Report of the Scientific Committee

The meeting was held at the Novotel London West Hotel and Conference Centre, Hammersmith, London UK, from 3-16 July 2001 and was chaired by J.E. Zeh. A list of participants is given as Annex A.

1. INTRODUCTORY ITEMS

1.1 Chair's welcome and opening remarks

Zeh welcomed the participants to Hammersmith. She thanked the chairs of the intersessional groups for their contributions to achieving progress on the many tasks assigned that are essential to the work of the Committee. In particular she thanked Allison for completing the large number of computing tasks she had been given.

Towards the end of the meeting, a participant from Iceland arrived. In welcoming him to the meeting, Zeh read out the following statement on behalf of the Chairman of the Commission:

> Iceland's recent deposition of an instrument of adherence to the International Convention for the Regulation of Whaling is expressly conditioned on a reservation to the commercial whaling moratorium found in paragraph 10(e) of the Convention Schedule. Until the Commission has the opportunity to review this matter, the participation of Iceland in the Scientific Committee does not prejudice the positions of individual members of the Commission on this matter.

1.2 Appointment of rapporteurs

Donovan was appointed rapporteur with assistance from other members where appropriate. Chairs of sub-committees appointed rapporteurs for their individual meetings.

1.3 Meeting procedures and time schedule

The Committee agreed to a work schedule prepared by the Chair. Grandy reported various housekeeping items and described the Secretariat facilities available to participants.

1.4 Establishment of sub-committees and working groups

The meeting was preceded by a two-day (3-4 July) Working Group to review Southern Hemisphere minke whale abundance estimates. The agenda items covered by this meeting were subsumed into the main agenda and the report of the sub-committee on in-depth assessments (Annex G). A number of sub-committees and Standing Working Groups were established:

Annex D – Sub-committee on the Revised Management Procedure;

Annex E – Standing Working Group on the Development of the Aboriginal Whaling Management Procedure;

Annex F – Sub-committee on Bowhead, Right and Gray Whales;

Annex G – Sub-committee on the Comprehensive Assessment of Whale Stocks – In-Depth Assessments;

Annex H – Sub-committee on the Comprehensive Assessment of North Atlantic Humpback Whales;

Annex I – Working Group on Stock Definition;

Annex J – Standing Working Group on Environmental Concerns;

Annex K – Standing Sub-committee on Small Cetaceans;

Annex L – Sub-committee on Whalewatching;

Annex M – Working Group on Estimation of Bycatch and Other Human-Induced Mortality;

Annex N – Working Group on DNA Identification and Tracking of Whale Products.

1.5 Computing arrangements

Allison outlined the computing arrangements that included printing facilities for delegate use.

2. ADOPTION OF AGENDA

The adopted Agenda is given as Annex B1. Statements on the Agenda are given as Annex V. The Agenda took into account the priority items agreed last year and approved by the Commission (IWC, 2001a, pp.71-72). Annex B2 links the Committee's Agenda with that of the Commission.

3. REVIEW OF AVAILABLE DATA, DOCUMENTS AND REPORTS

3.1 Documents submitted

The list of documents is given as Annex C.

3.2 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, 1998c). A summary of the information included in the reports is given as Annex O.

A recommendation for progress reports to include additional information on ship strikes is given under Item 7.1.3.

Donovan reported that the progress reports will be made available on the IWC web site after the meeting. This is further discussed under Item 22.3.

3.3 Data collection, storage and manipulation

3.3.1 Catches and other statistical material

Table 1 lists data received by the Secretariat since the 2000 meeting. The Committee was particularly pleased to receive copies of the original historic Southern Hemisphere Soviet catch data collected by Zemsky, Mikhalev, Tormosov and Berzin which they have been working on since the early 1990s. Summaries of some of these data have already been published (e.g. Zemsky *et al.*, 1996; Zemsky *et al.*, 1995a; Zemsky *et al.*, 1995b). Arrangements for encoding these data are included under Item 20.

Borodin requested that the following statement appear in the report.

> For the last few years (IWC, 1997b, pp.137-8; IWC, 1998d, p.177) the Russian delegation has made a statement about the necessity for independent experts with primary information of whaling (vessel logbooks, scientific reports, etc.) to present these materials at the national level so that they may undergo an expert review. This has not been done. This year we repeat again our statement and the need for it to be included in reports.

3.3.2 Progress of data coding projects

Allison reported that coding of all the available individual catch data from the North Atlantic had been completed and was being validated. Work had also continued on coding of pre-1940 Southern Hemisphere catch data.

In addition, data from the 1998/99 SOWER sightings cruise had been validated and incorporated into the DESS database. The validation had included testing the new validation software developed within DESS in 1999/2000 under contract. Now that the software is operational, it should reduce the time required to validate the annual SOWER cruise data in future.

Smith commented that he had received a copy of the North Atlantic catch data during the year and had been impressed by the quality of the data. He expressed his appreciation to the people involved in encoding the data.

3.3.3 Progress on program verification projects and other computing tasks

Allison reported on progress with the computing work identified last year.

(1) AWMP

The Common Control Program implementing the Fishery type 2 (bowhead) model had been amended to implement all the factors agreed both last year and at the intersessional meeting of the Standing Working Group (IWC, 2001a, pp.13-19; SC/53/Rep1). The full set of data to run *Evaluation Trials* had been distributed by e-mail together with the software and been used successfully by procedure developers. Code for five potential *SLA*s had been forwarded to Allison and she had applied the *Evaluation* and *Robustness Trials* to each. Results are discussed under Item 8.2. Allison expressed thanks both to Punt for his assistance with modelling issues and to David Poole who had run some conditioning trials.

(2) RMP – *Catch Limit Algorithm*

The new program implementing the *Catch Limit Algorithm* (CATCHLIMIT) written by the Norwegian Computing Centre (NCC) had been incorporated into the Secretariat's suite of programs to implement the RMP. The accurate tuning to meet Commission specifications had been undertaken and the results are detailed under Item 5.1.

(3) RMP – *Implementation Trials*

The control program for conditioning and running the North Pacific minke whale trials had been amended as specified in IWC (2001b, pp.114-125). Both the initial set of trials and the subsequent set of trials agreed by the Intersessional Steering Group had been conducted. These are discussed under Item 6.2.1. There had not been time to make progress on the control program for North Pacific Bryde's whale trials.

(4) Other

The small set of BALEEN II trajectories to investigate the effect of scientific catches specified by the Intersessional Steering Group had been conducted.

Table 1

List of Data and Programs received by the IWC Secretariat since the 2000 meeting.

Date	From	IWC ref.	Comments
Catch data			
19 Oct. 2000	Norway: N. Øien		Revisions to the1995 and 1996 Norwegian minke catch data
26 Jun. 2001	Norway: N. Øien	E31	Individual catch records from the Norwegian 2000 commercial catch
6 Jun. 2001	Japan: T. Sakamoto	C00	Individual catch records from the Japanese 2000 North Pacific Special Permit catch (JARPN2) and 2000/01 Antarctic Special Permit catch (JARPA)
5 Jul. 2001	Zemsky, Mikhalev and Tormosov	C	Copy of the revised historic Southern Hemisphere Soviet catch data: individual catch data and daily summaries for several expeditions
Sightings data			
10 Nov. 2000	J. Borberg, SW Fisheries	CD11	IWC/CCAMLR 2000 survey: data for Kaiyo Maru + Yuhzmorgeologiya
24 Nov. 2000	J. Borberg, SW Fisheries		IWC/CCAMLR 2000 sightings survey: original data forms for Yuzhmorgeologiya
8 Mar. 2001	P. Ensor	E28-30	2000/01 SOWER cruise data (sightings, effort, weather, ice-edge, inter-stratum & way points)
Programs			
2 Apr. 2001	L. Burt	CD12	New version of DESS database: version 3.0
3 Jul. 2001	L. Burt	CD13	New version of DESS database: version 3.1. Includes 1998/98 SOWER data + 1997/98 bias factor correction

These are discussed under Item 15.1. Progress made on the sightings database contract is reported and discussed under Item 10.1.1.

3.3.4 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 O.

4. COOPERATION WITH OTHER ORGANISATIONS

4.1 CMS (Convention on the Conservation of Migratory Species)

4.1.1 Scientific Council

The report of the IWC observer at the May 2001 meeting of the CMS Scientific Council held in Edinburgh is given as IWC/53/13E.

The Scientific Council considered several items relating to cetaceans. An updated draft proposal to place the Gangetic susu (*Platanista g. gangetica*) on Appendix I was approved and the CMS Secretariat proposed to approach India to make a formal proposal to the next Conference of the Parties. The report of the Workshop on the Conservation of Small Cetaceans of West Africa held in Conakry, Guinea was presented. A draft outline of an Action Plan for the Conservation of Small Cetaceans and Manatees of Tropical West Africa was tabled and discussed; the ultimate aims are development and conclusion of a regional CMS Agreement on Small Cetaceans and Manatees of Tropical West Africa (ASCAMTWA). Funding was approved in principle for: (1) studies of abundance, habitat use and stock identity of the franciscana (*Pontoporia blainvillei*) in Argentina, Brazil and Uruguay; (2) conservation-research projects on South American small cetaceans (*Lagenorhynchus* sp., *Cephalorhynchus* sp. and *Phocoena* sp.); and (3) the Second International Conference on Marine Mammals of Southeast Asia, to be held in July 2002 in the Philippines.

The Committee thanked Perrin for attending on its behalf and **agreed** that he should represent the IWC at the next CMS Scientific Council meeting and the Conference of the Parties in Bonn, 2002.

4.1.2 ASCOBANS (Agreement on Small Cetaceans of the Baltic and North Seas)

The report of the IWC observer at the 3rd Meeting of Parties to ASCOBANS and the 8th Meeting of the ASCOBANS Advisory Committee is given as IWC/53/13I. Issues of relevance to the IWC included pollutants and cetacean health; bycatch mitigation; the influence of high-speed ferries; and abundance surveys. Key resolutions adopted were: (1) the reduction of threshold level for unacceptable porpoise bycatch at a target level to less than 1.7% based on the work conducted by the IWC/ASCOBANS Harbour Porpoise Working Group; (2) the development of a Recovery Plan for harbour porpoises in the Baltic Sea; (3) support for the IWC's POLLUTION 2000+ programme; and (4) planning of an abundance survey including a recommendation to survey waters west of the ASCOBANS area. Issues discussed at the Advisory Committee meeting included ways to realise bycatch mitigation following a contract report. A workshop to develop a Recovery Plan for Baltic Harbour Porpoises will be organised for early 2002; participants will include governments, relevant regional intergovernmental organisations, NGOs and industries.

The Committee thanked Reijnders for attending on its behalf and **agreed** that he should represent the IWC at the next meeting of ASCOBANS.

4.1.3 ACCOBAMS (Agreement on the Conservation of Cetaceans of the Black Sea, Mediterranean Sea and contiguous Atlantic Area)

Following an invitation from the ACCOBAMS interim Secretariat, the Committee **agreed** that a representative from the IWC Secretariat should attend the 1st Meeting of Parties as an observer designated as a full member of the ACCOBAMS Scientific Committee. This Committee will be established at the 1st Meeting of Parties to be held in Monaco, 14-16 February 2002; its role will, *inter alia*, be to: (1) provide scientific advice to the Meeting of Parties; (2) conduct scientific assessments of the conservation status of cetacean populations; (3) advise on the development and coordination of international research and monitoring programmes and make recommendations to the Meeting of Parties on further research needs; and (4) facilitate the exchange of scientific information and conservation techniques.

4.2 ICES (International Council for the Exploration of the Sea)

The report of the IWC observer at the ICES Annual Science Conference (ASC), Brugge, Belgium is given as IWC/53/13B. The Working Groups on Marine Mammal Population Dynamics and Trophic Interactions (WGMMPD) and Marine Mammal Habitats (WGMMHA) met jointly in 2000 and evaluated the Baltic population of harbour porpoise, including *inter alia* distribution, migration, stock identity, reproduction and contamination. Subsequently these working groups were merged into one new group entitled the Working Group on Marine Mammal Population Dynamics and Habitats (WGMMPH).

The WGMMPH was requested to address questions relating to populations of marine mammals in the North Sea, including anthropogenic effects and health status in relation to habitat. It was also requested to provide recommendations for appropriate Ecological Qualitative Objective (EcoQO) indices for the North Sea populations. Other issues of relevance to the IWC include: (1) progress in studies of marine mammal habitat requirements; (2) adoption of a population simulation model framework aimed to assess population-level effects of environmental impacts; (3) development of a comprehensive database on North Atlantic marine mammal diet composition for evaluation of the two-way trophic interactions between marine mammals and fisheries; and (4) the impact of fisheries (particularly those in the North Sea) on small cetaceans. A theme session held during the ASC to consider trophic dynamics of top predators addressed issues of food selection and foraging behaviour in North Atlantic minke whales and diet composition in Pacific minke whales.

The Committee thanked Haug for attending the meeting on its behalf and **agreed** that he should represent the IWC at the next ICES meeting.

4.3 ICCAT (International Convention on Conservation of the Atlantic Tuna)

The report of the IWC observer at the meeting of the ICCAT, Marrakech, Morocco is given as IWC/53/13D. Several recommendations and resolutions were adopted although none were specifically relevant to cetaceans.

4.4 CCAMLR (Convention for the Conservation of Antarctic Marine Living Resources)

The report of the IWC observer at the 19th meeting of the CCAMLR Scientific Committee, held in Hobart, Australia is given as SC/53/13C. 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. During the topic of the 2000 krill survey, CCAMLR started to embark on discussions of sub-dividing total allowable krill catches (TACs) for CCAMLR sub-areas into smaller management units, interesting in that the IWC Scientific Committee has had similar discussions with regard to minke whale catches under the RMP. Following the first krill data evaluation workshop, a new krill biomass estimate of 44.2 million tonnes was given for the area covering the western part of the Atlantic Ocean sector between the South Shetland Islands and the South Sandwich Islands. The TAC for each of the CCAMLR sub-areas in the western Atlantic Ocean sector was about 1 million tonnes per sub-area; the TAC for a sub-area in the Indian Ocean sector was set at 440,000 tonnes. The present annual catch of krill, which is restricted to the western Atlantic Ocean sector, is in the order of 100,000-110,000 tonnes. CCAMLR recognised the participation of IWC observers during the 2000 krill surveys.

Matters relating to IWC-CCAMLR cooperation are discussed under Item 12.2.1 and in Annex J.

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

4.5 Southern Ocean GLOBEC

Matters relating to IWC collaboration are discussed under Item 12.2.2 and in Annex J. The Committee thanked Thiele for her work in promoting this cooperation.

4.6 NAMMCO (North Atlantic Marine Mammal Commission)

The report of the IWC observer at the 10th meeting of the NAMMCO Council, Sandefjord, Norway is given as SC/53/13A. Relevant topics included discussion of white whales and narwhals; concerns were expressed regarding the status of white whale stocks and the need for further research and management caution. In relation to marine mammal bycatch, contracting parties were encouraged to establish mandatory logbook data collection systems for identification of sensitive fisheries and areas. Further work is to be carried out to develop procedures for the collection of bycatch and to develop a policy for its use. It was noted that observations of sealing and whaling in Norway and pilot whaling in the Faroe Islands, were conducted under the NAMMCO International Observation Scheme.

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

IWC/53/13F noted that the 2001 annual meeting of the NAMMCO Scientific Committee had not yet been held and is scheduled for October 2001. However, during the intersessional period the Working Group on Abundance Estimation had met in Bergen, Norway. The tasks assigned to the Working Group were: (1) to prioritise and carry out further analyses from NASS-95; and (2) to assist in planning and coordination of the survey activity in NASS-2001. The highest priorities on the work plan were the reanalysis of the Icelandic aerial survey minke whale data and the documentation of the Icelandic and Faroese shipboard survey for minke whales. In NASS-2001, the priority species should be minke whales and fin whales and therefore the survey design should be optimised for these species. The Working Group examined the locations of sightings of minke and fin whales from earlier NASS surveys in order to determine the appropriate survey area. Areas considered for survey were Cape Farewell in southern Greenland; the Jan Mayan Icelandic area; the Faroese EEZ and adjacent waters; and Norwegian coverage of the North Sea. The Icelandic coastal shelf will be covered by an aerial survey using the cue-counting approach.

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

4.7 FAO – Committee on Fisheries

The report of the observer at the 24th session of the FAO Committee on Fisheries (COFI) is given as IWC/53/13G. Details of a forthcoming conference on Responsible Fisheries in the Marine Ecosystem were presented and welcomed. The FAO Committee agreed that it should conduct studies on and review the relationship between marine mammals and fisheries. Other issues of relevance included: (1) endorsement of an action plan to prevent unreported and unregulated fishing; and (2) promotion of improvements in global fisheries management, including the management of small-scale fisheries; development of ecosystem approaches to fisheries management; gear selectivity and waste reduction; and resource assessment and monitoring.

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

4.8 Other

4.8.1 PICES (North Pacific Marine Science Organisation)

Kato introduced the current activities of PICES. Members are Japan, Republic of Korea, Russian Federation, Canada, People's Republic of China and USA. The Working Group established in 1996 to assess the feeding impacts of top predators presented its final report in 1999 (Hunt *et al.*, 2000). A Workshop and Symposium to review the results of this Working Group met at the PICES 9th Annual Meeting, held in Hakodate, 2000. PICES continues to discuss how to incorporate top-predator components into ecosystem studies. The next Annual Meeting will be held in Victoria, Canada in October 2001. Noting its own interest in this subject (see Item 12.3.4), the Committee requested Kato to enquire whether the IWC could collaborate with PICES.

4.8.2 CITES (Convention on International Trade in Endangered Species of Wild Fauna and Flora)

Last year, the Committee recommended 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'. In response, the CITES Secretariat stated that the issue of expediting international movements of time-sensitive research samples of CITES-listed species is enjoying considerable attention within CITES. There seems to be a general understanding within the CITES Animals and Standing Committees that a procedure should be developed to facilitate the timely issuance of permits for certain types of samples and transfers under particular circumstances, primarily to expedite the determination that the trade in such samples would not be detrimental to the survival of the relevant species in the wild. The CITES Standing Committee has decided to form a working group to draft a resolution on this subject for consideration at the next meeting of the

Conference of the Parties (CoP12) in November 2002, with the aim of advising Parties which types, recipients and purposes of scientific samples should qualify for expedited issuance of CITES permits and certificates.

The CITES Secretariat also suggested that it may be worth considering providing some form of endorsement by the International Whaling Commission that can be submitted along with export document applications by persons and institutions that are affiliated with the IWC.

The Committee thanked CITES for their reply and **agreed** that the IWC Secretariat should develop a standard endorsement that can be tailored to suit specific needs. The Committee also **urges** member nations to consider nominating certain 'centres' to be given institutional CITES permits to facilitate the import and export process.

4.8.3 IUCN (International Union for the Conservation of Nature and Natural Resources)

Cooke briefly reported on the activities of IUCN and its Cetacean Specialist Group (which contains several members of the IWC Scientific Committee). The Cetacean Action Plan is being revised. It contains some 50 cetacean research programmes, many of which have origins in discussions within the Scientific Committee.

4.8.4 ECCO (Eastern Caribbean Cetacean Commission)

The Committee welcomed Walters as an observer for this newly formed inter-governmental organisation which comprises: Antigua and Barbuda, Dominica, Grenada, St Kitts and Nevis, St Lucia, St Vincent and The Grenadines.

5. REVISED MANAGEMENT PROCEDURE (RMP) – GENERAL ISSUES (SEE ANNEX D)

5.1 Evaluation of *CLA* program and tuning

Last year, the Committee **agreed** that the new program implementing the *Catch Limit Algorithm* (CATCHLIMIT) written by the Norwegian Computing Centre performed better than the MANAGE program and recommended its use by the Secretariat. This year the Steering Group chaired by Hammond (IWC, 2001a, p.5) pursued four tasks:

(1) compute an accurate tuning parameter for the new program to meet Commission specifications (IWC, 1999d, p.61);
(2) incorporate the program into the Secretariat suite of programs, including incorporating the diagnostic warnings;
(3) adjust the convergence criteria to be robust when less precise integration is used, possibly optimising the two-level convergence criteria;
(4) evaluate the effect of differences between the CATCHLIMIT program and the MANAGE program using the appropriate tuning values. The appropriate value for MANAGE would be that used in simulations, while for CATCHLIMIT it would be the value computed in (1) above.

Allison had completed task (1) following the procedure outlined in IWC (1999d, p.80). Her results (Annex D, Appendix 2) show that the value of the tuning parameter for the RMP that produces a 72% final depletion in the D1 trial is 0.4020. The Committee **recommends** this value as a replacement for the value used previously. Allison also completed task (2) and the program is now included within the Secretariat suite of programs.

Task (3) remains to be completed; Smith and Skaug will consult with Allison on this matter.

For task (4), Allison presented the results of a series of simulation trials comparing the CATCHLIMIT and the MANAGE programs (Annex D: Adjunct 3 of Appendix 2). The purpose of these comparisons was to identify any differences in precision of the two programs that might raise questions about interpretations of such trials offered previously. The Committee **agreed** that the results did not raise any questions about the adequacy of previous work on simulation trials using the less precise computer program.

5.2 Population component to which MSYR, MSYL and density-dependence should apply

The Committee noted that this issue is related to both the RMP and the AWMP. The calculations specified at last year's meeting to inform discussions on the issue (IWC, 2001d, pp.91-92 and p.106) had not been performed owing to time constraints. The Committee **recommends** that the calculations be performed intersessionally for discussion at next year's meeting.

5.3 Evaluation of abundance estimators against simulated datasets

5.3.1 Report of intersessional group

The terms of reference for the Intersessional Working Group on Abundance Estimation agreed to last year (IWC, 2001d, p.93) were: (1) to develop draft annotations to the RMP relating to estimates of abundance from multi-year surveys; and (2) to continue evaluating abundance estimators using simulated datasets. Priority in the latter was given to evaluating estimators against simulated datasets conditioned on data from North Pacific surveys for minke and Bryde's whales and against datasets incorporating responsive movement.

The report of the working group is given in Annex D (Appendix 3). In relation to (1), the group made recommendations on several technical issues (see Item 5.4). In relation to (2) it recommended that additional variance between *Small Areas* should also be included when capping or cascading is used and that every estimate for a management area should be assigned a time stamp that is an effort-weighted average. It also discussed statistical methods of 'filling holes' in survey coverage.

The Committee **endorses** the recommendations of the Working Group.

5.3.2 Other

SC/53/IA31 outlined an abundance estimation method for dual-platform line-transect analysis. Simulation studies by Polacheck *et al.* (2000) found the radial distance method to be the best-performing density estimator with respect to bias and precision, for line transect surveys in the presence of heterogeneity, in detection probability related to group size, observer team and environmental conditions. The method applies to cases where there is substantial overlap in the search area of the two platforms. Its applicability is constrained by the requirement for an external estimate of the surfacing rate and the determination of simultaneity or otherwise of duplicates. A modification of the method is developed for use where the effective surfacing rate is unknown and/or the relationship between effective surfacing rate and group size is unclear. The modified method yields approximately unbiased estimates and has low sensitivity to unmodelled heterogeneity in cue strength.

In discussion, it was noted that the simulation trials used assumed that the mean surfacing rate was invariate. It was suggested that the estimated surfacing rates should be compared to the true values underlying the simulations to

ensure that they are appropriate. The ability to estimate surfacing rate relies on information about simultaneous and delayed duplicate sightings. In response to the question whether there was sufficient information available to estimate surfacing rate, the author noted that the procedure provides estimates of an 'effective surfacing rate' that is difficult to define: it is different from that obtained from radio tracking or direct observation of whales. The precision of estimates of this parameter is likely to be poor. The Committee encouraged additional work on this approach (see Item 5.3.3).

5.3.3 Future work

The Committee **agreed** to re-establish the Intersessional Working Group on Abundance Estimation (chaired by Palka) with the priority task of expanding the existing set of simulated datasets to evaluate performance over a wider range of potential survey and biological conditions. Five priority areas were identified for future simulation, based on consideration of general features that need to be addressed, as well as specific issues relevant to surveys in specific regions or for specific species:

(1) school size based models;
(2) surfacing rates;
(3) movement effects;
(4) Southern Hemisphere IDCR/SOWER minke whale abundance estimation;
(5) simulations related to abundance estimation of North Pacific minke whales and of North Pacific Bryde's whales.

Details are given in Annex D (item 5.3.3).

5.4 Annotations to the RMP

The Committee **recommends** the modifications listed in Annex D (Appendix 4).

5.5 Work plan

The Committee **agreed** that the following tasks should be completed before the next meeting:

(1) adjustment of the convergence criteria for the CATCHLIMIT program (Item 5.1);
(2) calculations related to the population component to which MSYR, MSYL and density-dependence should apply (Item 5.2);
(3) tasks identified for the Intersessional Working Group on Abundance Estimation (Item 5.3.3).

5.6 Other

SC/53/E18 considered a whale population model in which environmental variability is introduced into the population growth rate. The author noted that environmental variability has not been included in the models underlying trials of the RMP to date. Under the assumptions she made she found that simulations that include variability are likely to be difficult to interpret since slow but inevitable declines in population size may not be easily detected. Calculations of mean persistence time produced a wide range of results, but indicated that constant exploitation could substantially reduce the mean time to extinction, even if at less than the MSYR. In some circumstances, extinction times could be of the order of 1,000 years. The author believed that it is not correct to assume that long-term mechanisms for extinction, involving environmental variability, are unimportant in determining the response of whale populations to exploitation. She suggested that use of stochastic models is essential if this mechanism for population depletion or extinction is not to be excluded. She believed that further research was necessary to develop more realistic stochastic models and to validate them with independent data.

Detailed responses from several Committee members are reported in Annex D (item 5.6). Some of the points raised included:

(1) The Committee has used stochastic models, for example in developing an *SLA* for bowhead whales (see Item 8).
(2) While estimating parameters for such models has proved difficult, several assumptions in SC/53/E18 are inappropriate and unrealistic (in particular, the use of a Normal distribution with a 50% CV is incompatible with whale biology).

Finally it was noted that if the conclusions apply to whales they must also apply to any renewable resource.

The Committee noted that its agreed approach to evaluating the impact of uncertainty on the performance of the RMP was to develop and use simulation trials. Such simulations could assess the impact of the use of the RMP, which is designed to avoid setting non-zero catch limits for depleted populations, rather than of the constant catch and constant proportion harvest regimes considered in SC/53/E18. Such simulations could be used to examine whether the use of the RMP led to substantially increased risks of extinction. It was noted that the use of operating models including environmental variation is important for the evaluation of *SLA*s for aboriginal subsistence operations based on 'small' populations (Type 3 fisheries – see Item 8.5).

Since the issue is of wider interest than in the context of management procedures for commercial and aboriginal whaling (RMP and AWMP, respectively), the Committee **recommends** that a review be undertaken of the effects of environmental stochasticity on cetacean population dynamics.

6. RMP – PREPARATIONS FOR IMPLEMENTATION (SEE ANNEX D)

6.1 Purpose of *Implementation Simulation Trials*

A summary of background information on the purpose of *Implementation Simulation Trials* from previous reports, which highlighted some key issues, is given in Annex D (Appendix 5). The Committee noted that the *Implementation Simulation Trials* for North Atlantic and Southern Hemisphere minke whales had been developed and run relatively soon after completion of the Comprehensive Assessments for those regions. In contrast, information on stock structure for the North Pacific minke whales has increased substantially since the Comprehensive Assessment in 1992, leading to several revisions of the *Implementation Simulation Trials* for this species/region.

The Committee noted that the conditioning process involves selecting the values for the parameters of the operating model so that it adequately mimics the observed data. The question as to whether conditioning has been appropriately performed arose during the work of the Intersessional Steering Group for North Pacific minke whale *Implementation Simulation Trials* when some members observed that the fits to the abundance estimates for sub-area 9 were poor. The Steering Group agreed the trials should still be conducted and the results reported to the Committee, but it had not addressed whether and how the trials should be modified. The Committee **agreed** that the process of developing *Implementation Simulation Trials* is not the same

as identifying the 'best' assessment for the species/region, but involves considering a set of alternative models to examine a broad range of uncertainties with a view to excluding variants of the RMP that show performance that is not sufficiently robust across the trials. The Committee noted that part of this process included deciding whether any of the candidate variants of the RMP performed adequately and that account needs to be taken of the plausibility of the various trial scenarios when evaluating RMP variants.

The Committee recognised that there may be a need for Steering Groups to evaluate the conditioning of *Implementation Simulation Trials*, for example in intersessional meetings where preliminary results can be considered.

The Committee **agreed** that it was important to address the issues raised in Annex D, Appendix 5 (section 2) at the next meeting.

6.2 North Pacific minke whales

6.2.1 Implementation Simulation Trials

6.2.1.1 REPORT OF THE INTERSESSIONAL STEERING GROUP

Allison had completed development of the software to conduct the *Implementation Simulation Trials* for North Pacific minke whales agreed last year (IWC, 2001b) as well as the calculations identified by the Committee. The current trials were selected from a much larger set based primarily on their likely impact on the performance of the RMP in relation to conservation of the 'O' stock (IWC, 2000c, p.83).

The report of the Intersessional Steering Group is given in Annex D (Appendix 6). Its terms of reference (IWC, 2001c) included selecting, based on initial trials, which combinations of *Small Area* definitions and RMP variants to run for the full set of trials. The Committee thanked the Group, noting that it had completed its assigned tasks. It expressed appreciation to Allison for completing the coding and running of the *Implementation Simulation Trials* during the intersessional period.

The Committee **agreed** with the recommendations of the Group regarding: (1) modifications to the specifications identified by Allison; (2) the values for dispersal rates computed by Taylor based on the specifications agreed to last year (Inoue and Kawahara, 1999); and (3) the use of the approach included in the RMP for dealing with sex-imbalance of the catch. It then **accepted** the recommendation that three of the six RMP variants could be eliminated (see Annex D, fig. 1 for the RMP variants considered further). It noted that the Group had identified two additional RMP variants. Trials had been run intersessionally for one of them but time constraints during the intersessional period precluded consideration of the other.

6.2.1.2 DISCUSSION

The Committee noted that some of the *Small Areas* considered are not fully consistent with the RMP definition of a *Small Area* (IWC, 1994b, p.145) since catching operations in such *Small Areas* may harvest whales in proportions substantially different from their proportions in the *Small Area*. RMP variants C2 and C7 were identified as particular cases where some *Small Areas* were not consistent with the definition. For example, for variant C2, the *Small Area* is the combination of sub-areas 7, 8, 11 and 12 but harvesting is assumed to occur only in sub-area 11. This assumption had been made because it was likely to lead to the greatest risk of taking whales from the 'J' stock. The Committee **agreed** that, given the range of hypotheses considered in the trials, if performance was adequate for variant C2, that would also apply to other (more plausible) allocations of the catch in the 7+8+11+12 *Small Area* to sub-areas. Variant C7 differs from variant C2 because the catch limit for the *Small Area* is split between sub-areas 7 and 11. The Group believed that the assumption that all of the catch would be taken in sub-area 11 if sub-areas 7, 8, 11 and 12 constituted a *Small Area* was unrealistic and that the assumption that it would be split between sub-areas 7 and 11 was more realistic.

The Committee considered the application of the RMP to whale species on their feeding grounds and during migration. It noted that the RMP was originally developed for management of baleen whales on their feeding grounds only. Some of the RMP developers believed that one purpose of trials was to examine whether use of some variant of the RMP (e.g. C*atch-capping* or C*atch-cascading*), along with constraints on the temporal and spatial allocation of catches, could provide robustness against the uncertainties arising from management of whales during their migration to the feeding grounds as well as on them (IWC, 1994a, pp.120-121). Some members believed therefore that the trial results should provide the primary basis for the selection of *Small Areas* and that evaluation of whether the catches by stock in a *Small Area* differed 'substantially' from the relative proportion in the *Small Area* could be based on the trial results. The Committee reached no conclusion on this and **agreed** to discuss it further next year.

(A) EXAMINATION OF TRIAL RESULTS

In considering whether the trials had been adequately conditioned, two views were expressed. One was that there was no need to consider the adequacy of conditioning this year, given that there had been ample opportunity to comment on this in previous years, when there had been no indications of dissatisfaction with it; in any case, the conditioning for the present trials was much better than last year. The other view was that the adequacy of conditioning should be discussed this year because of the possible need to make decisions and recommendations to the Commission based on the trial results. In response to that concern, a summary of the spatial distribution by age and month implied by some of the trials (i.e. the catch-mixing matrices for these trials) was produced (Annex D, Appendix 8).

The Committee recognised the need to explain the behaviour and nature of the trials to more members of the Committee so that those other than the trial developers can contribute to the process of evaluating whether the trial scenarios are realistic. Statistics designed primarily to ease interpretation and understanding are already provided for each trial (IWC, 2001c, p.124-125) and members were encouraged to identify additional statistics that might assist understanding and interpretation. In that regard, the Committee noted that, with additional annotations, the information in Annex D (Appendix 8) would be helpful in understanding the behaviour of the trials. Graphical methods and approaches for summarising the variability associated with the mixing matrices will be considered in future.

