It was noted that the approach described in SC/52/E25, while promising, was one of two general approaches useful for linking environmental variables to cetacean demographics. Another approach, more commonly referred to as a process-oriented approach, attempts to understand the underlying environmental processes ultimately responsible for population demographics.

The Committee agreed that this topic should be on next year's agenda and members were encouraged to prepare and submit papers for review.

Several papers at this year's meeting presented the environmental data necessary to link changes in the environment with changes in demographic parameters of cetacean populations (e.g. SC/52/E26). It was recognised that such linkages could only be established in areas where detailed information on the demographics of a particular population were available, such as the area described in SC/52/E26.

Urban summarised the information contained in the environmental impact assessment on the San Ignacio Salt Work Project (Ramírez, 2000). A determination of 'no harm' had been made regarding the proposed construction and operation of the Salt Facility in San Ignacio lagoon. However, the Mexican government had decided to suspend the saltwork's expansion to San Ignacio. The Committee considered that the report fully met the intent of the Commission's early request for information regarding this matter. The Committee thanked the Mexican delegates for their efforts in seeing that the report was completed and submitted to the Committee.

**13.5 Health effects from the consumption of cetaceans**

IWC Resolution 1999-4 (IWC, 2000c, p.53) concerned human health effects related to the consumption of cetacean products. Several papers presented at this year's meeting pertain to this request for information and are summarised in Table 12. While no papers were presented at this meeting on

Table 12
Documents pertaining to human health effects related to the consumption of cetacean products.

| SC/52/ | Authors | Title |
|---|---|---|
| E1 | Krahn *et al.* | Environmental assessment of eastern North Pacific gray whale: Lipid and organochlorine contaminant profiles. |
| E8 | Fossi *et al.* | Non-destructive biomarkers in the ecotoxicological study of Mediterranean cetaceans. |
| E13 | Simmonds *et al.* | Toxic equivalency and cetaceans: A note on the threat posed by environmental pollutants. |
| E20 | Choi *et al.* | Heavy metal concentrations in cetaceans from Korean coast. |
| E27 | Curry and Brownell | Consumption of cetacean products: preliminary overview of human health implications. |
| AS10 | Hobbs *et al.* | Using persistent organochlorine levels and patterns to identify minke whale stocks from the North Atlantic. |
| | O'Hara *et al.,*1999 | Organochlorine contaminant levels in Eskimo harvested bowhead whales of arctic Alaska. |
| | Krone *et al.,*1999 | Elements in liver tissues of bowhead whales. |

the positive health effects of cetacean products, there was no reason for Committee members to consider such reports unwelcome.

In the discussions in Annex J it was noted that considerable uncertainty existed as to how the Commission and possibly the World Health Organisation (WHO) would like information on human health effects reported. The SWG was aware that the WHO has high standards regarding its reporting requirements and that many of the tissue samples from cetaceans reported in the scientific literature would not meet these standards. Late in the meeting, a letter from the Food Safety Program, WHO, to the IWC (SC/52/E30) identified a new manual that provides information on presentation of data to be submitted to the WHO. It was agreed that DeMaster should form an Intersessional Working Group to review the information contained in this report, and report back to the Committee. Should questions remain following this review, DeMaster will work with Zeh to draft a letter to be sent on behalf of the Committee to the WHO addressing any remaining questions.

### 13.6 Work plan

(1) POLLUTION 2000+
   (a) Continue calibration study and field collections for Phase 1.
   (b) Prepare and plan for Phase 2.
   (c) Review additional information as it pertains to the impact of contaminants on the health and status of cetacean populations.
(2) Cooperative research in the Antarctic.
   (a) Results from SOWER 2000 cruise.
   (b) Progress in developing joint research programme with SO-GLOBEC.
(3) Linking environmental measures and cetacean demography.
(4) Research relevant to Arctic issues.
(5) Review progress in convening workshop on habitat degradation.
(6) Review progress in convening workshop on marine mammal-fisheries interactions.
(7) Review and update as appropriate the State of the Cetacean Environment Report (SOCER).
(8) Other business.

The following Intersessional e-mail Groups were established (chair of group in parentheses): POLLUTION 2000+ (Reijnders); SO-GLOBEC (Thiele); Arctic issues (Moore); habitat degradation workshop (Simmonds); marine mammal-fisheries competition workshop (Northridge); SOCER (Perry/Stachowitsch); and WHO contaminant reporting requirements (Rowles).

Financial issues are considered under Item 21.

## 14. SMALL CETACEANS (SEE ANNEX K)

### 14.1 Review of the status of freshwater cetaceans

Freshwater dolphins and porpoises are among the world's most threatened mammal species (Reeves *et al*., 2000). The habitat of these animals has been highly modified and degraded by human activities, often resulting in dramatic declines in their abundance and range. This year, the Committee considered the status of freshwater cetaceans, together with marine populations of the tucuxi, Irrawaddy dolphin and finless porpoise. In its deliberations, the Committee used the classification scheme of the IUCN as a starting point of discussion for each species.

#### *14.1.1 Boto*

The boto (*Inia geoffrensis*) occurs throughout much of the Amazon and Orinoco watersheds, and in the Beni river system in Bolivia (SC/52/SM13). Analysis of skull characteristics and preliminary genetic research has suggested the existence of three populations in the Amazon, Orinoco and Beni systems (da Silva, 1994). Botos in the Beni system may, in fact, constitute a separate species although, at present, only a single species is recognised. Few rigorous estimates of abundance exist for any area, but numerous reports have been made of minimum counts, encounter rates or densities for particular stretches of rivers. Differences in survey methodology, river morphology and hydrology make any meaningful comparisons between the numerous studies extremely difficult. Nevertheless, density estimates of this species for a 120km section of the Colombian Amazon are among the highest for any cetacean (SC/52/SM15). Reliable information on population trends is lacking. Overall, however, population densities of this species appear to be relatively high throughout much of its range.

There are no measures of the magnitudes of directed takes, although there are reports of some deliberate killings apparently due to interactions with fisheries (SC/52/SM7). Most reports of anthropogenic mortality of this species involve incidental capture in fisheries. There are no estimates of total incidental mortality. Oil exploration and production are potential threats to *Inia.* Human populations are expanding rapidly in many areas of the range of the boto, especially in Colombia and Brazil. Such population increases result in increased agriculture, deforestation, cattle ranching and the establishment of plantations. The effects of these changes on the ecology of botos have not been assessed but some impact might reasonably be expected. Hydroelectric schemes are also a potential threat to botos. In Brazil there are now six small dams and four large ones, but another 70 have been planned. Despite these observations, in some areas such as Ecuador and Bolivia, human pressures remain fairly low, and densities of botos appear to be high throughout much of its range.

The IUCN considers the boto to be 'Vulnerable.' The Committee **recommends** that research should be directed towards detecting trends in abundance or any diminution of range, and identifying causes of any declines. The Committee also **recommends** that information should be collected to allow evaluation of the relative levels of mortality, both indirect and direct, associated with different fishing methods.

*14.1.2 Tucuxi*

There are still many unresolved aspects of the taxonomy of the tucuxi (*Sotalia fluviatilis*). Both marine and freshwater forms occur and skull morphometrics and preliminary genetic work suggest that there may be two species. The tucuxi is widespread throughout much of Brazil, extending upstream into Peru, Ecuador, Colombia and parts of the Orinoco in Venezuela. There are no estimates of abundance for any population, although the species appears to be relatively abundant throughout its range. There are no records of past or present commercial fisheries directed at this species, nor any evidence of direct capture for human consumption in the Amazon, although the marine tucuxi has been taken for public display in oceanaria (SC/52/SM8). Most reported mortality is due to accidental entrapment in fisheries. There are no reliable estimates of total numbers taken anywhere, but anecdotal evidence suggest that large bycatches are not common in the central Amazon. In the Amazon estuary, however, large numbers of tucuxi are taken in gillnet fisheries. Beltrán (1998) recorded 938 animals taken in driftnets from the port of Arapiranga, Brazil during the summer of 1996 and a further 125 taken during the winter. Throughout the Amazon basin, human population growth and consequent forest clearance, oil and mercury contamination and dam construction are all potential threats to this species.

The species is classified as 'Data Deficient' by the IUCN. Little information exists regarding the marine form of this species, and in many areas, such as the Orinoco, it is not clear which form exists. The Committee **recommends** that research should be directed towards detecting trends in abundance by making repeatable and statistically rigorous estimates of density in a range of regions and habitats. The Committee also **recommends** that information be collected to allow evaluation of the relative levels of incidental mortality of the tucuxi associated with different fishing methods.

*14.1.3 Indus susu*

The Indus susu, or bhulan (*Platanista minor*) is endemic to the Indus river drainage system. Although historically distributed throughout the Indus river mainstem, and in the Sutlej, Ravi, Chenab and Jhelum tributaries (Anderson, 1879), it is now limited to three areas of the mainstem (Reeves and Chaudhry, 1998; Reeves, 1998). These three sub-populations are isolated from each other by barrages, but may occasionally receive 'recruits' from upstream if dolphins pass through barrage gates. It is highly unlikely that upstream movement occurs across barrages. Direct-count surveys of the main distribution areas have been conducted regularly by the Sindh and Punjab wildlife agencies since the early 1980s. The largest sub-population is located in the Sindh Dolphin Reserve between the Guddu and Sukkur barrages at the downstream end of the species' range, where 458 individuals were counted in 1996. The second largest sub-population is located between the Taunsa and Guddu barrages, and the count here was 143 individuals in 1996. The count for the sub-population between the Chasma and Taunsa barrages in 1996 was 39 individuals. A few scattered individuals may remain upstream of the Chasma and Panjnad barrages (Reeves *et al*., 1991). Reeves (1998) interpreted the counts reported above to indicate a total of approximately 600-700 individuals for the species as a whole.

Deliberate killing for meat and oil was a traditional practice until at least the early 1970s (Pilleri, 1980). Hunting is now banned but poaching still occurs occasionally (Reeves and Chaudhry, 1998). Little detailed information is available, but the level of incidental take is not thought to be high. Permanent losses from the population occur when animals swim into irrigation channels (SC/52/SM9). The most significant cause of decline in this species is habitat fragmentation and loss brought about by the construction of numerous irrigation barrages (Reeves *et al*., 1991). Due to water abstraction, the Indus River becomes virtually dry in several places in the low-water season, especially downstream of the Sukkur Barrage, thereby eliminating suitable habitat in the lower reaches (Reeves *et al*., 1991). The greatest future threat to the survival of the Indus susu is the continuing decline in water supply due to the construction of new diversion structures and from increasing extraction from aquifers.

The IUCN lists the Indus susu as 'Endangered'. The species now has a low absolute abundance and a reduced and geographically fragmented range. The Committee commended the Sindh Wildlife Department for their initiative to return Indus dolphins to the Indus River from irrigation canals, and **recommends** that future operations be conducted with development and application of a protocol that has been reviewed by specialists with previous experience of the capture and safe release of cetaceans. The Committee **recommends** research be conducted to elucidate the possible effects of barrages and canal gates on dolphin movements, paying particular attention to the design of these structures.

*14.1.4 Ganges susu*

The Ganges susu (*Platanista gangetica*) occurs throughout most of the Ganges and many of its tributaries, from the delta to below the Bijnor barrage. The complete range includes parts of India, Nepal and Bangladesh. The species is fragmented into at least eight sub-populations by dams and barrages. Although the aggregate range-wide abundance of Ganges river dolphins was estimated by Jones (1982) as 4,000-5,000 individuals and more recently by Mohan *et al.* (1997) as fewer than 2,000 individuals, these were no more than educated guesses. Population assessment has generally been based on counts of dolphins on relatively small sections of river, with no estimates of precision.

Deliberate killing of susus is believed to have declined in most areas but still occurs in India (Mohan *et al*., 1997) and Bangladesh (Smith *et al*., 1998). Dolphins are also killed for their oil, which is used as a fish attractant (Smith and Reeves, 2000). The magnitude of direct take in recent years is unknown, but is probably not high. Entanglement in fishing gear, most often nylon gillnets, occurs throughout most of the range (Smith and Reeves, 2000). No rigorous estimates have been published but the problem of accidental killing is expected to worsen as the demand for fish and for fishing employment increases. Construction of at least 50 dams within the known or suspected historic range of susus has dramatically affected their habitat, abundance and population structure. Suitable habitat is also threatened by

water abstraction from surface pumps and tube wells, especially in the Ganges where the mean dry-season water depth has been dramatically reduced in recent years.

The IUCN considers the Ganges susu to be 'Endangered'. The current population size has been reduced by an unknown amount compared to historical levels, but is still large enough to be viable in the long-term if adequate conservation measures are taken soon. The Committee **recommends** that the distribution, abundance and population discreteness of Ganges susus be assessed in areas where adequate surveys have not been conducted hitherto. The Committee also **recommends** that an evaluation of population discreteness of Ganges susus be conducted among river systems.

*14.1.5 Irrawaddy dolphin*

The Irrawaddy dolphin (*Orcaella brevirostris*) occurs in the tropical and sub-tropical Indo-Pacific, from the Bay of Bengal to northeastern Australia. It is a coastal species, but also occurs in several major river systems of southeast Asia including the Mahakam River systems in Indonesia, the Ayeyarwady (Irrawaddy) River systems of Myanmar, the Mekong River of Cambodia, Vietnam and Lao PDR (Stacey and Arnold, 1999). Preliminary studies of geographical variation in the cranial morphology of *Orcaella* suggest that dolphins in Australia/New Guinea and southeast Asia belong to separate forms (SC/52/SM33). No statistically rigorous estimates of the abundance of this species are available from any portion of the species' range. For coastal areas, very little information is available. Information on the relative abundance of Irrawaddy dolphins in freshwater systems is restricted to small geographical areas.

Live captures have occurred recently for the oceanarium trade in the Mahakam River and coastal regions of Indo-Malaysia. In both these areas there are also reports of direct killing. Entanglement in fishing gear, particularly gillnets, has been reported from a number of areas. In addition, fishing with explosives may adversely affect this species in some areas. The status of the Irrawaddy dolphin, for all areas examined, is largely unknown.

The IUCN considers this species as 'Data Deficient'. Densities appear to be low in most areas and several populations are believed to be seriously depleted and threatened with extirpation, particularly in freshwater areas of their distribution. The Committee **recommends** that further investigations be carried out using morphometric and genetic techniques to better elucidate stock structure over the geographical range of the species and to examine potential differences between freshwater and marine habitats. Given the paucity of data on distribution and abundance, the Committee **recommends** that comprehensive surveys be conducted to assess the abundance and distribution of Irrawaddy dolphins.

*14.1.6 Finless porpoise*

The finless porpoise (*Neophocaena phocaenoides*) is a tropical to warm-temperate species, occurring mostly in nearshore and riverine waters. Its range extends from the Persian Gulf around the rim of the Indian Ocean to the eastern islands of the Indo-Malay archipelago and central Japan. Studies of Japanese animals have identified a minimum of five local populations (SC/52/SM22) and the Committee noted that similar local populations may exist elsewhere throughout the range of this species. An isolated freshwater population occurs in the Yangtze river (SC/52/SM17). Jefferson noted that two species may exist, each with sub-species. The Committee agreed that a taxonomic re-examination of the genus is needed, but that it should await molecular genetic evidence, which is currently lacking.

Estimates of abundance have been made only for specific areas in China and Japan. SC/52/SM22 showed a dramatic decline in the abundance of finless porpoises in the eastern and central Inland Sea between the 1970s (Kasuya and Kureha, 1979) and the present. No large-scale hunts of this species have been recorded. A few tens of finless porpoises have been live-captured for public display and research in Japan, China and Thailand (IWC, 1984), although such takes do not occur currently in Japan. The species is available in local markets in Korea (SC/52/SD6 and SC/52/SD17); the source of these animals is believed to be from bycatch in coastal Korean waters (SC/52/ProgRepKorea). Incidental mortality is likely to be substantial throughout the species' range (Jefferson and Curry, 1994). Yang and Zhou (1996) estimated that 2,100 animals are killed incidentally each year in the coastal waters of Zhejiang and Guangxi provinces alone. In Japan, porpoises are taken incidentally in various fisheries, but the reported takes are low.

The finless porpoise is listed as 'Data Deficient' by the IUCN, although the Yangtze river population is classified as 'Endangered'. The species as a whole is in no immediate danger of extinction, but several populations (possibly representing separate taxa) are apparently declining. The Committee **recommends** that the magnitude and effects of such bycatches be investigated as a matter of priority. The Committee also **recommends** that further research be conducted to determine the causes of the population decline of this species in the inland Sea of Japan.

*14.1.7 Baiji*

The Yangtze river dolphin, or baiji (*Lipotes vexillifer*) is restricted to the Yangtze river mainstem from Yichang to the river mouth, a distance of some 1,600km. Baiji were once commonly observed as far downstream as the river mouth, but are now rare below Nanjing. The remaining baiji are found in the middle reaches between Tongling and Xuewenzhou and between Dongting and Poyang lakes (SC/52/SM17). No precise estimates of current or past abundance are available. The population size was estimated to be 300 in 1986, less than 200 in 1990, and currently probably less than 100 (Chen *et al*., 1997). Only thirteen animals were seen in a survey of the entire range in November 1997, and even fewer in 1998 and 1999, although these surveys were less comprehensive. The 'best guess' of the current population size is a few tens of animals (Reeves *et al*., 2000).

No directed takes have been recorded in recent years. Other human activities account for the deaths of more than 95% of all collected specimens (Chen *et al*., 1997) and entanglement in fishing gear is responsible for half or more of the mortality of recovered carcasses (Chen, 1989). In particular, the rolling hook fishery, which consists of long-lines with thousands of unbaited hooks used for snagging bottom fish, has been responsible for a substantial number of deaths. The Yangtze river runs through one of the densest areas of human occupation in the World, and the river is used intensively for transport, as a food resource and as a waste dump.

The baiji is listed as 'Critically Endangered' by the IUCN and is the most endangered of all cetacean species. Rapid and widespread development has degraded the Yangtze environment to such an extent that local scientists have judged that the river can no longer sustain the species (Zhou *et al*., 1998). Since 1993, the primary strategy for preventing

extinction of the baiji has been to capture and translocate as many dolphins as possible into the Shi Shou Baiji Semi-natural Reserve, an oxbow channel of the Yangtze River, with the intention of establishing a self-contained breeding population (Zhou *et al*., 1994; Zhang *et al*., 1995; Zhou and Gao, 1995). This *ex-situ* approach was taken in light of the rapid decline in abundance of the species and deterioration of the Yangtze environment (Leatherwood and Reeves, 1994). The Committee was unable to reach consensus on the difficult question of whether or not to recommend the continuation of efforts to live-capture and place baiji in a semi-natural reserve. To date, only one baiji has been relocated to the reserve; in 1995, the emaciated carcass of this specimen was found entangled in a net used to separate the reserve from the main river. Based on this fact and other information submitted to the Committee, it was agreed that a suitable semi-natural habitat is not available at present.

It was recognised that, notwithstanding the Committee's lack of consensus, domestic authorisation for continued baiji captures was likely. Therefore it **strongly recommends** that the following requirements be met prior to any further removals of baiji from the wild:

(1) the environmental quality and carrying capacity of the semi-natural habitat are ensured at levels adequate for the long-term maintenance of a group of baiji;
(2) the semi-natural habitat is developed to ensure that dolphins cannot move into the river, regardless of flood level;
(3) there is no other cetacean species in the semi-natural habitat;
(4) the risk of baiji entanglement and mortality in fishing gear within the semi-natural habitat is eliminated;
(5) capture and relocation operations are conducted with minimal risk of dolphin mortality (with advice and participation of relevant experts who have experience in the capture and handling of cetaceans);
(6) sufficient resources are available to ensure that a group of dolphins of adequate size and demographic composition can be established in the semi-natural habitat within a relatively short time;
(7) sufficient resources are available to support monitoring and management of the semi-natural habitat;
(8) a panel of independent international experts is established to evaluate conditions in the semi-natural reserve and determine that they are suitable - this panel would observe the capture and relocation operations and have full access to all sites, with adequate resources to undertake their tasks; and
(9) a parallel effort is made to enhance or restore the natural habitat for baiji in the Yangtze River system, aimed at future reintroduction.