The RMP variants considered by the Committee had been specified to minimise catches of 'J' stock animals. The RMP's performance in terms of unintentionally taking 'J' stock whales can be evaluated by examining the estimates of catch by stock. Although the total catch of 'J' stock animals is often relatively high (e.g. a median average annual catch

over the 100-year period of roughly 60 whales for trial NPM101-J1), by far the major source of these catches is incidental removals off Korea and Japan. For example, for the C1 variant, the median average annual commercial catch of 'J' stock animals for trial NPM101-J1 is only 1.3 out of 60 (Annex D, Appendix 10).

Based on the trial results presented, Cooke, Wade and Lyrholm believed that certain implementation options could be eliminated, but that in recommending an RMP implementation option, the Committee should also draw attention to the apparently poor prognosis for the 'J' stock. In their view, an in-depth assessment of the 'J' stock should be conducted, outside the context of the RMP. Details of their concerns appear in Annex D (item 6.2.1).

In response, Butterworth drew attention to discussions at the 1999 Committee meeting. For reasons detailed in Annex D (item 6.2.1), he was surprised at the views expressed, in that they ignored Committee assurances given previously. He noted, *inter alia*, that consideration of the relative plausibilities of trials is a crucial component of the process of sensibly interpreting the results of *Implementation Simulation Trials*.

Some members strongly disagreed that the assurance referred to above precluded examination of the performance of different RMP variants when considering the results of the simulation trials, if these are intended to be the final trials, as surely that must be within the competence of members of the Committee. They felt that discussion of the simulation trials is different from the process by which the Committee recommends a specific RMP variant.

The Committee then considered, at some length, new information on stock structure (see Annex D, item 6.2.1.2). Information in two papers presented (SC/53/RMP12 and SC/53/RMP13) is inconsistent with some of the assumptions regarding mixing of 'J' and 'O' stocks included in the trials conducted to date. It **agreed** that further *Implementation Simulation Trials* would be needed to take this new information into account. Such trials would include allowing 'J' stock animals in sub-area 2 and modifying the estimates of the mixing proportions for sub-areas 2, 7 and 11 used when conditioning the trials to utilise the new samples from the Sea of Japan and those collected from sub-area 2.

After further discussion of genetic analyses in the context of stock boundaries, the Committee **agreed** that future analyses of genetics data for sub-areas 7, 8 and 9 should exclude any animals that are likely to be from the 'J' stock.

The Committee **agreed** that hypotheses in which some 'W' stock animals are found in sub-area 8 should be included in any future trials. A potential method to identify stock boundaries is given in SC/53/SD7 (and discussed under Item 11). Some members questioned its appropriateness as it had yet to be shown to perform reliably for other free-ranging species. The Committee **recommends** that Taylor, Pastene and Goto collaborate to analyse the genetics data spatially. One aim of the collaboration would be to estimate the fraction of animals from the different stocks in the sub-areas defined for North Pacific minke whales, which would be of value when evaluating the plausibility of different stock structure hypotheses.

Cooke, Smith and Wade considered that the *Implementation* should be completed at this meeting, as agreed last year and that recommendations should be made on the basis of the available trial results; proposals for further trials should be held over to the next *Implementation Review*. They considered it was unrealistic to expect a situation where the trials covered all of the identified possibilities. They noted further that many issues had arisen during the process, such as the question of the current status of the 'J' stock, which were peripheral to the focus of the trials and which would be better addressed in a broader context, such as in the next in-depth assessment of this stock.

The Committee discussed whether it was possible to recommend a variant of the RMP for this *Implementation* at this meeting, in accordance with the timetable agreed last year. It **agreed** that there remained issues which had not been fully resolved. In discussion, two views emerged: (1) the previously agreed timetable should be adhered to and that this *Implementation*, which has been in preparation for nearly 10 years, should be concluded this year, with recommendations for the choice of a variant of the RMP based on the trial results available to date; and (2) that a delay of one year was necessary because the further genetic data available at this meeting implied appreciably different 'J'-'O' stock mixing proportions in various months for sub-areas 11 and possibly 7 than had been used to condition the trials. Further details of both views are given in Annex D (item 6.2.1.2 and Appendix 11).

Smith commented that while he was prepared to complete the *Implementation* at this meeting, he agreed not to pursue this because some members from Japan indicated a preference for taking account of the new information rather than attempting to obtain management advice on the basis of the available trial results. Given that, he agreed that several additional issues should be accounted for in revising the *Implementation Simulation Trials*. He noted that the new information in SC/53/RMP12 revealed that the Committee's agreements in 1999 and 2000 did not include sufficient consideration of plausible ranges of uncertainty. He urged that the Committee re-consider the process by which plausible hypotheses are developed.

Following extensive discussion, the Committee **agreed** the following timetable for completion of the *Implementation Simulation Trials* for North Pacific minke whales:

(1) further *Implementation Simulation Trials* to be specified based on the new information presented during the current meeting (see Annex D, item 6.2.1.3);
(2) conditioning of the trials to be conducted intersessionally - this will require oversight by the Committee to ensure that conditioning is satisfactorily achieved;
(3) results of the *Implementation Simulation Trials* to be examined at the 2002 meeting with the goal of recommending to the Commission one variant of the RMP irrespective of any further data forthcoming in the interim - this will constitute the end of the *Implementation*.

The Committee then discussed the following modifications to the existing trials (details and the rationale for each are given in Annex D, item 6.2.1.3):

(1) revised input of 'J' stock proportions, calculated on the basis of SC/53/RMP12 and SC/53/RMP13 data, for sub-areas 2, 7 and 11;
(2) allowance for catches in sub-area 12 that reflect a different 'J'-'O' stock ratio from that in that sub-area at that time (this process should include an implementation option of dividing sub-area 12 into more than one *Small Area* to account for uncertainty about the 'O' and 'J' stocks in that sub-area);
(3) revised specification of mixing proportions of stocks in sub-areas 7, 8 and 9 based on a spatial analysis of the

genetics data and subject to oversight before the results are used in trials;
(4) account for temporal variability in the spatial distribution of the stock(s) found in sub-area 9;
(5) higher additional values for the 2000 depletion of the 'J' stock;
(6) revisions to the incidental catch numbers for Korea and Japan;
(7) additional trial for incidental catch model;
(8) additional trials with $MSYR_{mat} = 4\%$ and a higher proportion of 'O' stock in sub-area 12;
(9) other issues, including the population component to which MSYR applies.

The Committee **agreed** to the detailed trial specifications given in Annex D, Appendix 15.

New information presented at the meeting raised the possibility that alternative RMP variants might need to be considered. For example, as requested by the Government of Japan, the variants currently considered in the trials exclude the possibility of harvesting from sub-area 11 in April when a high proportion of the animals present are from the 'J' stock. Given that updated genetic data suggest higher 'J' stock proportions than previously in some other months, the Government of Japan might wish to amend the months for which harvesting from sub-area 11 should be excluded, in the revised RMP variants to be considered.

The Committee therefore **agreed** that the variants of the RMP to be considered needed to be re-specified in order to complete the specifications of the trials. These variants include specifications that involve not only options for specifications of *Small Areas* that are either sub-areas or combinations of sub-areas together with the use of capping and cascading options, but also the details of when and where harvesting will occur. In 1993, the RMP variants to be considered in the *Implementation Simulation Trials* were based on statements concerning Japan's future whaling plans (IWC, 1994a, p.123), provided in response to the need for this information noted at the 1992 meeting (IWC, 1993, p.102). The Committee requires similar guidance, once the revised the 'J'-'O' stock mixing proportions by month in sub-areas 7 and 11 have been computed, in order to conduct the revised *Implementation Simulation Trials* to be defined this year.

The Committee noted that the process of requesting nations for these details was intended to limit the large number of potential RMP variants that need to be considered in the *Implementation Simulation Trials* to realistic numbers, by restricting consideration to variants consistent with practical whaling operational factors and nation intentions. This is not, however, *in lieu* of the Committee's responsibility to develop/add, if appropriate, a limited number of appropriate further RMP variants to the set to be considered in the trials. The Committee **agreed** to ask the Commission to approach relevant nations for the necessary information.

In that context, the Committee suggested that consideration should be given to some RMP variants that include more than one *Small Area* in sub-area 12.

The Committee **recommends** that the Secretariat code the trials in the intersessional period. Oversight of developing, coding and conditioning the *Implementation Simulation Trials* is required. It **agreed** that the only way to achieve this is through an intersessional meeting, with the following Terms of Reference:

(1) Review results of further analyses of genetic data for sub-areas 7, 8 and 9 and decide what trial modifications may be necessary in consequence and re-estimation of mixing proportion between 'J' and 'O' stocks in sub-areas 7 and 11.
(2) Specify final trials in the light of discussions at this meeting and the results of trials run intersessionally and decide upon which combinations of *Small Area* definitions and RMP variants to run the final trials.
(3) Initiate discussion on approaches to advise on the relative plausibility of trials and their application in this instance, to facilitate discussion on this matter at the 2002 Scientific Committee meeting.
(4) Specify Terms of Reference for continued work under the intersessional e-mail group until the 2002 meeting.

Oversight would necessitate re-establishment of the Intersessional Steering Group (Butterworth (Chair), other members as last year and augmented by Goto, Pastene, Martien and Wade). That group would have responsibility for making the meeting arrangements and should:

(1) facilitate the conduct of analyses of genetic data for sub-areas 7, 8 and 9 in time to advise the intersessional meeting;
(2) facilitate the specification and running of an initial set of trials to facilitate choices of final trials at the intersessional meeting.

The final trials are to include both trials to diagnose influential factors and trials chosen to aid the discussion of plausibility in the Scientific Committee. Accordingly these trials may involve combinations of factors considered singly in the initial set of trials.

6.2.2 Sightings surveys

The Committee received reports of two sightings surveys in the Sea of Okhotsk in northern summer 2000 (SC/53/RMP5) and in the Sea of Japan in 2000 and 2001 (SC/53/RMP6). For the former, the Russian Federation had granted permission for a survey in its Exclusive Economic Zone (EEZ) with some restrictions. Half of the area was covered in IO passing mode; primary sightings in the 1,657 miles traversed were 45 schools (46 animals). Dive time experiments were conducted. In the latter, the survey was a joint programme between Japan and Korea, undertaken in coastal waters off western Japan, including a former whaling ground. Primary sightings were 1 school (1 animal) in 2000 and 3 schools (3 animals) in 2001.

The Committee received a research plan for a minke whale sightings survey in the Sea of Okhotsk and adjacent waters in July-September 2001 (SC/53/RMP7). Because the Japanese application for conducting the survey in the Russian EEZ had been rejected, the survey plan had been revised. Three research vessels will be used, the first two to conduct the Bryde's whale component of the survey (see Item 6.3.2). Biopsy sampling will be conducted in Pacific coastal waters off northern Japan using the *Larsen* gun during the last half of the cruise.

Some members believed that preliminary plots of sightings angles and distances should be provided in survey reports as had been recommended at previous meetings. However, it was recognised that this may be premature when surveys have only just concluded. The Committee also stressed that biopsy sampling on the surveys should be encouraged. The Committee **recommends** that the Commission requests the relevant authorities of the Russian Federation to grant permission in a timely fashion for Japanese vessels to undertake surveys in its EEZ.

SC/53/RMP21 presented an analysis of spatial and temporal distribution patterns of minke whales off the east coast of Korea during whale sightings surveys in June 1999 and May 2000, using a series of statistical analyses and the Geographic Information System (GIS). Whale distribution was correlated with distance from the shore, slope and depth in May and with distance from shore, depth and water temperature in June. Potential minke whale habitat occurs close to the coast in both months, with a shift northward from May to June. Kim noted that distribution information from recent sightings surveys was comparable to that based on the past commercial catch.

SC/53/RMP22 presented the cruise report of the Korean whale sightings survey conducted in the western waters of Korea in April-May 2001, in accordance with the plan endorsed last year (IWC, 2001a, p.12). Primary sightings were 28 schools (29 animals), in inadequate sighting conditions: only 56.9% of the original plan (810.3 n.miles) could be covered owing to adverse weather. The Committee noted that Miyashita had provided Committee oversight for this survey and had reported that it conformed with the accepted methodology.

SC/53/RMP23 presented the cruise report of a whale sightings survey conducted in the eastern coastal waters of Korea in autumn 2000. Primary sightings were 7 schools (8 animals) of minke whales, all in northern coastal waters; no sightings were made in the offshore area. Kim presented a plan for a sightings survey in the western waters of Korea in autumn 2001. It is being undertaken due to the poor results of the survey reported in SC/53/RMP22. Its objectives are to gain an understanding of the distribution and abundance of minke whale, for use in the assessment of the 'J' stock and in *Implementation Simulation Trials* for North Pacific minke whales.

Kim also introduced a plan for a sightings survey in the eastern waters of Korea, in spring 2002. It has two objectives: (1) to confirm the migration pattern of minke whales observed in the 1999 and 2000 surveys; and (2) to attempt to collect better abundance information with increased sighting effort. The results will contribute not only to the assessments of the 'J' stock but also to the present *Implementation Simulation Trials* for north Pacific minke whales. Plans include attempts to obtain biopsies using the *Larsen* gun.

The Committee **endorsed** the surveys in terms of the RMP and asked Miyashita to provide Committee oversight. It **agreed** that the survey plans should be elevated to full paper status (SC/53/RMP26 and 27) to ensure the details are entered into the record.

In this context, Wade raised issues regarding design features of recent surveys and survey plans in the western North Pacific. He described specific features that may not follow completely the survey design recommendations in the requirements and guidelines for conducting surveys within the Revised Management Scheme (IWC, 1997d). Included were identification of survey strata, whether transect lines had a randomly chosen start point and whether transect patterns provided approximately equal coverage probability throughout each stratum. Recommendations to ensure that future surveys in the western North Pacific meet these specifications are provided in Appendix 14 of Annex D.

The Committee recognised that the material in Appendix 14 of Annex D constituted desirable features of a survey design, but that other practical considerations might need to be taken into account in specific cases. It **agreed** that they should therefore be considered as guidelines, not immutable obligatory requirements. Nevertheless, when survey designs have features that are not in accord with such guidelines, it is important that those presenting such designs to the Committee explain the reasons and provide some evidence that the consequences for the results from the survey will not be large. The Committee **agreed** that, in future, research plans should include a detailed explanation of priorities and survey techniques, or provide a reference to where this information is recorded.

6.2.3 Other

The Committee considered a proposal for an in-depth assessment of North Pacific minke whales to provide a thorough scientific examination of stock structure, migration, segregation by age and sex, recent survey data and other information, involving appropriate experts. The examination should occur outside the context of the *Implementation Simulation Trials*, because discussions related to such trials inevitably occur only in the language of modellers rather than of biologists. *Implementation Simulation Trials* discussions effectively exclude many of the most relevant scientists from participating. An in-depth assessment would allow the most appropriate biologists to suggest a range of scenarios for stock structure and movement that reflect the biological information, which could then be translated into the details of the simulation models during the subsequent *Implementation Review*.

Other members noted that an in-depth assessment is needed because of the current uncertain status of the 'J' stock and its prognosis in many of the *Implementation Simulation Trials*.

The Committee **recommends** that an in-depth assessment of North Pacific minke whales, particularly to include the 'J' stock, be conducted urgently after the completion of the current *Implementation Simulation Trials*.

6.3 Western North Pacific Bryde's whales

6.3.1 Report of the Implementation Simulation Trials group

Implementation Simulation Trials for western North Pacific Bryde's whales were specified in 1999 (IWC, 2000d). The results were not yet available as there had not been time, given other priorities, to code the relevant computer programs. Butterworth expressed concern that no progress had occurred over two years and suggested that this pointed to a need to reconsider the process of achieving progress with *Implementation Simulation Trials* (and see Item 6.5). The Committee **recommends** that the trials be coded and run by the Secretariat during the intersessional period. The Steering Group chaired by Butterworth (members: Allison, Bravington, Butterworth, Cooke, Hatanaka, Karahara, Okamura, Perrin, Polacheck, Punt, Smith) was re-established, to guide the development of the trials and resolve any questions over technical specifications.

The Terms of Reference for this Steering Group are to resolve any inconsistencies in the trial specifications and to guide the coding of the computer software to implement the trials (see IWC, 2001c).

6.3.2 Sightings surveys

The results of a systematic sightings survey conducted mainly during August-September 2000, the third year of a four- year project, were reported in SC/53/RMP8. In 2,821 n.miles (71% of the original track line) there were seven primary sightings (eight animals) of Bryde's whales. Shimada had provided Committee oversight for the survey and reported that it was conducted in accordance with the approved procedures (IWC, 1997d).

SC/53/RMP9 provided a research plan for a sightings survey in August-September 2001, the fourth year of the project, to provide an abundance estimate for use in the RMP. The survey area includes the EEZ of the Federated States of Micronesia and the Republic of Palau but excludes their territorial waters. Given the discussions on survey design in Item 6.2.2, the Committee was informed that the transect starting points would be randomised. The Committee **endorses** the survey in terms of the RMP and has asked Shimada to provide Committee oversight.

Two additional survey vessels will be involved in the 2001 surveys because the original plan for a minke whale sightings survey in the Sea of Okhotsk was not approved by the Russian Federation. The objectives are: (1) to complete the multi-year sightings survey for western North Pacific Bryde's whales in 2001; and (2) to obtain information about their longitudinal distribution for use in multi-year survey data analyses. The cruise will follow the protocol submitted in 1997. In response to the discussion under Item 6.2.2, Miyashita stated that the starting point for the surveys will be randomised. The Committee **endorses** the two plans and asked Miyashita to provide Committee oversight.

SC/53/RMP10 reported on the results of three winter sightings surveys during 1999 to 2001 to obtain information on large cetacean distribution. Each cruise was conducted for about 40 days, mainly from early February to mid-March. In 4,709 n.miles searching, 67 schools (106 animals) of Bryde's whales were sighted, including 13 cow-calf pairs.

The Committee noted that Bryde's whale sightings were made south of 5°S on those surveys and it is possible that they belong to the North Pacific stock. It discussed possible stock structure of Bryde's whales around the Solomon Islands and recalled its earlier discussions on their identity (Hatanaka *et al.*, 1999; Perrin *et al.*, 1999). Some members believed that they could be pygmy Bryde's whales. The Committee noted that biopsy samples have only been collected from the high seas and not near the Solomon Islands. Few biopsy samples were collected during the cruises and the Committee **urged** that attempts to augment the biopsy efforts in the lower latitudes of the western Pacific be continued.

6.3.3 Other

SC/53/RMP24 presented data from a recent book by a former executive of Japan Whaling Co. Inc. on the history of Japanese coastal whaling. Details were provided on unreported catches of large whales, the manipulation of catch records in Japanese coastal whaling operations and how those manipulations occurred. Total Bryde's whale catches during whaling (1981-1987) off the Bonin Islands were 1.6 times larger than the numbers reported to the IWC, supporting information on other past unreported catches (Kasuya, 1999; Kasuya and Brownell, 1999).

Some members welcomed the new information in SC/53/RMP24 relating to the catches from 1981-87. They expressed concern at the size of the differences between the catches in SC/53/RMP24 and those recorded officially. They encouraged further investigation of this issue for discussion at the next meeting.

Morishita and others expressed concern about the lack of validity and usefulness of the information as it is not verified. Morishita stated that the Government of Japan would conduct a serious investigation into the matter with a view to verifying the information. Morishita and others agreed that verification of the information is essential before it can be used, as the accuracy of the information is unknown. He also stated that the results of the investigation will be reported to the Committee.

The Committee welcomed the Government of Japan's offer to provide information to the Committee and **encouraged** further investigation of the issue. The Committee also agreed to request the author (Mr Kondo) to prepare a paper (including presentation of primary documentation) for the Committee's consideration at its next meeting. It also agreed that the Government of Japan should be encouraged to provide information for discussion at that meeting. Many members thought that, in addition to the request for Mr Kondo to prepare a paper, it was important that he should be invited to attend the next meeting as an Invited Participant.

Brownell requested that the Japanese investigate the additional under-reported Japanese catches detailed by Kasuya (1999) and Kasuya and Brownell (1999).

The Committee noted that the *Implementation Simulation Trials* for North Pacific Bryde's whales had not been developed to the extent that might include specifications related to uncertainty about historical catches and **agreed** that trials would be developed next year to adequately represent that source of uncertainty. It noted that the performance of the RMP is robust to some extent to past under-reporting of historical catches (IWC, 1992b, p.88).

Clapham noted that these new data, together with previous reports of falsified sperm whale catch records, raised the question of whether other, unexamined, catch data could be considered reliable.

In response to questions from Brownell and Lento, Pastene noted that genetic analyses of Bryde's whale samples collected under JARPN II have been undertaken. Statistical analyses are underway and the results will be reported next year. Pastene also noted that ordinary type Bryde's whales from different oceans and regions are not phylogenetically independent from each other; phylogenetic approaches are not always useful for stock identification. The ordinary form Bryde's whale data used by Yoshida and Kato (1999) were from a small sample from the western North Pacific and Indian Ocean and are not representative of the western North Pacific stock.

Some members suggested that phylogenetic analyses could be very useful for the elucidation of stock structure in some cases, although other genetic markers such as microsatellites were often more useful where only shallow evolutionary divergences (e.g. differences in mtDNA haplotype frequencies) exist between stocks.

The Committee **agreed** that this issue will be discussed next year.

6.4 North Atlantic minke whales - plan for *Implementation Review* in 2002

6.4.1 Sightings surveys

SC/53/RMP3 reported on a sightings survey conducted in summer 2000, in the southeastern Barents Sea, with most of the survey area occurring in the Russian EEZ. Although permits for entering the Russian waters were issued for certain parts of the survey area, conditions were set which could not be accepted by Norwegian authorities. Accordingly, only areas outside the Russian EEZ and those within it that could be surveyed without restrictions were considered. The survey was conducted in the period July-August, with 104 primary observations of minke whales from all platforms combined.

In response to a query over the correspondence between the areas covered in 2000 and 1995, the Committee was informed that although the amount of trackline surveyed was substantially greater in 2000 than in 1995, the realised spatial coverage was similar. It noted that the adopted trackline resulted in changing survey intensity, which should be avoided. The Committee thanked Øien for serving in an oversight role and **agreed** that the surveys should continue in a manner suitable for use in the RMP; Øien was asked to continue his oversight role.

The Committee noted that this year a Norwegian research vessel planning to do a sightings survey in the North Sea was denied access to the UK EEZ. The surveys are part of the ongoing work in preparation for the *Implementation Review* of the North Atlantic stocks of minke whales and are giving valuable information about abundance and, in addition, distribution of other whale species. The transects are designed in accordance with the Committee's requirements and guidelines and are performed under Committee oversight.

Walløe noted that in the North Atlantic area and after World War II only Russia (previously the Soviet Union) had for certain periods denied access for research vessels doing sightings surveys (or similar types of oceanographic or fishery research) to some sea areas outside its territorial waters (but inside its fishery zone, or, more recently, its EEZ).

The Committee recalled recent examples where such permission had not been granted. These were USA surveys in part of the Caribbean and Japanese surveys in the Okhotsk Sea. It further noted that last year the Committee recommended that the Commission request the relevant authorities in Russia to grant permission for Norwegian research vessels to survey its EEZ waters. Such permission has been given for this year.

The Committee therefore emphasised its hope that all nations in the region will provide clearance for and/or collaborate in conducting surveys in their waters to enable more complete coverage of this portion of the species' range.

Many members recommended that the Commission request the relevant authorities in the UK to grant permission for Norwegian research vessels to survey in its EEZ waters in the future. They expressed deep concern that not all members of the Committee supported their recommendation. Access to EEZ regions for sightings surveys is essential to the work of this Committee and more generally essential to the conduct of marine research worldwide.

6.4.2 Other

SC/53/RMP19 reported on a study of bias and precision in North Atlantic minke whale age estimates based on growth zones in bulla tympanica. The results gave a poor fit between age and number of ovulations, with a 27% underestimate of the true age. Precision was higher than for Antarctic minke whales aged using earplugs, but the high bias reduces the applicability of the bulla method in routine age-determination with a management objective.

The Committee expressed its appreciation to the author and **concluded** that the study shows that there are currently no reliable methods for estimating age of North Atlantic minke whales. Earplugs are only found in 20-25% of the animals and those available are more difficult to read than those from other oceans.

SC/53/RMP4 notified Norway's intent to conduct minke whale sightings surveys in the northeast Atlantic in 2002-2007 with a new estimate of minke whale abundance to be presented in 2008. Details of the proposal are summarised in Annex D, item 6.4.2. The Committee noted that there are plans to collect dive time data using VHF tags. Cruise reports will be submitted to the Committee. Biopsy samples will be collected when possible both from minke whales and other cetacean species.

In discussion of methodology for distance and angle estimation, the Committee noted that Leaper and Gordon (2001) describe a photo-grammetric method that should be considered.

6.4.3 Preparation for Implementation Review

The Committee agreed last year to conduct an *Implementation Review* of the RMP *Implementation* in 2002. This year it **agreed** on a number of issues to be addressed in preparing for completing an *Implementation Review*, as detailed in Annex D, item 6.4.3. It **endorsed** those proposals.

The Committee asked Smith (or Palka if he is unavailable) to convene the *Implementation Review*. A Steering Committee was established as an intersessional e-mail group including Skaug, Walløe, Øien, Kawahara and Cooke; other Committee members should be co-opted as required.

Guidelines and requirements for the RMP suggest that data and analyses should be made available to the Committee six and three months respectively in advance of the next meeting. The Committee was informed that Norway plans to have the data available by November 1, 2001 and analyses by January 15, 2002. Øien will coordinate such access to data as may be required.

The Committee **agreed** that a bibliography of new information developed since the *Implementation* should be prepared and circulated to Committee members to assist them in preparing for the *Implementation Review*.

6.5 Work plan

The Committee **agreed** that the following tasks, in order of priority, should be completed before the next meeting:

(1) modify and run the *Implementation Simulation Trials* for the North Pacific minke whales (Annex D, item 6.2.1.3);
(2) hold an intersessional meeting to provide oversight for the *Implementation Simulation Trials* for North Pacific minke whales and the associated analyses (including genetic spatial analyses) (Annex D, item 6.2.1.3);
(3) complete preparations for the North Atlantic minke whale *Implementation Review* (Annex D, item 6.4.3);
(4) code the initial North Pacific Bryde's whale *Implementation Simulation Trials* (Annex D, item 6.3.1).

Following concerns expressed under Item 6.2.1 about the length of time taken to complete the *Implementation* for North Pacific minke whales, the Committee discussed how such delays could be avoided in the future. Key to this was finding a way to take account of available data whilst ensuring that *Implementations* (*Implementation Reviews*) were completed in timely fashion.

The Committee **adopted** the following approach, noting that it should consider this issue further at the next meeting, particularly with a view to including this timetable into the RMP annotations.

(1) *Implementations (Implementation Reviews)* should not extend over several years, incorporating new

information as they proceed. Instead, they should be conducted quickly at discrete intervals, using the data available at one point in time.

(2) The part of the *Implementation (Review)* process that reviews the biology of a species in a *Region*, including stock structure, should be based on the ongoing programme of in-depth assessments, which should be kept up to date.

(3) Each *Implementation (Review)* should be completed in two consecutive annual meetings of the Committee, with an intersessional working group meeting between the two meetings, if required.

(4) At the first meeting, the data to be used should be identified and stock structure hypotheses formulated, based on the most recent in-depth assessment of the species in the *Region*. If necessary, *Implementation Simulation Trials* should be specified in broad terms.

(5) If *Implementation Simulation Trials* have been specified, an intersessional working group should complete the specifications and oversee running the trials, with an intersessional meeting, if deemed necessary.

(6) At the second annual meeting, recommendations for specific *Implementation* options shall be made, based on the results of the *Implementation Simulation Trials*, if any and on the other information identified at the first meeting.

Butterworth noted that account needed to be taken of the possibility of initiating an *Implementation Review* earlier than anticipated if significant new information became available (annotation 9 to the RMP), but that there needed to be a very high standard for deciding whether the new information necessitated an earlier than planned *Implementation Review*.

The Committee expressed its appreciation to the RMP sub-committee rapporteurs, particularly Punt.

7. ESTIMATION OF BYCATCH AND OTHER HUMAN-INDUCED MORTALITY (SEE ANNEX M)[1]

7.1. Bycatch estimation methods

The Committee noted that before it could decide on the most appropriate means of estimating the bycatch rate of whales in any fishery, it would be necessary to identify the fisheries concerned. The Committee **agreed** that priority should be given to those areas where the RMP is likely to be implemented – such as the northwestern Pacific and the northeastern Atlantic.

The Committee **agreed** that four steps are required: (1) identification of the relevant fisheries; (2) description and categorisation of those fisheries to allow a sampling scheme to be devised; (3) identification of a suitable sampling strategy or strategies; and (4) design and implementation of the sampling scheme to enable estimation of the total bycatch.

To initiate this process, information was collated from recent IWC Progress Reports (1997-2001) on the types of fishery that are associated with baleen whale bycatch (see tables 1 and 2 in Annex M). Most of the baleen whales recorded were minke whales. There was a diversity of gear types associated with these bycatches. The only fisheries in the northeastern Atlantic that were specifically identified were lobster or crab pot fisheries in Scotland. In the northwestern Pacific several categories of fishery were identified as having had whale bycatch, including gillnets, set nets, trap nets, stow nets, driftnets, trawls, longlines and squid jigs.

These records represent an initial step in identifying the relevant fisheries, but it is not clear to what extent these are the result of opportunistically obtained information rather than a systematic survey of the available fisheries. It is therefore possible, especially in the North Atlantic where fewer records exist, that the available data do not adequately represent the extent to which whales are taken in each of the fisheries of these areas.

Further information on fisheries is required for both steps (1) and (2) above. The Committee reviewed a list of categories of information that are needed in this regard (Table 2). Some members questioned whether sending out forms requesting information of this type was a useful approach, given the difficulties of obtaining useful data in this manner. Others noted the limited data on fisheries in many parts of the world and believed this may help in attempts to develop a catalogue of relevant fisheries. It was **agreed** that Northridge would chair an intersessional working group (Rogan, Perrin, Bjørge, Tregenza and Read) that, using Table 2 as a basis and concentrating initially on known or suspected fisheries with whale bycatches in the priority areas, would: (1) define the specific objective for a questionnaire survey; (2) define the target groups for such a survey; (3) design suitable forms specific to the target groups; and (4) evaluate the feasibility of meeting the objectives of the questionnaire survey.

Table 2

Categories of fishery information required for each identified gear type.

(1) Area of operation (and major ports)
(2) Target species/types of fish
(3) Are data available on vessels (numbers, type, size)?
(4) Are data available on operations (time of year, trip lengths, position of net e.g. bottom, midwater, surface, soak time)? Including typical and ranges of values for these parameters.
(5) Landing data available? (in what form* and by what geographical unit)
(6) Effort data available? (voluntary, mandatory, inspection schemes and in what form* and by what geographical unit)
(7) Observers/inspectors present? Sampling/complete coverage, voluntary/mandatory, duties (general or with specific knowledge of cetaceans)
(8) Have interactions with cetaceans been reported? How and by whom? Are estimates/observed numbers of bycatch available? Are any references available.

* e.g. Published, available on request, available electronically.

Table 2 is neither exhaustive nor prescriptive and it will be necessary to adjust the detail of information required depending on local conditions.

The adopted approach therefore involves two parallel processes. The first involves trying to obtain enough detailed information about fisheries that are already known to take whales (even very occasionally), in order to decide how best to sample them. The second involves the identification of other fisheries within each region that may be responsible for whale bycatches. Several methods might be used for this (as they have been used in the past to identify fisheries likely to take small cetaceans) and examples are given in Annex M (item 5).

Once the relevant fisheries have been identified and adequate information on their operation is available, it should be possible to decide upon the most suitable sampling method to determine bycatch rates and then to design and

[1] Komatsu indicated that Japan had reservations on all statements under Items 7.2, 7.3 and 7.4 that included the words 'agreed' or 'recommends'.

implement the sampling programme, based upon a suitable stratification of the fishery and a power analysis to determine the level of monitoring required.

The Committee reviewed the following methods that have been used in the past for estimating the rates of cetacean bycatch.

7.1.1 Estimates based on fisheries data and observer programmes

The Committee reviewed a summary drawn from a previously published review of methods to estimate small cetacean bycatch rates (Northridge, 1996). Independent observer schemes have been recognised as being the most reliable means of obtaining statistically robust estimates of small cetacean bycatch rates (IWC, 1996a, p.90; IWC, 1997c, p.171). These can be addressed either by placing observers on board vessels for the duration of a trip or by making observations from an independent nearby platform such as a fishery inspection vessel.

The basic method is to estimate the bycatch rate of the fishery from a sample of the total number of fishing trips and then to extrapolate from the sample to the whole fleet, normally by using a simple ratio estimator.

There are several important considerations in establishing such a scheme. Observers should ideally be placed on a random sample of vessels and trips. In practice this is not possible, so it is important that the observer scheme organisers know enough about the fishery to be sure that observer sampling is not being covertly excluded from any periods or areas of fishery operations. The sampling scheme also needs to be stratified to take account of likely different catch rates among different elements of the fleet being sampled (for example inshore and offshore elements). The bycatch rate needs to be recorded in some unit that can be compared to the rest of the fleet. It was suggested that it should be possible to integrate such cetacean bycatch observation work with existing on-board fishery monitoring schemes where these exist. However, the importance of ensuring that fishery observers should be trained in methods appropriate for sampling and identifying cetaceans was stressed. It was also noted that bycatch rates may vary considerably from year to year in certain fisheries and the need for long term monitoring was stressed.

The Committee considered a simple method for estimating the maximum likely bycatch rate, given a limited amount of observer effort and zero bycatch observations. Statistical power analysis should be conducted prior to the start of any observer scheme, especially where sampling effort covers only a small part of the total fleet fishing effort, to ensure that a lack of observation of bycatch is not falsely interpreted as proof of a zero fleet bycatch rate.

Although observer schemes in the USA have been able to generate sufficient observations to generate estimates of minke whale bycatch, live animal observations to estimate entanglement rates and strandings schemes may be more useful methods in situations where large whales collide with fishing gear and carry it away.

The Committee recalled a previous recommendation that reliable estimates of bycatch mortality should be obtained using statistically-based observer programmes (IWC, 2001t, p.8) and the conclusion in 1996 that bycatch estimates derived from independent observer schemes are desirable and that other methods are less reliable (IWC, 1997c, p.171). The Committee **agreed** that independent observer schemes are generally the most reliable means of estimating bycatch rates in a statistically rigorous manner, but that they may not always be practical and will require careful design.

In Japan, where minke whales are regularly reported caught in trap net fisheries, there has been a recent revision of the rules governing the use of bycaught whale products (Ministerial Ordinance 92 (*www.maff.go.jp/mud/410.html*)). The new regulations allow the trap net fishermen to harvest whales that are found in their traps and to sell these on to the market, provided they register the animal by supplying a DNA sample.

Morishita noted that the market value of a minke whale is a powerful incentive to report such bycatches. However, because marketing whale meat is a very specialised trade in Japan, trap net fishermen may not always be able to sell bycaught whales, in which case a bycaught animal would be incinerated or buried. He commented that trap net fishermen usually try to release trapped whales as they can damage or destroy the fishing gear, resulting in costs much greater than the value of the whalemeat. In such a situation only a small proportion of the bycatch will enter the market.

In the Republic of Korea, all bycatches must be reported to the local authorities and each such event is then investigated. During this investigation period (2-3 days) the animal cannot be sampled. After the inspection, if it is clear that the animal has not been deliberately harvested, it can be sold. By the end of 2001, the Government will implement a DNA sampling scheme from bycaught whales; since December 2000 it has promoted measures for fishermen and fishery authorities to release live whales. The present regulations state that no whale may be killed, even though bycaught.

There was considerable discussion regarding mandatory reporting schemes. The Committee **agreed** that the proportion of animals that are reported under such schemes would likely depend on the perception of the fishermen as to what the consequences of reporting such events might be.

The Committee discussed the use of strandings information in relation to bycatch studies and noted that this will merely result in minimum estimates rather then produce total estimates. The Committee also noted the previous conclusions of the Committee that strandings data could only give a general indication that bycatch may be occurring, not the magnitude or location of the bycatch (IWC, 1996b, p.165).

Questionnaire surveys have been used in several places to obtain information on bycatches of cetaceans. The Committee **agreed** that such methods can be useful to identify locations or fisheries in which bycatch might occur, but that they are not useful for providing rigorous estimates of bycatch rates. Again, the Committee noted its previous conclusion that questionnaire surveys of fishermen result in unquantifiable biases (IWC, 1996b, p.165).

7.1.2 Estimates based on genetic data

Genetic data can be used at various levels with varying levels of certainty to assign animals from species, ocean and stock down to the level of an individual, as discussed by the Committee last year (IWC, 2001p).

The Committee considered papers SC/53/RMP13-16 and SC/53/SD6 in the context of the use of genetic methods to derive estimates of bycatch with satisfactory precision for management. For details of these papers see Annex M (item 5.5) and Annex D (item 6.2.1.2).

The consistency among the results from different Japanese surveys was investigated in SC/53/RMP13. It was found that the proportion of 'J' stock products varied among surveys, even between surveys conducted in similar periods of the year. Such inconsistency was attributed to the non-random nature of the surveys and to the different

availability of North Pacific minke whale products in different regions and periods of the year. It was also found that the proportion of 'J' stock products was higher in western Japan.

It was noted that although the distribution and movement of whale meat products around the market may be complex, the registration of all legal animals on the market in a central DNA registry will enable these markets to be tightly controlled. It was also noted that products from protected species continue to be found on the Japanese market (SC/53/SD6) and that this raised the question of the documentation of bycatch that reaches the market.

The major purpose of the new regulations in Japan (Ministerial Ordinance 92 (*www.maff.go.jp/mud/410.html*)) is to improve overall whaling and whale meat marketing management and enforcement measures by strengthening market control and introducing penalties. The ordinance will also require the collection of DNA samples from bycaught whales and came into effect on 1 July 2001. These new regulations cover the 13 species included in the IWC nomenclature. The sale of products from bycaught whales is only allowed from set or trap nets under several conditions including submission of DNA samples. However, such species as blue, bowhead and right whales are protected under other Japanese domestic laws and products from these three species may not be sold. In response to a question of whether this exception includes other protected species, such as gray whales, Morishita stated that it does not. The Government of Japan discourages fishermen from selling species other than minke whales and in many cases fishermen try to free bycaught whales to minimise damage to fishing gear.

Brownell and Kasuya reported their understanding that this Ministerial Ordinance No. 92 allowed the marketing of meat from whales killed when entangled with trap nets, subject to DNA analysis and submission for individual identification. It is intended to change the 'ambiguous' management of whales in an older Ministerial Ordinance and will allow the domestic sale of any whales incidentally entangled with trap nets with the exception of bowhead, blue and right whales. Therefore any entangled whales do not need to be released alive as long as a DNA sample is collected and analysed. The end result of the new regulation will be that the number of entangled whales recorded as dead will increase in future Progress Reports from Japan.

It was reported that the DNA register maintained by the Institute of Cetacean Research includes a very substantial proportion of the DNA profiles from whale meat sold legally in the Japanese market. As sample analysis proceeds and as frozen stockpiles diminish over the next few years, the DNA register will include 100% of DNA profiles from whale meat on the market. DNA profiles from any future imports of whale meat will also be included in the register. At that time, the system will be 'fully diagnostic' meaning that market monitoring will be 100% effective since the DNA profile from a sample taken from the market that is included in the register will be from a legal source and the DNA profile from a sample not included in the registry would be clearly identified as being from an illegal source.

The Committee welcomed these new developments as they provide more information to allow bycatch to be estimated. It was noted that the aim was to have a fully diagnostic register as soon as possible but that this might take 4-5 years. Depending on progress with analyses it will be clear within a year or two whether the date of 1 January 2004 for a fully diagnostic register, that had been suggested at an earlier meeting, was still realistic.

The Committee discussed the use of market sampling to estimate bycatch and noted that there is a need for considerable detailed knowledge about the market. Issues related to sampling design and the use of mark-recapture methods based on market sampling have been discussed in previous years. It was noted that the minimum estimates produced were useful for indicating where other sources might not be giving a complete record. If, for example, the minimum estimate from market sample data was more than the reported figures then that would indicate cause for concern. It was noted that the sampling design of market surveys was a critical issue for absolute estimates but that minimum estimates could be developed without a random sampling design. The length of time that products from a single individual remain on the market is an important question. In the Korean market, products appear to move through the market within a few months whereas on the Japanese market by-products from the same individual can be available for a period up to three years.

It was suggested that it might be possible to obtain some kind of interim estimate which was better than the minimum figure but did not rely on the random sampling of markets that is necessary for standard mark-recapture techniques. Whereas a snap shot of the market from a single survey only provides limited information, a sequence of market samples might in principle be used to derive a minimum estimate of annual numbers entering the market. Detailed methodology was not presented and any proposals for such approaches would need to be fully evaluated by the Committee. It was suggested that this might be considered at the proposed workshop to consider the use of genetic methods discussed below. Such methods would be more powerful if there was a full diagnostic DNA register containing all the documented individuals that had entered the market. In the absence of such a register, market sampling is a less powerful technique. The Committee **agreed** that estimation of bycatch would be improved by the ability to compare market samples with a diagnostic register and **recommends** that such registers be established where they do not exist.

The Committee noted that estimates of total bycatch were required for the RMP and that minimum estimates may not be adequate. The Committee **agreed** that although genetic methods based on market samples may not be the primary approach to estimating bycatch, they could provide useful supplementary data that could not be obtained in another way. In addition, use of market samples to provide absolute estimates should not be ruled out but would require further developments in sampling design with input from experts outside the Committee with detailed knowledge of market sampling issues. It was suggested that sampling of markets had a useful motivational role and made it more likely that bycatch would be accurately reported. The importance in distinguishing between diagnostic and probabilistic assignment of animals to sub-stocks was noted when using genetic methods (e.g. with respect to 'J' and 'O' stock whales in the North Pacific).

Walløe noted that for the northeastern Atlantic, he believes that bycatch of minke whales in Norway is fully reported. This is of the order of about one minke whale per year, or less and he believed there was no need for alternative methods in order to estimate the bycatch in Norway. Bycatch in Norway may be eaten but cannot be sold. For this reason market sampling will not give any information about bycatch. No system exists for obtaining DNA samples from bycaught or stranded animals but this will be encouraged in the future on a voluntary basis.

The use of market surveys to improve on minimum estimates of bycatch and provide more realistic unbiased estimates will necessitate an adequate sampling design. This will require information on:

(1) whale bycatches and the fisheries involved;
(2) methods of storage, collection and analysis of genetic samples (including existing registers);
(3) the outlets for whale meat in specified countries and the pathways to those outlets (including direct whaling and bycatches);
(4) food/market surveillance systems; and
(5) the statistical design and analysis of market or other sampling.

It was noted that obtaining the necessary information on these issues would be best addressed by a multi-disciplinary workshop involving people with expertise beyond that of the Committee. Most members believed that the terms of reference for such a Workshop should be to review the use of genetic methods to provide information on direct anthropogenic removals (other than known direct legal catches). The workshop would specifically address the cases of minke whales in the northeastern Atlantic and the western North Pacific to provide advice on mechanisms whereby the number of these removals might be estimated. They believed that such a workshop would enable progress on the consideration of the use of genetic methods to estimate bycatch based on data from market sampling and should be held at the earliest possible opportunity. Delegates from Norway and Japan drew attention to the statement of their Governments appended to Annex N (Appendix 2) and stated that they could not support a recommendation for such a workshop.

Morishita stated that aside from legal issues and the position of Japan, he had a great doubt about the utility of such a workshop. The participation of people with expertise on the Japanese market for whale products is essential if such a workshop is to meet its objectives. Such experts work in industry and are not employed by the Government. In addition, those involved in the marketing of whale products in Japan may have doubts about the competence of the IWC. Japan would not block such a workshop but its participation would be limited. However, he would try to help with identifying relevant contacts and sources of data.

Walløe stated that finding information about the market for whale products was unrealistic without the cooperation of people involved in the industry. In the case of Norway it is illegal to sell meat from bycaught whales and so these products do not enter the market. Norway would not block the workshop but would not bring any information regarding the Norwegian markets.

Noting the difficulties described above, the Committee **agreed** to form an Intersessional Steering Group to: (1) investigate further the feasibility of holding a workshop and, if it is found to be feasible, (2) develop a full proposal following the usual guidelines for Scientific Committee workshops. This will include identifying appropriate experts. The group is Berggren (chair), Cipriano, Donovan, Kasuya, Lento, Perrin, Rojas-Bracho and Taylor.

7.1.3 Other methods

Carcass retrieval schemes have also been employed in some areas to provide information on bycatch. Under such schemes, fishermen may be rewarded for bringing back cetacean carcasses, or parts thereof. Once again, these are likely to provide only minimum estimates of bycatch, but by encouraging fishermen to report bycatches in a verifiable manner, they may provide other information about bycatches, such as seasonality, or the locations of areas or fisheries with high bycatch rates.

It was noted that the Japanese scheme for allowing the sale of bycaught whale meat from the trap net fishery, provided it was registered, was effectively a reward scheme for reporting bycaught animals.

Monitoring the numbers of cetaceans that are landed as bycatch has also been used in the past to derive estimates of bycatch. This method relies on most or all of the cetaceans that have been bycaught ending up in the market. This may not be the case if there is some discarding at sea, or if there is dispersal of cetacean meat informally or outside the market.

By monitoring live whales for evidence of fishing gear or entanglement scars, it is possible to determine the rate of entanglement in a whale population (SC/53/NAH25). The majority of these entanglements were minor and although 1-2% were classed as severe events, it was not possible to determine the mortality rate due to entanglement from these studies.

7.2 Estimation of mortality from ship strikes

The Committee noted that it is likely that most incidents involving fatal collisions between vessels and whales either go unnoticed or unreported. Examination of log books was discussed as a possible source of data. It was noted that although it is unlikely that reliable estimates of collision mortality could be based on data from incidents reported by vessel operators, such data could nevertheless be very valuable in leading to a better understanding of the factors which affect collision risk. Rose offered to investigate whether logbooks from the United States navy might be examined for reports of collisions with whales. Other navies and marine based Governmental organisations could similarly be approached for information on ship strikes.

The Committee considered SC/53/RMP20 which included a review of some available data relevant to the assessment of ship strike mortality. Many of the data in the paper were taken from a recently published review of collisions between whales and ships by Laist *et al.* (2001).

Estimates of mortality based on observed numbers of vessel strikes have rarely been attempted. Where studies have been attempted, the lower bound, as indicated by the number of reported incidents and upper bounds, based on simulation of whale-vessel encounter rates, frequently differ by several orders of magnitude. Although there is evidence that vessels travelling at high speed have a higher risk of collision with whales, the relationship between collision risk, vessel type and speed is not well understood. The relationships between whale size, age, behavioural activity (e.g. travelling or feeding) and risk of collision with vessels are also poorly understood. For some species, it appears that incidences of vessel strikes are higher among juveniles.

There are a number of incidents in which the larger rorqual species have been reported stuck on the bows of large ships. In some areas the number of incidents in which whales become stuck on the bows of ships may allow estimation of total deaths if suitable hydrodynamic modelling studies are conducted to estimate the proportion of fatal collisions that are likely to result in the whale remaining on the bow of the vessel. However, in the majority of areas, data from strandings would appear to offer the best chance of estimating mortality from existing data sources. Careful consideration needs to be given to the assumptions

that are made in order to determine whether vessel strike mortalities are correctly identified and whether strandings are representative of total mortality.

The importance of focusing on areas in which collision rates might be of relevance to the RMP was recognised. However, the assessment of collision rates and estimates of subsequent mortality are new areas of work. Any information which leads to a better understanding of the relationship between risk of collision with vessels and other factors including vessel type, vessel speed and whale behaviour would help improve estimates of mortality. These factors will be of particular importance for sampling designs that rely on some index of vessel activity. It was noted that large vessels tended to follow consistent routes across oceans between major ports but the resolution of data on vessel activity within a particular area would be dependent on the spatial scale chosen for analysis. The use of large-scale acoustic arrays such as the SOSUS system which have been used to monitor whale vocalisations could also be used to monitor levels of shipping activity.

It was suggested that suitable areas with the best data on vessel activity, whale distribution and evidence of collisions could be selected for detailed pilot studies to test methods of estimating vessel strike mortality. These selected areas would allow the best opportunities to test model predictions of collision rates against observed data.

Whales may be more vulnerable to collisions with vessels if they are suffering from disease which may result in them spending more time at the surface or make them less able to respond to an approaching ship. The Committee **recommends** that wherever possible whales struck by vessels should also be examined for symptoms of diseases that might make them more vulnerable to being struck.

The Committee reviewed reports of vessel strikes from the last five years of Progress Reports. It was noted that there were many incidents that did not appear in Progress Reports. Data on the total number of stranded animals, the number for which vessel strikes were attributed as the cause of death and the extent of the examination of these carcasses (no examination, cursory examination, in depth post-mortem flensed to the bone) are necessary for any estimates of ship strike mortality based on strandings data. The Committee again **recommends** that such data be reported in Progress Reports (IWC, 1997a, p.59).

An observer programme to monitor ship strikes by high speed ferries had been attempted in the Canary Islands (SC/53/WW1). At least one collision was known to have occurred when the observer was on board but the observer failed to realise it. This highlighted the difficulties of detecting vessel strikes.

Examination of injuries seen on live whales was also discussed as a source of data that might lead to a better understanding of the types of interaction that occur during a collision.

SC/53/E12 addressed the use of active sonar to enable whales to be detected ahead of vessels. Although such methods are not directly relevant to the estimation of mortality due to vessel strikes, one of the issues discussed in the paper was acoustic propagation. Observations indicate that acoustic propagation conditions might need to be taken into account when stratifying shipping activity in relation to collision risk.

Other ways of collecting data that might be used to estimate vessel strikes were discussed. It was suggested that logging accelerometers placed on high-speed vessels might indicate a sudden deceleration of the vessel due to a collision with a whale. Another possible method put forward was to collect samples of skin for genetic analysis by developing a device that could be attached to vessels that would retain a sample in the event of a collision.

It was noted that the US National Marine Fisheries Service is organising a workshop on ship strikes. The Committee **requests** that the report of this meeting is submitted to its next meeting.

7.3 Other

The Committee discussed other sources of human-induced mortality, which some considered might be important considerations for any implementation of the RMP. These additional sources of human-induced mortality included such things as entanglement in marine debris, mortality resulting from acoustic trauma, mass die-offs due to disease that might be induced through the immuno-supressive action of pollutants, or kills due to oil spills. The Committee recognised that these matters were outside the Working Group's terms of reference as currently drafted. Some members believed that the Committee should ask the Commission to expand terms of reference to allow the Committee to consider methods to estimate mortalities from these additional sources.

Other members considered that the RMP as developed was robust to such human-induced mortalities and that it would be a fruitless task to attempt to quantify these sources of mortality. Furthermore, any massive die-offs would be accounted for in terms of a reduced population size that would be detected in the periodic assessments of abundance that would be undertaken under the RMP. It was also pointed out that the RMP had been designed to be robust to catastrophic events such as mass die-offs.

The Committee **agreed** however, that to the extent that these additional human induced mortalities could reasonably be estimated they should be flagged for future consideration by the Committee.

It was noted that a cetacean strandings scheme was being planned in China. The Committee **agreed** that this could potentially provide some very valuable information on the nature and distribution of ship strikes in Chinese waters and whale bycatches in Chinese fisheries. The Committee **recommends** that the Secretary of the Commission contact the Chinese authorities and request that a report on the proposed scheme, together with details of the methods of necropsy that would be used, is submitted to a future meeting of the Committee.

7.4 Work plan

The Committee discussed the priority items for consideration at the next year's meeting and beyond. The following workplan for SC/54 was **agreed**:

(1) Further review of information and methods to estimate bycatch based on fisheries data and observer programmes.
   (a) Review progress from intersessional group on collating information on fisheries.
(2) Further review of methods to estimate bycatch based on genetic data.
   (a) Review progress from the Intersessional Steering Group to investigate the feasibility of developing the workshop.
   (b) Further development of analytical tests for assignment to stocks and/or areas.
(3) Further review of information and methods to estimate mortality from ship strikes.

(a) Consider inviting participants with special expertise on ship strikes.

(4) Consider methods for estimating additional human-induced mortalities.

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.42-43). 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 December 2000 (SC/53/Rep1). The primary topic for discussion at this year's meeting was the selection of preferred candidate *Strike Limit Algorithms* (*SLA*s) for the Bering-Chukchi-Beaufort (B-C-B) Seas bowhead whales. It is appropriate at this stage to acknowledge the work of all of the developers during recent years. Progress has only been possible because they have shared their ideas, approaches and code - equally important lessons have been learned from approaches that have not succeeded as well as those that have. Whichever procedure is finally chosen will owe a considerable debt to the other developers and members of the SWG, which has worked in a spirit of cooperation and collaboration throughout.

8.1 Review intersessional progress

The intersessional workshop (SC/53/Rep1) continued the work of the SWG as given in table 6 of IWC (2001a, p.19). The main topics discussed were: finalising the *Evaluation, Robustness and Cross-validation trial* structure and specification for bowhead whales and moving towards this for gray whales; finalising performance statistics and determining the most appropriate graphical and tabular presentation of results; general consideration of methods for selecting preferred *SLA*s; and work plan. Discussion of these items is part of the ongoing process and such discussions are referred to throughout this report where appropriate. A large number of computing and other tasks were agreed at the Workshop and excellent progress was made with these by both Allison and the developers.

8.2 Bering-Chukchi-Beaufort Seas bowhead whales

8.2.1 Description of potential procedures for bowhead whales

Potential *Strike Limit Algorithms* developed by four groups of Scientific Committee members were considered. Non-technical descriptions of the procedures written by the developers themselves are given in Annex E. Brief summaries of each of the procedures are given below. All *SLA*s can be 'tuned' to balance the inevitable trade-off between need satisfaction and stock recovery. Authors provided different 'variants' of their *SLA*s with different tunings. Thus, in addition to the author's preferred tuning, these have been categorised in the discussion of results under Item 8.2.4 below as: (H) - high i.e. with relatively greater emphasis on need satisfaction; and (L) - low i.e. with relatively greater emphasis on stock recovery.

8.2.1.1 THE DEREKSDOTTIR-MAGNÚSSON (D-M) *SLA*

The procedure is described in detail in SC/53/AWMP7 and Dereksdottir and Magnússon (2001). It centres on the 'Kalman Filter', a tool widely used in engineering to estimate the state of a stochastic system with noisy observations, i.e. a system with both 'process' noise and observation noise. A simple Pella-Tomlinson population model, without age structure and without a delay in the dynamics, is used to describe the stock dynamics and a linear relationship between observed stock size and true stock size is assumed. The way the Kalman filter works is that the most recent stock estimate is projected forward in time (a prediction) until a new observation is available. The prediction is then compared to the observation and an updated estimate of the state calculated. This updating of the most recent stock estimate is carried out whenever a new observation of the stock size (a survey estimate) is made.

The stock dynamics model and the observation model contain a number of unknown parameters: two (*MSYL* and natural mortality) are fixed and three (*MSYR*; *K*, carrying capacity; and *B*, observation bias) are estimated by Bayesian methods. Each of the three parameters (*MSYR*, *K*, *B*) ranges over a sequence of discrete values that thus gives a three-dimensional grid of parameter values. A prior probability distribution is given to the parameter combinations in the grid and a Kalman filter is associated with each combination.

The probability associated with each parameter combination is updated by Bayesian methods each time a new survey estimate becomes available. The estimate of the state associated with each of the combinations is updated at the same time by the corresponding Kalman filter. This combination of Kalman filtering and Bayesian methodology is known as Adaptive Kalman Filtering (AKF). The overall estimate of the present state (stock size) is then obtained by summing all the stock estimates corresponding to the different parameter combinations, weighted by the respective probabilities.

When a catch control law is specified, a strike limit, conditional on the values of three parameters (*MSYR*, *K*, *B*) and the corresponding stock estimate, can be calculated. Associated with each conditional strike limit is the most recent posterior probability of the particular parameter combination.

The catch control law used in the present version of the AKF-*SLA* is the minimum of pre-specified aboriginal need and the strike limit given by the *H*-rule (IWC, 2000e). Thus, when all the Kalman filters corresponding to each of the parameter combinations have been applied, a sequence of strike limits (same number as the number of parameter combinations) and associated probabilities are available. Arranging all the strike limits in an increasing sequence, the associated probability distribution makes it possible to construct the cumulative probability distribution for the strike limit. Setting a percentile of this distribution gives the eventual strike limit. This percentile is the tuning parameter of the *SLA*; the higher the percentile, the higher the final strike limit. In the basic version of the procedure applied to the B-C-B bowhead stock, the bias factor is taken to be unity (i.e. no bias) in all the filters so that a two-dimensional grid of (*MSYR*, *K*) values is used.

8.2.1.2 GIVENS *SLA* 1 (G-G)

The procedure is described in detail in SC/53/AWMP3. The strike limits are calculated from a linear model fit using a strategy known to provide Bayes rule optimality as described by Givens (1999). The *SLA* places greater weight on

ensuring at least moderate catch in all cases where this is appropriate, rather than trying to obtain a high but unreliable or even risky catch in some cases. It also gives higher priority to need satisfaction in the first 50 years of management than it does for high need in years 75-100.

The strike limit calculation proceeds as follows. Given survey abundance data, the model and estimation procedure of SC/53/AWMP5 are used to estimate five quantities: carrying capacity; next year's yield (truncated) given a current-year catch of 120; current stock size; the default SC/53/AWMP5 strike limit; and a sort of trailing mean estimated stock size. The raw strike limit in years 0-34 is a linear function of the first three of these and the ratio of yield to carrying capacity. From year 35 onwards, the slope with respect to yield is modified. The coefficients of these linear functions are determined to achieve a Bayes rule optimality.

The raw strike limit is bounded above by need and bounded below by 90% of the previous limit. To this raw strike limit, several adjustments are made. If three or more consecutive strike limits each equal 90% of their predecessor, the raw strike limit is averaged with 75% of the default SC/53/AWMP5 (J-B *SLA)* strike limit. The strike limit must not be less than 90% of the previous limit, nor exceed the previous limit by the maximum of 15 whales/year or 15%. If the strike limit would satisfy at least 95% of need, it is raised to 100% of need.

From year 35 onwards, if the trailing mean stock size is less than 6,700, the strike limit is reduced by 30%; if it is less than 6,000 in year 50 or later, the strike limit is reduced by 50%. In any year, if the estimated total stock abundance based on all available past data is less than 2,000, then the strike limit is set to zero.

This results in a *Strike Limit Algorithm* with the following general behaviour: strike limits increase as estimated stock size or yield increases and decrease as carrying capacity increases. For a stock near *MSYL*, the strike limit is essentially a linear function of carrying capacity, replacement yield, current stock size and *MSYR*. The *SLA* can be tuned using several tuning parameters and/or by re-optimisation using alternative Bayesian priors and loss functions. Sensitivity to tuning seems to be low for the former approach and moderate for the latter.

8.2.1.3 GIVENS *SLA* 2 (G-M)

The procedure is described in detail in SC/53/AWMP4. It represents a simple merging of the *SLA*s described in SC/53/AWMP1 (the A-P *SLA* – see below) and SC/53/AWMP5 (the J-B *SLA* – see below). It combines the better short-term performance of the former with the better long-term performance of the latter.

The strike limit calculation depends on the strike limits output from these two *SLA*s, omitting their quota variability dampening and phase-out features. For years 0-20, the raw strike limit is set equal to the corresponding result from the A-P *SLA*. Thereafter, the raw strike limit is set equal to the maximum of the output of the J-B *SLA* and a weighted average of the outputs of the two *SLA*s. This weighting is parameterised by a single tuning parameter. The weighted average equals the A-P *SLA* output when the tuning parameter is 1 and it equals the J-B *SLA* output when the tuning parameter is 0. For tuning values between 0 and 1, the weighting shifts linearly. Two adjustments are made to the raw strike limit. First, the strike limit is not allowed to be less than 90% of the previous limit. Second, when the strike limit would satisfy at least 95% of needed strikes, then the limit is raised to 100% of needed strikes.

The performance of this *SLA* can be adjusted through the choice of the tuning parameter, or by changing the tuning of the two individual *SLA*s. If the tuning parameter is set to zero, this *SLA* essentially uses the A-P *SLA* strike limits for the first 20 years and the J-B *SLA* strike limits thereafter.

This merging approach generally can provide superior need satisfaction - especially over the first 20-years and at the 5th percentile at any time span - while maintaining risk to the stock at a level between the individual *SLA*s.

8.2.1.4 THE JOHNSTON-BUTTERWORTH (J-B) *SLA*

The procedure is described in detail in SC/53/AWMP5. It is based upon the same simple population model as the *CLA* of the RMP. However, a penalised maximum-likelihood method, rather than the Bayes-like approach of the *CLA* is used in fitting the model to the available data. The rationale for this is that although Bayesian estimation is appealing in its presentational simplicity, in practice the development of computer code for its accurate implementation is a lengthy and expensive process. A maximisation instead of an integration process is simple to implement numerically.

A penalty function is added to the log-likelihood for two reasons. First, to stabilise estimates of model parameters and secondly to 'bias' initial model estimates in a manner that reduces the risk of unintended depletion while nevertheless not causing strikes to drop too much below need levels. The *SLA* sets strike limits equal to need unless both the model estimates the population to be below *MSYL* and not to be achieving a specified rate of increase.

The *SLA* incorporates an option to constrain the inter-5-year strike variation levels. The base-case (and both tunings) of the J-B *SLA* use a 15% downwards only inter-5-year strike constraint without restricting increases. This assists in reducing variability in need satisfaction without compromising conservation objectives.

The J-B *SLA* has three tuning parameters.

8.2.1.5 THE PUNT (A-P) *SLA*

The procedure is described in detail in SC/53/AWMP1. It determines the strike limit as the greatest future catch which, if continued over the next 20 years, is consistent with either the population in 20 years exceeding *MSYL* with a pre-specified probability, or the population in 20 years exceeding a target fraction of the current population size with a pre-specified probability. The strike limit for a 5-year block is constrained not to differ by more than 20% from that for the previous 5-year block. The calculation of these probabilities is based on a Bayesian-like estimation approach where a prior is placed on *MSYR* and the only data included in the likelihood function are the estimates of abundance from surveys (assumed to be unbiased). The coefficients of variation assigned to these estimates of abundance are adjusted to give less weight to less recent abundance estimates. The population dynamics model used is that which underlies the *CLA* of the RMP. This *SLA* explicitly includes precaution when setting strike limits by using a prior for *MSYR* which assigns highest probability to values for $MSYR \leq 0.01$. This *SLA* includes the phase-out rule presently included in the RMP.

The A-P *SLA* has eight tuning parameters. These parameters determine the relative prior probability for $MSYR \leq 0.01$, *MSYL*, the extent to which historical survey estimates are downweighted, the target value for the ratio of the population size in 20 years to that at present, the probability of being above *MSYL* in 20 years, the probability that the population size in 20 years relative to that at present exceeds the target value and the extent by which strike limits

for a future block may differ from that for the previous block. The values for these parameters are selected to achieve a desired balance between need satisfaction, risk avoidance and stability of strike limits.

The design criteria for this *SLA* include being as generic as possible (so that the *SLA* can be tailored straightforwardly to additional aboriginal whaling operations), to be as similar to the *CLA* of the RMP as possible (to avoid the introduction of a completely new algorithm for managing whale populations), to include Bayesian features (so that greater uncertainty implies lower strike limits) and to be consistent with the spirit of paragraph 13(a) of the Schedule. The current version of the A-P *SLA* is reasonably generic and is based roughly on paragraph 13(a). In principle, the only modification needed to apply it to an additional aboriginal whaling operation would be to select the values for the eight control parameters to achieve the desired risk-need satisfaction balance. In contrast, the *SLA* does not include a formal Bayesian estimation framework (although it does include a Bayesian-like framework that achieves essentially the same outcome) and the only features of the *CLA* of the RMP included in this *SLA* are its population dynamics model and phase-out rule.

8.2.2 Principles of selection of SLAs

The IWC's objectives for aboriginal whaling management given by the Commission are:

(1) ensure that the risks of extinction to individual stocks are not seriously increased by subsistence whaling;
(2) enable aboriginal people to harvest whales in perpetuity at levels appropriate to their cultural and nutritional requirements, subject to the other objectives; and
(3) maintain the status of stocks at or above the level giving the highest net recruitment and ensure that stocks below that level are moved towards it, so far as the environment permits.

The first objective has been accorded highest priority by the Commission.

Consideration of the results of the *Evaluation trials* (Table 3) will play the primary role in the selection of preferred *SLA*(s). The purpose of the *Robustness* and *Cross-validation trials* (Tables 4 and 5) is respectively to examine *SLA* performance for the full range of plausible scenarios and to examine performance for scenarios not available to the developers.

Equivalence tuning is a way to provide *SLA* developers with the opportunity to adjust their *SLA*s to strive towards a pre-specified balance of risk, satisfaction of need and recovery. However, at the present meeting, the merits of this approach were reconsidered. It was noted that performance differs markedly across trials and performance statistics, even when equivalence tuning is achieved. Given this, it was agreed that it was sufficient to group the 13 variants into the three categories (high, low, author-preferred) discussed at the beginning of Item 8.2 based on a rough evaluation of the emphasis each *SLA* placed on risk avoidance.