Given the critically endangered status of the baiji, the Committee **requests** that the Secretary of the IWC ask the government of China to report progress on the conservation of this species to the Scientific Committee on an annual basis.

*14.1.8 General recommendations on freshwater cetaceans*

The Committee noted that many populations of freshwater cetaceans have been fragmented by dams and barrages. The Committee **recommends**, therefore, that the impacts of water development on freshwater cetaceans should be investigated thoroughly and that future plans for water development projects and water usage in the range of these species take into account the habitat requirements of freshwater cetaceans and the demographic implications of population fragmentation.

The Committee recognised the potential value of protected areas in conserving populations of freshwater cetaceans. It noted, however, that many protected areas offered little real protection for these populations due to insufficient size, inadequacy of regulatory measures and/or a failure to enforce these measures. It **recommends**, therefore, that any future protected areas or time/area fishery restrictions intended to conserve populations of freshwater cetaceans be of appropriate size and location, that potential threats be eliminated or greatly reduced in such areas and, further, that such measures are adequately enforced.

The Committee noted that fishing effort was increasing rapidly in many areas where freshwater cetaceans occur and expressed concern over bycatches of freshwater dolphins and porpoises in gillnets and other fishing gear. The Committee **recommends** that the relative magnitude of this threat be assessed and that, where necessary, appropriate mitigation strategies be developed.

The Committee **recommends** that the effects of environmental contaminants, such as mercury, pesticides, anti-foulants and oil, be evaluated for freshwater cetaceans, particularly with species that inhabit highly polluted areas. Such studies will require the development of new approaches, such as those being developed by the Pollution 2000+ programme.

The Committee noted that few reliable estimates of abundance were available for any species of freshwater cetacean and that the habitat and behaviour of these species posed particular problems for abundance estimation. The Committee **recommends** that scientists with appropriate theoretical and/or analytical skills should be directly involved in river cetacean studies, so that surveys result in statistically robust estimates or indices of abundance, using a variety of techniques. Further specifications of this programme are included in Annex K.

**14.2 Bycatch mitigation measures**

At its Annual Meeting in 1999 the Committee reviewed the subject of bycatch mitigation measures involving the use of acoustic devices (IWC, 2000k, pp.235-43). It was agreed that the subject of non-acoustic approaches to bycatch mitigation should be addressed in a separate workshop immediately before the Scientific Committee's annual meeting in 2000. Therefore, a Workshop was held in Adelaide on 12-13 June 2000 to consider mitigation measures other than those involving active acoustic approaches. Workshop participants noted that relatively little material was available for review, particularly in comparison to the large amount of research that has been conducted on acoustic alarms. At the beginning of its deliberations, the Workshop was reminded of the government of Japan's statement concerning small cetaceans, which appears in annex T of IWC (200l, p.317).

*14.2.1 Spatial or temporal restrictions on fishing effort*

The Committee reviewed examples of spatial and temporal restrictions on fishing effort designed to reduce the bycatch of dolphins and porpoises (SC/52/SM16). Flexibility should always be incorporated into the determination of boundaries of protected areas, even when such designations are permanent. A good example is the upper Gulf of California

where the boundaries of the nuclear zone of the Biosphere Reserve, as initially designated, encompassed only a small part of the range of the vaquita. The utility of time/area restrictions as a strategy for bycatch mitigation depends on the behaviour and distribution of the species of concern. Closures may be effective if instituted in times and areas where the bycatch rates of small cetaceans is predictably high. The effectiveness of any closure scheme will also depend on the spatial and temporal relationships between fish catch rate and the bycatch rate of cetaceans. In the case of Banks Peninsula, New Zealand, it was possible to maintain a viable fishery by relocating fishing effort outside the boundaries of the Sanctuary. In contrast, in New England it has been necessary to allow fishing (with pingers) in areas of seasonally high porpoise density to maintain the economic viability of the fishery.

*14.2.2 Modification of fishing gear and practices*

The Committee reviewed preliminary field tests of acoustically reflective gillnets in the Bay of Fundy (SC/52/SM26). The Committee agreed that it was desirable to pursue acoustically reflective gillnet material as a potentially practical, long-term alternative to pingers and time area restrictions, but that any development or evaluation of this mitigation strategy should consider the following two points. First, the acoustic reflectivity of the new material should be evaluated in relation to the acoustic abilities and behaviour of the cetacean species of concern. Second, these experiments should take into account previous, and largely negative, experiences in modifying the acoustic properties of gillnet material in attempts to reduce bycatches of Dall's porpoises (*Phocoenoides dalli*) in the North Pacific and various delphinids in the Timor Sea (Hembree and Harwood, 1987; Hatakeyama *et al*., 1994).

Experiences from the USA in modifying fishing gear and practices to reduce the bycatch of harbour porpoises were also reviewed (SC/52/SM24). This analysis used Generalised Additive Models (GAMs) to explore relationships between bycatch in a given haul and various features of that haul (net characteristics and fishing practices). There were correlations between bycatch rate and gear modifications, such as tie-downs, mesh size, twine size and float line material. The primary value of this analysis is to identify promising variables to consider in an experimental framework. On the basis of the results in SC/52/SM24, mesh size and twine size appear to show the most promise in this regard. Similar exploration of data from observer programmes in other areas and fisheries would help further refine the hypotheses to be tested.

*14.2.3 Alternative gear*

A new cod pot developed in Norway to catch high-quality cod for live storage was reviewed briefly (Furevik, 1997). The Committee recognised that such fishing gear can also have undesirable effects, such as entanglement of large whales and seals in the pot lines. The Committee **recommends** further development of alternative fishing gear designed to reduce the bycatch of small cetaceans, and that any new fishing methods be tested for other ecological effects before they are implemented on a commercial basis.

*14.2.4 Bycatch quotas*

No new information was available on this agenda item.

*14.2.5 Other*

SC/52/SM23 described an evaluation of the effectiveness of acoustic alarms (pingers) in the New England sink gillnet fishery. Pingers have reduced porpoise bycatch, although their deployment under regular fishing conditions has not reduced it to the very low levels experienced in experiments. In its deliberations last year, the Committee expressed concern that the widespread use of pingers might ensonify large portions of the marine environment, perhaps displacing small cetaceans from important habitat (IWC, 2000k, pp.240-1). To address this question, SC/52/SM28 used landings data from the Danish North Sea bottom-set gillnet fisheries to estimate the total extent of the area ensonified by acoustic signals, if all fisheries with bycatch were to use pingers. In most areas, less than 1% of the total area would have been ensonified, assuming that pingers ensonify a 400m radius. The Committee felt that these results were encouraging and **recommends** that empirical studies of porpoise distribution be conducted in areas where pingers are used.

*14.2.6 General recommendations regarding bycatch mitigation measures*

As noted in previous years, there is little or no information on the magnitude of cetacean bycatches in most of the world's fisheries. The Committee reiterated its previous **recommendation** that information on the bycatch of cetaceans in fisheries and mariculture operations be collected, preferably using independent observers. The Committee also reiterated concern expressed in previous meetings that, in developing countries, pingers are unlikely to be a workable solution to bycatch problems. In these cases, solutions must be inexpensive, technologically simple and require a minimum of prior information. With this pressing need in mind, the Committee **recommends** that particular effort be devoted to developing strategies for reducing bycatches of small cetaceans in the developing world. The Committee also **recommends** that if time area restrictions are to be used as a bycatch mitigation measure, the following conditions should be met: (1) extensive information should be available on the spatial and temporal distribution of small cetaceans, rates of bycatch, and fishing effort; (2) proper enforcement must occur, as without it, e.g. in the case of the vaquita, any effectiveness is undermined; and (3) a monitoring scheme must be developed and continue even after management goals appear to have been achieved. Finally, the Committee **recommends** further research to identify alternative fishing gear and methods, other than acoustic approaches, that could serve as long-term solutions to the bycatch of small cetaceans.

**14.3 Action arising from the 1999 meeting**

*14.3.1 Progress of the IWC/ASCOBANS Joint Harbour Porpoise Working Group*

At its meeting in 1998, the Committee convened a joint IWC/ASCOBANS Working Group to provide scientific advice to the Advisory Committee of ASCOBANS on issues relating to the assessment of the status of harbour porpoises in the North Sea and adjacent waters. The Working Group met in St. Andrews, Scotland in March 1999 and outlined a simulation modelling approach that would allow ASCOBANS to develop algorithms to meet their conservation objectives. Northridge noted that this modelling work was initiated in January 2000 and will be completed by the end of this year. The Committee looked forward to reviewing the modelling results at next year's meeting.

*14.3.2 Progress of the vaquita recovery programme*

Rojas-Bracho reminded the Committee that the government of Mexico has convened the International Committee for the Recovery of the Vaquita (CIRVA) to create a recovery plan based on the best available scientific information and which considers the socio-economic impacts of regulations on resource users in affected areas. Last year, CIRVA recommended that the bycatch of vaquitas be reduced to zero as soon as possible. However, it was not possible to implement such protection immediately, therefore CIRVA recommended that gillnet fishing be removed in three stages, starting with large-mesh gillnets and capping the numbers of fishing vessels at present levels. A conceptual framework has been developed that includes economic and social incentives for the communities of fishermen in the Upper Gulf of California, to gain their support for such measures. A proposal to expand the southern boundary of the Biosphere Reserve was submitted to the appropriate governmental authorities and acoustic surveys of the species have begun. Permit revisions are being considered for alternate gear types, such as experimental shrimp fishing. An educational and outreach proposal, designed to create public awareness of the vaquita, has been developed. The Committee commended the government of Mexico for its continuing efforts to conserve the vaquita and looks forward to receiving an update on further progress on this matter at next year's meeting.

*14.3.3 White whale stocks of particular concern*

Aerial surveys for white whales in Cook Inlet conducted in June 1999 resulted in an abundance estimate of 357 (CV = 20%). There was no subsistence harvest from this stock in 1999, although maktak and meat was taken opportunistically from two white whales that stranded and died in the upper Inlet in late summer. The USA National Marine Fisheries Service continues to work with representation from native subsistence hunting groups to establish a co-management agreement to manage harvests.

Last year, the Committee expressed concern regarding a number of stocks of white whales that were depleted, likely depleted or known to be of small size (IWC, 2000k, pp.243-50). Three of these stocks, in Shelikov Bay, Sakhalin-Amur and Shantar, occur in waters of the Russian Federation in the Okhotsk Sea. A harvest of white whales in the Okhotsk Sea was started in 1999, in which approximately 36 whales were killed in a directed hunt for commercial purposes; additional animals were live-captured from these stocks. In its review last year, the Committee concluded that stocks of white whales in the Okhotsk Sea are likely depleted and noted that considerable uncertainty exists regarding stock structure in this region (IWC, 2000k, pp.243-50). The Committee reiterated its concern regarding these removals and **recommends** that further assessment be undertaken of these stocks, paying particular attention to status and stock structure.

**14.4 Other presented information on small cetaceans**

SC/52/SM2 described field studies of white whales in Svalbard, Norway. The paper noted that research has been conducted on individual movements obtained by satellite telemetry, levels of organochlorine contaminants, assessment of diet through analysis of fatty acids in blubber, vocal behaviour and genetics.

SC/52/SM11 described the genetic discovery of a new species of beaked whale. Over a period of four years in the 1970s, four beaked whales stranded within 50 miles of each other along the southern Californian coast, and were identified as Hector's beaked whales (*Mesoplodon hectori*) based on their cranial morphology, the first and only records of this species in the Northern Hemisphere. However, comparison of the published mtDNA sequence from these specimens to other Hector's beaked whales in the database from strandings in the Southern Hemisphere suggest that they were not of this species, nor any other species in the database.

Bjørge introduced plans to survey the abundance of small cetaceans in Norwegian coastal waters, including fjords (SC/52/O14). The first year is a feasibility study of abundance surveys in very complex coastal waters. Results and experiences from this work will be reported for consideration by the Committee next year.

SC/52/ProgRepJapan reported that the national quota for Baird's beaked whales in Japan had been increased from 54 to 62 animals.

The Committee last considered Baird's beaked whales in 1990 (IWC, 1991a, p.186) when it noted that there was 'insufficient data to judge whether annual catches of approximately 60 whales are sustainable.' The most recent abundance estimate for the Sea of Japan is 1,260 (CV = 0.45; Miyashita, 1990) and that for the Pacific coast is 5,029 (CV = 0.56; Miyashita and Kato, 1993). The Committee was informed that Japan has been carrying out research in this region and has its own national management plan. Given the Committee's view in 1990, member governments are invited to provide information that will enable the Committee to determine whether sufficient new data exist to review the status of this species at a future meeting. Komatsu informed the Committee that Japan did not seek its advice on this species which is being appropriately managed and for which it did not see a need for collaboration. He reiterated Japan's view that the management of small cetaceans is outside the Commission's competence. The detailed position of Japan on small cetaceans is given in Annex X.

**14.5 Takes of small cetaceans in 1999**

As in previous years, the Committee noted that the table of recent catches of small cetaceans (Annex K, Appendix 4) is incomplete. Therefore, the Committee reiterated its **recommendation** of previous years that member nations should submit full and complete information on direct and incidental takes in their progress reports. Furthermore, the Committee **agreed** that the IWC publish information that assists in interpretation of the catch and bycatch statistics of small cetaceans included in national progress reports, in addition to the annual statistics themselves, on a stock by stock basis (see Item 4.2).

**14.6 Work plan**

The Committee reviewed its proposed schedule of priority topics (IWC, 2000k, p.255). In light of Commission Resolution 1999-9 (IWC, 2000a, p.55), the status of Dall's porpoise will be a priority topic for its next meeting (Table 13). Komatsu informed the Committee that this resolution had been opposed by Japan and it was not the position of the government of Japan to collaborate with the IWC on this matter. In addition, at its next meeting the Committee will review briefly progress on: the IWC/ASCOBANS harbour porpoise working group; the Vaquita Recovery Programme, plans for improving survey methodology for freshwater cetaceans; the results of the Norwegian feasibility survey in complex coastal waters; and conservation of the baiji.

Table 13
Small cetaceans work plan.

| Year | Topic | Justification |
|---|---|---|
| 2001 | Status of Dall's porpoise | IWC resolution 1999-9 |
| 2002 + | Systematics and population structure of *Tursiops* | Large amount of new research results |
| | Status of ziphiids in the Southern Ocean | Lack of previous assessment |
| | Status of small cetaceans in the Caribbean Sea | Lack of previous assessment; continuing catches and bycatches |

## 15. WHALEWATCHING (SEE ANNEXES M AND N)

At last year's meeting, the Committee recommended that a Workshop be held before its 2000 meeting to expedite the collection, exchange and synthesis of information necessary to assess long-term effects of whalewatching on cetaceans.

The Committee identified four priority topics for this year:

(1) review the findings of the above Workshop;
(2) review the updated report on National guidelines;
(3) review new information on dolphin feeding programmes; and
(4) review information on swim-with programmes that involve whales and dolphins.

A representative of Japan drew attention to the following statement (Annex M, item 3).

> The government of Japan believes that whalewatching is outside the competence of the IWC. Japan does not deny that studying the effects of whalewatching on whale stocks in order to obtain better understanding of the stocks. [sic.] However, because the IWC has a limited budget, the budget should be used for the primary objectives of the IWC, such as stock assessments. Japan believes that time and monetary resources should be spent on discussing other issues that have higher priorities than whalewatching.

### 15.1 Review of the Workshop on Assessing the Long-term Effects of Whalewatching on Cetaceans

The Report of the Workshop is given as Annex N. Its terms of reference are given below.

(1) The identification and presentation of case studies of established whalewatching programmes and accompanying research programmes to monitor the potential effects of whalewatching on whales (e.g. history of the whalewatching programme, trends in whalewatching effort, cetacean species observed, experimental design utilised to monitor these programmes including data collection and analyses).
(2) The development of a list of population parameters that can be monitored in conjunction with whalewatching programmes and used to assess the long-term status of whales. Such parameters might include: seasonal abundance and density in whalewatching areas; habitat use patterns; measures of fecundity-calving rates of individual females; survivorship based on re-sightings of individuals; and evidence of physical injury and/or disease.

The Workshop had agreed that rather than focus on long-term (versus short-term) effects of whalewatching on cetaceans, it was important to focus on biologically significant effects. It had requested the sub-committee to further elaborate the research opportunities that had been identified at the Workshop (e.g. Annex N, table 1) and to suggest methodologies and research protocols for whalewatching operations.

The Workshop agreed that there were a number of parameters that can be observed and measured in a standard way while whalewatching is occurring including: number of boats; time spent with whales; distance from whales; ambient sound; boat noise; and parameters involving energetic expenditure (e.g. swim speed, respiratory rates, heart rate). Such measurements can be used in appropriate models to develop 'critical response thresholds' in an attempt to identify potential impacts with biological significance for the individual. It may be possible to extrapolate some individual effects to the population level. It believed that further consideration should be given to the further identification and development of 'critical response' parameters (i.e. parameters likely to provide information of biological significance).

The Workshop also agreed that population abundance, trends and distribution should be monitored independently of whalewatching efforts to assess long-term impacts. Parameters such as survival and productivity are needed to explain any observed population trends. Extensive photo-identification efforts that result in repeat sightings of individuals can contribute and are contributing to estimating such parameters.

The interpretation of any changes in these population parameters requires controls and these should be part of any such study whenever possible. Controls could include areas that are closed to whalewatching but in all other respects are comparable to whalewatching areas; shore-based data collection with no boats present; or identified individuals with a wide range of exposure to whalewatching vessels. The Workshop also agreed that fatal or near-fatal collisions between whales and whalewatching vessels should be considered biologically significant and therefore monitored.

The Workshop also considered the kinds of data that can be collected from whalewatching platforms. Given adequate consideration of bias, whalewatching data can potentially contribute to the assessment of a number of parameters in cetacean populations (see Annex N, table 1). Most useful data include photo-identification and, in areas where cetacean populations are poorly known, presence or absence of particular species. As discussed in IWC (1990), photo-identification data can be used to make migratory links and measure a number of population parameters including: fecundity/calving rates of individuals; survivorship based on resightings of individuals; and evidence of physical injury or disease. The measures of fecundity and survival rates, however, require carefully planned data collection procedures, consideration of bias, and likelihood of obtaining adequate resighting rates. Statistical power calculations based on available data will assist in determining if resighting rates will be adequate. Whalewatching data can be useful in assisting directed research on abundance and density, for some species and in some areas (see SC/52/WW9). Experienced, knowledgeable persons should collect data recorded on whalewatching vessels. These persons may be boat operators or naturalists.

In discussion of the Workshop report in Annex M, an expanded and revised version of Annex N, table 1 was developed. This is given as Annex M, Appendix 3. The revised table characterised the types of data that could be collected into three levels:

Level 1 – data that any whalewatching operation could be encouraged to collect;
Level 2 – data that all whalewatching operations with the capacity/facilities/resources could be encouraged to collect (in addition to data to be collected at Level 1); and
Level 3 – data that all whalewatching operations, when paired with directed, scientific research lead by an experienced scientist, could be encouraged to collect (in addition to data collected at Levels 1 and 2).

It was **agreed** that all levels of information should be collected with the oversight of an experienced researcher wherever possible.

One member expressed strong reservations about some of the types of data being requested from whalewatching operations. While there was a clear justification for requesting data related to the operations themselves, which would document their possible impacts on whales (e.g. recording the number and the duration of encounters per day) there was less justification for requesting data that could be used for research *per se*. The limitations of and likely biases in the data collected on such platforms should be recognised. Any requests for data should be clearly hypotheses-based and not random.

It was stated that it was not the intention to generate population statistics from Level 1 and 2 whalewatching data. In certain parts of the world, these kinds of data are the only access to information about whales and the process should therefore be encouraged. Although not all of these data would be valuable in all areas, whalewatching platforms can supply data that would not necessarily be obtainable by dedicated researchers. Researchers should be identified to receive data collected by whalewatching operators whenever possible and provide feedback to them.