In the context of Commission objective (2), the Committee has placed emphasis on consultation with hunters via the Commission. Additional comments from the Alaska Eskimo Whaling Commission (AEWC) were provided in SC/53/AWMP3. Issues covered have included: the importance of catch stability; a preference for need satisfaction in the shorter term versus satisfaction of a hypothetical projected need[2] in the longer term; the

[2] Especially at the upper end of the need 'envelope'. The need envelope sets bounds on the situations that an *SLA* has to be able to cope with in the AWMP simulations.

Table 3

The *Evaluation trials* for the Bering-Chukchi-Beaufort Seas stock of bowhead whales.

Trial No.	Description	Model	$MSYR_{1+}$	$MSYL_{1+}$	Final need	Historical survey bias	Future survey bias	Survey CV (true, est)	Age data	Other
BE01*	Base case	D, S_E	2.5%	0.6	134	1	1	0.25, 0.25	Good	
BE02	Constant need	D	2.5%	0.6	**67**	1	1	0.25, 0.25	Good	
BE03	Future +ve bias	D, S_E	2.5%	0.6	134	1	**1→1.5 in yr 25**	0.25, 0.25	Good	
BE04	Future –ve bias	D	2.5%	0.6	134	1	**1→0.67 in yr 25**	0.25, 0.25	Good	
BE05	Underestimated *CV*s	D	2.5%	0.6	134	1	1	**0.25, 0.10**	Good	
~~BE06~~	Deleted SC2000									
BE07*	$MSYL_{1+} = 0.8$	D, S_E	2.5%	**0.8**	134	1	1	0.25, 0.25	Good	
BE08	10 yr surveys	D	2.5%	0.6	134	1	1	0.25, 0.25	Good	10yr surveys
BE09*	$MSYR_{1+} = 1\%$	D, S_E	**1%**	0.6	134	**0.67 → 1**	1	0.25, 0.25	Good	
BE10*	$MSYR_{1+} = 4\%$	D	**4%**	**0.8**	134	1	1	0.25, 0.25	Good	
BE11	Bad data	D	2.5%	0.6	134	1	**1→1.5 in yr 25**	**0.25, 0.10**	Poor	
BE12*	Difficult 1%	D, S_E	**1%**	0.6	134	**1 → 1.5**	**1.5**	**0.25, 0.10**	Poor	
BE13	Difficult 1%; constant need	D	**1%**	0.6	**67**	**1 → 1.5**	**1.5**	**0.25, 0.10**	Poor	
BE14	Need increases to 201	D	2.5%	0.6	**201**	1	1	0.25, 0.25	Good	
~~BE15~~	~~Future +ve bias; 201 need~~	~~D~~	~~2.5%~~	~~0.6~~	~~**201**~~	~~1~~	~~**1→1.5 in yr 25**~~	~~0.25, 0.25~~	~~Good~~	
BE16	$MSYR_{1+} = 1\%$; 201 need	D, S_E	**1%**	0.6	**201**	**0.67 → 1**	1	0.25, 0.25	Good	
~~BE17~~	Demoted to BR04 SC2000									
~~BE18~~	Demoted to BR04 SC2000									
~~BE19~~	Demoted to BR04 SC2000									
BE20*	$MSYR_{1+} = 4\%$; 201 need	D	**4%**	**0.8**	**201**	1	1	0.25, 0.25	Good	
BE21*	Integrated	D	**U[1,4%]**	**U[.4-.8]**	134	1	1	0.25, 0.25	Good	
BE22*	Time lag in density dependence	D, S_E	2.5%	0.6	134	1	1	0.25, 0.25	Good	20yr lag
BE23	Strategic surveys; 201 need	D	2.5%	0.6	**201**	1	1	0.25, 0.25	Good	Strategic surveys
BE24*	Inertia Model (A_i/A=0.5)	D	**Selected from 0.1 – 2%**§	0.6	134	1	1	0.25, 0.25	Good	Inertia model

* Requires conditioning. § $MSYR_{1+}$ here refers to MSYR in the absence of inertia dynamics.

Table 4

The *Robustness Trials*. The trials indicated with asterisks were deleted during the meeting.

Trial	Factor	Basic trials (see table 2)	Factor Level
BR01	A: Density-dependence	1, 1^S, 9, 9^S,10*	Density-dependence on mature (BE trials use 1+)
BR02	B: Stochastic dynamics	2^S*, 8^S, 13^S	Stochastic dynamics (with serially-correlated environmental variation)
~~BR03~~	~~D: Form of need time dependence~~	~~1, 9, 9^S, 10~~	~~Step function in year 2053~~
BR04	E: Survey frequency	9, 13, 14, 16, 20	15 yrs
		16, 20	10 yrs
BR05	F: Strategic surveys	1*, 9	Yes + CV = (0.25, 0.25)
		1*, 9	Yes + CV = (0.34, 0.25)
BR06	G: Survey bias time dependence	1	Historic bias: 1.5 constant; Future bias: decreasing (1.5→1)
		1	Historic bias: 0.67 constant; Future bias: increasing (0.67→1)
		9, 9^S	Future bias: sinusoidal from base value in yr 0 to maximum of 150% in yr 40
		12, 12^S	Future bias: decreases (1.5→1)
		14	Future bias: increases from 1→1.5 in yr25 and constant thereafter (formerly BE15)
BR07	H: Future survey *CV*	1	CV = (0.1, 0.1)
		1*, 1^S	CV = (0.34, 0.25)
		9	(0.1, 0.1) + sinusoidal survey bias (factor G)
BR08	I: Historic catch bias	14, 16*, 16^S,20*	0.5
		14, 16, 16^S	1.5
BR09	K: Time dependence in *K*	1, 2*, 9, 10	*K* halves linearly over 100 years
		1, 2*, 9, 10	*K* doubles linearly over 100 years
		1	*K* varies sinusoidally from base value in year 0 to maximum of 150% in year 40
		1, 21	Tent *K: K* doubles linearly between years -50 to 0 and halves between years 0 to 50
		1, 9	*K* halves linearly over 100 years + strategic surveys
BR10	L: Time dependence in *MSYR*	10	*MSYR* halves linearly over 100yr,
		9	*MSYR* doubles linearly over 100yr
		1, 2*, 8	Step *MSYR* 2½%→1%→2½% every 33 yrs (alone)
		1, 2*, 8	Step *MSYR* 2½%→1%→2½% every 33 yrs in sync with *M* (compute *MSYR* first) – if it is practical (halve *M* for each age class)
		1	*K* and *MSYR* halve linearly over 100 years
		1, 21	*K* and *MSYR* vary as tent *K* (see BR09)
BR11	M: Time dependence in *M*	1, 2*, 9, 10	*M* halves linearly over 100 years
		1, 2*, 9, 10	*M* doubles linearly over 100 years
BR12	N: Episodic events	1, 1^S, 2*, 9, 9^S, 10*, 10^S*	2 events in which 20% of animals die occur between years 1-50
BR13	O: Integrated.	1, 11, 14	$MSYR_{1+}$~U[0.01, 0.04]; fixed $MSYL_{1+}$=0.6
		11, 14	$MSYR_{1+}$~U[0.01, 0.04]; $MSYL_{1+}$~U[0.4, 0.8]
		1, 1^S, 2*, 11, 11^S, 14	$MSYR_{1+}$~U[0.01, 0.04]; $MSYL_{1+}$~U[0.4, 0.8]; historical catch bias ~U[0.5, 1.5]; Serial correlation ~ U[0.47, 0.95]
		1^S, 11^S	$MSYR_{1+}$~U[0.01, 0.04]; $MSYL_{1+}$~U[0.4, 0.8]; historical catch bias ~U[0.5, 1.5]; Serial correlation ~ U[0.47, 0.95]; time delay in density dependence ~U[0, 30]
BR14	P: Initial year of population projection	1, 9, 10*	1940 (reference or base case level is 1848)
BR15	Q: $MSYL_{1+}$=*0.9*	1, 9, 10	
BR16	R: Different stochastic parameters	1^S	Correlation in recruitment ρ = *-0.75*
		1^S	Correlation in recruitment ρ = *0.9*
		1^S, 9^S, 10^S	Correlation in recruitment ρ = *0.9;* + episodic events
		1^S	Change σ_ε^2 to give 3* variation in population size at equilibrium
		1^S, 9^S	Serial correlation = *0.9* + change σ_ε^2 to give 3*equilibrium variation + episodic events
BR17	S: Time lag in density dependence	9*	20 year time lag

Table 5

Factors and ranges for constructing the *Cross-validation* trials.

Factor	Range
$MSYR_{1+}$	1 – 4%
$MSYL_{1+}$	0.4 – 0.8
Final need	67 – 201
Survey bias in future year 25	0.67 – 1.5
Estimated survey CV	0.1 – 0.4*
Time-lag	0 – 20

* Modified from 0.25 agreed at the last meeting.

importance of obtaining the best performance even if this resulted in complex *SLA*s; and the need to place performance over speed of adoption.

After considerable discussion, it was agreed not to assign formal weights to each of the *Evaluation trials* although it acknowledged that individuals would assign their own weights to each trial during the selection process. However, it agreed that general relative weighting could be based on a number of factors, including the biological plausibility of the trials, the realism of the need trajectory and the ability of the trial to distinguish *SLA* performance. Based on the comments by the AEWC and earlier comments by the Commission, the SWG agreed that the trials with final need levels of 201 should generally be assigned a lower weight than those with final need levels of 67 and 134 - especially with respect to need satisfaction - and that if two *SLA*s perform similarly, satisfaction of need for the first 20 years of the 100-year projection period should be given emphasis. In previous discussions it had been noted that, performance being equal, a substantially simpler *SLA* might be preferred if, for example it greatly reduced future computational requirements and eased the process of validating the computer code for the preferred *SLA*. It was agreed however, that all candidates identified in Item 8.2.1 may be

sufficiently complex as to render complexity differences between them irrelevant, at least with respect to explaining them to the Commission.

It was noted that a more formal weighting of trials may be necessary once the number of candidate *SLA*s is reduced. If the number of trials on which performance differs is small, the number of trials that would need to be weighted would be reduced from the current 26.

8.2.3 Review of results of the bowhead trials

Considerable time has been spent discussing the graphical and tabular presentation of results (e.g. see SC/53/Rep1). The full suite of tables and graphs is available in a Master Summary available from the Secretariat. Full details of the seven graphical summaries and two tabular formats are given in Annex E. Tabular summaries included lists of the values of the performance statistics (5^{th}, 50^{th} and 95^{th} percentiles) for each *SLA*. In discussion it was also agreed to compare the performances of the 13 *SLA*s with that of the (hypothetical) *Strike Limit Algorithm* that involves always setting the *strike limit* equal to need.

The process of selecting preferred candidate *SLA*(s) would be divided into two stages. The first stage involved an initial examination of the results of the *Evaluation trials* (Table 3) to eliminate unsuitable candidates.

8.2.3.1 INITIAL CONSIDERATION OF PREFERRED CANDIDATE(S)

It was agreed that the task of summarising the performance statistics and hence selecting preferred *SLA*(s) was considerably simplified if the number of candidates could be reduced from 13. Nine variants were eliminated from further consideration for the following reasons.

A-P(L) and J-B(L): Poor performance in terms of satisfying need over the first twenty years of the 100-year management period for trials (such as BE01) in which need can be fully satisfied.

D-M(H): This *SLA* drives the resource to low levels in some trials (e.g. BE12) and its performance is, in any case, not very different from those for D-M(L) and D-M for most trials.

A-P(H) and J-B(H): Very poor performance in terms of resource conservation for trial BE12. The time-trajectories of population size for these *SLA*s drop monotonically over the 100-year period for this very difficult trial.

G-M and G-M(H): Performance of these *SLA*s tends to be worse than that for the G-G and G-G(H) *SLA*s on several performance statistics for several trials.

A-P and J-B: These *SLA*s are far more variable than the two D-M and two G-G *SLA*s.

In addition it was noted that while the 'catch = need' *Strike Limit Algorithm* performs perfectly (as expected) for many of the 'easy' trials it leaves the resource at unacceptably low levels for *Evaluation trials* in which $MSYR_{1+} = 0.01$ (for example, trials BE09, BE12 and BE16) and in many of the *Robustness Trials*.

It was therefore **agreed** to proceed by considering only the following variants: D-M, D-M(L), G-G, G-G(H). In making this decision reference was made to the invaluable contributions made to the overall process by all developers.

8.2.3.2 COMPARISON OF *SLA*S USING THE EVALUATION TRIALS

The performance statistics for the D-M, D-M(L), G-G and G-G(H) *SLA*s were compared for each of the 26 *Evaluation trials*. The aim of this comparison was to identify differences and similarities in the performance for these four *SLA*s. The intention was not to produce a mechanical scoring system from which automatically to choose the *SLA* with most points. Any ultimate decision would be made via a composite view of all of the factors discussed in Item 8.2.2 above. During the examination of the *Evaluation trials*, the basis and method of comparing performance evolved and expanded. It also recognised that the various statistics all provided insight into the performance of the *SLA*s and that in any one trial it was possible for individual statistics to imply different relative performance inferences.

The SWG noted that performance on the lower 5^{th} percentile statistics reflected the 'guaranteed' performance of an *SLA* while performance on the median statistics reflected its 'expected' performance. Final evaluation requires human integration over a number of factors including the assignation of relative weights to performance in terms of 'guaranteed' versus 'expected' performance, overall plausibility of trials and the magnitude of any observed differences. Given these provisos, the SWG examined each of the trials and attempted to identify the 'best' *SLA*s for each trial as detailed in Annex E, item 5.3. They are not included here in the light of the conclusion reached under Item 8.2.3.5.

8.2.3.3 GENERAL FEATURES OF THE D-M AND G-G *SLA*S

Examination of the results of the *Evaluation trials* and the technical specifications of the *SLA*s led to some preliminary observations regarding the four *SLA*s.

The G-G and G-G(H) *SLA*s perform better at satisfying need over the first 20 years of the 100-year period than the D-M and D-M(L) *SLA*s although the difference in performance is often insubstantial (the largest difference is 5% but most differences are less than 1%) and some of these differences may be due to the 'snap-to-need' feature that forms part of the G-G and G-G(H) *SLA*s. Over the entire set of *Evaluation Trials*, 95% of the strike limits set by the G-G and G-G(H) *SLA*s were between 67 and 129; 95% were between 67 and 132 for the D-M and D-M(L) *SLA*s.

Upon inspection of the time trajectories of strike limits for *Evaluation Trials*, there were instances where each *SLA* provided strike limits that became more variable as time progressed, even though both procedures generally satisfied need well in the first 20 years.

It was noted that both the G-G and D-M *SLA*s employed a protection level below which harvest could be limited. In both cases, the estimated stock size based on all available data must be above 2,000 to avoid a zero strike limit. It was noted that these protection levels had never been invoked by either *SLA* in any of the bowhead *Evaluation trials* and that the location and severity of such protection levels could be easily adjusted or removed with no effect on *Evaluation Trial* results and probably limited effect on *Robustness Trials*. It was also noted that such a protection level was broadly consistent with the current management scheme expressed in sub-Paragraph 13(a) of the Schedule: there is some minimum population level below which catches should not be taken.

The preliminary calculations of advisable catch used by the G-G *SLA* are a piecewise linear function of time and the final strike limits are subject to two intermediate protection levels that are invoked only after 35 years of management. Many members believed that the performance gains produced by this strategy were not sufficient to warrant reliance on an *SLA* that produced strike limits that were not guaranteed to be a continuous function of time. Small changes in the abundance data could have disproportionately large impacts on strike limits. It was noted that the SWG had previously agreed to place no limitations on the use of the

time variable in *SLA*s. However, some uses of time-dependence are less desirable than others. This aspect of the G-G *SLA* is one that might be improved with future work.

It was noted that both *SLA*s included design aspects that the SWG believed could be improved with further opportunity for development, but it was unclear whether these changes would result in substantial improvements in performance.

In order to observe how the *SLAs* react to a sharp decline in abundance, the SWG agreed that an exploratory trial should be conducted in which the population size drops to 2,000 in the first year of the projection period. This is not because the SWG believes that such a scenario is even remotely plausible (and thus it is neither an *Evaluation* nor a *Robustness Trial*) but it will provide information that can be used to assess the relative speed at which the *SLA*s react to large changes in population size. However, the SWG noted that such a trial would be difficult to interpret since there are both positive and negative aspects of reacting quickly to such a change. The SWG believed that large changes in population size approaching this magnitude would lead to an *Implementation Review*; the *SLA* would not be applied blindly for 100 years even though the survey estimates dropped markedly.

With respect to *Performance Tuning* (and options that might be put forward to the Commission), developers noted that their *SLA*s were easily *performance tuned* and in both cases tunings to increase risk avoidance were easier to achieve than tuning to increase need satisfaction.

8.2.3.4 COMPARISON OF SLAS USING THE *ROBUSTNESS* AND *CROSS-VALIDATION TRIALS*

The purpose of the *Robustness Trials* (Table 4) is to examine whether a preferred *SLA* performs as expected when it is used to manage scenarios that are plausible but (occasionally much) less likely than those that underlie the *Evaluation trials.* They may also be used as one method of selecting between two *SLA*s that are 'tied' after examination of performance on the *Evaluation trials*.

The performance of the four variants on the *Robustness Trials* was examined and all performed well. The BR12-9^S and BR06-12^S trials were most notable in terms of distinguishing among the *SLA*s. The G-G and G-G(H) *SLAs* achieve better risk avoidance than the D-M and D-M(L) *SLA*s for these trials. The SWG did not have the full set of results for trials BR16E-9^S (large and temporally correlated environmental variability) and BR-11a (reductions in natural mortality). The results for the modified versions of these trials should be examined at the proposed intersessional workshop (see Item 8.2.4.5).

The SWG reviewed the current *Robustness Trials* and agreed to modify them as follows:

(1) Delete trials BR01-10 and BR08a-20 as they lead to unrealistic time-trajectories of population size.
(2) Delete all *Robustness Trials* based on a constant need of 67 and $MSYR_{1+} = 2.5\%$ as these trials are not informative.
(3) Delete trials BR05a-1, BR05b-1, BR12-10, BR12-10^S, BR14-10 and BR17-9 as these trials are not informative.
(4) Delete trials BR07b-1 and BR08a-16 as their stochastic variants are more challenging.
(5) Recondition trial BR06b-1 in the hope of eliminating several highly atypical trajectories produced by the currently conditioned parameter sets.
(6) Improve the interpretability of the plots that show time-trajectories of population size for all *Robustness Trials* in which carrying capacity changes with time. The plots would be clearer if there was a dotted line showing the pointwise median time-trajectory of population size under zero catch for comparison with the simulated trajectories.
(7) Reduce the extent to which natural mortality increases over time for the BR11a trials so that the population can avoid extinction under zero catch.

Cross-validation Trials (Table 5) are case-specific trials to be held aside from *SLA* development so that resulting *SLAs* can be subjected to a subsequent independent test. Cross validation is an informal check for whether the selected *SLA*s perform roughly as expected. The *Cross-validation Trials* conducted intersessionally examine whether unpredictable behaviour occurs within the interior of a tested region of parameter space due to over-fitting.

No evidence for over-fitting is evident from the results of the five *Cross-validation Trials*, which are interpolative, nor from the *Robustness Trials* which examine behaviour for scenarios beyond the *Evaluation trials*. The SWG agreed to increase the number of *Cross-validation Trials* from five to ten to better sample the distributions for the model parameters considered in the *Cross-validation Trials*. It also agreed to increase the range for the estimated survey *CV* from 0.1-0.25 to 0.1-0.4 so that the value that forms the central value for the *Evaluation trials* is also the central value for the *Cross-validation* trials.

8.2.3.5 SELECTION OF PREFERRED *SLA*(S)

An enormous quantity of tabular and graphical material had to be considered at this meeting as part of the evaluation and selection process. It was clear from this that there were two excellent procedures available (four variants) which exhibited very similar performance. Given the similarity, selection of a single procedure from the vast array of results is not a trivial task, even if more time was available. In addition, the SWG had identified a number of issues that it wished to consider in more detail, in terms of further plots for some of the *Robustness Trials*, modifications to certain *Robustness Trials*, additional *Cross-validation Trials* and further work on certain issues concerning each of the procedures (see Item 8.2.3.4). The Committee **agreed** that given the importance of the decision, the complexity of integrating the performance results before it and the additional work identified, it preferred to postpone a final decision.

In the 'ideal' work plan given in SC/53/Rep1, the SWG had stated that it would 'examine trial results and determine 'preferred' candidate(s)'. Given the importance of the decision, the Committee **agreed** that it would still be able to meet its 'ideal' timetable if it did not choose a single candidate for presentation at the present meeting. It therefore **recommends** that the work identified in Item 8.8 be undertaken and that the results be examined at an intersessional workshop (estimated cost £12,000 as last year). The Committee **agreed** that this would enable it to make a recommendation for an *SLA* for the Bering-Chukchi-Beaufort Seas stock of bowhead whales to the Committee at the 2002 Annual Meeting.

8.3 Eastern North Pacific gray whales

There was insufficient time to consider the further development of gray whale trials at this meeting and no new *SLA*s for this fishery were presented. SC/53/AWMP6, in an

application to gray whales, further elucidated the features of the inertial dynamics model whose development was encouraged by the SWG in recent years. Although the SWG did not have time to review this document, it was discussed in some detail in Annex F. It was **agreed** to informally consider aspects of gray whale trial development after the close of the SWG meeting and *via* the intersessional working group.

8.4 Progress on development of potential *SLAs* for Greenlandic fisheries and the Greenland Research Programme

As noted in previous years, little progress is envisioned in this regard until results from the Greenland Research Programme become available. The Greenland Research Programme (e.g. see SC/53/Rep1) was considered in the context of possible data needs for a management procedure for Greenlandic whaling. It builds upon previous discussions (e.g. IWC, 2001r). It was **agreed** to focus on West Greenland, since catches off East Greenland are few. The currently exploited species are fin and minke whales. Catches of minke whales are now mainly inshore within the West Greenland archipelago.

8.4.1 Stock structure, range, movement

As is well documented, a major problem is the lack of information on the identity and range of the stocks from which the catches are taken (see IWC, 2001r). Witting *et al.* (2000) and SC/53/O2 reported on feasibility studies of biopsy sampling of minke whales in this area. Despite certain problems with the design and execution of these feasibility studies (e.g. see IWC, 2001g and SC/53/Rep1), the SWG concluded that it is unlikely to be possible to biopsy sufficient animals for the stock structure studies proposed last year.

SC/53/O2 reported on a fin whale that was satellite-tagged on 30 September 2000 in coastal West Greenland (68°42'N 52°50'W). The tracking data shows a clear connection between inshore and offshore fin whales in West Greenland and it indicates that the potential area of distribution of fin whales to be included in an abundance survey for West Greenland is larger than what has been covered in previous surveys.

The Committee noted that although satellite tagging was no easier, the technique is more promising because useful information about movements of animals in the hunted stock can be obtained from a smaller sample size than that required for a biopsy programme.

8.4.2 Abundance and trends

Inshore surveys within the archipelago are relatively feasible due to the more favourable weather conditions. Witting indicated that an annual shipborne survey of the inshore area might more readily get support, given that the survey could record other wildlife in addition to cetaceans. The surveys could sample an area in which approximately 80% of the catches occur and could thus provide an index of abundance directly related to the stock components being exploited. Since a relative abundance series first becomes useful after about 10 annual data points have been collected, it is a long-term project that should preferably be conducted within the means available within Greenland for research.

The usual data collection protocols for shipborne line transect surveys, including dual platforms, could be followed. Survey designs within the archipelago will be constrained by navigational conditions, so it is not certain that sighting rates could be expanded to abundance estimates. In any case, such a study area presumably represents only a small part of the summer range of the stocks. A fixed-track design, repeating the same track each year, would be the best approach for producing an abundance index. The surveys should be conducted in late summer in the period of maximum minke whale abundance. One would also expect greater inter-annual consistency at this time, given that the time of the arrival of whales early in summer can vary considerably.

It was recognised that an abundance index alone would probably not provide a sufficient basis for a management procedure and would need to be supplemented with surveys covering a larger area for which absolute abundance should be estimated. A large-scale survey at *ca* 10 to 15 year intervals may be realistic, but would require external funding. The logistics of offshore surveys are less favourable than inshore surveys, with much time lost to poor weather.

Satellite tracking data, even of a limited number of individuals, is important for determining the summer range of whales from the hunted stock and hence the area that should be surveyed. Satellite tagging could be conducted from survey vessels, but would require dedicated time during which ordinary survey mode is suspended.

8.4.3 Preliminary consideration of management procedures

Work done during the development of the RMP indicated: (1) absolute abundance surveys conducted at 10-year intervals were nearly as useful as 5-yearly surveys; (2) annual indices of relative abundance can provide a valuable supplement to the absolute abundance estimates, provided the indices are reasonably valid, albeit not linearly proportional to abundance.

The Committee agreed that preliminary trials of simple management procedures using an annual inshore abundance index coupled with 10-yearly surveys should be conducted before the next Annual Meeting. These must cover cases where there is inter-annual variability in the index. The results of these would help determine the utility of proceeding with the annual series of inshore surveys starting in late summer 2002. One potential problem with a relative abundance index is that it could decline for reasons possibly unrelated to exploitation. In such circumstances, it might be necessary to bring forward the next absolute abundance survey of the larger area.

Sightings of fin whales in the annual inshore surveys would be few in number, such that it might not be possible to obtain a useful index for this species. Given the poor prospects for obtaining substantial information on this species in the area, due to its low numbers and other factors, it might be appropriate, at some future time, to consider management approaches in which the specified need (640 tonnes of meat annually) is met without any hunting of fin whales.

8.4.4 Biological data

Greenland intends to collect tissue samples from as many caught animals as possible. These should be analysed on an ongoing basis and compared with samples from other countries (e.g. Iceland, Canada, Norway, USA), with a view to determining possible relationships of West Greenland minke whales to those in other areas based on haplotype frequencies. It may be possible to have this work undertaken at no cost to Greenland or the IWC, by geneticists who have a scientific interest in the material.

8.4.5 Recommendations

8.4.5.1 ANNUAL INSHORE SURVEYS

Planning should proceed for an annual series of inshore surveys starting in late summer 2002, with a view to producing a relative abundance index, preferably within the research resources available within Greenland. Survey design should take account of the available information on the distribution of the target species. Detailed survey plans and methodology should be developed during the intersessional period and presented to the AWMP group for review. Funding for such surveys should be considered the responsibility of the Greenland Home Rule Government.

8.4.5.2 EXPLORATORY SIMULATION STUDIES

Preliminary simulation studies of management procedures utilising a combination of an annual relative index and infrequent absolute abundance estimates should be conducted. Witting, Magnússon, Dereksdottír and Cooke agreed to cooperate on this issue and present results to the 2002 Annual Meeting. It was **agreed** that this would be a suitable case for funding from the AWMP Developers' Fund (see Item 8.8). Results from this preliminary work may or may not indicate modification of the plans for the inshore index surveys.

8.4.5.3 SATELLITE TAGGING

An annual programme of satellite tagging in conjunction with the inshore surveys should be started in 2002, with the aim of gradually building up records of animal movements, based on a target of four informative tracks per year. IWC funding should be provided to cover the tags themselves, equipment, personnel and some ship time from the surveys for the tagging. It was **agreed** that the remaining £36,000 from the funds allocated to the Greenland Research programme last year should be spent on this work, over the next two years as follow.

Summer 2002 - personnel £4,000; travel £1,000; 4 tags £8,000; 5 days ship time £5,000 (Total £18,000).

Summer 2003 - personnel £4,000; travel £1,000; 4 tags £8,000; 5 days ship time £5,000 (Total £18,000).

The Committee agreed that it may be appropriate to make all the tags available in the first year to allow a degree of flexibility in the number of tags that may be implanted per year.

8.4.5.4 PLANNING FOR A LARGE-SCALE SURVEY

Based on the results of the first few years of satellite tagging, which are used to determine the area to be surveyed, plans should be drawn up for a large-scale survey to be held in about five years time. The intention is that subsequent surveys would be conducted at infrequent (10-15 year) intervals, with the area to be covered to be based on the state of knowledge on stock range at the time.

8.5 Progress on consideration of fishery Type 3

A Type 3 fishery is characterised by a small total population size (on the order of 300 animals) where demographic and environmental stochasticity may have potentially critical effects on the survival of the stock and aboriginal harvest of even a few whales would be a matter for careful scrutiny (and see Item 9 below).

The SWG regretted that it did not have time to consider the interesting and important work described in SC/53/AWMP2 submitted for consideration under this item. The Committee noted that the SWG will consider this in detail at a future meeting for the management of a Type 3 fishery.

8.6 Scientific aspects of an Aboriginal Subsistence Whaling Scheme

The Committee **agreed** that it was premature to consider the appropriateness of developing detailed specifications for the AWMP at the level that now exists for the RMP (1999d) and its associated guidelines with respect to surveys and data.

However, there are a number of issues the Committee wished to draw to the Commission's attention.

8.6.1 'Rules'

8.6.1.1 CARRY-OVER

Last year, the Committee presented the Commission with an example of a carry-over scheme and five-year blocks:

For the purposes of illustration only, it is assumed that the block is five years, that the total strike limit over the five-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.

In response the Commission agreed:

> that blocks of five years with an inter-annual variation of fifty per cent were satisfactory in terms of allowing for the likely variability in hunting conditions. It therefore agreed that these values are appropriate for use in trials. It was recognised that this does not commit the Commission to these values in any final aboriginal whaling management procedure.

In order to allow the Commission to consider this further, the Committee noted that if under a recommended *SLA*, current need is met (and there is no indication from the present results that this will not be the case), then a revised Schedule paragraph might look something like that below:

> For the years **[2003-2007**] inclusive, the total number of strikes shall not exceed [**335].** The *Strike Limit* in any one year shall not exceed [**100**].

8.6.1.2 PHASE-OUT (AND SURVEY INTERVAL)

Weather and ice conditions often prevent the completion of a successful bowhead abundance survey even when all best efforts are made. Since 1988, three successful censuses have been made (1988, 1993 and 2001) in six attempts.

Phase-out is the process by which annual strike limits should be gradually decreased to zero in the absence of a new abundance estimate. The Committee **recommends** that phase-out should begin in the 10^{th} year after the year of the most recent abundance estimate. Since it might require several attempts to obtain a successful abundance estimate, this might mean that an attempt to undertake a census might begin after about seven years from the most recent success. This will probably result in a survey interval of about 7-10 years in practice. Attention is drawn to the fact that the risk

and need satisfaction performance of the G-G and D-M *SLA*s was not diminished in *Evaluation trials* when surveys occurred at 10-year rather than five-year intervals.

The appropriate length and abruptness of the phase-out itself was also discussed. One phase-out method might be to reduce the strike limit by 20% for each year starting in the 10th year after the most recent abundance estimate. This would be in line with the rule in the RMP. However, in the limited time available for discussion, it was noted that there are several other potentially useful approaches to phase-out that require further consideration. The Committee noted that the SWG would consider this issue further during the coming year.

Finally, the issue of the quantity to which any phase-out rule would be applied was considered. *SLAs* generally estimate a maximal allowable catch, which is then reduced to the need level if it exceeds need. If the phase-out rule was applied to the maximal allowable catch before comparison with the need level, this could eliminate the gradualness of the phase-out and delay its invocation. If instead the phase-out rule was applied to the strike limit after it was bounded by the need level, this could provide an inducement for the hunters to seek increases in the need level to soften the potential effects of phase-out.

The Committee requested that the Commission review its progress on survey interval and phase-out to confirm that the introduction of phase-out in the 10th year after the most recent abundance estimate would be an approach compatible with its management goals. Furthermore, the Commission is asked to indicate if it wishes to impose any constraints on: (1) the type of phase-out rule employed; (2) the maximum length of time it would take for phase-out to reach zero strikes; and (3) the quantity to which phase-out should be applied.

8.6.2 Guidelines for surveys

Three issues were considered in relation to abundance estimates for use in an *SLA.* The Committee **agreed** to the following principles given below.

8.6.2.1 SURVEY/CENSUS METHODOLOGY AND DESIGN

Plans for undertaking a survey/census should be submitted to the Scientific Committee in advance of their being carried out, although prior approval by the Committee is not a requirement. This should normally be at the Annual Meeting before the survey/census is being carried out. Sufficient detail should be provided to allow the Committee to review the field and estimation methodology. Considerably more detail would be expected if novel methods are planned.

8.6.2.2 COMMITTEE OVERSIGHT

Should it desire, the Scientific Committee may nominate one of its members to observe the survey/census to ensure that proposed methods are adequately followed. This will be more important if novel methods are being used.

8.6.2.3 DATA ANALYSIS

All data to be used in the estimation of abundance should be made available to the Scientific Committee suitably in advance of the Annual Meeting at which an estimate was to be presented. If new estimation methods are used, the Committee may require that computer programs (including documentation to allow such programs to be validated) shall be provided to the Secretariat for eventual validation by them.