The Committee **endorsed** the report of the Workshop and **agreed** that an Intersessional e-mail Correspondence Group should consider further Annex M, Appendix 3 with the aim of preparing draft forms (and detailed usage notes) that whalewatching operators could complete and that would give them guidance in terms of what factors they could monitor. These should be reviewed by the sub-committee on whalewatching next year. The Committee also **agrees** that the Intersessional Group should consider further the question of important research needs relating to assessment of parameters that may yield information relating to whalewatching impacts of biological significance, and in particular how to record, measure and evaluate these parameters. It should consider what appropriate research would contribute towards this and provide an outline to encourage research development for review next year.

### 15.2 Review of update of National Whalewatching Guidelines

In response to a Committee request of last year, Carlson presented an update of national whalewatching guidelines covering over twenty-seven countries and territories. She noted that the report was not exhaustive and should be considered part of an on-going process as new regulations and guidelines are developed.

The 'Australian National Guidelines for Areas of Special Interest for Cetacean Observation' have recently been published and these are regarded as the minimum standard for use in Australian waters. The introduction of more stringent regulations is encouraged in areas where interactions with cetaceans regularly take place. The Guidelines took over two years to finalise and included input from Federal and State Governments as well as a range of stakeholders.

SC/52/WW4 detailed research conducted along the East Australian coast to examine compliance of whalewatching operators with regulations and guidelines. The study concluded that although overall compliance by the operators is high, further investigation is necessary. Results from this research will be used to plot vessel and whale movement to further examine compliance by operators in regards to approaches and departures around whales.

SC/52/WW17 described UK National and European legislation to protect cetaceans and national guidelines for cetacean watching. It has recently been confirmed that the EU Habitat and Species Directive applies to all national waters; it thus probably includes the most important cetacean habitats in Europe.

SC/52/WW12 included information contained in the Mexican Regulations for Whalewatching. Previous initiatives, in force since 1996, are now included in an official regulation (NOM-131-ECOL-1998) that came into force for the 2000 season. The Regulation recognises the fundamental value of scientific research specifically targeted to generate information on the effects associated with whalewatching activities.

SC/SC/WW3 presented the preliminary analysis of behaviour and management of two solitary, sociable white whales in eastern Canada. The paper concluded that early implementation of a management protocol as soon as cetaceans begin interacting with humans is key to management success.

SC/52/WW20 reported on new trends and developments of increasing dolphin-watching activities in Patagonia. The dolphin tours are difficult to control and the established rules for whalewatching are not applicable due to the different behaviour and character of the species of dolphins involved. The authors recommended that guidelines be developed for each species and that they be based on scientific information.

In the light of the review, the Committee **recommends** that:

(1) the IWC Scientific Committee Principles for Whalewatching should be taken into account when regulations are being formulated;
(2) Carlson continue to gather information on National Guidelines and Regulations and that this compendium be placed on the internet, possibly by the IWC Secretariat, for wider distribution;
(3) research on the compliance with and effectiveness of guidelines and regulations be conducted; and
(4) laser range finders be used, where possible and appropriate, for research and compliance studies (the laser range finders should be tested for accuracy before use in such studies).

### 15.3 Review of new information on dolphin feeding programmes

Last year, the Committee had repeated its request that member governments provide new information on dolphin feeding programmes.

Information from Australia is given in Annex M, Appendix 2. Feeding programmes are subject to the new Australian Guidelines discussed above. Management regulations for the feeding programme at Monkey Mia were implemented due to concerns expressed by local researchers, in the Montecastello Workshop (International Fund for

Animal Welfare, 1995) and commissioned reports to CALM (Department of Conservation and Land Management, WA). However, all feeding programme management strategies have been implemented independently of each other. Although the Federal Government wished to phase out the dolphin feeding activities, this did not appear feasible.

An unpublished report to the US Marine Mammal Commission (Samuels and Bejder, 1998) on habitual interaction (involving illegal feeding) between humans and wild bottlenose dolphins near Panama City Beach, Florida was considered. There have been several instances of aggressive behaviour (including serious bites) by animals towards people who did not feed them or were slow to feed them. Some animals have been hurt and the feeding has affected their foraging behaviour. The presenter concluded that current levels of education and enforcement are ineffectual.

The Committee stressed that dolphin feeding programmes do not follow the IWC's suggested Principles for Whalewatching, specifically that '…cetaceans [are allowed] to control the nature and duration of the interactions'. It noted that the practice can be detrimental to both dolphins and humans. Although feeding programmes are legal in some areas, the Committee expresses serious concern about the continued feeding of wild cetaceans and **recommends** that such programmes be prohibited.

### 15.4 Review of whale and dolphin 'swim-with' programmes

SC/52/WW13 reported on commercial swim programmes with dwarf minke whales on the northern Great Barrier Reef since 1996. The duration of encounters appear to be generally controlled by the whales. Further information on the gender, length, habitat use and residency time of individual whales involved in the interactions is needed for more detailed analyses. Habitat use and residency time are currently monitored through photo-identification studies based on underwater photographs and digital videography. The author believed that management strategies to address such encounters should be developed and implemented. Until more information is available, the swim programmes need to be managed cautiously, particularly in terms of maintaining the relatively low growth rate of the industry.

SC/52/WW2 provided a literature review of behavioural indicators of stress in sociable odontocetes subject to human interactions. It identified short-term reactions that might represent biologically significant responses. It noted that certain kinds of animals might prove useful in attempting to study this issue, including solitary, sociable odontocetes, and captive animals. The review indicated that sociable odontocetes demonstrated more 'stress-related' behaviours when swimmers were present than when only boaters were present.

SC/52/WW3 described two preliminary case studies of solitary, sociable white whales in Canada. In both cases, the whales were more attracted to boats than people and people initiated in-water interactions. The whales appeared to tolerate swimmers, although agonistic behaviour was more often directed towards swimmers than boaters.

In discussion, it was suggested that such situations may be analogous to wildlife viewing in National Parks where animals react more to people outside, not inside vehicles. Studies that compared the behaviour of wild dolphins to swimmers versus their behaviour to conspecifics showed that behaviour exhibited towards swimmers is similar in context and form to that towards conspecifics.

Dolphin swim programmes are run in a number of locations in Australia. Regulations for this industry are relatively new and industry self-regulation or operator codes-of-conduct are usually in place before legislation is enacted. Research into dolphin swims will be presented to next years' meeting.

SC/52/E11 reviewed diseases in marine mammals. The paper noted that emergent, infectious diseases were often characterised by the movement of a pathogen from one species to another. Swim-with programmes potentially pose threats to both cetaceans and humans and would seem to give increased opportunities for the transfer of pathogens to occur. However, human-to-dolphin transmission has not been demonstrated. There are two examples of contracted low-grade tubercular infection in humans from exposure to whale bacteria. The most widely recognised disease in humans caused by contact with marine mammals at this time is the condition known as 'seal/whale finger', although the precise identity of the pathogen concerned remains unclear.

The 'Wild Dolphins Swim Program Workshop' (Dudzinski *et al*., 1999) examined the management and research issues surrounding wild swim-with programmes around the world. A general conclusion was that different species respond differently to swimmers and while there should be general, precautionary management guidelines, these guidelines could and should be tailored to specific situations, based on research. There may be some situations where swim-with programmes should be prohibited entirely (e.g. if the area is critical to the animals in a way that is incompatible with human in-water interaction).

Constantine and Baker (1997) studied the reactions of bottlenose and common dolphins to swim-with programmes in the Bay of Islands, New Zealand. The authors documented differences in the reactions of the two target species as well as differences in dolphin reactions to swimmer introduction strategies. Strategies were defined as 'line abreast', where the operator released the swimmers ahead of, but not directly in the path of the dolphins; 'in path', where the swimmers were placed directly in front of the dolphins and 'around boat', where swimmers were introduced amongst dolphins that were already attracted to the boat. The authors concluded that the 'line abreast' strategy provided the animals with the most options to respond, as it resulted in the highest rates of neutral responses and provided the lowest rates of avoidance for both species.

In discussion, it was noted that this represents the type of research that should be conducted to evaluate all swim-with programmes. Although some general guidelines may apply to these programmes, there are behavioural and habitat use differences between species and populations within species. It was suggested that in such studies a neutral response may be the ideal management goal and that in the absence of data and interpretation of behaviours, management strategies that minimise avoidance should be developed.

SC/52/WW19 reviewed methods to assess impacts of whale and dolphin watching. Different methodologies make comparison of results problematic. The authors recommend that studies be conducted from land wherever possible, so that whale and dolphin behaviour can be observed in the presence of boats and swimmers and compared with behaviour in the absence of boats and swimmers (including researchers). Where land-based observation is not possible, the effect of the research vessel itself should be evaluated. Long-term studies are needed to determine the biological significance of any short-term behaviour changes observed. The authors also concluded that the magnitude of behaviour

changes as well as the statistical significance should be reported, and that full consideration be given to changes in natural conditions that may make it difficult to isolate the effects of whale/dolphin watching.

Barr and Slooten (1999) described a study on the effects of tourism on dusky dolphins at Kaikoura, New Zealand. Changes in dolphin behaviour were noted when boats and swimmers were present. In general, dolphins appeared to be more sensitive to disturbance after late morning. This has resulted in a 'time out' period for dusky dolphins at Kaikoura, with no commercial tours allowed to operate from 11:30-1:30 every day. The study had specifically addressed questions that would provide information useful for management, and management action had been taken in response to the results of the study.

Bejder *et. al.* (1999) described a study of responses by Hector's dolphins to boats and swimmers in Porpoise Bay, New Zealand. Hector's dolphins were not displaced from the Bay by these activities but their response to the boat changed over time. In the initial stages of an encounter, dolphins tended to approach the vessel, but by 70 minutes into an encounter, they either actively avoided the boat, or were equivocal towards it, approaching significantly less often than would be expected by chance. Hector's dolphin groups were also significantly more tightly bunched when a boat was in the Bay (as seen with dusky dolphins also).

The Committee had thus reviewed three kinds of swim-with programmes: boat-based (where swimmers are attached by ropes to the boat); boat-based (where swimmers are dropped in the water); and, shore-based (where individuals swim out to the animals).

A draft report on wild swim-with bottlenose dolphin programmes in Port Phillip Bay, Victoria was also considered. The study monitored the number of whistles per minute produced by dolphin pods in response to the presence and absence of swim-with vessels. The response was measured in relation to three types of vessel approaches and the authors concluded that only parallel approaches to the animal be used. Acoustic methodology may be applicable to the measurement of biological effects such as stress. Of four conditions to which swim-with operators must comply in Victoria, the study showed that only one of the four was complied with.

Berggren reported on a swim-with dolphin programme in Zanzibar, East Africa where tourists swim with local populations of Indo-Pacific bottlenose and humpback dolphins in an area where direct hunting occurred until 1996. The activity has grown to such an extent that there are now about 35 boats bringing about 2,000 people per month out to the dolphins. The activity is unregulated. Behavioural studies have indicated a high frequency of behaviours indicative of stress when tourist boats and swimmers interact with the dolphins. Researchers have produced a draft set of guidelines for operators which was distributed in 1998 but little or no compliance has been observed to date. The author hoped that recent developments will lead to the adoption, implementation and enforcement of the guidelines and concluded that on a positive note, no directed take of dolphins has been observed in the area after 1996 when dolphin tourism started to expand.

After reviewing the scientific information provided, the Committee noted:

(1) that the impact of swim-with programmes in the wild will vary among species, populations and locations and, therefore, that the impacts of such programmes should be assessed on a case-by-case basis;
(2) that the available evidence indicated that swim-with programmes in the wild could be considered as being highly invasive; and
(3) **recommends** that swim-with programmes in the wild be further evaluated for effects on cetaceans.

### 15.5 Work plan

The Committee agreed the following work plan, in order of priority:

(1) review the report of the Intersessional Correspondence Group;
(2) review information on noise production from vessels and aircraft involved in whalewatching and the potential effects on cetaceans;
(3) review research on effectiveness of and compliance with national whalewatching guidelines and regulations.

Additional work would be to review: new information on dolphin feeding programmes; national guidelines and regulations for whalewatching; and new information on swim-with programmes.

## 16. SCIENTIFIC PERMITS

### 16.1 Advice on the effect on stock(s) of scientific permit catches

This item has been on the Committee's agenda for several years but has not been discussed in any detail since 1996 (IWC, 1997a), at which time there was no consensus view on what methodological approach was appropriate to address this question, either for shorter- or longer-term programmes. Discussions had focussed largely on the possibility of using RMP simulations or HITTER-FITTER. Particular difficulty arose when dealing with programmes for which the total duration was unknown or which had the potential to be renewed. Attention was drawn to the approach used by Butterworth and Geromont (1996) to examine this question. It was noted that both approaches can produce population trajectories for as long as was desired.

The matter was discussed this year in the context of providing advice on the effect of the JARPA programme catches. The specific concerns are discussed under Item 16.3.2 below.

Some members considered that the history of these scientific permit catches has been that they are ongoing, and this year's documentation does not dispel the impression that they may be continued, revised and/or extended for the indefinite future. Accordingly, the effect of such catches is most reasonably analysed by modelling long-term ongoing removals, and any such analysis is therefore usefully compared to other tools used by the Committee to formulate continuing management advice, such as the RMP and future AWMP.

Other members did not agree that it was necessary to assume that any research catch would continue for 100 years when assessing its effect on the stock. This would give a misleadingly large impression of the effects of much shorter programmes which could be justified for sound scientific reasons. They believed it might be wiser to consider the effects of catches over a variety of timeframes when programmes are initiated, but only sensibly on a case-by-case basis and in any event not more than 20 years.

Despite the above concerns, the Committee **agreed** a general principle that when addressing the question of the effect of scientific permits on catches, it would examine the

effects of proposed catches assuming they were ongoing, as well as for a shorter period, even if the proposal was initially presented as a feasibility study.

## 16.2 Review of results from existing permits

*16.2.1 Japan – Southern Hemisphere minke whales*

SC/52/O20 summarised the thirteenth field season of the JARPA programme. Research was conducted in Area IV and the eastern part of Area III from 5 December 1999 to 10 March 2000.

The sightings vessels covered almost 5,000 n.miles and the three sighting and sampling vessels covered about 3,800 n.miles each. A total of 1,507 (6,581 individuals) sightings of minke whales were made, whilst 661 (1,269 individuals) primary sightings of humpback whales were observed.

In Area IV, minke whales were most abundant in the southern area, particularly in the east-south stratum where large schools were observed. Most of the primary sightings in Prydz Bay were minke whales.

Minke whales in Area IIIE were also concentrated near to the pack ice, mainly west of 56°E. Most of the minke whales were seen in the northern stratum at its southern edge and only a few minke whales were seen off the ice-edge in Area IIIE. Humpback whales in Area IIIE were clearly separated from minke whales. They were concentrated in the western part of the northern stratum and southern stratum between 56°E and 62°E. In Area IV, similar apparent segregation between species was observed in the northern stratum, but in the south between 90°E and 112°E there were densities of both species. Humpback whales were seldom seen in the Prydz Bay.

Of 1,106 schools (4,810 individuals) sighted by the two sighting/sampling vessels, 468 individuals were targeted and 439 individuals were taken.

A total of 125 individuals were photographed and 49 skin samples were collected by biopsy from humpback, blue and right whales. Acoustic records were obtained for a total of 19 hours and 38 minutes from seven cetacean species. XCTD and CTD were conducted at 123 and 87 locations in the research area. Hydro-acoustic surveys with EPCS were also conducted.

Mature females were dominant in the east-south stratum and Prydz Bay, whereas mature males were dominant in the north strata, west-south stratum in Area IV and Area IIIE. The percentage of immature females was highest in all strata in Area IIIE and that of mature females was the lowest. The maximum length of the sampled animals was 9.45m for males and 9.92 for females. The minimum lengths were 4.71m and 5.23m respectively.

SC/52/O19 reported on the result of an experiment to try an alternative sampling strategy proposed by Schweder (Schweder, 1998). This attempted to take into account: (a) over-sampling from small schools; (b) easier detection of larger schools; and (c) under-surveying in areas of high density. The experiment revealed that a considerable amount of time was lost along the trackline in areas of high density. The authors concluded that these experiments should continue for a proper evaluation of the proposed method.

*16.2.2 Japan – North Pacific minke whales*

**16.2.2.1 REPORT OF THE JARPN REVIEW MEETING**

Bannister presented the report of the Workshop held in Tokyo, 7-10 February 2000 (SC/52/Rep2). In addition to Japanese participants, 11 others were present, of which seven were Invited Participants. Sadly, the Convenor, Smith, had been prevented from attending at the last minute.

The Workshop's terms of reference, as agreed by the Scientific Committee last year (IWC, 2000f, p.57) were to:

(1) review methods and results of the research programme, 1994-1999;
(2) assess the further potential of existing data for meeting
  (a) JARPN objectives
  (b) other objectives;
(3) evaluate whether the main objectives have been achieved.

The main objectives of JARPN were to determine:

(1) whether or not the 'W' stock exists and if so to estimate mixing rates between the 'O' and 'W' stocks; and
(2) the feeding ecology of minke whales in the North Pacific.

The Committee had expected that the Workshop report would provide it with information on the plausibility of options being considered in the RMP *Implementation Simulation Trials* for North Pacific minke whales (IWC, 2000f, pp.8-10) when those results are considered at this Annual Meeting.

OUTLINE OF JARPN AND PAST COMMITTEE DISCUSSIONS

The JARPN surveys started in 1994 with the primary objective of elucidating the stock structure of minke whales in the northwestern North Pacific to assess the plausibility of working hypotheses developed by the Working Group on North Pacific Minke Whale Management Trials (IWC, 1994a, pp.120-44). Originally there were three sub-objectives:

(1) to assess whether the 'W' stock exists;
(2) to provide data to estimate the mixing rate of the 'W' and 'O' stocks; and
(3) to assess the validity of the 'O' sub-stock scenario.

In 1996, the Committee had agreed that the 'O' sub-stock structure scenario should be dropped from the *Implementation Simulation Trials* for North Pacific minke whales. Since then, that third sub-objective had not been considered. A second objective, 'the feasibility study on the feeding ecology of minke whales in the research ground', was added in 1996. In 1999, a sub-objective was added to the primary objective, i.e. to estimate the mixing rate between the 'J' and 'O' stocks.

There had been substantial discussions of the programme by the Committee at the programme's inception, in 1994, when there was a detailed review (IWC, 1995b, pp.82-5), and in 1999 (IWC, 2000f, pp.54-57). Discussions in the intervening years largely referred to comments on the 1994 review.

At the 1994 Committee meeting, the proposal was reviewed in accordance with the Committee's agreed five sets of guidelines, A-E. For three, A (The Proposal), B (Objectives) and E (Research cooperation), the Committee had agreed that the relevant guidelines had been met. For C (Methodology) there was detailed discussion, particularly of genetic analyses. In addition, the importance of abundance estimates in the context of the RMP led to confirmation of the importance of sightings estimates as well as sampling. For D (The effect of catches on the stock), after some discussion the Committee had noted the difficulties experienced in the past in adequately providing advice on the matter, referring however to its previous advice that the effect of a small take for a short period would be negligible. It had agreed to consider the general question of how to provide such advice at its next meeting, but there was little

subsequent progress in addressing the problem, despite, for example, extensive discussions at its 1997 meeting (IWC, 1998b, pp.95-106).

Last year, the Committee reviewed two options for the 1999 survey, one requiring permission from the Russian Federation for sampling in its waters. In the event, a majority of the Committee was unable to respond positively to a request for the Russian Federation to be urged to allow access to its waters for the proposed sampling.

In addition to those Committee discussions, initial results from the programme were discussed in some depth during the 1996 meeting of the Working Group on North Pacific Minke Whale Trials (IWC, 1997c, pp.203-26). Information from the research was used in revising the trials.

The Workshop reviewed the reasons for the selection of the boundaries for the sub-areas specified for North Pacific minke whales (SC/52/Rep2, fig.1) as detailed in IWC (1994a, p.122).

### OVERVIEW OF SAMPLING METHODOLOGY AND RESULTS

Sampling methods in the first two JARPN surveys, which were considered to be feasibility surveys, were similar to those in JARPA surveys. But methods were modified in 1995, including sampling from secondary sightings and restricting surveys to waters $< 15°C$. A total of 498 animals was collected in sub-areas 7, 8, 9 and 11. Samples were not taken in sub-area 12 because it is in the Russian Federation EEZ and permission to sample there was not given. Sampling efficiency (animals sampled per animal sighted) in 1994 was 0.49, but, after the modification to the sampling methods, it improved to 0.6-0.7. The Workshop was informed that the distributions of minke whale sightings roughly matched the distribution of minke whale samples, thus indicating that the samples were collected randomly from the areas sampled.