8.6.3 Guidelines for data/sample collection

The Committee **agreed** that data from each harvested animal should be collected and made available to the IWC. The following information should normally be provided for each whale: species, sex, date struck, position of catch (to the nearest village), length of catch (to 0.1m). It further requested that information/samples on reproductive status and samples for genetic studies be collected where possible.

8.7 Presentation to the Commission

The Committee reiterated the importance it attached to continuing dialogue with the Commission and hunters throughout the development process. It referred to Item 8.6 above 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.

8.8 Work plan (Table 6)

A small working group continued to meet after the close of the SWG's business to: (1) develop the detailed work plan related to the work necessary to be completed on the D-M and G-G *SLA*s including deadlines for both developers and for computing tasks; (2) to determine the timing, costs and venue of an intersessional workshop; and (3) to refine the work needed to move towards final specification of *Robustness Trials* and *Cross-validation Trials* for the gray whale.

The Committee **recommends** the continuation of the AWMP developers' fund at the level of £8,000 as last year. Donovan noted that this fund had been critical to SWG's rapid AWMP development pace and to the excellent quality and quantity of *SLA*s submitted for consideration to the SWG thus far.

9. ABORIGINAL SUBSISTENCE WHALING STOCK ASSESSMENTS

9.1 Annual review of catches and catch limits

9.1.1 Bering-Chukchi-Beaufort seas stock of bowhead whales (see Annex F)

9.1.1.1 NEW SCIENTIFIC INFORMATION

SC/53/BRG9 presented preliminary results of the ice-based census in spring 2001. The census was conducted from 5 April to 7 June near Barrow, Alaska. Observers recorded a total of 3,295 new and 526 conditional bowhead whale sightings during 1,135 hours of watch effort (sightings are scored as conditional when observers are not certain that the whales have not already been seen). The totals included 121 new and 6 conditional calves, comprising 3.7% of the new whales counted. The number of new whales counted in 2001 differs by < 100 animals from the number counted during the previous census in 1993 (3,383 new). The number of calves counted in 2001 is nearly twice that of 1993 and is the highest ever recorded. George noted that the visibility conditions were poorer in 2001 than in 1993.

SC/53/BRG17 described the preliminary results of the 2001 acoustic survey effort undertaken from mid-April through early June 2001 as part of the coordinated dual-mode census of bowhead whales off Point Barrow, Alaska. Preliminary acoustic results indicate that: (1) whales continued to migrate throughout the survey period independent of any obvious changes in ice condition; (2) the offshore distribution of whales varied throughout the season;

Table 6
Proposed Work plan for AWMP.

Time	Ideal (bowhead)	Scheme	Ideal but unlikely (gray)
Post 2001 Meeting	Incorporate feedback from Commission. Run any necessary additional or revised trials	Incorporate feedback from Commission	Finalise specifications of all *Trials*
Workshop	Review intersessional work. Select preferred candidate and advise on tuning options for presentation to the Commission		Candidate *SLA(*s) coded and sent to Secretariat; *Evaluation Trials* coded, run and results circulated;
2002 Meeting	Finalise all aspects for presentation to Commission		*Robustness Trials* run and results available at meeting; Examine trial results and determine 'preferred' candidate(s). Revise *Cross-Validation Trials* if necessary.

(3) calling rates were similar to those in previous years; and (4) singing rates were much lower than in 2000 but typical of other years.

George stated that a census had been organised on the Russian coast that had run concurrently with the spring 2001 census in Alaska. The Committee looked forward to seeing results of both censuses at next year's meeting.

9.1.1.2 CATCH INFORMATION

A total of 47 bowhead whales was struck and 35 landed during the 2000 Alaskan subsistence hunt, a hunting efficiency (74.5%) that was similar to the average over the past 10 years (75.9%). Twenty-one (or 60%) of the whales landed were female of which six were presumably mature (> 14.2 m long). Two of the mature females were pregnant, one with a 38.2 cm and the other with an approximately 60cm foetus. Since 1980, 29% of the presumably mature females for which records are available were pregnant. It was noted that the high proportion of young individuals in the catch was probably the result of size selection by the whalers, as they preferred to target smaller individuals for ease of handling and more palatable features of skin and blubber.

Two bowhead whales were reported taken in the Russian aboriginal hunt, a 14.9m male in 1999 and a 10m female in 2000.

9.1.1.3 MANAGEMENT ADVICE

The Committee noted that the current catch limit ends in 2002, although a major assessment of this stock of bowhead whales is not scheduled until 2004. It had received no new information that would cause it to change the management advice given previously (IWC, 1999e, p.185), namely, 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 also noted that it expected to be able to recommend a *Strike Limit Algorithm* for this stock at next year's meeting (see Item 8.2.3.5).

9.1.2 Eastern North Pacific stock of gray whales (see Annex F)

9.1.2.1 NEW SCIENTIFIC INFORMATION

SC/53/BRG3 reported on the 2000/2001 shore-based census of the southbound migration at Granite Canyon. The primary objective of the study was to provide another in the series of abundance estimates such that the trend analysis could be continued. Systematic counts of gray whales were conducted from 13 December 2000 to 5 March 2001, covering most of the duration of the southbound migration. During the gray whale census 1,684 pods of gray whales (2,741 whales) were recorded from the primary observation shed. Mean pod size of gray whales recorded in 2000/01 was 1.63, which is intermediate between mean pod size estimates of 1.83 in 1995/96 and 1.57 in 1997/98.

The encounter rate of gray whales in 2000/01 was low relative to counts in other years in the recent past. There are several factors that could explain part or all of this difference. However, conclusions cannot be drawn from the raw sighting rates, as these still must be corrected and adjusted for various factors before a final abundance estimate is produced. This should be available in time for next year's meeting, when the assessment of gray whales would be considered in detail.

SC/53/BRG4 provided an analysis of gray whale calf sightings recorded during aerial surveys conducted in January 1996 and shore-based surveys conducted during the winters of 1995/96, January 1997, 1997/98 and 2000/01 at Granite Canyon, California. The proportion of calves to adults observed from 1996-2001 was similar to those recorded from 1984-95. The proportion of calves to adults visible from the air in 1996 was much higher than the proportion observed in 1988, but fell between the proportions observed in 1993 and 1994. The average of these four years was 0.025. A low rate of concurrence between observers (mean = 16%) indicates that many calves go unseen by shore-based observers.

SC/53/BRG11 summarised and updated a review of gray whale calf production 1994-2000. Counts from the past three years (1999-2001) are about 70% lower than counts from the previous five-year period (1994-1998). The fluctuations in calf numbers were positively correlated with the length of time that primary feeding habitat was free of seasonal ice during the previous year.

SC/53/BRG18 presented the results of research in Laguna Ojo de Liebre, Mexico, in winter 2001. The peak number of adult whales was 486, with maxima for mothers with calves and single whales of 333 and 232, respectively. The residency pattern was similar to that observed in Laguna San Ignacio in previous years, 22.1 days for mothers with calves and 13.2 days for single whales. In relation to the two previous winter seasons, the increase in the number of mothers with calves, the drastic reduction in mortality and the very few records of 'skinny' whales, indicate a recovery of these whales after the high mortalities in 1999 and 2000.

Calambokidis *et al.* (In press) presented information on a feeding aggregation of gray whales from California to southeastern Alaska. The authors concluded that there are a few hundred gray whales that range in summer from at least northern California to southeastern Alaska. It was unclear how separate these whales were from the rest of the population. Only limited genetic studies had been done so far, a comparison of mtDNA from 16 'resident' whales with whales from the overall population failed to detect any

significant difference. Whales from this feeding aggregation appeared to migrate to Mexico and were therefore part of the larger breeding population.

Information in SC/53/BRG21 showed that strandings of gray whales during the first six months of 2001 have returned to normal or below normal levels. Only 13 gray whales stranded along the entire coast of western North America between 1 January and 15 June 2001, compared to 198 and over 200 whales for the same period of time in 1999 and 2000, respectively. Also the numerous examples of both live and dead 'skinny' animals reported in 1999 and 2000 were not repeated in 2001. The low number of strandings in 2001 suggests that the general condition of the whales has improved from 1999 and 2000. The low number of calves seen in 2001 may in part still be related to the poor nutritive condition of many whales over the past two years.

The Committee **agreed** that the 1999-2000 episode of increased gray whale strandings and sightings of emaciated individuals should be considered as a stochastic event whose magnitude may have been exacerbated by the possibility that the population was at or close to its carrying capacity (IWC, 2001h, p.167).

Catch statistics for eastern gray whales were presented in SC/53/BRG16. Over 8,200 catch records were reported including 6,817 aboriginal subsistence takes, 992 commercial catches, 326 scientific catches and 138 in illegal pelagic whaling. The authors estimated that missing records during early North American commercial whaling were unlikely to total more than 2-3% of the total 20th century catches but they also noted it was difficult to judge what aboriginal catches might be missing during the first half of the 20th century. Brownell noted that he had not yet compared this catch series with that used previously in population modelling exercises, but he believed the differences would be small.

9.1.2.2 CATCH INFORMATION

SC/53/BRG23 and 24 provided details of the aboriginal catch of gray whales in Chukotka waters in 1999 and 2000. The State Committee for Environmental Protection of the Russian Federation had allocated a quota of 135 gray whales each year. Regulations attached to the permit specified *inter alia* that mothers and calves were protected, that a 'passport' giving details of capture and biological information for each whale taken should be completed, that only 119 whales were to be allocated amongst whalers (with the remaining 16 held in reserve in case of extra need) and that drowned animals, or those mortally wounded by killer whales or washed ashore from natural causes, should not be included in the allocation. The total catch in 1999 had been 121 whales, of which 68 were males and 53 females. Lengths of whales taken had ranged from 7.8-14.9m and whaling had occurred from 100m to 28km from shore. In 2000, a total of 113 gray whales had been harvested, including 62 males and 51 females. These figures did not include two wounded whales and one dead whale washed ashore following an apparent killer whale attack. Lengths of whales taken ranged from 7.0-13.3m and whaling occurred from 50m to 23km from the coast. Whaling had stopped at the end of October following poor weather conditions and a shortage of fuel.

It was reported that one gray whale was taken by the USA in Washington State waters in 1999 and that there was no take in 2000.

In reply to a question about whales landed in 1999 and 2000, Borodin replied that he was unaware of any reports of obviously thinner whales.

9.1.2.3 MANAGEMENT ADVICE

Information so far available for gray whale strandings on the Canadian, USA and Mexican coasts in 2001 indicated that the rate had returned to (or was even lower than) that reported prior to 1999. The incidence of sightings of emaciated ('skinny') whales had also declined. Nevertheless, the proportion of calves is still depressed from what it had been in earlier years and sighting rates in the 2000/2001 census at Granite Canyon had been lower than in the previous survey. However, until the census data had been fully analysed it was not clear whether these would translate into a lower abundance estimate. Given that a full assessment of gray whales was scheduled for next year's meeting, the Committee did not feel it was necessary at this time to change its advice from last year, namely, that a take of up to 482 whales a year is sustainable and is likely to allow the population to stabilise above the maximum sustainable yield level. It noted that this is one of the priority stocks being considered in the AWMP development process.

9.1.2.4 REVIEW PREPARATION FOR 2002 IN-DEPTH ASSESSMENT

Plans for proposed USA research in 2001/2002 were given in SC/53/BRG21. These included: (1) a total abundance estimate of the southbound migration in 2001/2002; (2) an estimate of calf production from the northbound migration in 2002; (3) photogrammetric sampling to determine the nutritive condition of southbound 'skinny' animals; (4) continued monitoring of strandings, including collection of pathological material from fresh specimens; (5) collection of tissue samples from 'stinky' and fresh normal individuals from Russian aboriginal harvest; and (6) a study of the distribution of whales on the feeding grounds. Brownell reported that these efforts would have to be prioritised because insufficient resources were available to undertake all of them.

Brownell listed the papers that the USA intended to produce for the in-depth assessment in 2002. Apart from those resulting from items (1) to (5) above, a review of the status of the population taking into account the high mortality rate in 1999 and 2000, the low calf counts of 1999-2001 and the abundance estimate for 2000/2001, will be prepared.

Urban reported that Mexico planned to continue its monitoring of the population on its wintering grounds in the lagoons, especially using photo-identification to study movement between lagoons and the turn-over rate of mother-calf pairs, with a view to producing a better estimate of calf production.

Mexican scientists will produce background papers on: (1) a summary of strandings in the calving lagoons for 2002; (2) the distribution of cow-calf pairs in the lagoons in 2001/2002 (which will help provide some idea of final calf production for 2002); and (3) the movements of whales within and between lagoons using genetic samples.

The Russian Federation will also provide information on the harvest (morphological, biological, physiological) to next year's meeting.

The Committee welcomed these plans and looked forward to receiving reports at next year's meeting.

9.1.3 Minke whales and fin whales off Greenland (see Annex E)

The Committee noted that in 2000, 142 minke whales (102 females, 36 males, 4 unknown) were taken off West Greenland and three were struck-and-lost. In the same year,

10 minke whales (2 males and 8 females) were taken off East Greenland and 6 fin whales (3 males and 3 females plus 1 struck-and-lost animal) were taken off West Greenland.

The Committee has never been able to provide satisfactory scientific advice on either the fin or minke whales off Greenland. This reflects the lack of data relating to both stock structure and abundance and is the reason the Committee first called for a Greenland Research Programme to be established in 1998 (IWC, 1999g). This inability to provide advice is a matter of great concern, particularly in the case of fin whales where the best available abundance estimate dates from 1987/88 and is only 1,096 (95%CI 520-2,106). The Committee **urges** continued funding of the research discussed under Item 8 at the requisite levels, by both Greenland and the IWC. It reminds the Commission that without such information it may be many years before it is able to provide satisfactory scientific advice on these stocks. Even with the success of the programme, it is difficult to envisage that the SWG will be able to develop a suitable *SLA* (or *SLA*s) for the Greenlandic fisheries before 2006.

9.1.4 Humpback whales off St Vincent and the Grenadines (see Annex H)

Given the inability of the Committee to complete the Comprehensive Assessment at this meeting and the absence of any substantially new information regarding humpback whales in the southeastern Caribbean, the Committee **reiterates** its view of the last two years that a catch of up to three whales taken annually would be unlikely to harm this stock.

The Committee noted that the question of the abundance and population identity of humpback whales in the southeastern Caribbean remains unresolved.

The Committee reiterated its request made in previous years that photographs and tissue samples for genetic analysis of animals taken in the St Vincent hunt be collected and analysed and the results presented to the Committee. The Committee was informed that some samples had been collected from animals taken in St Vincent but that these had not yet been analysed. The Committee looked forward to receiving results.

9.2 Catches by non-member states (see Annex F)

The IWC Secretary was informed by Fisheries and Oceans, Canada, that, under the authority of a license issued by the Minister of Fisheries and Oceans, one bowhead whale (a male 11.7m long) was landed at Leyson Point, Southampton Island, in the eastern Canadian Arctic on 11 August 2000. The Committee concluded that this animal was from the Hudson Bay/Foxe Basin stock. This is discussed further under Item 10.7.1.1.

9.3 Contaminated gray whales from the eastern North Pacific stock (see Annex F)

Last year the Commission specifically asked for more information on the 'stinky' whales reported from the Chukotka catch. Borodin stated that none had been encountered this year. O'Hara reported that, as part of a joint USA/Russian project, 10-20 harvested gray whales would be sampled in or near Lorino, focussing on animals with the offensive odour and others to use as controls. The examination and sampling procedures for the Chukotka harvested gray whales would be consistent with those used by NMFS personnel and others for examining dead gray whales in the USA and Mexico. These procedures will include the collection of morphometric data, stomach contents (frozen) and tissue samples for determination of contaminant concentrations; tissues to be sampled will include frozen blubber, muscle, kidney and liver. A major effort will be examination and sampling of any whales with the unusual odour, as this will be critical in determining the causative agent (i.e. through analytical chemistry) and hopefully in addressing food safety issues. The Committee noted that Russian and USA personnel need to work out the details of the CITES permits so that any samples collected this summer can be shipped back to the USA as rapidly as possible. In this regard it was noted that the USA Laboratory involved already possesses an institutional CITES permit. Komatsu indicated that Japanese scientists would also be interested in cooperating with these studies and would be willing to facilitate issuance of Japanese CITES permits in this regard. The general question of CITES permits is discussed under Item 4.

9.4 Work plan

The Committee noted that last year, the priority item for next year's agenda was an in-depth assessment of eastern North Pacific gray whales. It reaffirmed this and proposed that Ohsumi and an appropriate Russian scientist should join the steering committee for that assessment which had been set up under Brownell. It agreed that the status of the western stock of gray whales would be reviewed at next year's meeting in parallel with that of the eastern stock.

Some discussion took place regarding whether the assessment of the Bering-Chukchi-Beaufort bowhead whale stock scheduled for 2004 should be brought forward to 2003, especially as the current Schedule only sets catch limits for this stock up to and including the 2002 season. The necessity for this was unclear, since Scientific Committee recommendations regarding new quotas do not ordinarily require a simultaneous in-depth assessment. The Committee decided to leave the work plan for 2003 unspecified, pending events in the Scientific Committee and Commission.

10. WHALE STOCKS (SEE ANNEX G)

10.1 Matters relevant to more than one stock

10.1.1 DESS: progress with data entry and analysis options

Changes made to the Database Estimation Software System (DESS) intersessionally are detailed in Annex G (Appendix 2).

The most recent analysis of the SOWER data was from the 1998/99 survey in Area IV (SC/53/IA3). Data from the two most recent surveys are not yet in DESS. The Committee noted the importance of estimates from these surveys in addressing the issue of possible trend in abundance and **strongly recommends** that data from the two most recent surveys be validated and entered in DESS as soon as possible and that these surveys be analysed before next year's meeting.

10.1.2 SOWER Circumpolar cruises

10.1.2.1 SOWER 2000/01

The survey was conducted in two parts: a minke whale research component and a blue whale research component. Due to mid-cruise damage to the propeller of the *Shonan Maru*, her speed was restricted to 10.5 knots, necessitating some changes to the survey design and restricting biopsy sampling activities. Nevertheless, good trackline coverage was achieved. There were 324 minke whale sightings of 801 whales and six true blue whale sightings of 16 whales. In

addition, two species very rarely encountered during previous IDCR/SOWER surveys were seen: a group of 14 pygmy right whales in New Zealand waters and three groups of spectacled porpoise. A total of 20 biopsy samples from 11-14 blue whales were obtained, all individuals were videotaped, photographs were obtained from 6-8 individuals, acoustic recordings were made in the vicinity of a group of four animals and dive times were recorded for a solitary animal. A feasibility study to assess the effectiveness of the *Larsen* gun in regard to biopsy sampling of minke whales was conducted under very favourable conditions, with nine samples obtained. Biopsy samples were also obtained from 36 humpback whales, 3 sperm whales, 2 killer whales and 1 Arnoux's beaked whale that was found dead.

It was noted that the current analyses of concentration boundaries of Antarctic sea ice routinely obtained from the US National Ice Center (NIC) may not be available during future cruises. These are vital in determining the construction of the cruise tracks and the research would be severely compromised without a substitute source of information. If the NIC analyses are not to be available in the future, alternative sources of ice information must be found.

The Committee expressed its gratitude to the Government of Japan for providing the vessels to conduct the survey and congratulated the officers and crews of both vessels, the Cruise Leader, Paul Ensor and the researchers for their efforts during what was a particularly difficult cruise because of the damage to the *Shonan Maru.*

10.1.2.2 PLANS FOR FUTURE CRUISES

Only Area V remains unsurveyed on the third circumpolar set of surveys. The Government of Japan offered to make two survey vessels available for SOWER surveys in 2001/02 and 2002/03. The report of the *ad hoc* working group to plan logistical aspects of the 2001/2 survey is given in Annex G (Appendix 3).

In view of concerns that the later timing of recent surveys compromises the comparability of the series of minke abundance estimates from IDCR/SOWER surveys (see below), it was proposed that the 2001/02 survey reverts to a timing similar to that used for surveys prior to 1994/95. Because of the difficulty of surveying Area VE and the possibility that an additional vessel might be available from the JARPA programme in 2002/03, it was also proposed that Area VW be surveyed in 2001/02. The blue whale component of the survey is to be conducted within the minke whale component and attempts will be made to biopsy individuals from which acoustic recordings have been obtained, to provide data to assist species identification by acoustics.

Some members were concerned about the simultaneous operation of SOWER and JARPA surveys in Area VE in 2002/03 and the possible effect that this could have on results. Others noted that previous cruises had avoided possible conflict with commercial or scientific whaling operations through negotiation and appropriate timing and were optimistic that this potential conflict could be similarly resolved.

Noting the importance of the IDCR/SOWER surveys to its work and the need to complete the third set of circumpolar surveys, the Committee expressed its gratitude to the Government of Japan for making vessels available, accepted the recommendations of the report and **recommends** IWC participation in the surveys in 2001/02 and 2002/03.

10.2 Southern Hemisphere minke whales – abundance estimation

10.2.1 Review of new data

The estimate of abundance from the 1998/99 SOWER survey in Area IV (7,130 whales, with a CV of 34%) was much lower than those from any previous IDCR/SOWER survey in this Area (in 1978/79, 1984/85[3] and 1988/89). It is difficult to draw inferences from inter-year comparisons, for reasons given below. In particular, the survey occurred later than previous IDCR/SOWER surveys in this Area and the ice-edge was substantially further north than on previous surveys; this might have resulted in a substantial proportion of the population being outside the survey region. The proportion of sightings classified as 'like minke' followed the increasing trend seen on previous recent surveys and this too makes comparison difficult.

Analysis had been conducted using DESS with options that have become standard[4] for analyses of these surveys (notwithstanding the fact that the analysis methods are currently under review). Alternate options might also be reasonable. While it was agreed that the analyses of these data might be particularly sensitive to changes in the options used, the results did not suggest that the standard estimate was inadequate. The effect of adequate alternate analysis options on the abundance estimate is to be investigated intersessionally.

10.2.2 Updated estimates by Area

10.2.2.1 OVERVIEW OF DATA COLLECTION AND TRAINING METHODS

10.2.2.1.1 IDCR/SOWER CRUISES

Changes in the IWC/IDCR and SOWER Antarctic survey designs and data collection protocols were reviewed. Notwithstanding the importance of maintaining consistency over time, there have been two major modifications and various minor modifications of survey design during the course of the surveys.

The programme was modified from a combined Discovery marking and sightings programme to a rigorous and systematic sightings programme from the second circumpolar set of surveys (starting 1985/86 and referred to as CPII for brevity). At that point, strict identification guidelines were established for sightings of Antarctic minke and Southern bottlenose whales. In the third set of circumpolar surveys (starting in 1991/92; CPIII for brevity), the survey design was modified to cover the whole region south of 60°S, at the expense of full longitudinal coverage of Management Areas in a single year.

10.2.2.1.2 JAPANESE SCOUTING VESSEL DATA

Japanese scouting vessel (JSV) data comprise daily summaries of sightings from four kinds of vessels (full-time scouting vessels, operating catcher boats, national dedicated survey vessels and IDCR vessels), but mainly from full-time scouting vessels. For a number of reasons (there is no systematic track design, no record of sighting distance information, no identification of primary/secondary sightings), the JSV data are not suitable for direct density estimation. However, unlike IDCR/SOWER data, they cover latitudes north of 60°S. Although they do not extend later than the 1987/88 season, they are potentially useful for extrapolating IDCR/SOWER abundance estimates northwards and for examining seasonal migration. Some members expressed reservations about using JSV data for

[3] The 1984/85 survey covered only the eastern half of Area IV.
[4] See Annex G, item 6.2.2 and Appendix 5.

extrapolation because weather conditions change with latitude. JSV data with minke whale sighting records are available from the 1970/71 season; data with less systematic and reliable recording of minke whales are available from the mid-1960s. Dwarf minke whales are not distinguished from Antarctic minke whales in the data.

10.2.2.1.3 JARPA

Methodology from the sighting and sampling surveys in the JARPA programme was reviewed and the similarities and differences in procedures between the JARPA and IDCR/SOWER programmes were reviewed. Both involved searching at about the time of the peak abundance of Antarctic minke whales on the feeding grounds. IDCR/SOWER cruises had shorter research periods (early January to late February) than the JARPA cruises, which typically started in late December and ended in early March (see Appendix 4 of Annex G). JARPA surveys involved simultaneous searching by different vessels in closing mode ('SV mode' in JARPA terminology – where 'SV' stands for 'sighting vessel') and in 'search and sampling' mode (SSV mode). In SSV mode animals are caught so that this mode involves more time off-effort in order to close on and catch whales. JARPA surveys covered only Areas IV and V, whereas the IDCR/SOWER surveys covered all Areas. The areas covered by the JARPA surveys in Area V were almost always smaller than those covered by the IDCR surveys.

10.2.2.2 REVIEW OF CURRENT IWC LINE TRANSECT ANALYTICAL METHODOLOGY

The development of the 'standard' analysis methodology was reviewed; its evolution within the IWC Scientific Committee is summarised in Annex G (Appendix 5). Use of the word 'standard' does not imply that this methodology could not be improved further; indeed a substantial component of the current review of Antarctic minke whale abundance estimates involves a review of the methods and development of improved methodology. The methods are 'standard' insofar as they have evolved by agreement within the Committee (and have been applied consistently over a number of IDCR/SOWER surveys in the past).

Branch and Butterworth (2001b) report the results of applying this standard methodology to minke whale sightings data from all IDCR/SOWER surveys up to and including the 1997/98 survey, using the IWC software DESS (Version 3.0). It is possible that the resulting Antarctic minke whale estimates may include a very small proportion of dwarf minke whales. Estimates of abundance obtained for three circumpolar sets of surveys: 1978/79-1983/84, 1985/86-1990/91 and 1991/92-1997/98 (*still incomplete) and are 608,000 (CV = 0.130), 766,000 (CV = 0.091) and 268,000* (CV = 0.093) respectively. These surveys have covered 65%, 81% and 68%, respectively of the areas south of 60°S and the ice edge. These estimates are negatively biased estimates of Antarctic minke whale abundance because areas inside the pack ice cannot be surveyed, not all minke whales are in the survey region, the assumption is made that all whales on the trackline are sighted and 'like minke' sightings are omitted.

The Committee welcomed the estimates, which had been updated to accommodate concerns and suggestions made by the Committee on the estimates presented to it in 2000. It expressed its appreciation of the work involved in revising the estimates intersessionally.

It was suggested that alternative methods of analysis, stratification, detection functions, strip width models, pooling methods and school size estimation were unlikely to make a large difference in either the magnitude of the estimates or the relative estimates in the three surveys. By contrast, the potentially large differences in the proportion of the minke whale populations covered on each survey were thought likely to affect the estimates to a much greater extent.

It was noted that violation of the assumption that all animals on the trackline are detected ($g(0) = 1$), on which the estimates of Branch and Butterworth (2001b) are based, would affect the estimates in ways that are not entirely predictable. It was also noted that it would be preferable to estimate abundance without the assumption that $g(0) = 1$. Several attempts to estimate abundance without the assumption in the past have been unsatisfactory, but recent methodological developments are promising in this regard.

10.2.2.3 FACTORS THAT MAY INFLUENCE ABUNDANCE ESTIMATES AND THEIR TRENDS

10.2.2.3.1 SCHOOL SIZE ESTIMATION

The performance of the DESS school size estimation rule was examined against two alternatives. It was noted that the standard methods of estimating school size depend on $g(0) = 1$ and that this was certainly not true for all schools in all conditions. It was also noted that the regression method used to estimate mean school size might be sensitive to the form of the detection function used. Investigation of alternate estimation methods that do not rely on the $g(0) = 1$ assumption was considered important.

The Committee **recommends** that the modified approach to estimating school size suggested in Branch and Butterworth (2001b) should be implemented in DESS and should be used in future analyses from IDCR/SOWER surveys pending the development of models which either provide satisfactory estimates of $g(0)$ or do not build certain detection on the trackline into their assumptions.

10.2.2.3.2 STRATIFICATION/POOLING

Sample size considerations limit the degree to which stratification can be used in estimation. Following recommendations made last year, Branch and Butterworth (2001b) investigated pooling options for estimation of effective strip width (*esw*) and mean school size and suggested that the AIC criteria usually used to decide on pooling should be replaced by an alternative rule outlined in Annex G. In addition, other possibilities were suggested in discussion. The Committee agreed that the use of this new method needed to be considered further. It also noted that methods that model detection probability as a function of covariates should require less pooling of data and should be investigated and applied to these data.

10.2.2.3.3 OBSERVER EFFICIENCY

Average observer experience on the third set of circumpolar surveys is lower than on previous surveys. Results of analyses investigating the relationship between observer experience and sighting efficiency were presented to the Committee. It was noted that this analysis suggests a substantial and significant difference in the sighting rates with experience when observers work alone in the IOP. However, it is not clear what the overall effect of this is in practice because other observers may sight schools that the less experienced observer might have missed. The data are inadequate to determine if this is a cause of the lower abundance estimates obtained from the third set of circumpolar surveys because the increased proportion of less

experienced observers since 1990 has resulted in there being too few observations involving experienced observers alone in the third circumpolar survey.

The effect of two methods of estimating observer efficiency on circumpolar estimates of abundance was examined. Two analyses based on different assumptions indicated either: (1) that changes in observer efficiency changed overall abundance estimates by only a few percent; or (2) they resulted in an increase in the ratio of third to second circumpolar abundance estimates from some 35-40% to 45-50%. It was noted that the effect of observer efficiency on $g(0)$ may be more complicated than is assumed in the above analysis.

10.2.2.3.4 CHANGES IN 'LIKE-MINKE' CLASSIFICATION

When observers believe a sighting is of a minke school, but have some degree of uncertainty about this, the sighting is classified as 'like-minke'. Results were presented showing that the proportion of 'like minke' sightings had increased over time, from negligible levels in the first circumpolar set of surveys to over 30% in IO mode in the third. If 'like minkes' are included in abundance estimates, those for closing mode increase only slightly because *esw* estimates also increase. The IO mode estimates for the second and third circumpolar sets of surveys increase by some 10% and 20% respectively.

Analyses examining the relationship between observer experience and the proportion of 'like-minke' sightings concluded that the increase of 'like minke' whale sightings in recent years seems not to be caused by the introduction of inexperienced observers. Other reasons, such as the increasing number of species codes and the extent of survey coverage to the northern stratum (in which weather is worse and school sizes smaller on average) may have caused difficulties in determining the species.

10.2.2.3.5 ANIMALS MISSED ON THE TRACKLINE AND DUPLICATE IDENTIFICATION

'Standard' analyses assume that all animals on the trackline are detected i.e. that $g(0) = 1$. Probability of detecting animals on the trackline is likely to depend on school size and the assumption that $g(0) = 1$ for small schools at least, is almost certainly violated; abundance estimates are biased as a result, although the bias may be small. There was considerable discussion about whether multi-platform analyses could yield estimates of $g(0)$, given the problems encountered in attempting this in the past. One of the major problems discussed was that of non-independence of sightings from the IO and barrel platforms due to the availability of visible cues. The approach outlined in SC/53/IA31 could in principle accommodate this difficulty (although it requires accurate species identification) and the Committee **recommends** that this method be applied to the IDCR/SOWER data.

Net bias in abundance estimates when $g(0)$ is less than 1 is necessarily negative, even though $g(0)$ depends on school size and so estimation of mean school size by extrapolating to perpendicular distance zero (as the regression method does) provides a positively biased estimate of mean school size (see Appendix 15 of Annex G).

Crude estimates from SC/53/IA27 suggest an effect of about 15% due to assuming $g(0) = 1$. Crude analyses of duplicate proportions suggest that $g(0)$ might have decreased by as much as 40% in Area I from CPII to CPIII (see Appendix 6 of Annex G).

10.2.2.3.6 EFFECT OF ENVIRONMENT ON SIGHTING CONDITIONS

Results were presented indicating that *esw* depends on sighting conditions, as expected. The Committee **recommends** that methods be developed and applied that model detection probability as a funciton of covariates (including sightings conditions) and that further effort be invested to develop methods that would allow reliable estimation of abundance without assuming $g(0) = 1$.

10.2.2.3.7 TIMING OF SURVEYS AND ENVIRONMENTAL FACTORS

Analyses on the timing of migration to the Antarctic were presented, using: (1) JSV data from 1966/67 to 1987/88 in the waters south of 40°S in the Areas III, IV and V; and (2) CPUE and sightings survey data information. Both indicated a peak abundance of whales in the waters south of 60°S in late January. There is also indication of a rapid decrease in the proportion of whales in this region in February. This suggests that a longer research period in February in the recent SOWER surveys may have resulted in increased negative biased abundance estimates from recent surveys. Although taking account of the migration trends indicated by the CPUE and sightings data increases estimates of abundance by roughly 25%, it affects the ratio of the estimates for the third and second circumpolar sets of surveys negligibly. This may be a consequence of Area-specific differences in migration timing and the fact that the Ross Sea, which contains high abundance, was surveyed relatively later.