The Workshop reviewed the results of the 1999 JARPN cruise including sampling results for that year, as described in SC/52/Rep2, item 9.

### STOCK STRUCTURE

In this context the Workshop reviewed past discussions of stock structure and methods of analysis, and received detailed reports on investigations of DNA and allozyme structure, biological (e.g. reproductive) data, morphometric and morphological data, geographical distribution, pollutant burdens, parasite loads and other data; the latter included carbon and nitrogen stable isotopes in baleen, muscle and liver, and condition (fatness) factors (SC/52/Rep2, items 10.2.1-10.2.7).

### EXISTENCE OF THE 'W' STOCK

In reaching its conclusions, the Workshop was greatly helped by preliminary views summarised by Hatanaka (SC/52/Rep2, Annex G) and Taylor (SC/52/Rep2, Annex H). Its conclusions were as follows:

(i) From DNA analysis – revised mtDNA analyses carried out during the Workshop, with commercial data both excluded and included, gave a significant effect (at the 5% level) between sub-areas 7 and 8 on the one hand and sub-area 9 on the other when commercial data were excluded, and a small but not significant (at the 5% level) effect when they were included, possibly arising from samples taken in the western part of sub-area 9 in 1995. The Workshop agreed that further analyses should be carried out to explore those findings further, as detailed in SC/52/Rep2, Annex I. In the light of the results the Workshop agreed that the possibility of the existence of some group of minke whales to the east of Japan that differed from the 'O' stock could not be ruled out, but that the data nevertheless provided a basis to restrict the number of 'W' stock hypotheses that need to be considered in the RMP trials.

(ii) From allozyme analysis – in theory allozymes should provide less resolution of stock structure than mtDNA and microsatellites. However, although this was often born out in practice, there is at least one case where the reverse holds, e.g. in the North Atlantic. The Workshop emphasised the need to consider results of various genetic analyses in combination.

(iii) From biological parameters - the Workshop agreed that while differences in mean conception dates comprise strong evidence for more than one stock, it is much less certain what inferences can be drawn in the reverse situation. While it agreed that the reverse situation could increase probabilities assigned to a one stock hypothesis prior to such information being available, it would be difficult to quantify the extent of the change.

(iv) From morphological and morphometric analyses - the Workshop agreed that discussions of the implications of these analyses were complicated by the fact that though some differences (significant at the 5% level) had been found, many tests for differences had been conducted.

(v) From pollutants, parasites, stable isotopes and other analyses - the Workshop agreed that the pertinence or otherwise of information under these headings to stock structure determination depended particularly on residence time and accumulation effects. More information was needed on these factors before any significant differences detected under these headings can be interpreted in the context of stock differentiation.

In summary, the Workshop agreed that some of the difficulties experienced in discussing stock structure arise from lack of clarity in the Committee as to what constitutes a 'stock'. This needs to be expressed in terms of likely dispersal rates between 'stocks', where 'dispersal' refers to gene flow. In the context of trials, the Workshop recognised that 'dispersal' is modelled as permanent transfer from one breeding population to another. For example, established differences between the 'J' and 'O' stocks were sufficiently large that any such dispersal rate must be negligible on the time scale relevant to demographics and management. Three participants had expressed a minority view (SC/52/Rep2, item 1.3.1.6).

### ESTIMATION OF MIXING RATES BETWEEN 'O' AND 'W' STOCKS

In the context of the hypothesised 'W' stock, 'mixing' relates to the sub-areas (and times) where animals from this stock might be present. The Workshop agreed that it would be premature to draw conclusions on the extent of the possible presence of 'W' stock animals west of sub-area 9, prior to completion of further analyses (detailed in SC/52/Rep2, Annex I). However, it also agreed that if such analyses provided no evidence to change the existing sub-area stratification from a stock structure identification perspective, then sub-areas 7 and 8 need not be distinguished for that purpose. Furthermore, current hypotheses placing 'W' stock animals in sub-area 7 and/or 8 could then be rejected. The Workshop **recommended** that the results of these further analyses be reported to the Committee for consideration.

Regarding dispersal, the Workshop agreed that if there was a 'W' stock, there had also to be a non-negligible level of dispersal between this and the 'O' stock, for reasons already discussed. This in turn probably means that such dispersal effects should be included in the RMP trials. Based on the conclusions of a sub-group to advise on the further computations necessary to assist in determining ranges of dispersal rates appropriate for consideration in the trials, the Workshop **recommended** that a particular program (Taylor *et al*., 2000) should be used for that purpose and that the sub-group should monitor the progress of the associated computations and report accordingly to the next Committee meeting.

### ESTIMATION OF MIXING RATES BETWEEN 'J' AND 'O' STOCKS

The Workshop reviewed estimates of the proportion of 'J' stock animals in sub-area 11, by month and sex, based on data from JARPN surveys and past Korean and Japanese coastal operations. Given that some of the mixing rates reported were based on the assumption that all samples from sub-area 9 were from the 'O' stock, the Workshop **recommended** that the sensitivity of these results to omission of the samples for the west of sub-area 9 (i.e. west of 162°E) in 1995 be checked as it may contain some 'W' stock animals. The results should be reported to the Committee to take into account for further refinement of the *Implementation Simulation Trials*.

### IMPLICATIONS FOR *IMPLEMENTATION SIMULATION TRIALS*

The Workshop noted that its discussions and decisions on mixing rates above are also relevant in this context. However, a key aspect of the trials, to which those discussions do not refer, is the variety of assumptions about the proportion of animals in sub-area 12 (the Okhotsk Sea) that may originate from the hypothesised 'W' stock. There are no data available from JARPN for this sub-area (or portions of sub-areas 7, 8 and 9 in the Russian EEZ). The Workshop **recommended** that further genetic samples from, particularly, sub-areas 12 and 9, and possibly 8, be obtained to facilitate clearer discrimination among alternative 'W' stock hypotheses.

### FEEDING ECOLOGY

Following consideration of the background, methods and results of feeding ecology studies, the Workshop recognised that while two different methods had been used to estimate daily and seasonal food consumption, both need refinement. In method (1), the assumption of an average passage time of eight hours for all food items was made. Since no information is yet available on food passage time for minke whale stomachs, the assumption is subject to considerable uncertainty. The Workshop agreed that if this method, originally designed to calculate consumption rates in fish, is to be used in future minke whale studies, some of the assumptions should be refined using empirical data. It noted that, with the logistics applied in the JARPN surveys (including the use of a large mother vessel), experiments addressing some of these questions might well be carried out in the field. For method (2), it noted that the energetic costs of blubber deposition and visceral fat deposition had not been taken into consideration in the calculations. It was suggested that this be done, and that future calculations of food consumption using method (2) follow the approach described by Folkow *et al.* (2000) in their calculations of minke whale food consumption in the northeast Atlantic.

The Workshop noted that the consumption calculations were performed only for August and September. With the sampling design used in JARPN so far, a quantitative measure of temporal and geographical changes in minke whale diets can not be obtained. Thus, extrapolations to calculate the annual consumption of the entire population found in the research areas can not be performed. It agreed that if surveys are to be performed in the future, the sampling design should permit such calculations.

In conclusion, the Workshop noted that the feeding ecology investigations under JARPN were only a feasibility study. The primary objective was to obtain data necessary to address questions related to stock identity, implying a sampling design less than optimal for the ecological studies. The latter were conducted using well-established and appropriate methods, and the Workshop considered the study to be successful within those limitations.

The Workshop agreed that if ecological studies of minke whales are to be conducted in the area, the sampling regime must be designed to allow for a more quantitative estimation of temporal and geographical variation in diet. Given the migration patterns of minke whales in the area, it is also of the utmost importance for future ecological studies that access be obtained to the unsurveyed feeding grounds in the Russian EEZ, including the northern parts of sub-areas 8 and 9, and all of sub-area 12. The Workshop agreed that surveys in those areas would give a more complete picture of both the ecology and more general biology of the whole population, including, particularly, mature females.

The Workshop also agreed that it is necessary to obtain an improved understanding of the distribution and abundance of relevant prey species to better understand the dynamics of minke whale food choice and consumption. It therefore **recommended** that acoustic and trawl surveys, designed to address such questions, should be conducted concurrently with future whale surveys, if possible.

### OTHER STUDIES (E.G. OCEANOGRAPHY)

The Workshop discussed an overview of oceanographic conditions in the western North Atlantic using information collected during JARPN (SC/52/Rep 2, item 12).

### COMMISSION RESOLUTION 1999-2

The Workshop noted that under this Resolution the Committee had been asked to advise the Commission on whether the information sought in research programmes under Special Permit was: (a) required for management; and (b) could be obtained by non-lethal means.

Bannister had conveyed the views of the Committee Chair, that while the item should be on the Workshop agenda, there should not be a long discussion of it. Full discussions should occur during the Annual Meeting.

In that context, the Workshop noted that it had not discussed matters relevant to item (b) above, but that in relation to item (a), information obtained during JARPN had been and will continue to be used in the refinement of *Implementation Simulation Trials* for North Pacific minke whales, and consequently was relevant to their management.

### RECOMMENDATIONS

Two recommendations were identified in addition to those already formulated.

(1) Research potentially employing new technology should be undertaken to find the breeding grounds, recognising that the most definitive stock structure data will likely come from such grounds.
(2) The age-composition data collected during JARPN should be analysed further to provide information for

use in conditioning of *Implementation Simulation Trials*.

All the Workshop's recommendations are listed in SC/52/Rep2, table 2.

In response to the suggestion that research be conducted in sub-area 13, the Workshop **recommended** that a full proposal be presented for consideration at the Committee's next meeting.

*Committee discussion*

The Committee **endorses** the recommendations of the Workshop. It noted that aspects of the report would be considered by the sub-committee on the Revised Management Procedure (Annex D). With respect to the Commission's Resolution, it noted the Workshop's comments above on whether the information obtained was useful for management, i.e. information obtained during JARPN had been and will continue to be used in the refinement of *Implementation Simulation Trials* for North Pacific minke whales, and consequently was relevant to their management.

With respect to the question of non-lethal research methods, the Committee referred to its previous discussions on this subject (e.g. IWC, 1995b, p.82), noting that no consensus view was reached.

**16.3 Review of new or revised proposals**

*16.3.1 JARPN II*

The Committee received an extensive new proposal by the Government of Japan, 'Research Plan for Cetacean Studies in the Western North Pacific under Special Permit (JARPN II) - Feasibility Study Plan for 2000 And 2001' (SC/52/O1). The priority for this programme, which is intended to follow on from JARPN, is to be on feeding ecology. It is envisioned that 100 minke whales (effectively O Stock and putative W Stock), 50 Bryde's whales (Western North Pacific Stock) and 10 sperm whales (Western Division Stock) will be sampled in each year. The proposal was circulated to the Committee in advance of the meeting.

Morishita expressed regret and concern that despite the document clearly being marked as confidential, it had been leaked almost simultaneously in four countries. He also stressed that although the proposal had a strong cetacean component, it was much broader and aimed to provide information for the overall conservation, management and sustainable utilisation of marine resources (including cetaceans) in the western North Pacific, and especially within the EEZ of Japan. He noted that this was a feasibility study for a highly ambitious research programme involving multi-disciplinary research and involving a wide number of Japanese research institutes.

The major discussion of the components related to the stock identity of minke and Bryde's whales took place in the sub-committee on the Revised Management Procedure (Annex D), whilst that related to pollutants took place in the Standing Working Group on Environmental Concerns (Annex J). Given the extent of the proposal and the overall workload of the Committee, the Chair had encouraged participants to submit working papers. These working papers, are included as Annex P to this report as, for convenience, are the discussions from Annex D and Annex J:

Annex P1- Comments by the sub-committee on the RMP;
Annex P2 – comments by the SWG on environmental concerns;
Annex P3 - questions arising about JARPN II;
Annex P4[4] – response to 'Questions arising about JARPN II';
Annex P5 – a comment on the usefulness of biopsy techniques;
Annex P6 – response to 'A comment on the usefulness of biopsy techniques';
Annex P7 – research design of JARPN II;
Annex P8 - data and samples for feeding ecology studies in the past commercial whaling and scientific permit takes (JARPN).

In the general review of the Commission's Guidelines (Annex Y) given below, points made in these detailed Annexes are usually mentioned only in general terms unless illustrative examples are given. The proposers views are included immediately after the Guidelines. This is followed by Committee comments and discussion.

The Commission's attention is drawn to the fact that there was insufficient time to fully discuss each of the questions or comments made to the proposers of the proposal, nor the responses they received. However, the authors of Annex P3, whilst appreciative of the effort made to answer their points, indicated that the replies given in Annex P4 did not fully satisfy all their concerns, even though considerable time was spent addressing some of the questions raised. The proposers indicated at the end of the discussion that they had tried to respond to the questions in detail and that they were willing to respond to further comments and questions after this meeting.

**A. The Proposal**

The relevant guidelines are as follows:

(1) 'A Statement as to whether the permit proposal adequately specifies the four sets of information required under paragraph 30 of the Schedule.' (IWC, 1986a, p.133).
(2) 'Objectives of the research;' (IWC, 2000e, p.89)
(3) 'Number, sex, size and stock of the animals to be taken;' (IWC, 2000e, p.89)

*Proposal*

The objectives of the programme are given in Section III of SC/52/O1. The overall goal of the research is to contribute to the conservation and sustainable use of marine living resources including whales in the western North Pacific, especially within Japan's EEZ. For the overall goal, it is important to gather the information on resources and to merge it as a whole ecosystem. In this research, special attention will be paid to the ecosystem surrounding cetaceans, and the data and materials related to cetaceans, prey species and oceanographic conditions will be collected. The sub-projects are: feeding ecology (including prey consumption and preferences of cetaceans and ecosystem modelling); stock structure; environmental effects on cetaceans and the marine ecosystem.

Numbers of animals and their management stocks are specified in the proposal. A total of 100 minke whales (effectively O Stock and putative W Stock), 50 Bryde's whales (Western North Pacific Stock) and 10 sperm whales (Western Division) will be sampled in each year. Random sampling will be carried out and thus the sex and length of the catch cannot be specified.

[4] In response to Annex P4, the authors of Annex P3 noted that they provided the questions in it to assist the Committee and Japan to address outstanding issues without pre-judging the results of discussions. They strongly objected to the second sentence, which ascribes views to the Scientific Committee (and indirectly them). Annex P3 does not support those views, and this sentence serves only to encourage an atmosphere of pre-judgement and to discourage an open dialogue on the scientific issues involved with the proposed research whaling.

*Comments and discussion*

There were some questions raised about the more detailed objectives of the sub-projects. In particular the proponents clarified that the overall hypothesis to be tested is 'Top predators influence the dynamics of prey species which are the target of commercial fisheries and competition exists between top predators and fisheries'. However, they stressed that this is intended to be a feasibility study and that more detailed hypotheses corresponding to each component will be developed later. Some members thought that the proposal was too poorly developed and narrow to distinguish among the effects of such factors as fishing, predation and climate change such as the recent 'regime shift'.

Others stressed that the main purpose of a feasibility study is to improve methodology, and that from such a perspective, the proposal is reasonably balanced between detailed hypotheses and established methodology on one side and more open ideas on the other.

REFS: POINTS 1, 5, 24 IN ANNEXES P3 AND P4; ANNEX P1; ANNEX P2.

**B. Objectives**

The relevant guidelines are as follows:

(1) 'Comments on the objectives of the research to be carried out under the proposed scientific permit, including in particular how they might relate to research needs identified by the Scientific Committee.' (IWC, 1986b, p.133)
(2) 'The proposed research is intended and structured accordingly to contribute information essential for rational management of the stock;' (IWC, 1987, p.25)
(3) Is 'required for the purposes of management of the species or stock being researched' (IWC, 2000b)
(4) 'The research addresses a question or questions that should be answered in order to conduct the comprehensive assessment or to meet other critically important research needs;' (IWC, 1988b, pp.27-28)
(5) 'The number, age and sex of whales to be taken are necessary to complete the research and will facilitate the conduct of the comprehensive assessment;' (IWC, 1987, p.25)

*Proposal*

The proposal states that the primary objective of the programme is broader than the IWC's remit. It considered this to be a critically important research need. However, it identifies some aspects of the programme that address research needs identified by the Committee, some of which are directly relevant to management. These include: (1) elucidations of minke whale structure on whether the hypothesised 'W' stock exists, and mixing rates for J and O stocks; (2) elucidation of the stock structure of Bryde's whales which is important in the development of *Implementation Simulation Trials* for those species - stock structure information on sperm whales is relevant to the future Comprehensive Assessment of that species; (3) information relevant to some aspects of the possible effects of environmental changes on whales (and their prey); (4) studies on pollution; (5) information relevant to the Committee's consideration of marine mammal-fishery interactions; (6) elucidation of the role of cetaceans in the ecosystem. Section V of the proposal details the consideration of sample size.

*Comments and discussion*

There were some concerns expressed that the estimation of sample sizes was inadequate in certain cases, notably with respect to all aspects of the sperm whale component and aspects of the pollution and stock structure components. In response, the proposers stated that this was intended to be a feasibility study, particularly in the case of the sperm whale component. Sample sizes for some aspects of the programme would be modified in the light of the results obtained.

Some members expressed concern that most of the objectives of the programme did not address questions of high priority for the rationale management of the stocks concerned and would not contribute significantly to research needs identified by the Committee – the Bryde's whale samples do not relate to *Implementation Simulation Trials*. They particularly doubted the value of the sperm whale component which they believed would not provide any useful results for any of the three sub-objectives.

In response, the proposers stated that for all three objectives the study could obtain useful information to formulate a full scale study especially of feeding ecology as the sperm whale plays an important role in the ecosystem.

Some other members strongly believed that the proposal does not directly address any of the five guidelines above. They recognised that the primary objective of the proposal which pertained to top predators was scientific in nature, but believed that none of the objectives or sub-objectives were necessary for the management of any of the large whale species being killed.

Other members drew attention to the ambitious nature of the programme and drew parallels with the feeding ecology programme carried out by Norway, which also began with a feasibility study and has now made a valuable contribution towards multispecies modelling and management. They also noted the importance, to large fishing nations as well as small island states, of the need to determine the impact of cetaceans on fish stocks as a matter of some urgency. Thus, in addition to the information on North Pacific minke whale stock structure relevant to *Implementation Simulation Trials*, they believed that it represented an attempt to address a critically important research need.

REFS: POINTS 10, 25 IN ANNEXES P3 AND P4; ANNEX P1; ANNEX P2.

**C. Methodology**

The relevant guidelines are as follows:

(1) 'Comments on the methodology of the proposed research and an evaluation of the likelihood that the methodology will lead to achievement of the scientific objectives. These comments may also include evaluation of the methodology in terms of current scientific knowledge;' (IWC, 1986b, p.133)
(2) 'The objectives of the research are not practically and scientifically feasible through non-lethal research techniques.' (IWC, 1987, p.25)
(3) '… whether the information sought could be obtained by non-lethal means' (IWC, 2000b)
(4) 'The research addresses a question or questions that cannot be answered by analysis of existing data and/or use of non-lethal research techniques.' (IWC, 1988b, pp.27-28)
(5) 'Whales will be killed in a manner consistent with the provisions of Section III of the schedule, due regard being had to whether there are compelling scientific reasons to the contrary;' (IWC, 1987, p.25) —[The Commission agreed that it has been intended by this for the Committee to report if cold grenade harpoons were used in special permit catches. (IWC, 1988b, p.13; IWC, 1988a)]
(6) 'The research is likely to yield results leading to reliable answers to the questions being addressed;' (IWC, 1988b, pp.27-28)

*Proposal*

Section IV of the proposal provides information on the methods to be used for the various sub-projects. Random sampling is to be employed for stock structure. The feeding ecology project will follow the protocols established in the Norwegian research programme regarding number, weight

and size of prey. There will be concurrent prey surveys conducted in the area using echo integrators, mid-water trawls, driftnets and jigs. Prey consumption will be measured indirectly (based on standard metabolism) and directly (temporal changes in stomach contents per day). Prey preference studies will mirror those used in the Norwegian surveys.

The stock structure sub-project will employ a number of genetic and non-genetic techniques (as did JARPN). Final choice of sampling area will depend on whether permission is obtained to enter the Russian EEZ. Pollutant studies will be carried out by examining samples from each whale caught, from stomach contents and trawls and from lower trophic levels, air and sea water. A variety of chemicals will be measured, largely organochlorines and heavy metals. The health condition of the animals will be examined by external and internal examination and chemical tests/measures of sex hormones, enzyme induction, immune system etc.

Oceanographic observations will be made using XCTD, CTD, EPCS and echo sounders. This and satellite information will be used in the feeding ecology and environmental studies.

Section VIII of the proposal considers the question of the use of non-lethal methods. For the feeding ecology project, the existing commercial data are not appropriate because only some qualitative and rough quantitative records are available.

*Comments and discussion*

There was considerable discussion of methodological issues. These can be roughly grouped under two headings: is the methodology described likely to meet the programme's objectives, and; can the research be carried out using non-lethal methods. After the initial presentation of the proposal, some concerns were expressed that insufficient methodological detail was given to allow proper evaluation of parts of the proposal. Further details were provided in some of the Annexes (see below).

Several members discussed the value of simultaneous prey sampling. As one example of the methodological problems, some members stressed that the methodology does not exist to sample quantitatively the range of cephalopod species consumed by sperm whales. Given this, they asserted that there was no scientific rationale for the inclusion of sperm whales in JARPN II. In response, the proposers noted that deep sea squid may be caught using driftnets at night or mid-water trawls for quantitative analysis. There was no time for further discussion of this and no agreement was reached.

Some members commented that with the sample size and methods proposed, it was unlikely that several of the objectives of the programme would be met. In particular they believed that the sperm whale component would provide little information and that at least should be dropped from the proposal. Concern was also expressed that the ecosystem modelling approach was poorly developed. They also noted that the likely precision of any fisheries information (both past data and future) was poor and that this would be a key component of any modelling exercise. Given their concerns they believed that the research programme was premature and that it be reconsidered by Japan following the FAO and IWC workshops on related matters. Until that time at least, they believed that the study should not proceed.

The proposers stated that Japan was willing to review the results of the meetings of FAO and others and incorporate useful information into JARPN II in order to improve the programme. However, Japan cannot agree with the view that these meetings are a prerequisite for initiating the research.

Other members stated that this was a feasibility study and that one of the aims was to investigate the methodology. They referred to the success of the earlier Norwegian programme. They felt that the sperm whale component was important in the context of trophic levels. Although there are not decades of abundance data for fish (the TAC management approach was only adopted in 1997) as is the case in Norway, there are substantial relative abundance data. Several Japanese Fisheries Agency research cruises would also be cooperating and providing abundance data for several fish species. Model development is at an early stage, but they believed that the combination of ECOSIM and MULTISPEC had the potential to address fundamentally important questions and the approach would be developed on a step-by-step basis. All aspects of the programme would improve as data became available.

With respect to the use of non-lethal means, some members believed that insufficient use had been made of presently existing samples and data, noting, for example the suitability of frozen samples for genetic analysis. They also noted that techniques now existed to address many questions related to feeding, stock structure and pollution through biopsy samples and such techniques were rapidly evolving (see Annex P5). Other members noted that detailed information on these items cannot be obtained from biopsy samples. They also commented on the difficulties in obtaining biopsy samples and thus the need for lethal sampling (see Annex P6). There was no time for further discussion of this item, and, as in previous discussions within the Committee on this (e.g. see IWC, 2000f), no consensus was reached.

REFS: POINTS 2, 3, 4, 8, 11, 13, 15, 16, 17, 18, 19, 20, 21, 22, 23 IN ANNEXES P3 AND P4; ANNEXES P1, P2, P5, P6, P7, P8.

**D. Effect of catches on the 'stock'**

The relevant guidelines are:

(1) 'A review of the most recent information on the stock or stocks concerned, including information on any exploitation, stock analysis and recommendations by the Scientific Committee to date (including, where appropriate, alternative analyses and conclusions and points of controversy).' (IWC, 1986b, p.133)
(2) 'An evaluation of the specification in the permit proposal of 'possible effect on conservation of the stock'. As appropriate, the Scientific Committee may carry out its own analysis of the possible effects. (IWC, 1986b, p.133)
(3) 'The research can be conducted without adversely affecting the overall status and trends of the stock in question or the success of the comprehensive assessment of such stocks;' (IWC, 1988b, pp.27-8)

*Proposal*

Section VI and Appendix 6 of the proposal address the question of the effect of catches on the stock. This is assessed by using the standard HITTER method (Butterworth, 1996).

For minke whales, two O Stock scenarios are used: (1) sub-areas 7+8+9+11+12 are O Stock; and (2) sub-areas 7+8+11+12 (40% in sub-area 12) are O Stock. One W Stock scenario case is used: western part of sub-area 9 and sub-area 12 (60%) are W Stock. These scenarios are based on the results of the JARPN surveys. The effects of the catch on the stock are assessed from the stock trend in the case of catch number at 100. From the results of HITTER calculation, it was concluded that the effect on the minke whale stock is negligible.

Bryde's whales will be sampled from the Western North Pacific Stock. Because the proposed sampling area is far from the coastal region of southwest Japan, in which the East China Sea Stock extends (Yoshida *et al*., 1997; Pastene *et al*., 1997) and also far from oceanic islands, it is unlikely that Bryde's whales from other stocks will be taken. Two stock scenarios are used: whole area and sub-area 1 according to the recent *Implementation Simulation Trials*. The effects of the catch (50) on the stock are assessed in the same way as in the minke whale. From the results of HITTER calculation, it can be concluded that effect on the Bryde's whale stock is negligible.

Sperm whales will be sampled from the Western Division. While no calculation was made for the sperm whales, the sample size is so small that is clearly below the critical level to affect the stock.

*Comments and discussion*

Some members commented that the values chosen for the HITTER method for the minke whale case were insufficient to adequately address the effect of the catches on the stock. They also questioned the criterion used to define 'negligible.' Other members believed that the approach taken used the best data available and the conclusion was valid. The Committee noted that the calculations were based on the assumption that catches continue for only two years. Attention is drawn to the Committee's discussion of this under Item 16.1.

REFS: POINT 7 IN ANNEXES P3 AND P4.

**E. Research cooperation**

The relevant guideline is:

(1) 'Comment on the adequacy and implications of specified arrangements for participation by scientists of other nations'. (IWC, 1986b, p.133)

*Proposal*

The proposal stated that participation of foreign scientists, especially those from neighbouring countries, is welcome, insofar as their qualifications meet the requirements set by the Government of Japan. These requirements are the same as those for JARPN.

*Comments and discussion*

As it had for JARPN (IWC, 1995b, p.84), the Committee **agreed** that this guideline had been met.

*16.3.2 JARPA*

**PROPOSAL**

SC/52/O2 outlined the JARPA survey plan for the 2000/2001 season. The objectives, survey items and methods are the same as the previous years. The survey for the coming season will cover Area V and the western half of Area VI to focus on the issue of the distribution of the stocks. The reason to carry out research on stock structure is as follows: mtDNA analysis of available JARPA samples in Area IV and Area V and Area III East, suggested that a Core Stock is found in both Area IV and V while a different Western Stock was found in Area IVW in the early migration period. In order to examine the eastern boundary of the Core Stock, two surveys have been conducted in Area VIW (1996/97 and 1998/99). Although the analyses of mtDNA from samples collected in the previous two surveys (1996/97 and 1998/99) do not suggest the occurrence of additional stock structure (i.e. an Eastern Stock), at this stage it is premature to reach any conclusion. Genetic analyses were presented in SC/52/IA3.

Thus, the survey in the adjacent western half of Area VI is being carried out in order to examine further the temporal/spatial mtDNA analysis and possible inter-annual variations in this area. In addition morphometric and reproductive characteristics of the whales sampled in Area VI West will be examined.

The progress of the JARPA tasks and other studies using JARPA samples are presented partly in documents SC/52/O6, O7, O19, O20, E4, E5, IA2 and IA19, which were presented in the relevant sub-committees.

The schedule for the 2000/2001 JARPA survey is as follows:

(1) research vessels leave Japan at the beginning of November and return in the middle of April 2001;
(2) the sample size is 300 animals in Area V and 100 animals in Area VI with 10% allowance;
(3) the type and number of vessels are the same as in previous years - one research base vessel, three sighting and sampling vessels and one dedicated sighting vessel;
(4) the participation of foreign scientists is welcomed.

In the 2000/2001 JARPA survey, in order to ensure comparability of data, the survey period and the sample size remain unchanged.

**COMMENTS AND DISCUSSION**

As this is an ongoing research permit and the Committee held a major review of this in 1997, the Committee draws the attention of the Commission to its previous considerations (IWC, 2000f). Smith noted that his concerns expressed last year over the investigation of the boundary to the east becoming a longer term extension of the programme applied equally to the exploration of the western boundary. In particular, he reiterated that the question of sample size needed to be properly investigated and reviewed by the Committee. He also noted that if a multi-year programme is required to obtain a sufficient sample size then this may mask inter-annual variability. Donoghue noted that it would be helpful if a map of the study area and a proposed cruise track could be added to future proposals.

In response, Fujise noted that due to a fire on board the base vessel, it had not been possible to obtain 'early' samples in Area VI last time, and as a result, this was only the second coverage of the area and is therefore not sufficient to address year to year fluctuation. Pastene commented that other JARPA results have shown that minke whale stock structure can be complex in the region, with temporal, geographical and distance from the ice-edge all seeming to play a role. Although the estimated sample size is 160, this may differ by these three factors, and the sample size of 100 may have to be modified in the light of new information in the future.

The question of whether the information could be obtained by non-lethal means has been discussed at several meetings. The Committee has reached no consensus on this matter and the alternative views are elaborated in Annex H to the Report of the JARPA Review Meeting (IWC, 1998a, p.412).

As noted under Item 16.1, concerns were expressed that the Committee has failed to give adequate advice on the effect of the catches on the status of the stocks. In particular, reference was made to the discussions over the abundance of minke whales in the various circumpolar surveys. Some members commented that if the declines suggested by the

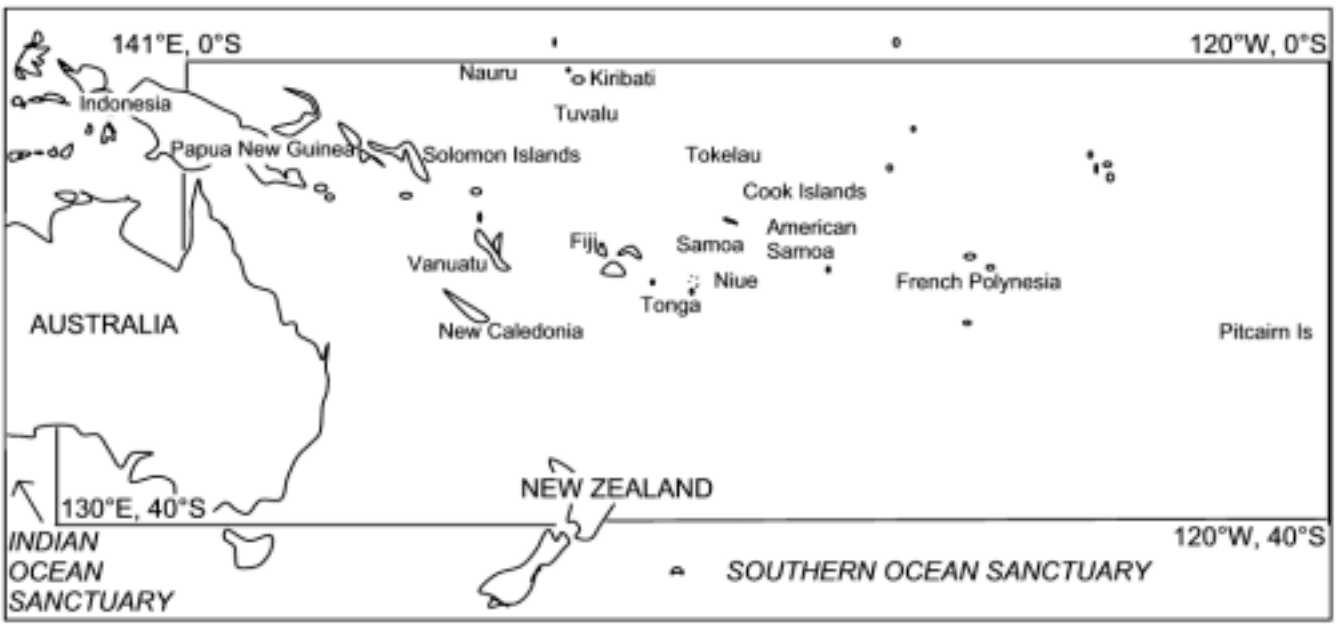


Fig. 2. Proposed IWC South Pacific Whale Sanctuary.

third circumpolar survey data prove to be real, then the need for the Committee to provide advice on the effect of the catches from JARPA was even more pressing. There was some discussion as to whether it was appropriate to use the RMP to examine this, and if so, how much work this would require. Some members believed that the Commission should be asked how best to meet its need for advice on the effect of JARPA catches on the stocks. Others members believed that this was purely a scientific matter.

Eventually, the Committee **agreed** to use the validated Secretariat version of BALEEN II to examine the issue of how the Committee can best address the task of providing advice on the effect of scientific permit catches on whale stocks in the intersessional period, along with a variant of this coded by Punt that could also examine questions of changing carrying capacity. It was **agreed** to carry out this work intersessionally and a Steering Group was established convened by Punt (with Allison, Brown, Brownell, Butterworth, Childerhouse, Cooke, Givens, Hakamada, Hatanaka, Nishiwaki, Leaper, Okamura, Smith, Wade, Zeh) to provide guidance to the Secretariat on the precise details. Punt agreed to circulate his software to the Intersessional Group.

## 17. WHALE SANCTUARIES

The Committee has been asked to comment on the scientific aspects of the proposal submitted by the Governments of Australia and New Zealand to the Commission last year to create a Sanctuary for great whales in the South Pacific (IWC/51/21). The proposed Sanctuary is shown in Fig. 2. Its longitudinal range encompasses Areas V and VI. It is contiguous with the Southern Ocean Sanctuary in this band. The proposal is that irrespective of stock status, there will be no commercial whaling allowed within the proposed sanctuary area.

The Committee **agreed** that it would not discuss legal, political or economic issues regarding the Sanctuary. These included questions of interpretation of the Convention, the level of support for the proposal amongst nations of the South Pacific forum and the relative merits and compatibility of whalewatching versus direct exploitation. Such matters were raised in several working papers submitted to the Committee but are not discussed here.

Several papers were presented that summarised information on whales in the South Pacific region (SC/52/IA6, 8, 20 and SC/52/O9, 12, 28, 33 and 34; and Reeves *et al*., 1999). Many of these papers were discussed in detail by the relevant sub-committees. Eleven species are known to occur within the proposed sanctuary area: blue whale; humpback whale; sperm whale; southern right whale; fin whale; sei whale; Antarctic minke whale; dwarf minke whale; Bryde's whale; pygmy Bryde's whale; and pygmy right whale. Fin, sei and pygmy right whales are rarely seen within the area. Almost all of these have been commercially harvested at some stage. The blue, fin, right and humpback whales are probably the most severely depleted but there is little firm evidence on the status of most of the species relative to their initial abundance. It is ten years since the status of any of these species was considered (minke whales in 1990; IWC, 1991b). SC/52/O34 illustrated the limited data available for even the better known species. Information on the breeding grounds and migration routes of the whales in the region is poor, apart from for the humpback whale. SC/52/IA6 and IA20 examined what is known on stock identity and movements for humpback whales in the South Pacific. The results indicate that the proposed sanctuary would include the wintering grounds of all Group V and most, if not all, of Group VI humpback whales.

SC/52/O28 summarised recent great whale research in the region, complementing the review of Reeves *et al.* (1999). Humpback whales and right whales are probably the best studied species compared to the others in the South Pacific. Generally, more is known of the mysticete species in their feeding grounds in the Antarctic than in the South Pacific.

There is no commercial or aboriginal/subsistence whaling in the area at the present time. Only the minke whale has been considered in the context of the RMP. There have been catches of Antarctic minke whales and dwarf minke whales in the same longitudinal band as the proposed sanctuary but south of its southern boundary.

There is little information on whether bycatches of large whales occur in fishing nets within the area (bycatches of large whales are known to occur in other areas when they come into contact with set or driftnets). Some entanglement of humpback and southern right whales has been documented off southeastern Australia.

Over the last 20 years, the Committee has had several major discussions of Sanctuaries, both in general terms and related to specific proposals for the Indian Ocean Sanctuary and the Southern Ocean Sanctuary. These discussions have been extensive in some cases (IWC, 1980; 1993a) but have never resulted in a consensus view by the Committee.

The Committee reviewed these discussions and **agreed** that the major points made in the past related to the desirability or otherwise of a sanctuary also applied to the South Pacific proposal. It was unable to reach a consensus view and the major arguments from this and previous meetings are summarised below.

*General arguments in favour of Sanctuary proposals*
Sanctuaries:

(1) provide a focus for regional cooperation at the government, inter-government and non-government level;
(2) provide a focus for the development of national and international non-lethal research programmes;
(3) provide a non-lethal research framework that will enable the Commission to make appropriate decisions to ensure the effective conservation of whale stocks in the region;
(4) provide an area to study whales undisturbed by any whaling activities;
(5) provide an 'insurance' against unforeseen problems with the RMP;
(6) protect all whales within a large habitat – an IWC sanctuary protects whales from commercial whaling and this is seen as a necessary first step in a more comprehensive management regime.

*General arguments not in favour of Sanctuary proposals*
(1) Sanctuary proposals only address direct catches. Current (Schedule) and likely future (RMP) management strategies of the IWC would only allow exploitation of abundant whale stocks and then at conservative and sustainable levels.
(2) Sanctuaries provide no extra protection for the most vulnerable depleted stocks from actual threats that they face such as habitat destruction, pollution, shipping, fisheries interactions, etc. and do not distinguish between areas of critical habitat and those of little importance. Such stocks are already protected under existing IWC management measures.
(3) Sanctuary provisions may prevent utilisation of stocks for which a sustainable catch would be allowed under the RMP/RMS.
(4) Whether or not an area is designated as a Sanctuary is irrelevant to whether or not research is carried out in the area.
(5) The need to provide information relevant for management and utilisation of one species may stimulate research that is also of value in monitoring depleted species.

In the context of these arguments, a number of points particular to the South Pacific Sanctuary were raised in discussion.

Childerhouse referred to Richards' (2000) review of historical sail whaling records from the Exclusive Economic Zones of Pacific Forum nations in the South Pacific, in which the number of whales killed was estimated (for EEZ waters alone). This was estimated at approximately 32,200 sperm whales (1804-1876), over 30,000 right whales (1827-1930) and over 3,100 humpback whales (1805-1909). If whales killed outside this area but within the South Pacific region are included, this figure would be significantly higher. 'Best guess' estimates of the present abundance in this same region are 13,200 sperm whales, 200 right whales and 4,100 humpback whales. A comparison of the magnitude of kills against present abundance estimates gives values of 41% for sperm whales and less than 1% for right whales. The present number of humpback whales is higher than the estimated number killed, which reflects the fact that humpbacks were not taken often by sail whalers, on whom much of this study is based. Childerhouse believed that these values support the conclusion that the present number of sperm and southern right whales in this region is significantly less than pre-exploitation numbers.

Morishita disputed the conclusion with respect to sperm whales. The annual average catch over the period was around 440 or 3.3% of the estimated current abundance. For humpback whales the value is 0.7%. He found it difficult to believe that such levels of removals would lead to severe depletion. He also noted that he did not believe that there were scientific or logical reasons to protect all species when not all are depleted.

Palazzo made the general comment that the National Aquatic Mammals Research, Management and Conservation Centre (the leading scientific and management authority in Brazil) had endorsed the sanctuary proposal.