It was noted that that the spatial modelling methods outlined in SC/53/IA29 could be used to estimate temporal as well as spatial trend in abundance in the survey regions and should be less susceptible to any bias resulting from possible differences in migration timing in different regions.

Results were presented detailing changes in the sea ice extent from 1979 to 2000. During the period of ice retreat, the monthly extent of the ice between mid-December and mid-February was highly variable, as expected. There was also considerable variation in its extent between years, with most variability in Areas II, V and VI. It was noted that the nature of the variability in sea ice concentration within years differed between geographic areas, suggesting the need to consider the effects of the ice configuration in its totality, not only its latitude, on abundance estimates. The Committee noted the importance of estimating minke whale abundance south of the ice-edge, but in the absence of more information, no quantitative conclusions about this abundance could be drawn. It **recommends** that this issue be addressed intersessionally.

10.2.2.3.8 CLOSING-PASSING MODE CALIBRATION

Since 1991, IDCR/SOWER analyses have applied a correction factor, R, to calibrate Closing mode estimates (which are acknowledged as potentially biased) to those estimates that would have been obtained had the Closing mode survey been in IO mode. Currently, a single estimate of R is calculated, this estimate being updated annually (although the estimate of R used in analyses of IDCR/SOWER data, such as those presented in SC/53/IA3, uses data from surveys up to and including the 1988/89 survey.) However, the Committee noted that the extent of bias in closing mode is believed to be density-dependent and thus that it was unreasonable to assume that R is constant across years. The change in the proportion of 'like-minke' sightings adds further evidence to support this conclusion

and it was agreed that alternative methods which allow a calibration to be estimated separately for each survey should be investigated.

10.2.3 Inter-year comparisons and trend

10.2.3.1 DEALING WITH VARIABLE PARTIAL COVERAGE

10.2.3.1.1 EXTRAPOLATION TO UNSURVEYED REGIONS

Problems with comparability between estimates from the three circumpolar sets of surveys arise because of two factors relating to survey coverage. Firstly, most surveys in the first two circumpolar sets did not completely cover the full latitudinal range to 60°S. Secondly, the third circumpolar set of cruises has not yet completed a full circuit of the Antarctic - the longitudinal ranges of 140°W-110°W and 80°E-130°E have yet to be surveyed. The Committee considered three possible approaches for estimating density in these unsurveyed regions. The first assumes that the unsurveyed northern areas have the same density of whales as the northern surveyed strata in each survey and uses the density in the covered part of these northern strata to extrapolate abundance estimates to a common area south of 60°S. Extrapolating in this way and correcting for different longitudinal coverage results in comparable circumpolar estimates of minke whale abundance on CPI, II and III of 729,000 (CV = 0.150), 824,000 (CV = 0.117) and 359,000 (CV = 0.108). These estimates apply to 280° of a possible 360° longitude for complete circumpolar coverage.

Exploratory analysis of the utility of two spatial modelling methods for extrapolating and interpolating into unsurveyed regions were presented. Both performed well on the data they were applied to and the Committee **recommends** that these approaches be developed further intersessionally.

10.2.3.1.2 JSV DATA

SC/53/IA11 used JSV data in the waters south of 40°S in Areas III, IV and V from 1966/67 to 1987/88 to extrapolate abundance estimates from IDCR/SOWER surveys north of 60°S to 40°S. A GLM with research period, season, latitude and longitude as explanatory variables and presence/absence as the binary response variable was fitted to the JSV data. Using JSV daily encounter rates pooled over longitude, together with the fitted GLM, relative abundance is predicted over the range of latitudes spanned by the JSV data. This is used to extrapolate the IDCR/SOWER estimates north of 60°S. Of the minke whale population in these Areas, 30% are estimated to be north of 60°S. There are a number of sources of possible bias associated with this extrapolation method, some positive and some negative.

Butterworth briefly outlined the results from an analysis of JSV data from 1978/79 (Borchers *et al.*, 1990). He reported that including minke whales (and dwarf minke whales) that are distributed north of 60°S would result in an increase of about 10% to the estimates using data from south of 60°S only.

10.2.3.1.3 ANIMALS WITHIN THE PACK-ICE

Results relating to the estimation of minke whale abundance south of the ice-edge were presented. The Committee welcomed this first attempt at estimating the number of minke whales that may be present within the pack ice, but was unable to reach any conclusions other than noting that some minke whales are present within the ice, but that their numbers are unknown. It encouraged efforts to ensure that more information on surveys within the ice are presented at next year's meeting. The Committee supported the conclusion in SC/53/IA14 that surveys within the ice would provide useful data on Antarctic minke whale abundance. The Committee **recommends** that the minke whale data available from the APIS program be analysed intersessionally to provide estimates of abundance south of the ice edge.

10.2.3.1.4 JARPA DATA

The Committee noted the likely utility of the spatial modelling methods discussed under Item 10.2.3.1.1 above, for extrapolation and interpolation of JARPA survey data into unsurveyed regions on IDCR/SOWER surveys within and between years.

10.2.3.2 TRENDS IN ABUNDANCE

At its last meeting, the Committee noted the fact that the overall abundance estimate from crude extrapolations from the third circumpolar set of IDCR/SOWER surveys[5] was appreciably lower than the total of the previously agreed point estimates by Area from the 1990 Comprehensive Assessment (IWC, 2001i, p.189). It also noted that there are a number of factors that make interpretation of this difficult. The Committee reconsidered the issue this year, in the light of the substantial new analyses that had been conducted intersessionally.

The possible utility of population dynamics models for the review of Southern Hemisphere minke whales had been noted last year (IWC, 2001j, p.199). At that time, initiation of work on population dynamics modelling had been considered premature. Having made substantial progress on other aspects of the review since then, the Committee revisited the issue.

It agreed that the interpretation of trend in a meaningful way required some form of population dynamics modelling and that this should take account of sightings and other data in addition to those provided by analyses of the IDCR-SOWER sightings data. While opinions differed on the likelihood of being able to interpret the results of such modelling in a way that would conclusively explain the trend in estimates (since the distinction between process error and sampling error was based on the modelling assumptions), the Committee **recommends** that population dynamics models should be examined at the earliest opportunity.

SC/53/IA13 examined year to year trends in the biological parameters of Antarctic minke whales from 1971/1972 to 1999/2000, using both commercial and JARPA data. The authors believed that these data provide no evidence to support a decline in Antarctic minke whale abundance after the early 1970s and in particular not since 1987.

Branch and Butterworth (2001b) contains updated estimates of abundance from the IDCR/SOWER surveys from 1978/79 to 1997/98 using currently standard[6] estimation methodology. It also contains estimates for each survey that have been corrected for different survey coverage of the population in a crude but reasonable way. The total estimated abundance from CPIII is significantly lower at the 5% level than the comparable total for CPII. This is true both when the estimates are corrected for different survey coverage and the inclusion of 'like-minke' sightings (but no other factors) and when they are not.

SC/53/IA27 considered the effect of the following factors on the abundance estimates: an increase in the proportion of 'like-minke' sightings over time; different survey coverage; changes in the method used to estimate mean school size; the decreasing trend in observer experience; changes in the

[5] The third circumpolar set of IDCR/SOWER surveys is abbreviated to 'CPIII' in what follows; the second set to CPII and the first set to CPI.

[6] See Appendix 5 of Annex G.

timing of the surveys. Results indicated that the effects with largest impact on abundance estimates were the change in the area covered by the survey and decreased observer efficiency[7], although no firm conclusions could be drawn in this regard, given the simple and exploratory nature of the analyses. Choices for the various factors in combination, which likely err towards positive bias, suggested an increase in the ratio of abundance estimates for the third compared to the second circumpolar set of surveys from 35-40% to 65-75%.

SC/53/IA12 presented estimates of the abundance of Antarctic minke whales in Areas IV and V from 1989/90 to 2000/01 using sightings data obtained from JARPA surveys. The standard methods were used (for comparability with analyses of IDCR/SOWER data) and trends in abundance estimates were examined. It was assumed that abundance estimates from SV data can be treated as a relative abundance index, as proposed previously (IWC, 2001i, p.188). Since the time series of sightings data from Sighting and Sampling Vessels (SSVs) is longer than that for than Sampling Vessels (SVs), the SSV data were converted to pseudo-SV data, using the method described in Haw (1991) to extend the time series available for examining trends in abundance. The trend in relative abundance using the SV and pseudo-SV abundance estimates was estimated to be −0.04% with 95% CI (-4.32%, 2.90%) in Area IV and 0.83% with 95% CI (-2.44%, 4.19%) in Area V; in neither Area is the estimated trend significantly different from zero. The authors conclude that neither a significant increase nor a significant decrease in the abundance of minke whales has occurred in Areas IV or V since the JARPA surveys commenced.

In discussion of these results, it was noted that the JARPA estimates had not been considered in the detail in which the IDCR/SOWER survey estimates had been considered at this meeting. It was also noted that some considerations that apply to the IDCR/SOWER survey estimates do not apply to the JARPA estimates (the major changes in survey design between circumpolar sets of surveys is a case in point) and *vice-versa*. It was also considered important that direct comparisons between JARPA estimates and IDCR/SOWER estimates for Areas IV and V be presented to the Committee's next meeting. The Committee **recommends** that an attempt should be made before next year to determine whether there is a statistically significant difference in trend between density estimates from JARPA survey data and those from IDCR/SOWER surveys in Areas IV and V and that IDCR/SOWER estimates be presented for Areas excluding IV and V. It further noted that application of spatial modelling methods to IDCR/SOWER datasets, as detailed in Annex G (Appendix 10) could provide estimates at higher spatial resolution.

The lack of a trend in these estimates contrasts with the fall in abundance estimates reported in Branch and Butterworth (2001b), although it should be noted that the JARPA surveys occur only in Areas IV and V, whereas the IDCR/SOWER surveys cover all Areas. The timing of JARPA surveys has remained approximately constant throughout, whereas since 1994/95, the IDCR/SOWER surveys have started later (see Appendix 4 of Annex G). Concerns were expressed about this change of timing as evidence of peak abundance in the survey region (see Item 10.2.2.3 above) suggests that the change to a later date may have led to some of the survey areas being covered after the peak in more recent surveys rather than at about the time of the peak on earlier surveys. Furthermore, the JARPA surveys spanned a longer period of time in the survey areas so one would expect that they might be less sensitive to the location of the peak. The Committee agreed that if it was logistically feasible, future IDCR/SOWER surveys should revert to the time schedule of earlier surveys. Although taking account of the migration trends indicated by the CPUE and sightings data increase estimates of abundance by roughly 25%, it affects the ratio of the estimates for the third and second circumpolar sets of surveys negligibly.

It was noted that even when the IDCR/SOWER abundance estimates of Branch and Butterworth (2001b) are adjusted using what in the context of results from SC/53/IA27 are likely positively biased correction factors, the total corrected abundance estimate from CPIII (corrected for the factors indicated in Branch and Butterworth, 2001b) remains lower than that from CPII. Interpretation of this result is difficult. The Committee did not have the necessary results to determine whether the difference between the corrected estimates of abundance for CPII and CPIII were statistically significant.

After considering many of the factors affecting abundance estimates that were identified last year, there is still evidence of a decline in the abundance estimates from CPII to CPIII, although it is not clear how this reflects any actual change in minke abundance. Three hypotheses that might explain these results were identified:

(1) a real change in minke abundance;
(2) changes in the proportion of the population that is present in the survey region at the time of the survey;
(3) changes in the survey process over the course of the surveys that compromise the comparability of estimates across years.

Fig. 1 shows the comparable estimates of the relative abundance of Antarctic minke whales from the three circumpolar sets of IDCR/SOWER surveys and estimates of relative abundance of Antarctic minke whales in Areas IV and V only from JARPA survey data. Note that the IDCR/SOWER survey estimates cover 280° of the possible 360° of longitude spanning the Antarctic, whereas the JARPA estimates cover only Areas IV and V.

The most likely mechanisms by which these last two types of change might come about are summarised in Table 7 (and in more detail in Appendix 8 of Annex G), together with indications of the likely size of the change due to each. There remains large uncertainty about the size of the effect of some of these factors on abundance estimates. The available data are inadequate to exclude any of the above three hypotheses. The Committee **agreed** that no firm conclusions about a change in true abundance can be drawn now. However, the decline in the IDCR/SOWER abundance estimates in recent years does highlight the need to work towards resolving the issue as a matter of urgency. The Committee therefore **strongly recommends** that very high priority be assigned to conducting such work as part of the current review of Southern Hemisphere minke abundance estimates.

10.2.4 Plans for completion of minke review

10.2.4.1 DESIGN ISSUES

The importance of maintaining a consistent survey design throughout the period under study was emphasised and it was noted that there are uncontrollable spatial and environmental factors which affect the estimation of trend

[7] The size of the observer effect can be estimated in two ways, depending on assumptions about the way it operates. The correction factor used here was obtained using those assumptions that result in it having the larger effect.

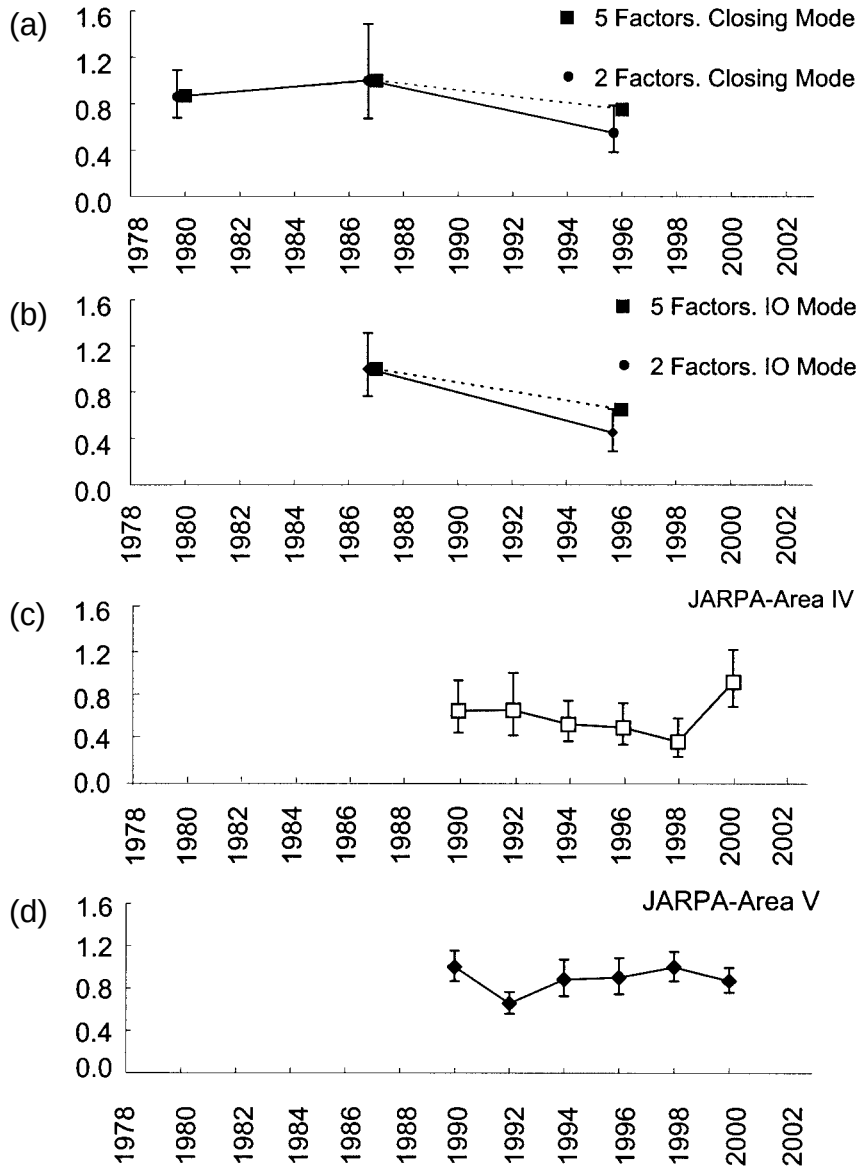

Fig. 1(a) and (b). Estimates of relative abundance of Antarctic minke whales from the three sets of circumpolar IDCR/SOWER surveys. Because of incomplete longitudinal coverage, the estimates account for only 280° of a possible 360° longitude. Estimates are shown separately for (a) Closing mode and (b) IO (Independent Observer) mode. Within each mode, estimates are shown which (i) include corrections for incomplete survey coverage south of 60°S and the inclusion of 'like-minke' (these are called '2 Factors' in the plots), and also for the case in which (ii) correction is made for incomplete survey coverage south of 60°S and inclusion of 'like-minke', school size estimation method, timing of the survey relative to the migration peak of minke whales south of 60°S, and observer efficiency (these are called '5 Factors' in the plots). Vertical bars represent approximate 95% confidence intervals. These are likely too narrow because they do not include uncertainty due to estimation of the correction factors. It should be noted that the estimates have not been corrected for any change in $g(0)$ (effect on abundance estimates could be large: 15 and 40%) , or the proportion of animals south of the ice edge that may have occurred. Estimates might change somewhat if different analysis options are used in obtaining the point estimates. Fig. 1 (c) and (d). Estimates of relative abundance in (c) Area IV and (d) V only, from JARPA data, together with estimated 95% confidence limits. These estimates do not include corrections for any of the factors noted.

Table 7

The likely size of the effect on the relative size of the IDCR/SOWER abundance estimates of Branch and Butterworth (2001b), from CPIII compared to estimates from CPII. The 'effect' is the percentage change in the ratio of abundance estimates from CPIII to CPII that results from correcting for the factor. For example, if half the population was surveyed on CPIII and the full population was surveyed on CPII, the effect would be 100%. An effect of 0% is no change.

Factors	Likely size of effect	Evidence of size of effect
Population-related factors		
Change in coverage of Management Area	Medium	Crude estimate: 20% effect
Change in location of ice	Uncertain, likely small	2%-7% increase in open water area
Change in timing of the survey	Uncertain	Recent IDCR surveys occur later in the year
Change in proportion of animals south of ice edge	Uncertain	11% decrease in ice area
Change in school size distribution	Small	
Survey-related factors		
Change in 'like-minke' proportion	Small	Crude estimate: 5% effect
Change in probability of detection on trackline	Uncertain, could be large	Crude estimates: 15% and 40%
Change in Closing mode vs IO Mode bias	Small	Estimate: change of a few %

and interpretation of results. The Committee noted the substantial process error associated with estimates of trend and abundance from the IDCR/SOWER surveys. Some design considerations are given in Annex G (Appendix 9), including outlines of two possible alternative transect designs.

10.2.4.2 WORK PLAN

Annex G (Appendix 10) details the tasks identified by the Committee to further the review of Antarctic abundance estimates, together with an indication of priorities for the next year. Noting the need to resolve the issue of whether or not minke whale abundance has declined in recent years, the Committee **strongly recommends** that substantial progress be made on high priority tasks by the 2002 meeting of the Committee. It also **recommends** that JARPA estimates of abundance and trend in Areas IV and V should be evaluated in a similar way to the way the IDCR/SOWER survey results were evaluated this year.

The Committee recalled that at its last meeting it had strongly recommended holding an intersessional workshop to consider estimation methods and estimates for Antarctic minke whale abundance and trend, but that this had not been funded. It reconsidered the issue this year and drew the Commission's attention once again to the importance of supporting the Committee's work under this Item if the review of Antarctic minke whale abundance and trend is to be successfully completed in the near future. It repeated that the review would necessarily span a number of years. It also noted that the process of methodological development was open-ended and that there was a need to specify a realistic deadline for completion of the review. Given that the third set of circumpolar surveys will be completed in 2002/03 and that the review cannot be completed by its 2002 meeting, the Committee **proposes** that estimates of Antarctic minke whale abundance and trend using the improved methodology developed in the course of the review be presented for the three full circumpolar sets of IDCR/SOWER surveys at its 2003 meeting. Recognising also that some further analyses might be required in the light of these results, the Committee proposed further that the review be finalised at its 2004 meeting. The Committee will develop more detailed plans for intersessional work related to the review at its 2002 meeting and, if necessary, at its 2003 meeting.

In order to provide sufficient time at its next meeting to consider the results of intersessional work and to plan its work for the remainder of the review, the Committee **strongly recommends** that a full two days be set aside immediately before the 2002 meeting specifically to address methods and results relating to the estimation of Antarctic minke whale abundance. It further noted that the arrangement this year, in which less than two days were set aside for this purpose and the second of these overlapped the first day of the Scientific Committee meeting, had compromised the effectiveness of the meeting.

The budget requests are considered under Item 21. They include successful completion of the 2001/02 SOWER survey, and the Committee **recommends** a two-day meeting and other high priority items from Annex G (Appendix 10).

10.2.5 Other

The results of genetic analyses in SC/53/IA17 re-emphasised the importance of collecting genetic samples from whales in putative breeding grounds in lower latitudes. It was also noted that the results suggest that estimation of population dynamics model parameters may be more complicated than previously envisaged.

10.3 Southern Hemisphere blue whales – plan for assessment (see Annex G)

10.3.1 Abundance estimation

SC/53/IA24 included a population estimate for blue whales in an area south of Madagascar in December 1996, as part of the SOWER blue whale research programme. All of the 110 identified blue whales were putative pygmy blue whales. The resulting estimate was 424 (CV = 0.42) whales, or 472 (CV = 0.48) whales if 'like-blue' sightings were included. This is believed to be only a partial population estimate, as the distribution of past catches in the region in December covered a much wider geographical extent than the research area. Some evidence of feeding on euphausiids was noted and possibly linked to the presence of an upwelling cell at the southeast tip of Madagascar. The Committee welcomed this population estimate, despite being only a partial estimate, as there were no other current estimates for this population.

Branch and Butterworth (2001a) provided estimates for blue whales in the Antarctic from the IDCR/SOWER surveys. The estimates for CPI, CPII and CPIII were 440 (CV = 0.41), 550 (CV = 0.48) and 1,100 (CV = 0.45). The proportion of 'like blue' whale sightings was substantial in CPIII. If 'like blue' sightings were assumed to be blue whales, the comparable estimates in CPI and CPII did not change, but the CPIII estimate increased to 1,340 (CV = 0.47). Some analyses were also presented which used the simple extrapolation method described above to provide comparable estimates among the three circumpolar sets. Comparable estimates were 550 (CV = 0.41), 610 (CV = 0.49) and 1,250 (CV = 0.45). Including 'like blue' sightings increased the third circumpolar estimate to 1,560 (CV = 0.46). The proportion of pygmy blue whales in these estimates is unlikely to be more than 5%. Last year (IWC, 2001l, p.222) a number of reservations were raised about the inferences in trend that could be drawn from the estimates for blue whales.

The Committee was pleased to receive these estimates and noted that almost all issues relating to estimation methodology raised previously had been addressed. These are detailed in Annex G (Appendix 11). Insufficient time was available to discuss these in detail.

Ohsumi raised the question of inter-specific competition between blue and minke whales and the Committee noted that this issue should be considered next year.

10.3.2 Progress on sub-species differentiation

SC/53/IA16 examined a total of 647 video sequences of 142 animals and 56 photographs of 31 animals obtained through IWC/SOWER and other cruises from 1995/96 to 2000/01, with the objective of producing distinctive external morphological keys for discriminating between sub-species of blue whales at sea. The paper concluded that blowhole shape, body proportions and a tendency for the putative pygmy blue to submerge without showing dorsal fin and keel are promising keys for discriminating between sub-species at sea (although the last was found not to be statistically significant). In light of these results, the Committee **recommends:** (1) video-taping the blowhole region using a high resolution digital camera whenever a blue whale is found; and (2) completing a genetic analysis of the blue whale biopsy material obtained on IDCR/SOWER cruises, taking account of the three morphological characters.

SC/53/IA28 described the preliminary results of the effort to archive and analyse the acoustic recordings from the IWC-SOWER cruises. Approximately 500 out of 700 hours of recordings have been digitised and analysed. These analyses reveal that: (1) blue whale sounds were recorded throughout each of the cruises in both mid- and high-latitude recording sites; (2) all blue whale sound types recorded south of 60°S were similar, independent of longitude; (3) blue whale sounds recorded south of 60°S were different from sounds recorded in mid-latitudes off either Madagascar (1996) or Chile (1997); (4) blue whale sounds recorded from the two mid-latitude locales were different from each other; (5) post-processing of acoustic data detected blue whales at more stations and detected many more blue whale sounds than noted in the field; and (6) blue whale acoustic detections were at least three to four times more likely than visual sightings. The priority now was determining the linkage between the sounds, the genetics and the morphology. This would require locating the calling whale in real time, through the use of a towed array or DIFAR sonobuoys. The Committee agreed with this suggestion and **recommends** that the matter be referred to the meeting of acoustic specialists that had been proposed (and funded thanks to individual contributions from the UK and Denmark) last year but which had not yet taken place. In addition, the Committee **recommends** that tapes held by Ljungblad be added to the archive.

The question of better seasonal coverage of blue whale acoustic behaviour in the Antarctic was raised. The Committee was informed by Thiele that year-round monitoring of blue whales in the Antarctic Peninsula region was being undertaken and that the results would be reported to the next meeting.

Results of an acoustic study off Perth, Western Australia were summarised. They suggested that calls were being received from in excess of 50km away and possibly much further, mainly along the edge of the continental shelf. Calls were twice as frequent at night as during the day. It was noted that the acoustic signatures of the blue whales off Western Australia were different from those of Antarctic blue whales recorded to the south of Australia and also different from those off Chile and Madagascar.

10.3.3 Other

Mikhalev presented a continuation of the work by Ukrainian and Russian scientists in recovering data to correct previously falsified records from Soviet whaling operations and covered the biological characteristics of blue whales taken in the Antarctic by the *Slava* and *Sovetskaya Ukraina* from 1954/55 to 1960/61. In all cases the actual blue whale catch was lower than that reported to the BIWS. The sizes of the whales taken were also significantly smaller than those reported, because blue whales of all sizes were killed as they were encountered, including suckling calves as small as 8.5m. The Committee greatly appreciated receiving this report, thanked Mikhalev for his efforts and looked forward to receiving further information if it became available.

10.3.4 Work plan

The Committee identified the following as important tasks to advance the assessment of Southern Hemisphere blue whales:

(1) acoustic species identification (see Annex G for details);
(2) address, as appropriate, issues of methodology and trend which had not already been considered (see Appendix 11, Annex G);
(3) access historic catch data for use in stock assessment;
(4) prepare for a stock assessment (including possible interactions with other species);
(5) consider feasibility of satellite-tagging Antarctic blue whales to establish location of breeding grounds;
(6) continue sub-specific differentiation by genetic markers, using the morphological keys.

The priority of the work on Southern Hemisphere blue whales relative to assessment of other species is discussed under Item 10.8.

10.4 Southern Hemisphere humpback whales – review progress towards assessment (see Annex G)

10.4.1 Abundance estimation

SC/53/IA18 presented estimates of current humpback abundance south of 60°S and their annual rate of increase in Antarctic Areas IV and V between the 1989/90 and 2000/01 seasons using JARPA data. In Area IV, the size of the humpback whale population in 1999/2000 was estimated as 12,093 (CV = 0.29) by SV and 11,960 (CV = 0.14) by SSV. The number of humpback whales in Area V in 2000/2001 was estimated as 4,251 (CV = 0.48) by SV and 3,477 (CV = 0.31) by SSV. Assuming that the data from closing mode on IWC IDCR/SOWER surveys and JARPA SV could be used in the same way, the estimates using SV were treated as indicators of the current abundance. Estimated annual rates of increase were 17.2% (CV = 0.29) and 10.2% (CV = 0.59) in Areas IV and V, respectively. In response to concerns about the biological plausibility of a rate of increase of 17.2%, it was noted that that this was a preliminary estimate over a time span of only 12 years and that there was genetic (and Discovery marking) evidence of stock-mixing in the area which might complicate interpretation of trends, especially if the mixing rate varied annually.

The Committee recalled that at its previous meeting it had concluded that insufficient evidence had been presented to resolve the issue of correlation or otherwise between minke and humpback spatial density distributions (IWC, 2001i, p.179). It had therefore recommended that this issue be investigated intersessionally, using data from JARPA and IDCR/SOWER surveys (IWC, 2001k). No new evidence or analyses were presented to the Committee this year, although its attention was drawn to the fact that some analyses had been conducted by Kasamatsu *et al.* (1998). As insufficient time remained to obtain and consider these analyses at the time the Committee was notified of them, it again **recommends** that this issue be investigated intersessionally using data from JARPA and IDCR/SOWER surveys and looked forward to seeing the results of these analyses in a paper presented to the 2002 meeting of the Scientific Committee.

In relation to the comparability of SV data from JARPA and closing mode data from IDCR/SOWER surveys, the Committee noted that although the two modes were essentially the same, (1) the bias of conventional line transect abundance estimates obtained from either of these modes depends on the degree of clustering; and (2) in the case of the IDCR/SOWER surveys, passing mode data was used to correct the bias and so obtain an index of abundance that was comparable across years - because passing mode estimates are believed to be robust to the degree of clustering of schools (see Clarke *et al.*, 2000). It was noted that the

Committee had recommended 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 (IWC, 2001i, p.189).

Branch and Butterworth (2001a) presented abundance estimates for humpback whales in the Southern Ocean area from the IDCR/SOWER surveys. The resulting estimates for the CPI, CPII and CPIII are 7,100 (CV = 0.36), 9,200 (CV = 0.29) and 9,300 (CV = 0.22). Some analyses were also presented which used the simple extrapolation method to provide estimates for humpback whales from comparable areas from these surveys. This method relies on the assumption that the density of humpback whales in each northern surveyed stratum is the same as the density in the corresponding unsurveyed area between that northern stratum and 60°S. Comparable estimates are 9,200 (CV = 0.37), 7,100 (CV = 0.29) and 10,800 (CV = 0.21). There is no evidence of statistical trend from these comparable estimates, although Area IV was not included because it had not yet been covered in CPIII. Area IV is south of Australia, where an increasing trend has been observed in humpback whales during the breeding period.

It was noted that although the IDCR/SOWER surveys had wider spatial coverage than JARPA surveys, the resulting estimates were substantially lower and did not show a similar rate of increase. Butterworth speculated that whatever factor was causing lower estimates of minke whales in the third circumpolar set of surveys might be affecting these results too and he felt this merited further attention. Attention was drawn to the large variability of the estimates and therefore it was queried how they could be used in the assessment. Another concern was that the estimates came from surveys targeted at another species, so it was not clear how appropriate the design had been for humpback whales.

The Committee noted that while there might be other estimates of current abundance available for stocks D and E that could be used in an assessment, this was not the case for some other stocks, for which the estimates from the cruises remained the only ones available.

10.4.2 Further population dynamics modelling

Initial assessments of breeding stocks of Southern Hemisphere humpback whales, presented last year, had been updated in SC/53/IA20 to follow suggestions made at that meeting. Changes to the model and data are given in Annex G. Results were similar to those presented at the previous meeting, except that incorporation of a demographically based upper bound on the intrinsic growth rate parameter led to some reduction in the estimated current depletion for breeding stock E (East Australia). The model fits to relative abundance data for breeding stocks D and E were broadly comparable with earlier CPUE trends off the West and East coasts of Australia respectively. In the absence of further catches, breeding stock D (West Australia) was predicted to approach its pre-exploitation level within the next 15 years and breeding stock E within the next 25 years. Alternative hypotheses for the allocation of historic catches to breeding stocks had little impact on assessment results, but these results were sensitive to inputs for recent abundance in absolute terms and to the rates of increase estimated from surveys in cases where these were not that precisely estimated.

The Committee welcomed this paper, which it considered a substantial advance on last year's analysis. A review of progress and recommendations for further work is given in Annex G (Appendix 13).

The Committee welcomed genetic analysis work detailed in SC/53/IA32 as an advance in our knowledge of possible stock structure in the West African breeding ground, but recognised that if the assessment was to be carried out on a breeding ground basis, such sub-division posed problems in terms of allocation of catches on the feeding grounds. This raised the issue of whether density-dependence occurs on the feeding or breeding grounds.

10.4.3 Other

The Committee was pleased to receive information on updates to the Antarctic humpback whale catalogue and **recommends** that the work continue to be supported. Best suggested that giving any scientist conducting research on humpback whales access to the catalogue would be in the interests of the Committee's work and that such access should be given. In response, it was noted that the terms agreed by the major contributors to the catalogue, when it was set up, were that only those contributing photos to it could access its contents. This issue will be discussed next year.

SC/53/IA2 reported on the distribution and abundance of humpback whales off the northeastern coast of Brazil. The Committee welcomed these results and looked forward to further work in this area.

SC/53/IA1 described a proposed photo-identification and genetics-based assessment of humpback whales in the wintering grounds of Areas V and VI. The Committee strongly endorsed this project, which they considered valuable for the work of the Committee.

Bannister referred to Jenner *et al.* (2001), a compilation of information on humpback whale movements off Western Australia based on the published literature and the results of original fieldwork. Important among the latter was a nine-year photo-identification study (1990-98). The Committee **recommends** that the results of the photo-identification study should be made available as soon as possible

Last year, the Committee welcomed the establishment of a coordinated research and conservation effort for humpback whales in the Indian and Southern Atlantic Oceans (including B1, B2, C1, C2, C3, Kenya/Tanzania and Oman). SC/53/IA23 provided a summary of a workshop that was organised and recently convened in Cape Town, South Africa, to discuss regional efforts on humpback research and encourage broader regional collaborative efforts in the Indian Ocean and Southern Atlantic waters mainly surrounding Africa's coast. The Committee welcomed the new information and proposal for coordinated activities for these under-studied areas of Southern Hemisphere humpback whale distribution. It **strongly recommends** that the coordinated programme proposed for the Indo-South Atlantic take place and the Committee looks forward to updates on progress from these efforts.

The Committee was pleased to receive information in SC/53/IA21 from a sightings survey in the coastal waters of Benin, which threw new light on the possible extent of the B1 stock. It looked forward to receiving more data on this population, its seasonality and movements.

SC/53/O14 presented catch totals for humpback whales, fin whales, blue whales and five other species involved in Southern Hemisphere whaling from 1904-1999. It was not clear to the Committee whether the catches used in this compendium were consistent with the series used in the assessment. The authors agreed to check this with the Secretariat.

10.4.4 Work plan

The Committee proposed the following work plan to further the assessment in the coming year.

(1) Obtain estimates of ROI, abundance and stock structure data relating to breeding grounds or migration corridors, especially for stocks for which no reliable information is currently available. The Committee believed that such information might be forthcoming for a number of populations before next year's meeting.
(2) To the extent possible, run the humpback population dynamics model for breeding stock E with three sub-populations, for which individual population estimates are available: catches on feeding grounds might be split using Discovery marking data.
(3) Conduct a sensitivity analysis for breeding ground C, using the combined Mozambique and low-latitude Madagascar abundance estimates, as reported in SC/52/IA10.
(4) Investigate use of a population dynamics model disaggregated by sex for stocks D and E.
(5) Investigate use of a model with some depensation.
(6) Investigate the data from whaling operations from a time shortly after blue/humpback whales were protected that are held by the IWC Secretariat (see IWC, 2001i, p.185), with a view to using them to provide relative abundance indices.
(7) Investigate the feasibility of using a model that incorporates information on biological parameters, similar to that being developed for the North Atlantic.
(8) Investigate the use of the abundance estimates from IDCR/SOWER and JARPA survey data in the population dynamics model.
(9) Update the Antarctic humpback photo catalogue.
(10) Investigate the issue of correlation between minke and humpback whale distributions on IDCR/SOWER and JARPA surveys.

The priority of work on Southern Hemisphere humpback whales relative to assessment of other species is discussed in Item 10.8 below.

10.5 Southern Hemisphere fin whales (see Annex G)

10.5.1 Abundance estimation

Estimates of current abundance of fin whales from JARPA surveys (SC/53/IA18) and from the IDCR/SOWER surveys south of 60°S (Branch and Butterworth, 2001a) were presented, but not discussed due to lack of time.

10.5.2 Work plan towards future assessment

See Item 10.8 below.

10.6 North Atlantic humpback whales (see Annex H)

Last year, high priority was given to undertaking a Comprehensive Assessment of North Atlantic humpback whales at this year's meeting (IWC, 2001a, p.26). A number of important preparatory intersessional tasks were identified and Commission funding was sought and received. Work that had been completed during the year included: (1) a workshop to bring together and to summarise the results of the Years of the North Atlantic Humpback (YoNAH) project; (2) a substantial review of the catch history; (3) the development of an assessment model to incorporate the known population structure and catch history; and (4) an analysis of genetic material to provide further information on stock structure. The Committee noted that completion of these tasks had been essential to the work of this meeting.

The Committee recognised the important contribution of the YoNAH project, noting that much of the data available for this Comprehensive Assessment is derived from it. This information is summarised in SC/53/NAH1, with additional detail in other papers presented to the meeting (Annex C). The Committee noted that YoNAH is a good example of successful international collaboration and draws attention to the value of such projects to its work.

10.6.1 Stock identification

The Committee reviewed existing information on the population structure and stock identity of North Atlantic humpback whales.

Humpback whales spend spring, summer and autumn on feeding grounds in temperate or high-latitude waters. In winter, animals migrate to mating and calving grounds in tropical or subtropical waters, where they are generally found associated with islands or offshore reef systems. In the western North Atlantic, humpback whales occur on feeding grounds from the eastern coast of the USA, through eastern Canada to West Greenland (Annex H, fig. 1). In the central and eastern North Atlantic, feeding grounds occur off Iceland and northern Norway, including around Jan Mayen and Bear Island. Whales from all of these areas have been assumed to mate and calve primarily in the West Indies in winter but some whales of unknown northern origin breed around the Cape Verde Islands.

The Committee received substantial new information on population structure and stock identity of humpback whales on their feeding grounds (SC/53/NAH8, 10, 11, 20, 21, 26), on migration (SC/53/NAH3, 13) and on their breeding grounds (SC/53/NAH11, 18, 19; Reeves *et al.*, 2001; Swartz *et al.*, 2001). Details are given in Annex H, items 5.1, 5.2 and 5.3, respectively.

New information on migration in the northeastern North Atlantic was available to the Committee from Charif *et al.* (2001) and as a report of unpublished information (Annex H, item 5.2).

In summary, the available data strongly suggest that population structure in North Atlantic humpback whales is characterised by relatively discrete feeding substocks, with strong fidelity to specific feeding grounds by individual whales and low rates of exchange among them. Strong site fidelity also influences movement patterns within feeding grounds; the extent of intra-area movement also declines with distance.

There is clear evidence for the existence of at least two breeding stocks in the North Atlantic. Western North Atlantic humpback whales migrate primarily to the West Indies. Barents Sea whales mainly breed in one or more other unknown locations. Whales that feed in the central North Atlantic come from more than one breeding stock, one of which is known to over-winter in the West Indies.

The only breeding ground, other than the West Indies, known from historical and contemporary data is the Cape Verde Islands, but to date there is no direct evidence to support the idea that this is a breeding ground used by central and eastern North Atlantic animals. That there may be a separate breeding population in the Norwegian Sea as suggested by Ingebritsen (1929) and the results presented in Annex H (item 5.2), raises the possibility that there are three separate breeding stocks in the North Atlantic.

10.6.2 Abundance and trends

10.6.2.1 METHODOLOGICAL ISSUES

Information on methodological issues relating to mark-recapture estimates of abundance using photo-identification data was presented in SC/53/NAH5 and NAH14. Details are given in Annex H (item 7.1).

10.6.2.2 FEEDING GROUND ESTIMATES

SC/53/NAH10 presented abundance estimates for the Gulf of Maine. These included a mark-recapture estimate of 652 (CV = 0.29) based upon YoNAH photo-identification data from 1992 and 1993 and line transect estimates based upon shipboard and aerial surveys conducted in 1999 of 816 (CV = 0.45), or 902 (CV = 0.41) including areas of the Scotia Shelf. Minimum numbers of individually identified animals known to be alive were given as 1992 (501 whales) and 1997 (497 whales).

SC/53/NAH1 gave mark-recapture estimates for eastern Canadian waters using YoNAH photo-identification data. A pooled estimate of 1,807 (CV = 0.053) was likely to be seriously negatively biased because sampling within eastern Canada was highly variable spatially. A spatially stratified estimate of 2,509 (CV = 0.077) did not account for movement of individuals between strata and almost certainly still suffers from significant negative bias due to spatial heterogeneity in sampling.

Mark-recapture estimates of abundance for West Greenland from 1988-1993 ranging from 362-615 were given in SC/52/IA1. The estimate from 1990-1991 was anomalously large and was based upon less representative geographic sampling coverage. A weighted mean of the remaining four estimates was 385 (CV = 0.062). An analysis of data from humpback whale sightings made during aerial surveys for minke whales in July/August 1993 in West Greenland was presented in SC/53/NAH23. The author agreed that, as the analysis was preliminary, the results should not be used as an estimate of abundance at this time.

SC/53/NAH24 presented an estimate of humpback whale abundance from shipboard line transect surveys around Iceland conducted during 1995. After some discussion it was agreed that neither the presented estimate nor confidence interval should be considered to represent abundance in the area.

SC/53/NAH21 gave results from extensive line transect surveys conducted principally for minke whales in the Norwegian and Barents Seas. For humpback whales, in addition to previously published estimates of 1,126 (CV = 0.31) for 1988 and 689 (CV = 0.59) for 1989, a new abundance estimate of 889 (CV = 0.32) for 1995 was presented.

Further details are given in Annex H (item 7.2).

10.6.2.3 BREEDING GROUND/OCEAN BASIN ESTIMATES

SC/53/NAH2 presented an estimate of ocean-basin-wide abundance from YoNAH data in 1992/93 of 11,570 (CV = 0.069). YoNAH sampling in the feeding grounds was not spatially representative and this represents a negatively biased estimate for the whole ocean basin.

SC/53/NAH2 also presented a series of estimates for the period 1979-1993 that did not use samples collected off Iceland and Norway, thus excluding animals from these areas that migrate to breeding ground(s) other than the West Indies. Because sampling on the West Indies breeding grounds appears to have been representative with respect to feeding ground origin, these should be unbiased estimates of the West Indies breeding stock. Estimates ranged from 6,920 to 12,580 and CVs ranged from 0.070 to 0.39.

After considerable discussion of the possible biases resulting from different combinations of data from feeding and breeding grounds included in the estimates, differences in animal distribution and timing of presence in the breeding ground, the Committee agreed with the authors that the series of estimates for the West Indies breeding stock should be used in the assessment with the exception of the four estimates utilising breeding ground samples for 1988/89-1990/91. Because of concerns that pooling samples from consecutive years in both feeding and breeding grounds introduced serial correlation, the entire series of abundance estimates and additionally a series using alternate estimates (to ensure independence) was used.

10.6.2.4 TRENDS

SC/53/NAH2 also presented an estimate of average annual increase in abundance of 0.031 (SE = 0.005) for the period 1979-1993.

10.6.3 Biological parameters

Average age at attainment of sexual maturity (more accurately, age at first birth minus one year) has been estimated at five years for the Gulf of Maine population for the period 1979-1991 (Clapham, 1992). An alternative estimate derived from the same dataset through an interbirth interval model gave a similar result (Barlow and Clapham, 1997).

In SC/53/NAH10, the growth rate for the Gulf of Maine population was estimated at either 1.00 (using a calf survival rate of 0.51) or 1.04 (using a calf survival rate of 0.875) using an inter-birth interval method applied to data from 1992-2000. Both estimates are outside the 95% confidence intervals of a previous estimate of 1.065 for the period 1979-1991 (Barlow and Clapham, 1997). Most of the difference appears to be the result of a reduction in calf survival rates between 1992 and 1995; however, reduced adult female survival and increased inter-birth intervals may also have contributed. The possibility that the apparent reduction in calf survival was related to a shift in distribution cannot be rejected; indeed, such a shift occurred during exactly the period (1992-95) in which estimates of survival rates declined.

An estimate of survival rate for the Gulf of Maine of 0.96 (SE = 0.008) was available from Barlow and Clapham (1997).

10.6.4 Catches and incidental takes

SC/53/NAH15 updated the review of catches by Mitchell and Reeves (1983) that focussed largely on the western North Atlantic, in an attempt to provide a more comprehensive overview of humpback takes from all known fisheries in the North Atlantic. The emphasis was on defining and delineating fisheries, describing the nature of data sources and identifying gaps in coverage. Thirteen 'fisheries' were defined based largely on whaling methods (e.g. non-mechanised, transitional or mechanised and pelagic vs shore-based), nationalities of the whalers and areas of operations. Three of these fisheries were further divided into a total of 20 regional 'sub-fisheries'. Details are given in Annex H (item 6.1).

SC/53/NAH15 identified several sources of data that merit further examination to improve the catch history, including the daily journals of West Greenland shore stations during the late 18th and 19th centuries, British colonial

records for Bermuda and possibly one or more islands in the West Indies and Portuguese archival and other records on Cape Verdes shore whaling. It was also emphasised that a detailed account of Sigurjónsson's (1988) method of estimating 2,800 humpbacks taken at Iceland prior to 1915 would be useful.

The Committee expressed its thanks to Reeves and Smith for the considerable amount of work invested in the production of the catch information.

Further work during the meeting determined an appropriate way to use sex composition information to allocate 19th century catch data from the Cape Verde Islands and West Indies by sex and determined an appropriate way to allocate estimated breeding ground catches by the American whalers between the West Indies and Cape Verde Islands. Further details are given in Annex H, item 6.1.

Annex H, Appendix 2 gives further details of the methods used to allocate catches and shows the total estimated landings by fishery and the total estimated removals from feeding and breeding grounds calculated using agreed struck and lost rates.

Aboriginal catches from locations in the North Atlantic were included in the catch series summarised in SC/53/NAH15. The Committee agreed to complete the catch series through 2000 using reports filed with the Commission by St Vincent and the Grenadines.

Information on incidental takes of humpback whales is available on a continuous basis only from the Gulf of Maine and from Newfoundland in earlier years. Annex H (item 6.3) gives details of available information. The Committee noted that incidental mortality is theoretically taken account of in Gulf of Maine survival estimates and agreed that known entanglement mortalities from Newfoundland/Labrador should be included (as minimum values) in its assessment.

10.6.5 Environmental concerns

The Committee briefly considered available information on a variety of environmental issues potentially affecting humpback whales. A study of chlorinated organic compounds in humpback whales off the northeastern coast of the USA (Lake *et al.*, 2001) found that contaminant burdens were significantly higher in males than in females. Samples collected from humpback whales in the Gulf of St Lawrence showed similar contaminant levels in most of the studied compounds.

Coastal development and the attendant increase in runoff, pollution, tourism, boat traffic and other factors were discussed as a potential threat to humpback whale habitats, especially in nearshore waters. Areas of particular concern were identified as the breeding grounds in the Caribbean and the Cape Verde Islands, as well as the southern Gulf of Maine, which is preferentially used by mothers with calves (SC/53/NAH12). High levels of noise from oil and gas operations in the Gulf of Paria were detected by the acoustic survey summarised in Swartz *et al.* (2001); the absence of humpback whales from this region contrasts sharply with data from American whaling logbooks, which show significant numbers of animals in this area in the 19th century (Reeves *et al.*, 2001). Whether the current paucity of humpback whales in the Gulf of Paria reflects abandonment of this habitat because of the noise there is unknown, but this issue represents a concern.

SC/53/NAH25 described a study of humpback whale entanglement in the Gulf of Maine. Assumptions that observed injuries were entanglement-related were successfully tested against whales with documented entanglements during the study period. Between 48% and 65% of each annually collected sample exhibited scarring that was likely to have resulted from a prior entanglement. Males were more likely than females to exhibit entanglement-related scars. Yearlings exhibited the highest rate of entanglement, although whales continued to become entangled when mature. Calves had a significantly lower rate of entanglement than all other age classes. As a group, females exhibiting evidence of a prior entanglement produced significantly fewer calves during the study period than did females with no evidence of a prior entanglement. Some 31% of the animals sampled in 1997 and re-sampled in 1999 acquired entanglement-related scars between events, while severe entanglement-related injuries were detected at an average rate of 1-2%.

10.6.6 Assessment and management advice

10.6.6.1 SPECIFICATION OF ASSESSMENT

SC/53/NAH16 provided a framework for the assessment of North Atlantic humpback whales. The underlying population dynamics model for this framework is density-dependent as well as age- and sex-structured. It allows for up to two breeding stocks and multiple discrete feeding substocks. The model is fitted to data on absolute abundance, trends in relative abundance, rates of increase and information about the proportions of animals in each feeding substock from each breeding stock (including details of catches of males, females and calves). The model does not include depensation.

Given the uncertainty in various aspects of the input to the assessment model, the Committee agreed that there should be tests of the sensitivity of model output to a range of values in some input data. These and general considerations regarding values to be used, are discussed below.

BREEDING STOCKS AND FEEDING SUBSTOCKS

The Committee agreed that, because there are at least two breeding stocks in the North Atlantic (see Item 10.6.1), the assessment should include two breeding stocks (the maximum number that can be accommodated by the assessment model). One clearly over-winters in the West Indies. Two scenarios would be used for the second: (1) that the second breeding population over-winters in the Cape Verde Islands; and (2) that the West Indies and Cape Verde Islands should be treated as a single breeding stock, with a second breeding stock which, for the purpose of this assessment, was assumed to over-winter in the southern Norwegian Sea (see Item 10.6.1).

The number of feeding substocks in the North Atlantic depends on how the Gulf of St Lawrence, Iceland and Norway are treated. In photo-identification comparisons, the former region shows higher levels of exchange with Newfoundland and Labrador than do other feeding grounds, but also has low but significant levels of difference in genetic analyses. In light of this, it was agreed that the assessment should be structured considering all of eastern Canada as a single substock and alternatively with the Gulf of St Lawrence and Newfoundland/Labrador considered as two separate feeding substocks.

With regard to Iceland and Norway, given the size of the areas concerned and the difficulty of assigning animals in region to a particular breeding stock, it was agreed that they should be treated separately for the purpose of the assessment.

The Committee agreed to allocate the proportions of animals from Iceland and Norway to the two breeding stocks using figures derived from the genetic data (SC/53/NAH11). The proportions of humpback whales from the second

breeding stock in feeding substocks off Iceland and Norway were estimated from nuclear as well as mitochondrial loci assuming that the samples from the Gulf of Maine contained only individuals from the West Indies breeding stock. The CV of the proportions was estimated assuming a binomial distribution, which ignores the contribution of variance from the genetic basis of the estimation. These values are given in Annex H (Appendix 5).

ASSIGNMENT OF CATCHES

The methods and rationale for the assignments of catches to specific areas are given in Annex H (Appendix 2).

Allocation of catches from the eastern North Atlantic to the hypothesised Norwegian breeding stock requires information on the seasonal and spatial distribution of those catches. Information was not available to the meeting to allow this. Accordingly, this hypothesis was not considered further at this time.

Annex H (Appendix 2) gives the catch series used in the assessment runs.

RATES OF INCREASE

It was agreed to run the assessment model using the estimated rate of increase of 0.063 (SD = 0.11) for the Gulf of Maine for the period 1979-1991 (Barlow and Clapham, 1997). The alternative, more recent values for the Gulf of Maine from SC/53/NAH10 were compromised by possible sampling problems, did not have an associated standard deviation (which is necessary for the model) and were not used. To reflect uncertainty over this, it was agreed to include a model run without information on rate of increase in the Gulf of Maine.

ESTIMATES OF ABUNDANCE

Estimates of abundance used in the assessment are given in Annex H (Appendix 5). No estimate was used for eastern Canada given that the only available estimate is known to be unreliable.

ESTIMATES OF RELATIVE ABUNDANCE

The relative abundance series for Iceland given in Annex H (Appendix 5) was used in the assessment.

SURVIVAL RATE

Based upon data from the Gulf of Maine (Barlow and Clapham, 1997; SC/53/NAH10) and considering possible differences in other areas, it was agreed to adopt a value of 0.96 for survival rate of age 1+ whales and to test the sensitivity of the model to a range of 0.94 to 0.98. It was recognised that application of the Gulf of Maine estimate to the entire North Atlantic, as is assumed by the model, may not be appropriate.

SEX RATIO OF CALVES

It was agreed to use an even sex ratio for calves in both catches and births based upon data in Smith *et al.* (1999) and other published sources.

Annex H (Appendix 5) gives a complete list of the (non-catch) data included as input to the assessment model.

10.6.6.2 RESULTS OF ASSESSMENT MODEL RUNS

Using the input data given in Item 10.6.6.1 and Annex H (Appendices 2 and 5), attempts to fit the model outlined in SC/53/NAH16 to the hypothesis of separate breeding populations in the Cape Verde Islands and the West Indies did not identify a single set of parameter values that is able to reconcile all of the information (catches, abundance estimates, mixing rates, rates of increase, etc). This lack of a satisfactory result meant that it was not possible to complete the Comprehensive Assessment at this meeting. The lack of model fit was further explored by attempting to fit the data after down-weighting selected input datasets. Details are given in Annex H (item 10.2).

The Committee agreed that while it was disappointing that the Comprehensive Assessment had not been completed at this meeting, considerable progress had been made. Furthermore, the assessment runs had illuminated some interesting questions and issues that should be explored further intersessionally (see Item 10.6.7) and it was anticipated that the Comprehensive Assessment would be successfully completed at the next meeting.

10.6.6.3 MANAGEMENT ADVICE

Although it had been unable to complete the Comprehensive Assessment at this meeting, the Committee agreed that the in-depth and in-breadth review of information on humpback whales in the North Atlantic confirmed that an appropriate unit that should be considered for management was that of the feeding substock. This is in agreement with the use by the Committee of the term 'feeding substock' as an example of either a 'substock' or a 'closed substock' in its deliberations on stock definition under Item 11.

10.6.7 Work plan for completing assessment

10.6.7.1 MODEL DEVELOPMENT

With regard to further development of the assessment model, there are several uncertainties in the model and in the input data that need to be considered to determine how all the data may be reconciled. The Committee **recommends** that the following tasks be undertaken intersessionally.

(1) Model development allowance for:

  (a) different MSYR rates in different feeding grounds (constrained not to vary dramatically among such grounds);
  (b) temporary movement of animals between feeding grounds (i.e. an overlap hypothesis);
  (c) differences in survival rate among feeding grounds;
  (d) three breeding stocks.

(2) Model testing examination of:

  (a) the impact of depensation;
  (b) the impact of removing each data source in turn;
  (c) the effects of where density-dependence is assumed to act.

To facilitate this work, the software developed to implement the model needs to be re-parameterised to a more robust formulation and additional software developed to allow more rapid graphical evaluation of the fits. The Committee **recommends** that an Intersessional Steering Group be formed to oversee this work (see Annex U).

10.6.7.2 CATCH DATA

The Committee recognised that it is important to obtain improved catch data to facilitate completion of the Comprehensive Assessment. Areas that would benefit from further work are listed below.

(1) Further examination of the American non-mechanised pelagic fishery catches from the West Indies and the Cape Verde Islands. Additional information is available in voyage logbooks, many held in public collections. The subset of logbooks used in this meeting was not a representative sample. It would be useful to examine a subset of logbooks, selected to be representative of the 'Atlantic' fleet, for voyage details such as species and area.
(2) Review of historical data sources for land station humpback catches in the Cape Verde Islands. A person has been identified who would be able to examine the historical sources in both Portugal and the Cape Verde Islands. Those sources are likely to improve understanding of the historical catches in this region.
(3) Examination of northeast Atlantic catch data by season. Additional information is available in Norwegian land station logs, many held privately. Other historical archives may also be useful in interpreting the catch data from the Northeast Atlantic.
(4) Review of additional historical data to allocate unidentified catches to species in the Faroe Islands and Iceland for the period approximately 1880-1930. Sigurjónsson had indicated to Smith that the data he had used earlier was available and that further analysis of this information was possible. The present allocation is not well documented and improvement is necessary.
(5) Further examination of Bermuda Blue Books and other colonial records on the Bermuda shore fishery. Additional sampling of the voluminous records on Bermuda history in the Public Record Office and in institutions in Bermuda would help resolve questions about scale of removals and fishery trends.
(6) Review of Blue Books for Grenada, St Lucia and other West Indies islands not previously covered in studies of whaling history. This matter was raised in sub-committee discussions, where it was noted that Grenada served as a major collecting point for whale oil to be shipped overseas and that St Lucia and possibly other islands not previously identified as having substantial shore fisheries for humpbacks should be considered. The relevant data sources should be available in the Public Record Office.
(7) Examination of whaling station diaries from West Greenland. As noted in SC/53/NAH15, there should be useful information on humpback whaling activity in West Greenland for the period late 1700s to mid-1800s in the diaries kept at West Greenland shore whaling stations. Documentation of humpback catches in Davis Strait during this period is otherwise poor. There is reason to believe that the primary source materials are available in Copenhagen; their use will require competence in Danish, but an individual has been identified who may be willing to assist with this effort.

The Committee agreed that all the items listed above should be pursued, with highest priority given to the first two items. Smith noted that funding for preliminary work under (1) would be made available through the USA. The Committee **recommends** that should this preliminary work be successful, Commission funding should be sought for the remainder of this task.

The Committee expressed its hope that local scientists or historians would assist in the search for and interpretation of, appropriate material under points (3), (4), (6) and (7) above. Lawrence informed the Committee that the work identified under (6) above would be taken forward and the Committee looked forward to receiving the results. Smith drew particular attention to the importance of completing the work under point (4).

Smith noted that his recent collaboration with the History of Marine Animal Populations Project (HMAPP, based at Southern Denmark University, the University of New Hampshire, USA and the University of Hull, UK) had been very helpful in facilitating work on historical whaling catches. He requested that the Committee accept HMAPP's offer to continue this collaboration. The Committee agreed and **recommends** that the Secretariat contact the HMAPP Steering Group to convey this.

10.6.7.3 ADDITIONAL ANALYSES AND DATA COLLECTION

The Committee agreed that the highest priority for future data collection was obtaining additional photographic and genetic samples from the Cape Verde Islands to elucidate the question of the stock identity of the animals which breed there. The sub-committee on the Comprehensive Assessment of North Atlantic humpback whales endorsed a proposal to conduct such work in the winter of 2002 (Annex H, Appendix 7) and recommended it to the Committee for consideration for funding. This is discussed further under Item 21.

The Committee also considered a USA proposal to conduct a large-vessel acoustic and visual survey in the eastern Caribbean, with emphasis on deeper-water areas away from the island chain (Annex H, Appendix 8). The Committee considered that while humpback whales do occur in these offshore waters, albeit in low densities, the priority for additional information from such a survey was lower than for the Cape Verde Islands.

As noted in SC/53/NAH22, other research in coastal waters of the West Indies is planned. The Committee encouraged cooperative research in this area. Carlson noted that opportunistic and/or dedicated surveys off Guadeloupe as well as off St Barthelemy and possibly Martinique would be conducted during the coming winter. The Committee welcomed this information.

The Committee encouraged the planned research in the West Indies and looked forward to receiving results at next year's meeting.

The Committee identified a number of additional analyses that would be a valuable contribution towards the Comprehensive Assessment.

(1) There are uncertainties about applying Gulf of Maine survival rates to other areas, survival rates could be estimated from photo-identification datasets other than the Gulf of Maine (e.g. West Greenland; the entire YoNAH data set). This would be aided by matching the YoNAH dataset to the North Atlantic Humpback Whale Catalogue (NAHWC). In addition, survival rates for the Gulf of Maine including data for more recent years should be estimated.
(2) Preliminary calculations from the Gulf of Maine photo-identification catalogue held by the Center for Coastal Studies suggest that mature females have produced an annual average of 0.32 calves surviving to approximately six months of age. Further analyses of these data are required to enable assessment model output to be interpreted (see Annex H, item 10.2).
(3) The extent of individual heterogeneity in capture probabilities could be explored using the extensive Gulf

of Maine dataset to evaluate the magnitude of potential effects on abundance estimates.
(4) Differences among animals from various feeding grounds in patterns of migration to the West Indies could be further evaluated. This would also benefit from matching the NAHWC to the YoNAH dataset.
(5) Patterns of migration of the putative Norwegian breeding population could be investigated using historical records.
(6) The present and previous distribution of humpbacks in waters around the British Isles and the Faroe Islands could be investigated from sighting and possibly historical records, especially because the present low abundance appears to be inconsistent with the historical catches.
(7) The YoNAH sampling was restricted spatially to the main breeding grounds in the West Indies. Recent survey results (SC/53/NAH17) suggest that there are groups of humpbacks to the east of the YoNAH study site in the Greater Antilles. Further information on the relationships between the animals in those areas with animals on Silver Bank and other West Indies breeding grounds would allow the possibility that YoNAH abundance estimates are biased to be investigated.
(8) The assumption that humpback whales found in the Lesser Antilles and those found in the Greater Antilles are all part of the same breeding population is based on limited information. Additional photographic and/or genetic samples from various island areas in the Lesser Antilles would allow this to be tested.

The Committee's attention was drawn to a major sightings survey taking place in the central and eastern North Atlantic in summer 2001. The results of this survey would provide valuable information for next year's meeting, particularly with respect to abundance around Iceland.

10.7 Other small stocks – bowhead, right and gray whales (see Annex F)

10.7.1 Small stocks of bowhead whales

10.7.1.1 DAVIS STRAIT/BAFFIN BAY AND HUDSON BAY/FOXE BASIN STOCKS OF BOWHEAD WHALES

SC/53/BRG1 provided information from five bowhead whales tagged with satellite transmitters in Disko Bay, West Greenland, in May 2001. Two of the whales moved from Disko Bay to northern Canada. These whales crossed the central part of Baffin Bay relatively rapidly, leaving little time for feeding. The whales were presumably feeding in both Disko Bay in May and in the North Water in June. This study confirms that bowhead whales move between West Greenland and the Canadian high Arctic and consequently may belong to the same stock.

SC/53/BRG5 reviewed genetic variation among populations of bowhead whales summering in Canadian waters. Renewed aboriginal subsistence harvests of bowhead whales in the eastern Canadian Arctic have prompted a need to more closely monitor the status of these animals. Information from the study of genetic markers can help answer questions about stock structure, distribution and movement, breeding strategies and population dynamics. Samples from 89 individuals representing three putative stocks were analysed for variability at 13 nuclear DNA microsatellite loci and along 343 base-pairs (bp) of mitochondrial DNA sequence. Mitochondrial DNA diversity was high, with 22 haplotypes represented in 89 individuals. Analyses of the data support the idea that the Davis Strait/Baffin Bay stock is distinct from the Hudson Bay/Foxe Basin and Bering-Chukchi-Beaufort Seas stocks. Results also suggest that the Hudson Bay stock is more similar to the Bering Sea stock than it is to the Davis Strait stock.

In SC/53/BRG6, genetic diversity and population structure in bowhead whales were evaluated through the use of both historical and extant samples. DNA has been extracted and sequence data obtained from the mitochondrial control region (D-Loop) from a total of 80 samples dating back to 1,000 years before present (YBP) from the eastern Canadian Arctic. These have then been compared with present day samples collected from multiple free-ranging populations. Planned future research will integrate collections of bowhead remains housed in museum collections in the United States, Canada, Norway, Russia and Greenland from present-day dating back to 10,000 YBP to evaluate stock structure through these different time periods and over an extensive geographic range. This information should provide a more complete picture of bowhead whale diversity and stock structure over the last 1,000 years. The Committee **recommends** that this work continue and welcomes results from these studies that provide valuable information on stock structure and changes in genetic variation in bowhead whales.

In its review of the Hudson Bay/Foxe Basin stock last year, the Committee received an abundance estimate of 'at least' 485 animals and identified a number of ways in which the estimate could be improved. It also received information that the Government of Canada had set a Total Allowable Catch for this stock of 1 animal in three years.

The Committee noted that this stock would be considered as a Fishery Type 3 case in the context of AWMP development (see Annex E). Fishery Type 3 refers to small populations (of the order of 300 animals) where demographic and environmental stochasticity may have a critical effect on the survival of the stock. The SWG on the AWMP has yet to consider this in detail but had noted the promising approach outlined in SC/53/AWMP2 (see Item 8.5 above).

Given the low estimated stock size, the lack of information on appropriate methods to manage small populations and the removal of one animal in August 2000, the Committee **urges** caution in the setting of any catch limits for this population and **recommends** that priority be given to research to:

(1) obtain improved abundance estimates;
(2) pursue modelling efforts for use in the management of small populations.

10.7.1.2 OTHER STOCKS

A long-term study that started in 1995 to better understand the status and ecology of Okhotsk Sea bowhead whales was continued in August and September of 2000. Thirty biopsies and 32 skin samples were collected during the 2000 field season. This study is part of the USA-Russia Agreement on Cooperation in the Field of Environmental Protection.

10.7.2 North Atlantic right whales – progress on recommendations

In recent years the Committee has expressed grave concern over the status of this population (e.g. IWC, 2001a, pp.33-35). In particular it has noted that **it is a matter of absolute urgency** that every effort be made to reduce anthropogenic mortality in the population to zero.

An update of North Atlantic right whale mortalities was provided. For the last three years, these were as follows: 1999, 2 (one ship-strike, one entanglement); 2000, 1

(unknown cause, carcass not recovered); and 2001 to date, 4 (two ship-struck calves and two neonatal mortalities). These new mortalities bring the total number of known right whale deaths from 1970-2001 to 50, with breakdown as follows: 18 due to ship-strike, 3 due to entanglement, 15 neonatal mortalities and 14 of unknown cause. It is likely that human-related mortalities are under-represented in these data, since not all carcasses were recovered and necropsies in earlier years may not have been sufficiently thorough to rule out ship-strike as a cause of death.