There was also some general discussion over the extent to which sanctuary declarations resulted in increased research. Schweder noted the extensive research in the Southern Ocean Sanctuary carried out by Japan, and queried whether there was increased research effort in 'non-use' countries. In response, attention was drawn to the Antarctic research programmes of Australia, Brazil, Chile, New Zealand, the UK and the work of the SOWER 2000 programme, details of which continue to be reported to the Committee. Attention was also drawn to the non-lethal research already occurring in the proposed area of the sanctuary which is providing information of benefit to management. For example information on stock structure and trends in abundance of humpback whales in the region has proved valuable to the in-depth assessment of this species currently being undertaken by the Committee. This also illustrates the value of collaborative research in the region.

Attention was drawn to Butterworth and Punt (1994) and Butterworth and de Oliveira (1994) which used simulation studies to investigate whether parameters such as *MSYR* and issues such as the effect of habitat deterioration could be better estimated for the Southern Ocean, with or without a 50-year Sanctuary provision. The authors concluded that the presence of an Antarctic-wide sanctuary did not aid in addressing these questions, whilst unnecessarily preventing 50 years of catch.

Cooke and Childerhouse noted that estimates of some other parameters of whale populations in the proposed Sanctuary have been obtained using non-lethal methods. These estimates already have a higher level of precision than that which, according to the simulations in the above studies

would be possible after 100 years of catches. They concluded that the results of those simulations had little bearing on the actual potential for monitoring whale populations in the proposed Sanctuary. Butterworth responded that if the view of Cooke and Childerhouse was correct this would have been revealed in the results of the papers whereas they had in fact shown the contrary.

Best observed that neither the Action Plan for Australian Cetaceans (Bannister *et al*., 1996) nor the South Pacific Regional Environment Programme (Reeves *et al*., 1999) commented on the need for a sanctuary in the region. It was also not the result of a recommendation by the Scientific Committee. He believed that this revealed little scientific or urgent conservation need for the Sanctuary as proposed.

In conclusion, the Committee noted that whilst it had received guidance from the Commission on factors of interest to the Commission in reviews of scientific permits, this was not the case for sanctuary proposals. A Technical Committee Working Group met in 1982 to consider requirements for the listing of sanctuaries but its report (IWC/34/14) was not adopted by the Commission. The Committee **agreed** that advice from the Commission with respect to reviews of sanctuary proposals would be useful in the future.

## 18. IWC-DESS

### 18.1 Report on other intersessional work

As reported under Item 10.2.2, all changes to DESS requested last year were made. They included updated definitions of species codes as proposed by an Intersessional Working Group.

Future proposals, developed by that working group at this meeting, appear in Annex G, Appendix 8. Item 10.2.2 includes a recommendation for their adoption.

### 18.2 Use of DESS in future Scientific Committee work

A working group was established to consider the most appropriate current and future role of DESS in the work of the Committee. The Committee **recommends** the following.

(1) The most appropriate long-term strategy is to separate the database and extraction component of DESS from the program Distance.
(2) Because the program Distance has become the standard package for distance sampling, and will shortly include a range of new and potentially useful methods, consideration should be given to writing a program which allows seamless import of data from DESS into Distance. Once created, this program would not require updating to take advantage of new developments in Distance, as future versions of Distance would be backwards compatible.

In the short term, to facilitate the review of minke whale abundances, changes should be made to allow DESS to take advantage of a wider range of the options already available in Distance (see Appendix 9 of Annex G). The necessary changes are relatively minor.

## 19. RESEARCH PROPOSALS

### 19.1 Review research results from 1999/2000

SC/52/O26 reported progress during year two of a three-year project to identify parent-offspring pairs by genotyping of multiple microsatellite loci in Gulf of Maine humpback and Sea of Cortez fin whales. Preliminary analyses of 506 samples have been completed, with the genotype determined at 16 microsatellite loci. The sex of each sampled whale has also been determined. Work on estimating and reducing the probability of false matches is ongoing.

### 19.2 Review proposals for 2000/2001

Three proposals were reviewed by the Intersessional Review Group and outside reviewers.

SC/52/RP1 (Schaeff and Best) proposed to conduct molecular genetic analysis of the right whale mating system and male-mediated gene flow between winter breeding grounds off South Africa and Argentina. It received a medium-high score.

SC/52/RP2 (Kleivane *et al.*) asked for the use of biopsy samples collected during IWC-SOWER cruises for assessing levels of organochlorines and fatty acid composition in blubber of killer whales as a possible method of sub-species identification. This proposal was given conditional support, pending further information about the scientific quality and chance of success of the project.

SC/52/RP3 (May and Conway) dealt with delineation of breeding stocks of the blue whale and was given a low to medium score.

The Committee agreed with the group's scoring and considered these proposals further under Agenda Item 21. Table 14 gives the funding requested and the evaluation criteria scores for each of these proposals.

### 19.3 Report of planning group for SOWER cruises

Plans for a 2000/2001 SOWER circumpolar cruise were considered in Annex G. The report of an *ad hoc* Working Group to plan logistical aspects of the cruise appears as Appendix 12 of Annex G and was discussed under Items 10.3.2 and 21.

Table 14

Requested funding and evaluation criteria scores.

| | SC/52/RP1 | SC/52/RP2 | SC/52/RP3 |
|---|---|---|---|
| Total amount requested | $20,026 | 0 | $2,600 |
| Evaluation Criteria Scores | | | |
| (1) Relevance to work of the SC | High | Low | High |
| (2) Scientific quality of project | Medium | Insufficient information | Insufficient information |
| (3) Chance of success | Medium | Insufficient information | Insufficient info./low |
| (4) Scientific competence of proposers | High | High | High |
| (5) Feasibility of work schedule | High | Insufficient information | Insufficient information |
| (6) Reasonableness of budget | Medium | N/a | High |
| (7) Multinational context | High | High | High |
| Overall Score | Medium-high | (Conditional Support) | Low-medium |

## 20. DATA PROCESSING AND COMPUTING NEEDS FOR 2000/2001

The Committee identified the requests for intersessional work by the Secretariat given in Table 15. In the light of its discussions on Committee priorities (Item 24), the Committee agreed that the work identified for furthering AWMP and the first four items listed under RMP should be accorded the highest priority. Allison noted that it should be possible to complete all the items listed in Table 15 before next year's Scientific Committee meeting, with the exception of completing the North Pacific Bryde's whale trials. The Committee recognised that final decisions on priorities would need to be made after the Commission meeting to take into account Commission deliberations. The Committee agreed that an Intersessional Steering Group (see Annex Z) will review progress during the year to decide if priorities need to be changed in the light of Commission decisions and/or experience.

## 21. FUNDING REQUIREMENTS FOR 2000/2001

Table 16 summarises the complete list of recommendations for funding made by the Committee. The total required to meet these is £432,769. The Committee **recommends** all of these proposals to the Commission. However, it also noted that the Commission's 'normal' research spending is around £200,000. The Committee therefore reviewed the full list, taking into account a number of factors including the work plan and priorities agreed last year and the Items expected to be of priority for discussion at next year's meeting. Should the Commission be unable to fund the full list of items in Table 16, the Committee **agreed** that the final column given in Table 16 represents a budget that will allow progress to be made under its major headings. This totals £225,000 and the Committee **strongly recommends** that this be accepted by the Commission.

A summary of each of the items is given below. Full details can be found under the relevant Agenda Items and Annexes as given in Table 16.

### (a) Items recommended for full funding under the 'minimum' budget

*AWMP and Aboriginal Subsistence Whaling*

**(1) AWMP INTERSESSIONAL WORKSHOP**

This Workshop was included in the AWMP work plan and timetable endorsed by the Commission last year. The US NMFS National Marine Mammal Laboratory has agreed to host the Workshop in Seattle in December 2000 or early in 2001. The Workshop is essential if the Committee is to proceed along the 'faster' track (see Item 8.9).

**(2) AWMP DEVELOPERS FUND**

The Commission has established an AWMP developers fund (IWC, 1999d, p.165) of £5,000. This has proved invaluable in ensuring progress in the work of the SWG. Given the increasing number of developers and the need to follow the 'faster' progress option, the Committee recommends that this be increased to £8,000.

**(3) GREENLAND RESEARCH PROGRAMME - SEPTEMBER 2000, SUMMER 2001**

Management advice on North Atlantic fin and minke whales harvested by aboriginal subsistence hunters from Greenland has been severely limited by a lack of recent survey data on abundance and a lack of information on stock structure. The Committee and the Commission have given high priority to developing a Greenland Research Programme. The first year of the research programme includes a feasibility study. The degree to which that is successful will affect the recommended funding level for research in the summer of 2001.

Table 15

Computing needs for 2000/2001.

| Task | Estimated time |
|---|---|
| **AWMP** | |
| Minor amendments to Fishery type 2 (bowhead) control program (stochastic RY and different future bias option); revise input data for *Evaluation Trials* and recondition where necessary (see Agenda Item 8.4.1.1). [Target date: 27 July 2000]. | 2 weeks |
| Modify Fishery type 2 (bowhead) control program to implement *Robustness Trials;* create input datasets and condition trials (see Agenda Item 8.4.1.2). The specifications may be amended by the Email correspondence group (Annex Z). | 1-2 month |
| Run bowhead *Robustness Trials* on any *SLA*s provided to the Secretariat intersessionally. | 1 week/*SLA* |
| Create input datasets and condition bowhead *Cross-validation Trials* (following specification at the intersessional workshop). | 1½ -4 weeks |
| Code control program to implement ***Initial*** *Exploration Trials* for Eastern North Pacific gray whales**.** | 1 month |
| **RMP** | |
| Incorporate the CATCHLIMIT program into the Secretariat suite of programs to implement the RMP (using an interface to be provided by Skaug), and conduct tuning according to the procedures given in IWC (1999c p.61) (see Agenda Item 6.1). | 1 month |
| Re-run a selection of simulation trials using the CATCHLIMIT program using a coarse tuning to match the version of the RMP used in trials (see Agenda Item 6.1). | 2-3 weeks |
| Undertake simulation trials to assist the Committee in understanding the implications of the choices of modelling density-dependence and defining *MSYL* in the *Implementation Simulation Trials* (see Agenda Item 6.4). | 1 month |
| Amend the control program and run the *Implementation Simulation Trials* for North Pacific minke whales, including resolving any inconsistencies remaining as specified in Appendix 10 (see Agenda Item 7.1.1.2). | 1-2 months |
| Begin coding *Implementation Simulation Trials* for western North Pacific Bryde's whales as specified in IWC (2000, pp.118-123) (see Agenda Item 7.2.1). | 2-6 months |
| **Other** | |
| Run a small set of BALEEN II population trajectories to investigate the effect of scientific catches (see Agenda Item 16.3.2). | 1-2 weeks |
| Validation of 1998/99 SOWER cruise data and incorporation into sightings database (see Agenda Item 18). Validation includes testing new validation software. | 8 months |
| Validation of 1999/2000 joint IWC/CCAMLR cruise data (see agenda item 13.2.1 of Annex D). | ? |
| Code any revised Soviet catch data if they become available. | ? |
| Complete coding of pre-1940 North Atlantic humpback catch data (see Agenda Item 9.5). | 6 months |

Table 16

Summary of funding requirements for 2000/1. For details see text. Amounts in pounds sterling.

| Item | For | Reference | Preferred budget | Reduced budget |
|---|---|---|---|---|
| **AWMP** | | | | |
| Intersessional Workshop | Invited Participants | Item 8.9 and Annex E | 12,000 | 12,000 |
| Developer's fund | Developers | Item 8.9 and Annex E | 8,000 | 3,000 |
| **AS/AWMP** | | | | |
| Greenland Research Programme (GRP), Autumn 2000 | Biopsy study | Item 9.3 and Annexes F and T | 18,000 | 18,000 |
| GRP, Summer 2001 | Equipment and fieldwork | Item 9.3 and Annexes F and T | 46,000 | 46,000 |
| **AS** | | | | |
| North Atlantic humpback assessment | Invited participants and preparatory work | Item 9.5 and Annex F | 36,000 | 27,000 |
| **OS** | | | | |
| North Atlantic right whale genetics workshop | Invited participants | Item 11.1.3 and SC/52/Rep1 | 4,500 | |
| Blue whale acoustics | Archiving | Item 11.2.1 and Annex H | 3,000 | |
| **E** | | | | |
| POLLUTION 2000+ | Field work and analyses | Item 13.1 and Annex J | 51,000 | 51,000 |
| SOWER 2000 | Field work, equipment and participation in workshops | Item 13.2 and Annex J | 61,143 | 20,000 |
| Habitat degradation preparatory meeting | Invited participants, preparatory work and administration | Item 13.4.2 and Annex J | 12,000 | |
| Marine mammal - fisheries competition planning workshop | Invited participants and preparatory work | Item 13.4.3 and Annex J | 19,000 | |
| IWC-CCAMLR data verification | Validation | Item 13.2 and Annex J | 3,000 | 3,000 |
| **IA** | | | | |
| SOWER circumpolar cruise | Cruise leader and senior scientist | Item 19.3 and Annex G | 81,500 | 20,000 |
| DESS contract and support | Ongoing maintenance and contract work | Item 18 and Annex G | [30,000]* | |
| Southern Hemisphere humpback whale photo-identification catalogue | Archiving | Item 10.1.3 and Annex G | 5,000 | 5,000 |
| Southern Hemisphere minke whale abundance and trends | Invited participants and preparatory work | Item 10.2.7 and Annex G | 50,000 | 20,000 |
| **Unsolicited research proposals** | | | | |
| SC/52/RP1 | | Item 19.2 | 20,026 | |
| SC/52/RP3 | | Item 19.2 | 2,600 | |
| **Total** | | | **£432,769** | **£225,000** |

* Ongoing funding, previously agreed.

*Environmental concerns*

**(4) IWC-CCAMLR DATA VERIFICATION**

Collection of these data took place under the SOWER 2000 programme, in collaboration with CCAMLR, that had been endorsed by the Commission last year. As the quantity of data was unknown at that time, the amount of money necessary for data validation and analyses could not be estimated. It is essential that the data are validated to allow analyses of the cetacean component to be carried out before the cooperative analyses with CCAMLR scheduled for a workshop next year.

*In-depth assessments*

**(5) PHOTO-ID CATALOGUE FOR ANTARCTIC HUMPBACK WHALES**

This is an ongoing project that is being undertaken at the College of the Atlantic on behalf of the Committee. The value of photo-identification data is increased dramatically when the data are catalogued. This work is making an important contribution to the in-depth assessment of humpback whales that is a priority item of the Committee.

### (b) Items recommended for partial funding under the 'minimum' budget

*Aboriginal subsistence whaling*

**(1) COMPREHENSIVE ASSESSMENT OF NORTH ATLANTIC HUMPBACKS**

The Commission has endorsed the high priority given by the Committee to work that enables it to provide management advice on stocks subject to aboriginal subsistence whaling. It was agreed last year that this should be the priority item considered at the 2001 meeting relating to aboriginal subsistence whaling. The Committee reviewed the initial proposal in detail and agreed that the reduced level of funding was the minimum amount required to ensure that sufficient progress was made intersessionally to allow the assessment to be made at the 2001 meeting.

*Environmental concerns*

**(2) POLLUTION 2000+**

Both the Committee and the Commission have given this ambitious and fundamental research programme high priority. It has been developed over a period of five years. Last year, the Commission provided partial support for this project and during the year the Steering Group investigated ways of obtaining additional funding. As noted in Annex J, the amount necessary to complete the minimum set of recommended field studies in 2000/01 was £51,000. This level of support would allow for post-mortem studies on harbour porpoise (£15,000), health assessment of bottlenose dolphin (£12,000), and laboratory analysis of existing specimen material from harbour porpoise and bottlenose dolphin (£24,000). The Committee welcomed the news that The Netherlands has now agreed to commit funding to support the Chair of the Steering Group which it believes is essential if the programme is to proceed. It also thanked the USA for additional support of the bottlenose dolphin component last year. It **strongly reiterates** its request that member governments consider making individual contributions for specific components of the programme to

enable this work to be completed. This programme is essential if the question of the effects of chemical pollutants on cetaceans is to be adequately addressed.

#### (3) SOWER 2000

Both the Committee and the Commission have also recognised the importance of the SOWER 2000 programme which has been developed in parallel with the POLLUTION 2000+ programme. The programme is fundamental to the Committee being able to begin to address the effects of global climate change on cetaceans. For reasons noted under Item 13.2, the programme has had to be modified from that agreed last year. The Committee recognises the great value of collaboration with SO-GLOBEC and wishes to ensure that this valuable opportunity is not lost. Both the collaboration with CCAMLR and SO-GLOBEC require that a substantial amount of equipment is purchased to enable IWC observers to participate in CCAMLR and SO-GLOBEC cruises. This will have long-term benefits in terms of the Committee's ability to place cetacean observers on such cruises. The agreed level of support will allow purchase of essential equipment and the placing of observers on at least one vessel. The Committee gratefully acknowledged the additional support given by the USA and the UK last year, and **strongly reiterates** its request that member governments consider making individual contributions for specific components of the programme.

*In-depth assessments*

#### (4) SOWER CIRCUMPOLAR CRUISE SUPPORT

Last year, the Committee had agreed that it was important to complete the full third circumpolar survey as soon as possible. Given the discussion under Item 13.2, the Committee agreed that the circumpolar components should be resumed. It once again recognised that the IWC contribution represented only a very small component of the total budget for these cruises and acknowledged the enormous contribution made by Japan in providing vessels. If the Commission is unable to fund the full request, the Committee agreed that as a minimum, the funding of the cruise leader and senior scientist should be made.

#### (5) INTERSESSIONAL REVIEW OF SOUTHERN HEMISPHERE MINKE WHALES

There has been considerable discussion as to how best to analyse the available data from the long time series available from the IDCR and SOWER cruises in the Antarctic (see Item 10.2). The need for a review of abundance estimates for minke whales was also recognised in the Committee's work plan last year, both in terms of absolute abundance and trends in abundance. This work is also of relevance to analysing data for other species seen on the cruises (see Item 10.3.1 and 11.2). The Committee agreed that it was important to ensure that sufficient preliminary work was carried out before a meeting to review the estimates. The original plan had included a recommendation for an intersessional workshop. The revised budget follows the option of holding a workshop immediately prior to next year's annual meeting with the work continuing during the Committee meeting itself as shown in the work plan agreed under Item 24. This allows considerable savings in the budget in terms of the expenses of invited participants and still leaves money for necessary contract work to be undertaken.

### (c) Items not recommended for funding at this time under the 'minimum' budget

As noted above, the Committee recommends all of the proposals included in Table 15. However, it believed that it was important to take into account the Commission's 'normal' research funding. The following projects are important to the work of the Committee but it agreed that, if priority had to be assigned, that these could be postponed or could possibly be carried out without Commission support. The Committee again requests that member governments consider making individual contributions to the research fund with respect to these projects.

#### (1) NORTH ATLANTIC RIGHT WHALE GENETICS WORKSHOP

The Committee considered the status of this highly endangered stock of right whales at a Workshop last year (see Item 11.1.1). The genetics workshop was one of the main recommendations. The Committee greatly welcomed the fact that the USA would largely sponsor the workshop, to be held in October 2000. It noted that central IWC funding was not essential for the Workshop to take place.

#### (2) SOUTHERN HEMISPHERE BLUE WHALE ACOUSTIC RESEARCH

As in the case of other IWC-sponsored projects, the Committee recognised the greatly-improved value of the data if they are suitably catalogued and archived. If this project is not funded by the Commission, the Committee noted that some money is available that had been allocated previously to this work and this would at least allow the project to be started.

#### (3) HABITAT DEGRADATION SCOPING MEETING

The Committee noted the value of this meeting in terms of its long-term work on environmental concerns. The aim of the scoping meeting is to make progress towards the development of a programme to monitor and evaluate the effects of environmental changes on habitat important to cetacean populations. An Italian research institute (ICRAM) has kindly offered to host such a meeting. The scoping meeting would allow experts to review appropriate material prepared for and presented at the meeting, in order to define and improve the aims and approaches to be incorporated into a future full-scale workshop. If the Commission decides not to fund the preparatory work at this time, some planning can continue intersessionally by the designated e-mail group.

#### (4) PREPARATIONS FOR CONFERENCE ON MARINE MAMMAL-FISHERY COMPETITION

The Committee also noted the value of such a meeting to its long-term plans. There had been strong support to address this topic by several member nations. To be successful, a considerable amount of planning is needed. If the Commission decides not to fund the preparatory work at this time, some planning can continue intersessionally by the designated e-mail group.

#### (5) SCHAEFF AND BEST PROPOSAL ON RIGHT WHALE GENETICS

The Committee recognised the merit of the research described in this unsolicited research proposal, but given its rating of medium-high priority by the Committee and the overall financial situation, it agreed that it should not be funded.

#### (6) MAY AND CONWAY PROPOSAL ON BLUE WHALE GENETICS

As above, the Committee recognised the merit of the proposal, but given the low-medium rating by the Committee, did not recommend support for this proposal at this time.

## 22. COMMUNICATIONS

In order to reduce the transmission time of long documents, it was **agreed** that such documents would be sent in pdf-format in future. Future e-mail communications will include the size of the file in the subject line. Other options that will be explored during the year include the possibility of a Scientific Committee web page.

## 23. PUBLICATIONS

Donovan reported on the first year of the new *Journal for Cetacean Research and Management.* Some 30 papers covering all the major subjects of interest to the Committee had been published. Some 81 authors from 20 countries were involved. In addition to the three issues of the Journal, the supplement containing the Scientific Committee report and the first special issue *Chemical Pollutants and Cetaceans* had also been published. He asked Committee members to consider submitting their papers to the Journal as their preferred option. The quality of papers is one of the criteria used in obtaining a ranking for the Journal. He also urged Committee members to request their libraries to subscribe to the Journal.

The Committee congratulated Donovan on the quality of the Journal and the smooth transition from *Rep. int Whal. Commn.*

## 24. COMMITTEE PRIORITIES AND INITIAL AGENDA FOR THE 2001 MEETING

As last year, with the Committee's agreement, after the close of the meeting the Convenors drew up the following as the basis of an initial agenda for the 2001 meeting. They took into account:

(a) the priority items agreed by the Committee last year and endorsed by the Commission (IWC, 2000f, p.62) and, within them, the highest priority items agreed by the Committee on the basis of sub-committee discussions;
(b) the general discussion in the plenary session on this item and in particular the need to reduce the workload of the Committee and, as far as possible, streamline the sub-committee system to avoid conflicts in the need for personnel to the extent possible;
(c) discussions over the budget in the full Committee.

The Committee noted that priorities may be revised in the light of the Commission's decisions. Following the Commission meeting, the Chairman will forward a summary of the Commission's conclusions as they affect next year's work to members for information along with a preliminary draft agenda. It will also provide a framework for determining invited participants to the 2001 meeting.

It was agreed that apart from the Standing Working Groups and Sub-Committees, the sub-committee structure should be seen as a way to most efficiently address the Committee's priority items. With this in mind, it was agreed to have the following sub-committees, noting that should other specific issues arise, then the option to appoint *ad hoc* Working Groups remains.

**RMP (Convenor – Bannister)**
As last year, this sub-committee would concentrate on two areas:

*(a) General issues*
(1) Incorporation of the program CATCHLIMIT into the Secretariat suite of programs that implement the RMP and its trials, re-tuning the RMP, using it and comparing trial results.
(2) Estimation of incidental catch and other human-induced mortality of baleen whales. (This will be undertaken by a Working Group to be established at the opening session of the sub-committee).
(3) Abundance estimation, especially annotations to the RMP regarding multi-year surveys.
(4) Implications of choice of component of population to which *MSYL* and density-dependence apply in RMP trials.

*(b) Preparations for implementation*
The priority item will be:

(1) North Pacific minke whales (review results of *Implementation Simulation Trials* and results from surveys).

Also discussed will be:

(2) Western North Pacific Bryde's whales (review of progress on trials and results of sightings survey).
(3) North Atlantic minke whales (planning for an Implementation Review in 2002).

**AWMP (Convenor – Donovan)**
This Standing Working Group will continue its development process and will have had an intersessional workshop in Seattle. It will also review results and progress on the Greenlandic Research Programme. Major topics will be:

(1) Select *SLA*(s) for Bering-Chukchi-Beaufort Seas bowhead whales and style of presentation to the Commission.
(2) Consider *SLA*(s) for Eastern North Pacific gray whales.
(3) Consider progress on development of potential *SLA*s for Greenland fisheries.
(4) Review and revise trials as necessary.
(5) Review results from Greenlandic Research Programme and revise programme if necessary.
(6) Consider discussion document and develop proposal for scientific aspects of an Aboriginal Whaling Scheme.

It will also carry out the:

(7) Annual review of catch data and management advice for minke and fin whales off Greenland.

**COMPREHENSIVE ASSESSMENT OF NORTH ATLANTIC HUMPBACK WHALES (CONVENOR – HAMMOND)**
The major work of this sub-committee will be to:

(1) Review results of the YoNAH programme with respect to stock structure, movements and abundance.
(2) Review progress towards obtaining a complete catch series and its use in determining the status of North Atlantic humpback whales.
(3) If appropriate, carry out an assessment or if not, determine the necessary work to be able to complete one.

It will also carry out the:

(4) Annual review of catch data and management advice for humpback whales off St. Vincent and The Grenadines.

**Bowhead, Right and Gray whales (Convenor – Walløe)**
The nature of the Committee's agenda makes it appropriate to establish this species-based sub-committee. It will consider:

(1) The annual review of catch data and management advice for B-C-B bowhead whales.
(2) Review information on other small stocks of bowhead whales.
(3) Review progress on recommendations relating to western North Atlantic right whales, including the results of the proposed Genetics Workshop.
(4) Review research progress on Southern Hemisphere right whales in the light of *inter alia* the report of the Cape Town Workshop.
(5) The annual review of catch data and management advice for eastern North Pacific gray whales.
(6) Consideration of information on western North Pacific gray whales.

**In-depth Assessments (Convenor – Borchers)**
The major work of this sub-committee this year will be:

(1) Consideration of issues relating to the abundance estimation of Southern Hemisphere minke whales (and, where relevant other species such as blue and humpback whales). There will be a two-day 'early start' to the work of this sub-committee which will continue to run through the normal sub-committee period. It will also include a review of data from the 2000/01 SOWER circumpolar cruise and plans for future cruises.

It will also devote limited time (two sessions in total) to:

(2) Planning for an assessment of Southern Hemisphere blue whales (including reviewing progress on the issue of sub-species differentiation).
(3) Review progress on identified work towards an assessment of Southern Hemisphere humpback whales.
(4) Consideration of the possibility of a future assessment of Southern Hemisphere fin whales.

**Stock Definition (Convenor – Bravington)**
As last year, given the overlapping personnel, it is envisaged that a Working Group will be established at the first session to address the Commission's Resolution 1999-8. The other major items will include:

(1) Case studies (North Atlantic minke whales, humpback whales worldwide).
(2) Recoveries of cetacean (sub)stocks after severe depletion.
(3) Review of utility of non-genetic information for stock definition and consideration of framework to incorporate genetic and non-genetic information.
(4) Consideration of 'archetypes' of stock structure, harvest regime and management objectives.
(5) Consideration of statistical issues pertaining to stock definition.
(6) Development of ways to define stocks for harvested or potentially harvested cetaceans.

**Environmental concerns (Convenor – DeMaster)**
The major items to be considered are:

(1) Review of additional information on the impact of contaminants on the health and status of cetacean populations and in particular progress on POLLUTION 2000+.
(2) Progress with SOWER 2000 including results from the 1999/2000 CCAMLR survey and plans for collaboration with SO-GLOBEC.

It will also cover:

(3) Linking environmental measures and cetacean demography.
(4) Research relevant to Arctic issues.
(5) Progress on Workshops/Conferences (habitat degradation and marine mammal-fisheries interactions).
(6) Review and update State of Cetacean Environment Report (SOCER).

**Small cetaceans (Convenor – Read)**
(1) Dall's porpoise (in response to Resolution 1999–9).
(2) Progress on previous recommendations.
(3) Takes of small cetaceans in 2000.

**Whalewatching (Convenor – Kato)**
(1) Review report of the intersessional correspondence group.
(2) Review information on noise from whalewatching vessels and aircraft and potential effects on cetaceans.
(3) Review research on effectiveness of and compliance with whalewatching guidelines and regulations.
Review new information on previously discussed topics (including dolphin feeding programmes; national guidelines and regulations for whalewatching; whale and dolphin 'swim with' programmes).

## 25. ELECTION OF OFFICERS

The Committee congratulated Zeh (Chair) and DeMaster (Vice-Chair) on surviving their first meeting in these posts.

## 26. OTHER BUSINESS

### 26.1 Working methods of the Committee (see Annex W)

The Committee considered a working paper that had been submitted to stimulate discussion on the working methods of the Committee, its workload, the system of Convenors and transparency within the Committee. There was discussion of a number of points in the working paper and general support for some of the ideas expressed in it as well as to suggestions for improvements or deletions. The Committee **agreed** to append the working paper as Annex W and to put the item on its Agenda for next year. Members were encouraged to develop further ideas on this general topic and to submit these at next year's meeting.

Whilst recognising the practical constraint that financial items were usually developed in sub-committees, it was agreed that a detailed document summarising requests for funding should be circulated as early as possible for consideration.

### 26.2 The Committee of Three

The Chair drew attention that to her great pleasure there were two members of the original 'Committee of Three' present at the meeting, K.R. Allen, ex-Chairman of the Committee, and S.J. Holt.

### 26.3 The Secretary

The Committee rose in appreciation in honour of Ray Gambell, who was retiring as Secretary after 24 years and longer service still as a member of the Committee and a friend to all he encountered. He and his staff had served the Committee with efficiency, diligence and good humour throughout that time. He had established and run a Secretariat that was widely acknowledged as one of the best of its kind. The Committee wished him well for the future. A

dinner in his honour was held in the evening at the South Australian Museum, courtesy of the Commission and the Museum, and the Committee presented him with a work of original native art from Alaska, the 'Fishing Madonna'.

## 27. ADOPTION OF REPORT

The report was adopted at 18:00 on Monday 26 June. The Chair thanked the staff of the Conference Centre for their courtesy and efficiency. The Chair also thanked the Commission, Cath Kemper and the South Australian Museum for their generosity in hosting the Scientific Committee dinner. She thanked Robyn McCulloch, Jane Carter, Georgianna Fien and the other Australian organisers for the superb meeting facilities and arrangements, and for all their help during the meeting. She expressed gratitude to Ray Gambell, Greg Donovan and all of the Secretariat staff for their usual cheerful and efficient assistance, particularly for the many extra hours of work to get the Committee's report completed on time. She thanked the delegates for their support and assistance, which had been critical to a successful meeting under a new Chair. The meeting was then adjourned.

## REFERENCES


Anderson, J. 1879. Anatomical and Zoological Researches: Comprising an Account of Zoological Results of the Two Expeditions to Western Yunnan in 1868 and 1875; and a Monograph of the Two Cetacean Genera, Platanista and Orcella [sic]. Quaritch, London.

Baker, C.S., Lento, G.M., Cipriano, F. and Palumbi, S.R. 2000. Predicted decline of protected whales based on molecular genetic monitoring of Japanese and Korean markets. *Proc. R. Soc. Lond. Ser. B.* 267:1-9.

Bannister, J.L., Kemper, C.M. and Warneke, R.M. 1996. Wildlife Australia, Endangered Species Program. The Action Plan for Australian Cetaceans. Project Number 30. Australian Nature Conservation Agency, Canberra. 242pp. [Available from: *www.environment.gov.au/library/pubs]*.

Barr, K. and Slooten, E. 1999. Effects of tourism on dusky dolphins at Kaikoura. Conservation Advisory Science Notes 229. Department of Conservation, Wellington, New Zealand. 28pp.

Bejder, L., Dawson, S. and Harraway, J.A. 1999. Responses by Hector's dolphins to boats and swimmers in Porpoise Bay, New Zealand. *Mar. Mammal Sci.* 15(3):738-50.

Beltrán, S. 1998. Captura acidental de Sotalia fluviatillis (Gervais 1853) na pescaria artesanal do Estuário Amazônico. M.Sc Thesis, Manaus, Brasil. 100pp.

Bloch, D. and Desportes, G. 1991. Report of research on marine mammals 1986-1990. Meeting of the North Atlantic Committee on Research on Marine Mammals. 2. Reykjavik, April 1991. 4pp. [Available from *doreteb@ngs.fo]*.

Butterworth, D.S. 1996. The effect on stocks of proposed scientific permit catches of minke whales from Antarctic areas V and VI and from the North Pacific. Paper SC/48/O1 presented to IWC Scientific Committee, June 1996, Aberdeen (unpublished). 13pp [Paper available from the Office of this Journal].

Butterworth, D.S. and De Oliveira, J.A.A. 1994. Estimating the natural growth rate of baleen whale populations - is a sanctuary a help or a hindrance, and what would be the implications of a deteriorating habitat? *Rep. int. Whal. Commn* 44:413-28.

Butterworth, D.S. and Geromont, H.F. 1996. On the provision of advice on the effect on stock(s) of scientific permit catches, with particular reference to proposed research catches of minke whales from Antarctic Area IV. *Rep. int. Whal. Commn* 46:653-5.

Butterworth, D.S. and Punt, A.E. 1994. An investigation of the merits or otherwise of the proposal for an Antarctic-wide whale sanctuary by means of adaptations of the simulation trials used to test the Revised Management Procedure. *Rep. int. Whal. Commn* 44:289-302.

Butterworth, D.S. and Punt, A.E. 1999a. Further analyses of Southern Hemisphere minke whale catch-at-age data using an ADAPT VPA. Paper SC/51/CAWS20 presented to the IWC Scientific Committee, May 1999, Grenada, WI (unpublished). 19pp. [Paper available from the Office of this Journal].

Butterworth, D.S. and Punt, A.E. 1999b. An initial examination of possible inferences concerning MSYR for Southern Hemisphere minke whales from recruitment trends estimated in catch-at-age analyses. *J. Cetacean Res. Manage.* 1(1):33-9.

Chen, P. 1989. Baiji Lipotes vexillifer Miller, 1918. p. 442. In: S.H. Ridgway and R.J. Harrison (eds.) Vol. 4. *Handbook of Marine Mammals.* Academic Press, London.

Chen, P., Liu, R., Wang, D. and Zhang, X.F. 1997. *Biology, Rearing and Conservation of Baiji*. Science Press, Beijing. 252pp.

Clark, C.W. and Ellison, W.T. 2000. Calibration and comparison of the acoustic location methods used during the spring migration of the bowhead whale, *Balaena mysticetus*, off Pt. Barrow, Alaska, 1984-1993. J. Acoust. Soc. Am. 107(6):3509-17.

Constantine, R. and Baker, C.S. 1997. Monitoring the commercial swim-with dolphin operations in the Bay of Islands. Department of Conservation, Wellington, New Zealand. *Science Conservation Series* 56.59pp.

da Silva, C.Q., Zeh, J., Madigan, D., Laake, J., Rugh, D., Baraff, L., Koski, W. and Miller, G. 2000. Capture-recapture estimation of bowhead whale population size using photo-identification data. *J. Cetacean Res. Manage.* 2(1):45-61.

da Silva, V.M.F. 1994. Aspects of the biology of the Amazonian dolphins, *Inia geoffrensis* de Blainville, 1817 (Cetacean, Iniidae) and *Sotalia fluviatilis* Gervais, 1853 (Cetacea, Delphinidae). Ph.D. Thesis, University of Cambridge. 327pp.

Dizon, A.E., Chivers, S.J. and Perrin, W.F. (eds.). 1997. *Molecular Genetics of Marine Mammals.* The Society for Marine Mammalogy, Lawrence, KS. 388pp.

Dizon, A., Baker, S., Cipriano, F., Lento, G., Palsbøll, P. and Reeves, R. 2000. Molecular Genetic Identification of Whales, Dolphins, and Porpoises: Proceedings of a Workshop on the Forensic Use of Molecular Techniques to Identify Wildlife Products in the Marketplace, La Jolla, CA, USA, 14-16 June 1999. US Department of Commerce, NOAA Technical Memorandum, NOAA-TM-NMFS-SWFSC-286. 52pp+xi.

Doroshenko, N.V. 2000. Soviet whaling for blue, gray, bowhead and right whales in the North Pacific Ocean, 1961-1979. pp. 96-103. In: A.V. Yablokov and V.A. Zemsky (eds.) *Soviet Whaling Data (1949-1979).* Center for Russian Environmental Policy, Moscow. 408pp.

Dudzinski, K.M., Frohoff, T.G. and Spraldin, T.R. 1999. Wild Dolphin Swim Program Workshop Proceedings. The 13th Biennial Conference on the Biology of Marine Mammals. The Society of Marine Mammology, Maui, Hawaii, 28 November, 1999. 70pp.

Dupuy, B.M. and Olaisen, B. 1998a. Report of the pilot project on genetic labelling of whale meat for the establishment of a DNA register for minke whales. Department of Forensic Medicine, University of Oslo, Norway. 25pp.

Dupuy, B.M. and Olaisen, B. 1998b. Typing procedure for the Norwegian minke whale DNA register. Department of Forensic Medicine, University of Oslo, Norway. 32pp.

Finley, K.J. 2001. Natural history and conservation of the Greenland whale, or bowhead, in the Northwest Atlantic. *Arctic* (54)1:55–76.

Folkow, L.P., Haug, T., Nilssen, K.T. and Nordøy, E.S. 2000. Estimated food consumption of minke whales *Balaenoptera acutorostrata* in Northeast Atlantic waters in 1992-1995. *NAMMCO Sci. Publ.* 2:In Press.

Furevik, D.M. 1997. Development of a new cod pot and comparative trials with commercial pots and longline. ICES Working Group on Fishing Technology and Fish Behaviour, Maburg, 14-17 April 1997 (unpublished) 7pp. [Available from: *http://www.ices.dk]*.

Ghosh, S., Karanjawala, Z.E., Hauser, E.R., Ally, D. and Knapp, J. 1997. Methods for precise sizing, automated binning of alleles, and reduction of error rates in large-scale genotyping using fluorescently labeled dinucleotide markers. *Genome Res.* 7:165-78.

Givens, G.H. 1997. Separable multicriterion design and performance optimization of AWMPs. Paper SC/49/AS4 presented to the IWC Scientific Committee, September 1997 (unpublished). 21pp. [Paper available from the Office of this Journal].

Givens, G.H. 1999. Optimising Strike Limit Algorithms: example search and results. Paper SC/51/AWMP3 presented to the IWC Scientific Committee, May 1999, Grenada, WI (unpublished). 23pp. [Paper available from the Office of this Journal].

Goto, M. and Pastene, L.A. 1997. Population structure of the western North Pacific minke whale based on an RFLP analysis of the mitochondrial DNA region. *Rep. int. Whal. Commn* 47:531-7.

Hammond, P.S., Mizroch, S.A. and Donovan, G.P. (eds.). 1990. *Report of the International Whaling Commission (Special Issue 12). Individual Recognition of Cetaceans: Use of Photo-Identification and Other Techniques to Estimate Population Parameters.* International Whaling Commission, Cambridge, UK. [vi]+440pp.

Hatakeyama, Y., Ishii, K., Akamatsu, T., Soeda, H., Shimamura, T. and Kojima, T. 1994. A review of studies on attempts to reduce the entanglement of the Dall's porpoise, *Phocoenoides dalli*, in the Japanese salmon gillnet fishery. *Rep. int. Whal. Commn* (special issue) 15:549-63.

Hembree, D. and Harwood, M.B. 1987. Pelagic gillnet modification trials in northern Australian seas. *Rep. int. Whal. Commn* 37:369-73.

Hori, H., Bessho, Y., Kawabata, R., Watanabe, I., Koga, A. and Pastene, L.A. 1994. World-wide population structure of minke whales deduced from mitochondrial DNA control region sequences. Paper SC/46/SH14 presented to the IWC Scientific Committee, May 1994, Mexico (unpublished). 11pp. [Paper available from the Office of this Journal].

Inoue, Y. and Kawahara, S. 1999. Recalculation of incidental take of minke whales in Japanese trap nets estimated by Tobayama *et al*. (1992). Paper SC/51/RMP17 presented to the IWC Scientific Committee, May 1999, Grenada, WI (unpublished). 7pp. [Paper available from the Office of this Journal].

International Fund for Animal Welfare. 1995. Report of the Workshop on the Scientific Aspects of Managing Whalewatching, Montecastello di Vibio, Italy, 30 March - 4 April 1995. Paper SC/47/O18 presented to the IWC Scientific Committee, May 1995 (unpublished). 45pp. [Available from the Office of this Journal].

International Whaling Commission. 1980. Report of the Scientific Committee. *Rep. int. Whal. Commn* 30:42-137.

International Whaling Commission. 1984. Report of the sub-committee on small cetaceans. *Rep. int. Whal. Commn* 34:144-60.

International Whaling Commission. 1986a. Report of the Scientific Committee, Annex J. Whale marking - progress report. *Rep. int. Whal. Commn* 36:118.

International Whaling Commission. 1986b. Report of the Scientific Committee, Annex L. Proposed guidelines for review of scientific permits. *Rep. int. Whal. Commn* 36:133.

International Whaling Commission. 1987. Chairman's Report of the Thirty-Eighth Annual Meeting. *Rep. int. Whal. Commn* 37:10-27.

International Whaling Commission. 1988a. Chairman's Report of the Thirty-Ninth Annual Meeting. *Rep. int. Whal. Commn* 38:10-31.

International Whaling Commission. 1988b. Chairman's Report of the Thirty-Ninth Annual Meeting, Appendix 1. Resolution on scientific research programmes. *Rep. int. Whal. Commn* 38:27-8.

International Whaling Commission. 1991a. Report of the Scientific Committee, Annex G. Report of the sub-committee on small cetaceans. *Rep. int. Whal. Commn* 41:172-90.

International Whaling Commission. 1991b. Report of the sub-committee on Southern Hemisphere minke whales. *Rep. int. Whal. Commn* 41:113-31.

International Whaling Commission. 1993a. Report of the Scientific Committee. *Rep. int. Whal. Commn* 43:55-219.

International Whaling Commission. 1993b. Report of the Scientific Committee, Annex I. Report of the Working Group on Implementation Trials. *Rep. int. Whal. Commn* 43:153-96.

International Whaling Commission. 1993c. Report of the Scientific Committee, Annex I. Report of the Working Group on Implementation Trials, Appendix 4. Specifications of the North Atlantic minke whaling trials. *Rep. int. Whal. Commn* 43:189-95.

International Whaling Commission. 1994a. Report of the Scientific Committee, Annex G. Report of the Working Group on North Pacific Minke Whale Management Trials. *Rep. int. Whal. Commn* 44:120-44.

International Whaling Commission. 1994b. Report of the Scientific Committee, Annex G. Report of the Working Group on North Pacific Minke Whale Management Trials, Appendix 3. Specifications of the North Pacific minke whaling trials. *Rep. int. Whal. Commn* 44:133-43.

International Whaling Commission. 1995a. Chairman's Report of the Forty-Sixth Annual Meeting, Appendix 4. IWC Resolution 1994-4. Resolution on a Review of Aboriginal Subsistence Management Procedures. *Rep. int. Whal. Commn* 45:42-3.

International Whaling Commission. 1995b. Report of the Scientific Committee. *Rep. int. Whal. Commn* 45:53-103.

International Whaling Commission. 1995c. Report of the Scientific Committee, Annex E. Report of the sub-committee on Southern Hemisphere baleen whales. *Rep. int. Whal. Commn* 45:120-41.

International Whaling Commission. 1996a. Report of the Scientific Committee. *Rep. int. Whal. Commn* 46:50-97.

International Whaling Commission. 1996b. Report of the Scientific Committee, Annex E. Report of the sub-committee on Southern Hemisphere baleen whales. *Rep. int. Whal. Commn* 46:117-38.

International Whaling Commission. 1997a. Report of the Scientific Committee. *Rep. int. Whal. Commn* 47:59-258.

International Whaling Commission. 1997b. Report of the Scientific Committee. Annex E. Report of the sub-committee on Southern Hemisphere baleen whales. *Rep. int. Whal. Commn* 47:128-52.

International Whaling Commission. 1997c. Report of the Scientific Committee, Annex J. Report of the Working Group on North Pacific Minke Whale Trials. *Rep. int. Whal. Commn* 47:203-26.

International Whaling Commission. 1997d. Report of the Scientific Committee, Annex J. Report of the working group on North Pacific minke whale trials, Appendix 3. Estimates of mixing between J and O stocks. *Rep. int. Whal. Commn* 47:214-5.

International Whaling Commission. 1997e. Report of the Scientific Committee, Annex K. Requirements and guidelines for conducting surveys and analysing data within the Revised Management Scheme. *Rep. int. Whal. Commn* 47:227-35.

International Whaling Commission. 1998a. Report of the Intersessional Working Group to Review Data and Results from Special Permit Research on Minke Whales in the Antarctic, Tokyo, 12-16 May 1997. *Rep. int. Whal. Commn* 48:377-412.

International Whaling Commission. 1998b. Report of the Scientific Committee. *Rep. int. Whal. Commn* 48:53-127.

International Whaling Commission. 1998c. Report of the Scientific Committee. Annex F. Report of the Standing Working Group on Environmental Concerns. *Rep. int. Whal. Commn* 48:160-9.

International Whaling Commission. 1998d. Report of the Scientific Committee. Annex G. Report of the Sub-Committee on Comprehensive Assessment of Southern Hemisphere Humpback Whales. *Rep. int. Whal. Commn* 48:170-82.

International Whaling Commission. 1998e. Report of the Scientific Committee. Annex I. Report of the Workshop on the Development of an Aboriginal Subsistence Whaling Management Procedure (AWMP). *Rep. int. Whal. Commn* 48:203-36.

International Whaling Commission. 1998f. Report of the Scientific Committee. Annex S. Modified Guidelines for Progress Reports. *Rep. int. Whal. Commn* 48:292-5.

International Whaling Commission. 1999a. Planning Workshop to Develop a Research Programme to Investigate Pollutant Cause-effect Relationships in Cetaceans - 'POLLUTION 2000+'. *J. Cetacean Res. Manage. (special issue)* 1:55-72.

International Whaling Commission. 1999b. Report of the Scientific Committee. *J. Cetacean Res. Manage. (Suppl.)* 1:1-52.

International Whaling Commission. 1999c. Report of the Scientific Committee. Annex D. Report of the Sub-Committee on the Revised Management Procedure. *J. Cetacean Res. Manage. (Suppl.)* 1:61-116.

International Whaling Commission. 1999d. Report of the Scientific Committee. Annex F. Report of the Standing Working Group (SWG) on the Development of an Aboriginal Subsistence Whaling Management Procedure (AWMP). *J. Cetacean Res. Manage. (Suppl.)* 1:157-78.

International Whaling Commission. 1999e. Report of the Scientific Committee. Annex G. Report of the Sub-Committee on Aboriginal Subsistence Whaling. *J. Cetacean Res. Manage. (Suppl.)* 1:179-94.

International Whaling Commission. 1999f. Report of the Scientific Committee. Annex N. The Revised Management Procedure (RMP) for Baleen Whales. *J. Cetacean Res. Manage. (Suppl.)* 1:251-8.

International Whaling Commission. 2000a. Chairman's Report of the Fifty-First Annual Meeting. Appendix 10. IWC Resolution 1999-9. Resolution on Dall's porpoise. *Ann. Rep. Int. Whaling Comm. 1999*:55-6.

International Whaling Commission. 2000b. Chairman's Report of the Fifty-First Annual Meeting. Appendix 3. IWC Resolution 1999-2. Resolution on Special Permits for Scientific Research. *Ann. Rep. Int. Whaling Comm. 1999*:52.

International Whaling Commission. 2000c. Chairman's Report of the Fifty-First Annual Meeting. Appendix 5. IWC Resolution 1999-4. Resolution on health effects from the consumption of ceataceans. *Ann. Rep. Int. Whaling Comm. 1999*:53.

International Whaling Commission. 2000d. Chairman's Report of the Fifty-First Annual Meeting. Appendix 9. IWC Resolution 1999-8. Resolution on DNA testing. *Ann. Rep. Int. Whaling Comm. 1999*:55.

International Whaling Commission. 2000e. International Convention for the Regulation of Whaling, 1946 Schedule. As amended by the Commission at the 51st Annual Meeting 1999, and replacing that dated September 1998. *Ann. Rep. Int. Whaling Comm. 1999*:79-90.

International Whaling Commission. 2000f. Report of the Scientific Committee. *J. Cetacean Res. Manage. (Suppl.)* 2:1-65.

International Whaling Commission. 2000g. Report of the Scientific Committee. Annex D. Report of the Sub-Committee on the Revised Management Procedure. *J. Cetacean Res. Manage. (Suppl.)* 2:79-92.

International Whaling Commission. 2000h. Report of the Scientific Committee. Annex D. Report of the Sub-Committee on the Revised Management Procedure. Appendix 7. Initial trial specifications for western North Pacific Bryde's whales. *J. Cetacean Res. Manage. (Suppl.)* 2:118-23.

International Whaling Commission. 2000i. Report of the Scientific Committee. Annex E. Report of the Standing Working Group on the Development of an Aboriginal Subsistence Whaling Management Procedure. *J. Cetacean Res. Manage. (Suppl.)* 2:125-54.

International Whaling Commission. 2000j. Report of the Scientific Committee. Annex H. Report of the Standing Working Group on Environmental Concerns. *J. Cetacean Res. Manage. (Suppl.)* 2:209-33.

International Whaling Commission. 2000k. Report of the Scientific Committee. Annex I. Report of the Sub-Committee on Small Cetaceans. *J. Cetacean Res. Manage. (Suppl.)* 2:235-57.

International Whaling Commission. 2000l. Report of the Scientific Committee. Annex T. Minority Statements. *J. Cetacean Res. Manage. (Suppl.)* 2:317.

International Whaling Commission. 2000m. Report of the Standing Working Group on Environmental Concerns. Annex H. Appendix 4. An Ànnual State of the Cetacean Environment' Report. *J. Cetacean Res. Manage. (Suppl.)* 2:232-3.

International Whaling Commission. 2000n. Report of the Standing Working Group (SWG) on the Development of an Aboriginal Subsistence Whaling Management Procedure. Annex E. Appendix 3B. Fishery type 2: Implementation for Bering-Chukchi-Beaufort bowhead whales. *J. Cetacean Res. Manage. (Suppl.)* 2:143-52.

Jefferson, T.A. and Curry, B.E. 1994. A global review of porpoise (Cetacea: Phocoenidae) mortality in gillnets. *Biol. Conserv.* 67(2):167-83.

Jones, S. 1982. The present status of the gangetic susu, *Plantista gangetica* (Roxburgh), with comments on the Indus susu, *P. minor* Owen. *FAO Fish.* Ser. (5) [Mammals in the Seas] (4):97-115.

Kasuya, T. and Kureha, K. 1979. The population of finless porpoise in the Inland Sea of Japan. *Sci. Rep. Whales Res. Inst., Tokyo* 31:1-44.

Kraus, S., Quinn, C. and Slay, C. 2000. A Workshop on the Effects of Tagging on North Atlantic Right Whales. Report available from the New England Aquarium, Boston, MA. 15pp.

Leatherwood, S. and Reeves, R.R. 1994. River dolphins: A review of activities and plans of the Cetacean Specialist Group. *Aquat. Mamm.* 20:137-54.

LeDuc, R.G., Rosenberg, A.E., Burdin, A.M., Blokhin, S.A. and Brownell, R.L.J. 1998. A preliminary genetic analysis (mtDNA and microsatelites) of two populations of bowhead whales. Paper SC/50/AS11 presented to the IWC Scientific Committee, April 1998 (unpublished) [Paper available from the Office of this Journal].

Mitchell, E. and Reeves, R.R. 1983. Catch history, abundance, and present status of northwest Atlantic humpback whales. *Rep. int. Whal. Commn* (special issue) 5:153-212.

Miyashita, T. 1990. Population estimate of Baird's beaked whales off Japan. Paper SC/42/SM28 presented to the IWC Scientific Committee, June 1990 (unpublished). 12pp. [Paper available from the Office of this Journal].

Miyashita, T. and Kato, H. 1993. Population estimate of Baird's beaked whales off the Pacific coast of Japan using sighting data collected by R/V Shunyo Maru in 1991 and 1992. Paper SC/45/SM6 presented to the IWC Scientific Committee, April 1993 (unpublished). 12pp. [Paper available from the Office of this Journal].

Mohan, R.S., Dey, S.C., Bairagi, S.P. and Roy, S. 1997. On a survey of the Ganges river dolphin Platanista gangetica of Brahmaptura River, Assam. *J. Bombay Nat. Hist. Soc.* 94:483-95.

Moritz, C. 1994. Defining 'Evolutionarily Significant Units' for conservation. *Tree* 9(10):373-5.

Nishiwaki, S., Matsuoka, K., Kawasaki, M., Kioshino, H. and Kasamatsu, F. 1997. Review of the sighting survey in the JARPA. Paper SC/M97/1 presented to the JARPA meeting, May 1997.(Unpublished) 42pp. [Paper available from the Office of this Journal].

Paetkau, D. and Strobeck, C. 1994. Microsatellite analysis of genetic variation in black bear populations. *Mol. Ecol.* 3:489-95.

Pastene, L.A., Fujise, Y. and Numachi, K. 1994. Differentiation of mitochondrial DNA between ordinary and dwarf forms of southern minke whale. *Rep. int. Whal. Commn* 44:277-82.

Pastene, L.A., Hori, H., Watanabe, K., Bessho, Y. and Goto, M. 1996. Phylogenetic relationships in the minke whale world-wide as revealed by two independent analyses of mitochondrial DNA. The 7th Working Meeting of Specialists in Aquatic Mammals of South America. 22-25 October 1996, Vina del Mar, Chile. Supplement. p.53.

Pastene, L.A., Goto, M., Palsboll, P.J. and Kato, H. 1997. Population structure of the Bryde's whale (Balaenoptera edeni) in the North Pacific based on analysis of mitochondrial DNA control region sequences. Paper SC/49/NP5 presented to the IWC Scientific Committee, September 1997, Bournemouth (unpublished). 12pp. [Paper available from the Office of this Journal].

Pilleri, G. 1980. The Secrets of the Blind Dolphin. Sind Wildlife Management Board, Wildlife and Forest Department, Government of Sindh, Karachi, Pakistan.

Punt, A.E. and Butterworth, D.S. 1997. Preliminary evaluation of a (generic) strike limit algorithm for aboriginal subsistence whaling with comments on performance statistics and simulation trials. Paper SC/49/AS7 presented to the IWC Scientific Committee, September 1997, Bournemouth (unpublished) 22pp. [Paper available from the Office of this Journal].

Ramírez, J.U. 2000. Environmental impact study, San Ignacio saltworks project - Gray whale issues. 24pp. [Available from: Marine Mammal Research Program, Marine Biology Dept., Universidad Autonoma de Baja California Sur].

Reeves, R.R. 1998. Conservation status of the Indus river dolphin in Pakistan. IBI Reports (International Marine Biological Research Institute, Kamogawa, Japan). 1-9.

Reeves, R.R. and Chaudhry, A.A. 1998. Status of the Indus River dolphin *Platanista minor*. *Oryx* 32(1):35-44.

Reeves, R.R., Chaudhry, A.A. and Khalid, U. 1991. Competing for water on the Indus Plain: Is there a future for Pakistan's river dolphins? *Environ. Conserv.* 18(4):341-56.

Reeves, R.R., Leatherwood, S., Stone, G.S., Eldredge, L.G. and Donoghue, M. 1999. Cetaceans in the area served by the South Pacific regional environment programme. Paper SC/51/O11 presented to the IWC Scientific Committee, May 1999, Grenada, WI (unpublished). 55pp. [Paper available from the Office of this Journal].

Reeves, R.R., Smith, B.D. and Kasuya, T. 2000. Biology and conservation of freshwater cetaceans in Asia. *Occasional paper of the IUCN Species Survival Commission* No.23. IUCN, Gland, Switzerland.

Rice, D.W. 1998. *Marine Mammals of the World. Systematics and Distribution.* Special Publication No. 4. The Society for Marine Mammology, Lawrence, Kansas. 231pp.

Richards, R. 2000. How many whales were killed in the EEZs of Pacific Forum nations? Report to the Ministry of Foreign Affairs, Wellington. 20pp.

Samuels, A. and Bejder, L. 1998. A pilot study of habitual interactions between humans and wild bottlenose dolphins near Panama City Beach, Florida. A report to the Marine Mammal Commission, Bethesda, Maryland (unpublished). 13pp.

Schweder, T. 1998. Report of the Scientific Committee. Annex U2. A proposed modification for the JARPA sighting and sampling protocol. *Rep. int. Whal. Commn* 48:298.

Smith, B.D. and Reeves, R.R. 2000. Report of the second meeting of the Asian River Dolphin Committee, 22-24 February 1997 Rajendrapur, Bangladesh. . In: R.R. Reeves, B.D. Smith and T. Kasuya (eds.) Biology and Conservation of Freshwater Cetaceans in Asia. *IUCN Species Survival Commission Occasional Paper* No.23, Gland, Switzerland.

Smith, B.D., Haque, A.K.M.A., Hossain, M.S. and Khan, A. 1998. River dolphins in Bangladesh: conservation and the effects of water development. *Environ. Manage.* 22(3):323-35.

Stacey, P.J. and Arnold, P.W. 1999. *Orcaella brevirostris. Mamm. Species* 616:1-8.

Taylor, B.L., Chivers, S.J. and Dizon, A.E. 2000. Estimating the statistical power to detect population subdivision using mitochondrial DNA. Paper SC/F2K/J4 presented at the JARPN Review Meeting, Tokyo, Japan, 7-10 February 2000 (unpublished). 13pp. [Paper available from the Office of this Journal].

Tobayama, T., Yanagisawa, F. and Kasuya, T. 1992. Incidental take of minke whales in Japanese trap nets. *Rep. int. Whal. Commn* 42:433-6.

Whitcher, B.J., Zeh, J.E., Rugh, D.J., Koski, W.R. and Miller, G.W. 1996. Estimation of adult bowhead whale survival rates. Paper SC/48/AS12 presented to the IWC Scientific Committee, June 1996 (unpublished). 22pp. [Paper available from the Office of this Journal].

Yang, G. and Zhou, K. 1996. Incidental catch and its impact on marine mammal populations. *Chinese J. Appl. Ecol.* 7:326-31.

Yoshida, H. and Kato, H. 1999. Phylogenetic relationships of Bryde's whales in the western North Pacific and adjacent waters inferred from mitochondrial DNA sequences. *Mar. Mammal Sci.* 15(4):1269-86.

Yoshida, H., Kato, H. and Kishiro, T. 1997. Phylogenetic comparison of Bryde's whales off Kochi with the whales in western North Pacific and off Solomon Islands by mitochondrial DNA sequence analyses. Paper SC/49/NP6 presented to the IWC Scientific Committee, September 1997, Bournemouth (unpublished). 7pp. [Paper available from the Office of this Journal].

Zhang, X.F., Wei, Z., Wang, X.Q., Yang, Y. and Chen, P.X. 1995. Studies on the feasibility of establishment of a semi-natural reserve at Tian-E-Zhou (Swan) oxbow for baiji, *Lipotes vexillifer*. *Acta Hydrobiol. Sin.* 19(2):110-23.

Zhou, K. and Gao, A. 1995. Semi-natural reserve is the best possible approach to rescuing baiji. *IBI Reports* 5:57-61.

Zhou, K., Ellis, S., Leatherwood, S., Bruford, M. and Seal, U. 1994. Baiji (Lipotes vexillifer) population and habitat viability assessment. Mammalogical Society of China, IUCN/SSC Cetacean Specialist Group, and IUCN/SSC Captive Breeding Specialist Group (Unpublished manuscript). [Available from *http://iucn.org*].

Zhou, K., Sun, J., Gao, A. and Wursig, B. 1998. Baiji (*Lipotes vexillifer*) in the lower Yangtze River: movements, numbers [*sic*.] threats and conservation needs. *Aquat. Mamm.* 24(2):123-32.