After several years of very low calf production (including only one calf in 1999/2000, three in 1998/99 and five in 1997/98), there were 30 calves observed in the winter of 2000/2001. This is the largest number ever observed in this population although of course the average annual calving rate remains much lower than this. To date (9 July 2001), four of the 30 calves are known to have died, including two killed by ship-strike. The cause of the extreme variability in calf production in recent years is unclear, but there is some evidence from body condition data suggesting that food limitation is involved. A study of reproduction is ongoing in this population, including endocrinological investigations examining steroid hormone levels from samples of right whale faeces.

SC/53/BRG2 provided the report of a workshop held in March 2001 to discuss right whale acoustics in relation to practical applications for effective conservation and management. The aim of the Workshop was to evaluate the technical feasibility of using passive acoustic monitoring to obtain information on North Atlantic right whale distribution, at appropriate spatial and temporal scales, to develop measures to reduce anthropogenic mortality. The Committee welcomed the Workshop Report. It noted the potential contribution of acoustic techniques to reduce anthropogenic mortality and commended the recommendations for future research.

Mate *et al.* (1997) described movements of satellite-monitored North Atlantic right whales tracked to identify their late-summer and early autumn habitat use patterns and the areas where anthropogenic interactions are most likely. Nine whales were tagged in the Bay of Fundy in 1989-91 and were successfully tracked for a total of 13,910km in 195 whale-tracking days. In addition to the Bay of Fundy, tagged whales were located over slope edges near banks/basins, upwellings, thermal fronts and the edges of warm core rings, where high concentrations of zooplankton can aggregate. The extensive movements recorded here may represent searching for food and it was speculated that the long-range movement of the female and calf may 'teach' the calf where and how to feed. Distribution of the tagged whales included areas of high anthropogenic activity, including shipping lanes and fishing areas.

SC/53/BRG7 described the feeding and migratory movements of North Atlantic right whales from satellite-monitored radio tags applied during July/August 2000. Sixteen North Atlantic right whales were fitted with Argos (satellite monitored) radio tags in the Bay of Fundy. Of the 16 whales tagged, 12 returned data, 9 of which provided locations for > 5 days, accounting for a total of at least 16,132km of travel. Many whales travelled broadly over the central to southwestern Scotian Shelf and/or throughout the Gulf of Maine. Most locations were over shallow shelf waters. These data will be used to assess risks to right whales from shipping and fishing activities. Future tagging will hopefully identify as yet unknown winter habitat for most of the population and the alternate summer feeding habitat.

Last year, in reviewing the results of the Workshop on the Effects of Tagging on North Atlantic Right Whales (Kraus *et al.*, 2000), the Committee had recommended 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 addition it had recommended (IWC, 2001a) 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 the attachment devices.

In response to a question as to whether this work had been carried out, Mate indicated that he had been unaware of the recommendations but to the best of his knowledge no additional work had been undertaken. The field work programme began only five weeks after the Annual Meeting. However, he stressed that efforts have been made to minimise the risk of infection since earlier studies, including some carcass testing. Further, Fujiwara reported to the Right Whale Tagging Workshop that the survival rate of previously tagged whales was the same as that of untagged whales. The data collected so far from the animals tagged in the 2000 study have not indicated any adverse effects, but monitoring will continue. He noted that the information derived from tagging North Atlantic right whales has proved valuable in helping to identify areas of high risk both in terms of ship collisions and fishing gear entanglements.

The Committee believed that it was unfortunate that its recommendations from last year had not been drawn to the attention of Mate and his colleagues. The Committee recognised the need to balance the potential gain for the population from the information obtained (e.g. in highlighting high risk geographical areas) with concerns for individual animals (and the possible long-term consequences for this small population). However, it **reiterated** both the concerns and recommendations made last year.

In this regard, it welcomed the fact that Mate and Kraus intended to carry out the analysis of risks referred to in the first of the recommendations given above.

The Committee was informed that a multi-disciplinary workshop was being planned to address issues related to the entanglement of right whales in fishing gear. Although precise details are not yet available, it was noted that this is in accord with one of the high priority items identified by the Committee (IWC, 2001, p.220) and the Committee therefore **endorses** the Workshop and looks forward to receiving the results from it.

Table 1 in Annex F updates the progress on the recommendations made last year.

10.7.3 Southern Hemisphere right whales – research progress

SC/53/BRG8 reported on a combined photo-identification/genetic study carried out on right whales in South African coastal waters between July and October, 1995 and 1996, in which a total of 327 non-cow/calf pairs was sampled. Apparent courtship groups ranged from 2-10 animals and tended to be larger than non-courtship groups. Most focal females were therefore young, pre-pubertal animals and being the focal animal did not normally result in conception. The study will continue with a microsatellite analysis of the 120 cow/calf pairs sampled in 1996 and 1997, to establish *inter alia* what proportion of males observed in the apparent courtship groups sired calves produced the

following year. Clark commented that acoustic monitoring of similar groups off Argentina had revealed a high level of vocal activity and the animals were very active during these interactions. He noted that it was an interesting enigma that individuals would expend this amount of energy on an activity that did not result in conception.

SC/53/E17 documented information concerning right whales incidentally caught in fishing operations in South Africa between 1978 and 2000. During this period, 22 instances of right whale interactions with fisheries were recorded. The majority of these (80%) were released alive.

10.7.4 Other small stocks of right whales

LeDuc *et al.* (2001) reported on recent surveys for right whales in the southeastern Bering Sea. Between 1997 and 2000, research vessel and aerial platforms were used to collect both genetic and photographic data from a small population of summering right whales. Aerial surveys were conducted during July of 1998, 1999 and 2000. Three sightings of single right whales and a single sighting of a pair were made in 1998. A single right whale was seen from the air in 1999 and five whales were seen during a concurrent vessel survey. During 2000, five sightings were made of a total of 13 animals. Genetic analyses revealed that of the 11 samples taken, the total number of unique individuals was six. The sample set contained two mitochondrial haplotypes and all genetic samples were from males. Eleven unique individuals were identified from the photographs taken over the three-year study. The total lengths of the whales measured ranged from 14.7-17.6m.

SC/53/BRG15 provided monthly plots of right whale sightings and catches from both the 19th and 20th centuries. The analyses confirm that the size and range of the right whale population is now considerably diminished in the North Pacific relative to the situation during the peak period of whaling for this species in the 19th century.

10.7.5 Western North Pacific gray whales

Western gray whales are isolated from eastern gray whales, remain highly depleted and show no apparent signs of recovering (SC/53/BRG12). Joint Russian-American research off Sakhalin Island, Russia, between 1995-2000 has produced important data on the current status of this population. The population size is small (< 100 whales – see SC/53/BRG12) and fewer than 50 reproductive individuals remain in the population. New concerns have now been identified. These include: (1) 'skinny' whales observed for the first time in the population during the summer of 1999 and during the summer of 2000 more 'skinny' whales were observed; (2) only a small number (12) of known reproductive females; (3) lower than expected number of calves on the summer feeding ground in 2000; (4) a > 2:1 male bias in the population; and (5) all nine calves biopsied to date are males[1]. These data in combination with potential impacts from anthropogenic threats throughout the range of this population raise strong concerns about the recovery potential and continued survival of the western gray whale.

SC/53/RMP5 reported that eight gray whales were sighted 15 n.miles off Sakhalin Island at a water depth of 80m. Photographs were taken of four animals. One was confirmed as a resighting (Brownell, pers. comm.). These were the only gray whales seen during the survey and this provides further information on the restricted distribution of this population at this time of the year. Brownell also noted that if copies of original photographs were available it may be possible to make additional matches.

Information in Baker *et al.* (2002) described the genetic detection of a gray whale in products from Japanese markets in 1999. These products might have originated from the gray whale known to have been landed at Suttsu in 1996, or they might have been from a different whale. The authors noted that based on genetics it was not known with certainty from which population any of these products came. The Committee noted the probability that the products were from the western population and viewed the removal of even one animal (genetic analysis revealed it to be a female) from this very small population with concern.

SC/53/BRG22 presented information of plans to conduct seismic surveys off Sakhalin Island in the Odoptu field along the northern half of the western gray whales feeding habitat during August 2001. The cumulative impact of gray whales avoidance to active seismic vessels could reduce the total number of feeding days available to the whales. Based on the current status of this population and the 'skinny' whales observed over the past two years, the authors recommended that no seismic surveys take place while the whales are on their feeding ground.

The short-term responses of migrating gray whales to experimental seismic activity were studied by Malme *et al.* (1983). The responses of mother-calf pairs had been immediate and obvious. Clark believed that the authors of SC/53/BRG22 had under-estimated the possible effects of seismic activity on this population. Ohsumi also expressed his concern for this population, especially given the background of social development taking place in countries in the region. He also pointed out that the population faced similar development threats at the southern end of its range, such as round Hainan Island, China. Although he was highly appreciative of the joint Russian/USA research programme, he felt that a wider international effort, involving other nations in the region and extended to other areas of the population's range, was necessary.

The Committee agreed with these concerns and those expressed in SC/53/BRG22. It concluded that the evidence that the western gray whale population is in serious trouble is compelling. It has been known as a relict population since it was rediscovered in 1979. Based on results from a joint Russian-USA project, which indicated a small population size with fewer than 50 reproductive individuals, this population was listed by IUCN in 2000 as 'Critically Endangered'. Since the listing, several new concerns have arisen, including the occurrence of 'skinny' whales in the summers of 1999 and 2000, the small number (12) of known reproductive females, a lower than expected number of calves in 2000 and a male bias in the population (including all nine calves biopsied to date). Given all the above, the Committee believed that it is a **matter of absolute urgency** that research and management programmes be continued and expanded immediately. This is the only way to ensure the survival of the western gray whale population. Actions needed include: (1) the expansion of the current international research and monitoring programme with an adequate and stable funding base; (2) the establishment of more effective monitoring and protection measures; and (3) an increase in the level of cooperation between scientists, industry and government officials.

The Committee **strongly recommends** that the long-term research and monitoring programme started in 1995 be continued and expanded for these whales and their habitat. The basic projects for monitoring the population

[1] Additional analysis of samples resulted in 60% males and 40% females respectively. Reanalyses of the nine calves resulted in 78% males.

(vessel-based photo-identification work, shore-based distribution and behavioral observations and biopsy sampling) must be continued annually. Additional research is urgently needed for: (1) benthic sampling; (2) theodolite-based behavioral observations; (3) acoustic monitoring; and (4) telemetry (movements on feeding ground and migration pathway). Benthic work is especially needed to better understand the current status of the feeding ground on the northeastern coast of Sakhalin Island. The 10 year research and monitoring plan presented to the Committee in 1999 needs to be updated, as soon as possible, in light of the new threats facing the population that were discussed this year. However, with respect to telemetry, the Committee draws attention to the concerns and recommendations it has made with respect to such work with critically small populations (see Item 10.7.2).

Tormosov introduced a letter on western gray whales from the Chair of the Inter-departmental Ichthological Commission (M.E. Vinogradov) in Moscow which in addition to points (1) and (4) above advises the following urgent measures:

(1) development of toxicological benthic control and control for whales in order to elucidate the causes of their current pathological condition; and
(2) devise a number of measures aimed at conservation of whales and protection of their feeding grounds during further development of the Sakhalin II project.

Komatsu received confirmation that the Ichthological Commission was not a Government Agency of the Russian Federation.

The Committee noted that it is a **matter of absolute urgency** that every effort be made to reduce anthropogenic mortality (including direct catches) to zero and to reduce various types of anthropogenic disturbances to the lowest possible level. The Committee took special note of a plan to conduct seismic surveys in the northern part of the gray whales feeding ground off Sakhalin Island in August 2001 and **strongly recommends** that no seismic work be conducted while whales are present, because: (1) gray whales are known to exhibit strong avoidance responses to seismic survey activities and could be displaced from critical feeding habitat; (2) this region is the only known feeding ground for the population; (3) the cumulative impacts of seismic operations on the health and survival of these whales are unknown; and (4) the observations of 'skinny' whales in the area in 1999 and 2000. Furthermore, all future monitoring and mitigation plans for seismic surveys and other activities related to Sakhalin oil and gas development need to be reviewed by experts not funded directly by industry.

The Committee noted that in previous meetings (IWC, 1997a, p.91; IWC, 1998b, p.94) it had recommended that the Commission should arrange to bring together scientists from countries with an interest in, or within the range of, this stock to identify the research and management measures required to maximise the chances of it recovering. The Committee **recommends** that a similar approach be adopted this year. It also noted the importance and value of continuing various comparative studies between the western and eastern gray whale populations.

The possible reasons for the unusual phenomena (lowered calf counts, emaciated whales, increased mortalities) recently seen in both stocks of gray whales were discussed. These reasons included a random stochastic event, density-dependence alone, density-dependence together with a stochastic event and a broader shift in the environmental regime. Although some support was expressed for just about all these possibilities, the Committee felt that the process of hypothesis generation should be separated from that of testing and that future population trajectories would assist greatly in such testing.

10.7.6 Work plan

The Committee agreed to assess the western stock of gray whales in parallel with the eastern stock in 2002 (Item 9.4).

10.8 Other

The Committee noted that the sub-committee on in-depth assessments had had insufficient time to discuss all items on its agenda at this meeting. In particular, no information relating to fin whales could be considered or results relating to blue whales discussed fully. It agreed that priority should be given to completion of the review of minke whale abundance at its next meeting, but expressed concern that this would leave insufficient time to devote to other species at that meeting. It had also been suggested that it should consider making provision for assessment of Southern Hemisphere sei whales at its next meeting or in the near future. It noted that the available data for Southern Hemisphere fin and sei whales were insufficient to support an assessment of the sort being conducted for Southern Hemisphere humpback whales, but recommended that a form of assessment appropriate to the quantity and quality of available data should be developed for these two species. It **recommends** that the Committee's agenda and sub-committee structure for the 2002 meeting should be reviewed with this in mind. This is considered further under Item 19.

11. STOCK DEFINITION (SEE ANNEX I)

11.1 Terminology

In 2000, the Committee had noted that there was a danger that inconsistent usages would develop within the IWC, with respect to words like 'stock' that relate to population structure and/or management. The Committee had recognised the value of clear and consistent terminology. Achieving this is more difficult than it sounds, mainly because many potentially suitable terms have already been used elsewhere for other purposes and moreover some terms have had multiple conflicting meanings.

Some members drew attention to the following definition of a 'unit stock' given by the FAO secretariat:

> In theory, a Unit Stock comprises all the individuals of fish in an area, which are part of the same reproductive process. It is self-contained, with no emigration or immigration of individuals from or to the stock. On practical grounds, however, a fraction of the unit stock is considered a 'stock' for management purposes (or a management unit), as long as the results of the assessments and management remain close enough to what they would be on the unit stock.

In their view, the term 'stock' should refer essentially to a self-contained biological unit based on the reproductive process and not on management considerations; management is essentially aimed at conserving that unit as a whole, rather than necessarily conserving any particular smaller units. These members believed that it is purely for reasons of practicality (including estimation errors) that

management area boundaries may differ from those encompassing the whole biological stock and that this view was implicit in the work of both the RMP and AWMP sub-committees. Other members disagreed, noting that there are several other current usages of the word 'stock' and that some of these are specifically linked to management objectives.

The Committee agreed to use the term 'biological stock' to describe all the individuals in an area that are part of the same reproductive process. A biological stock thus forms a self-contained unit, with emigration/immigration rates far lower than the intrinsic rate of population growth.

It was noted that, as well as the 'biological stock', there might be other appropriate units of management in some cases (see Item 11.7 and Annex I).

Several other working definitions were agreed, at least temporarily and for the purposes of consistent terminology in this year's report. However, it was noted that not all terms were fully satisfactory (particularly 'substock') and that further consideration would be required in future.

(1) Management stock/management unit: a human construct defined in the context of management, that may or may not be equivalent to a single biological stock. It refers to animals that happen to be present in a defined region and defined season where management is taking place or is contemplated. The term has a close connection to *Area* definitions within the RMP and therefore must be used carefully in the IWC to avoid RMP/AWMP implications unless this is specifically intended.
(2) Simulation stock/simulation substock: a computational approximation denoting a homogenous group of animals, used to obtain inferences for management (e.g. in *Implementation Simulation Trials*).
(3) Substock: this deliberately vague term describes a group of animals with some degree of biological cohesion. There are circumstances (for example, on a feeding ground where animals from two breeding stocks are mixed) where other terms might be more appropriate.
(4) Closed substock: this refers to a substock which has negligible interchange with animals outside the substock (i.e. at rates far lower than the intrinsic rate of population growth).

11.2 Case studies

11.2.1 Review of stock structure in North Atlantic minke whales

Because of heavy workloads, it had proved impossible to prepare documentation for this item. However, an *Implementation Review* of North Atlantic minke whales, including discussion of stock structure, is already planned for next year's RMP sub-committee.

11.2.2 Review of stock structure in humpback whales worldwide

DISTRIBUTION

Humpback whales are found in all oceans and from the tropics through to Arctic and Antarctic waters. Most but not all animals breed or overwinter in low latitudes and migrate to higher latitudes in summer to feed. In the North Atlantic and North Pacific, distribution is characterised by several distinct wintering/breeding grounds and by several distinct summer feeding grounds. In the Southern Hemisphere, there are several discrete wintering/breeding grounds and a smaller number of less-discrete feeding grounds. It is generally agreed that there is little exchange of animals between the hemispheres at present, but studies reported below show that such movements must have occurred at least occasionally in the evolutionary past.

The papers cited below (and of course many others) have all contributed to this overall picture, as well as making the specific points noted below.

THE WORLDWIDE PATTERN OF GENETIC DIVERSITY

Baker and Medrano (2001) summarised conclusions from a worldwide study of humpback mtDNA. Three major clades were identified, two in each of the North Atlantic and North Pacific and all three in the Southern Hemisphere. One clade occurred in all three oceans. Within each ocean, the frequency of each clade differed significantly between regions. The complex genetic spatial structure seen today can be explained (based on a phylogenetic reconstruction) by a small number of historical migration events. It was noted that the specific pattern of migration events suggested might be sensitive to imperfections in the difficult process of phylogenetic reconstruction.

Segregation of maternal lineages in the North Pacific and North Atlantic is consistent with a general picture of maternal philopatry on feeding grounds; that is, animals show strong fidelity to particular feeding grounds and calves learn their feeding ground by accompanying their mothers. Many feeding grounds therefore constitute 'closed sub-stocks', with very low immigration and emigration to other feeding grounds, although because of interbreeding the feeding grounds are not reproductively isolated. The degree of segregation among feeding regions is similar in both oceans. In the Southern Hemisphere, differentiation on the wintering grounds is significant, but less than on feeding grounds in the Northern Hemisphere. There were too few data to compare Southern Hemisphere feeding grounds.

There is a long-standing debate about which statistics to use for examining population differentiation (F, Φ, or χ^2). For humpbacks, different statistics might be appropriate for analyses conducted on different spatial scales (see Annex I).

NORTH ATLANTIC

In the North Atlantic, humpback whales feed in summer from the east coast of the USA to west Greenland, off Iceland and off northern Norway. There are several fairly distinct feeding grounds within this range. Interchange between feeding grounds is very limited except between Iceland and Norway. From every feeding ground, at least some whales migrate to the West Indies to overwinter and breed; there are some differences in migration timing depending on feeding ground. However, studies of nuclear DNA on eastern North Atlantic feeding grounds indicate that significant numbers of animals must belong to another biological stock (or stocks). The obvious breeding ground for this biological stock would be the old Cape Verde whaling grounds, to which some Norwegian-feeding whales are still known to migrate; however, acoustic and historical records also show that some whales overwinter off Norway. Photo-identification and genetic analyses of stock structure are in good agreement.

NORTH PACIFIC

In the North Pacific, feeding grounds are found along the eastern North Pacific rim from California to the Aleutians. Several wintering grounds are found off Hawaii, Alaska and Japan, as well as off Central America where samples are lacking. There is high site fidelity to particular feeding

grounds and to each of the three main wintering regions; rates of interchange between grounds within wintering region were generally somewhat higher, but dependent on separation distance. Migration is intricate; whales are known to use almost all combinations of feeding/breeding ground except for the furthest east-west crossings. However, within each wintering ground, there are preferences for some feeding destinations.

Calambokidis *et al.* (2001) reported the results of a vast pan-North-Pacific photo-identification study, on which the above is based. The authors noted that the IWC currently treats humpback whales in the North Pacific as one 'stock' for management purposes; however, the photo-identification results suggested that precautionary management should allow for up to six breeding substocks in different wintering grounds. Infact, it is many years since the IWC has considered the management of North Pacific humpback whales.

On the basis of abundance estimates, historical distribution and genetics, Urban *et al.* (2000) concluded that there is at least one unsampled summering ground containing more than 2,000 whales. The ground(s) may lie off the Aleutian Islands or in the Bering Sea, which would be within the known historical range of humpbacks.

Compared to the North Atlantic, there is a relative lack of distinct geographical features separating the feeding grounds, but there is nevertheless strong site fidelity and some conspicuous gaps in distribution. The gap off British Columbia is thought to be due to local extirpation from hunting in the 20th century. Migratory corridors, many of which cross each other, are very complex and not easy to predict from geography.

SOUTHERN HEMISPHERE

There are numerous discrete breeding grounds along continental margins and island chains in low- and mid-latitudes around the Southern Hemisphere, linked by migration corridors to feeding grounds all around the Antarctic. The feeding grounds are less distinct than within the Northern Hemisphere. Although animals from different wintering grounds do mix on particular feeding grounds, *Discovery* tag data, genetic analyses and photo-identification studies have all shown strong links between specific feeding and wintering grounds.

Genetic analyses of humpback whale biopsies in the Southern Ocean (IWC Areas IIIE, IV, V, VIW) were reported last year in Pastene *et al.* (2000). Most pairwise comparisons of mtDNA showed significant differences between Areas, except when sample sizes were small. Nuclear DNA was not as powerful for the pairwise comparisons, but did indicate non-random mating, implying that different biological stocks are mixed within a feeding ground.

Rosenbaum *et al.* (2000) and SC/53/IA32 described studies on mtDNA from seven breeding grounds or migration corridors within three wintering regions (southwest Atlantic, southeast Atlantic, southwest Indian), as well as comparisons with South Pacific and southeast Indian samples. Significant differences were found between but not within the three main regions. Further genetic work is planned, to elucidate substructure and to compare with feeding ground samples.

In the South Pacific, Garrigue *et al.* (2000) found low exchange rates between wintering grounds, based on photo-identification data. That so exchange does occur is also shown by recent song analyses; a sudden change in the song of humpback whales off eastern Australia is thought to be due to infiltration by some males from western Australia (Noad *et al.*, 2000).

OVERALL LESSONS FROM HUMPBACK WHALES

Humpback whale stock structure is complex but general patterns do emerge. Most humpback whales migrate between low and high latitudes to feed and breed, showing strong site fidelity to individual feeding and breeding grounds. However, humpback whales from a single breeding ground often use various different feeding grounds; and humpbacks on a single feeding ground often come from various different breeding grounds. There are exceptions: not all humpback whales undertake long migrations (e.g. Arabian Sea, northern Norway). Despite the complexity of the details and although the relationship between some sub-stocks remain uncertain particularly in the Southern Hemisphere, understanding of stock structure is generally impressive. This level of understanding relies mainly on genetic (mostly mtDNA) and photo-identification data, the latter being particularly successful for this species. Good understanding has been reached only through major research effort on both feeding and breeding grounds.

Based on the review, the Committee emphasised the need to consider humpback whale management within ocean basins on a case-by-case basis. In particular, consideration should be given to managing on the basis of feeding grounds as well as breeding grounds.

11.3 Recoveries of cetacean (sub)stocks after severe depletion

In the absence of any documentation, it was **agreed** to consider this item next year.

11.4 Non-genetic information

11.4.1 Utility for stock definition

SC/53/SD2 reviewed the various types of non-genetic data that have been tried for stock definition purposes. It was emphasised that utility for 'stock definition' depends on the management objectives; for example, if the unit of conservation is very large in scale, then quite crude measures of differentiation may suffice to delineate management stocks. Five main categories have been employed: morphological, distributional, behavioural/physiological (including age and sex structure), ecological and historical. Table 1 (Annex I) summarises the pros and cons of numerous types of data in each category. All non-genetic methods of stock differentiation (and all genetic methods) have limitations and it is crucial that these limitations be taken into account when considering utility.

Some types of non-genetic data hold special promise for some cases where genetic approaches encounter problems, *inter alia*: to resolve cases of medium dispersal rates where genetic significance tests are predisposed to fail but dispersal is too slow to prevent local over-depletion; to sort out temporary mixing from permanent dispersal; and to distinguish biological stocks which are still close genetically because of evolutionarily not recent separation.

The most successful uses of non-genetic data seem to be when several sources of evidence are used together; for example, in discriminating coastal and offshore stocks of Bryde's whales off South Africa, based on seven different measures. Differences between regions for any one type of non-genetic data can often be explained in several different

ways, but when several types of data are taken together, sometimes the only remaining viable explanation is that of closed breeding or feeding substocks.

Most uses of non-genetic data have been for hypothesis testing (apart from telemetry and photo-identification). Effect size is usually not addressed and significance test levels are chosen arbitrarily. It is thus particularly difficult to interpret negative results (lack of differences) from non-genetic data. In general, it would be preferable to use probabilistic analyses rather than hypothesis tests, although this is difficult when the underlying mechanisms of variation (e.g. the role of gene expression in morphology) are poorly understood; in such cases, efforts to develop this basic understanding should be encouraged.

SC/53/SD5 discussed three non-genetic markers (scarring, foetus length, pollutant load) for 'J'- and 'O'-stock minke whales in the northwest Pacific. For every animal, all three markers made the same assignment to stock. There were small differences compared with the genetic assignment, which is accurate in about 95% of cases. One problem with some non-genetic markers is that there are some age/maturity classes for which the assignment cannot be performed (e.g. because some pollutants accumulate over time except when females are lactating).

11.4.2 Framework for combining genetic and non-genetic information

No written materials were available, but the Committee briefly discussed a question about how to combine assignment probabilities from different markers (genetic and/or non-genetic). It was **agreed** that there was a need to understand how to handle this type of problem and members were encouraged to contribute documents on this topic to future meetings.

11.5 Archetypes of stock structure, harvest regime and management objectives

Archetypes of cetacean stock structure are supposed to be simplified models of plausible stock structures. They allow fundamental questions to be investigated without being overwhelmed by the details of real datasets. Thus, archetypes help develop thinking on appropriate ways to develop practical management approaches when population structures are complex. There are many different archetypes that might be relevant to baleen whale management. This year, there were several papers (SC/53/SD3, SC/53/SD7, SC/53/SD10; see Item 11.6 for details) relevant to two archetypes for continuous distributions: stepping-stone dispersal and the related case of isolation-by-distance. A number of questions arose centred around issues of statistical estimation and robustness of management schemes based on inferred population structures.

Opinions differed as to the relevance of the stepping-stone/isolation-by-distance archetypes to North Pacific minke and Bryde's whales, in particular. It was noted that, since breeding ground samples are lacking and other available data are not particularly informative, it was difficult to eliminate many hypotheses for North Pacific minke whales. The Committee agreed that several different archetypes need to be considered.

It was **agreed** that there should be further exploration of archetypes, to suggest simulation tests of the robustness of parameter estimation and of management schemes for populations with substructure. The Committee **agreed** to establish an Intersessional Working Group (convened by Taylor) to focus on plausible archetypes for minke whales. The four terms of reference are given below.

(1) Design simulation models consistent with minke whale biology that cover several types of population structure. These should eventually include at least: (i) no structure; (ii) stepping stones; (iii) overlapping stepping stones; (iv) isolation-by-distance; and (v) complex two-dimensional structure with behaviour dependent on age, sex, reproductive condition and year-to-year fluctuations.
(2) Choose several sampling schemes that replicate the approximate timing and number of existing samples.
(3) Distribute simulated datasets to analysts, who will try various methods of estimating/placing biological, management and simulation stock boundaries.
(4) Evaluate performance of the different methods in (3) across the range of hypotheses in (1).

The Committee looked forward to receiving the results at next year's meeting.

11.6 Statistical issues pertaining to stock definition

11.6.1 Issues relating to continuously-distributed populations

SC/53/SD3 presented a new method of investigating genetic structure within continuously-distributed populations. The method could be used to identify the presence of stepping-stone structure and/or to estimate dispersal rates in an isolation-by-distance model. The approach was illustrated using Baltic harbour porpoise, revealing evidence of stepping-stone structure within a general pattern of isolation-by-distance. It was noted that different measures of genetic similarity might be tried, depending on each dataset. The impact of seasonal movements was also discussed; ignoring the movements would blur the estimates of dispersal, but stratification by time would weaken statistical power.

SC/53/SD7 presented a new method to suggest plausible population structures for continuously-distributed species, using genetic data. Although tests already exist for certain types of population structure, all the tests first require specific hypotheses about where the substock boundaries are. It is often very difficult to know beforehand what the appropriate boundaries are likely to be, especially for continuously-distributed populations. Existing methods for boundary placement often work poorly in the presence of even very low dispersal rates. The new method was tested on a simulated stepping-stone population with removals concentrated at one end, using a management rule calculated over the whole substock identified to contain the removal site. So far, the method had performed very well in simulations, both for boundary placement and more importantly for robustness of management. Results also pertain to sampling design; it appears that sampling should be concentrated nearest to sites of removal, where conservation concern is *a priori* likely greatest.

The Committee noted the potential value of this work and encouraged the authors to develop the approach for other population structures relevant to whales, for example by extending it to two-dimensional spatial distributions. Numerous methodological issues were suggested for further investigation.

The individual-based models in Tiedemann *et al.* (2000) were briefly presented and discussed. The models can be used to estimate and investigate the effects of genetic dispersal under complex scenarios, such as differential dispersal by sex. First applications include investigation of: (1) comparative estimation of individual dispersion and gene flow; (2) genetic divergence across arbitrary management

stock boundaries when the real structure is isolation-by-distance; and (3) the effect of matrilineal social structure. The basic modelling framework is similar to SC/53/SD7 and SC/53/RMP17, although the dispersal models differ.

All the above individual-based or small-site-based approaches show promise for investigating structure in continuously-distributed populations. As mentioned under Item 11.5, an Intersessional Working Group has been established to further work along these lines.

11.6.2 Other statistical issues

SC/53/SD10 examined the use of mtDNA-based Mantel tests to test for isolation-by-distance, when the real structure consists of stepping-stones with or without dispersal; see Annex I for discussion.

SC/53/O5 presented a method of assessing power for statistical tests of genetic differentiation, using the F_{ST} statistic as an example. The general value of the method was agreed, although as in previous years it was agreed that F_{ST} was not a good criterion for minimum detectable differences.

SC/53/RMP17 and SC/53/RMP18 concerned dispersal rate estimates and significance tests between various sub-divisions of areas 7, 8 and 9 for North Pacific minke whales. There are several methodological aspects of interest (but see also Item 6.2.1 for discussion of aspects with immediate relevance to current *Implementation Simulation Trials*). First, dispersal rate estimates differed significantly across the different area boundaries. Second, when tests of differentiation were performed across different boundaries, the observed *p*-value decreased, which would not be expected if the boundaries of management stocks matched the boundaries of biological stocks. The Committee agreed that one might legitimately interpret unexpected directions of change in *p*-values when putative boundaries are moved as suggestive (but not statistically conclusive) evidence about the location of any real boundaries. Population structure remains uncertain within the ranges of the putative 'O' and 'W' stocks and that further exploration, including other hypotheses about the possible location of stock boundaries, is warranted.

SC/53/SD4 addressed general issues concerning the definition of population structure for minke and other large whales, including the relationship between dispersal rate and gene flow, sampling schemes and timing, differences in basic models of movement; implications for inferring population structure; and the possibility of inappropriate use of genetic analyses. Members expressed a variety of opinions about the limitations to genetic analysis suggested in the paper. Overall, it was agreed that the ideal situation would be to have information from biological as well as genetic studies and to analyse samples from both feeding and breeding grounds.

Two Bayesian approaches to stock definition were considered. From experience, it was **agreed** that Bayesian analyses using the program *Structure*, as used in SC/53/IA25 to examine structure and mixing of true and pygmy blue whales in the Antarctic, were almost never successful in identifying population structure, except when a very strong evolutionary signal is present. It was **agreed** that simulations would be useful to determine the level of dispersal at which the method breaks down.

SC/53/RMP1 outlined a Bayesian mtDNA analysis that assigns relative probabilities to hypotheses of single versus multiple stocks and illustrated some results for North Pacific minke whales. Unfortunately, overall results were highly sensitive to choice of hyperprior parameters. Nevertheless, the approach was **agreed** to be worth further development and detailed suggestions were made for this.

In last year's discussion of gray whales, a simulation study had indicated that genetic differentiation tests should likely have high power to detect any closed substocks. SC/53/SD8 reported the results of such a test, to establish whether the southern feeding group was a maternal genetic isolate established by rare founding events. The data were not consistent with this hypothesis.

11.7 Ways to define stocks for harvested or potentially harvested cetaceans

There was much discussion of the role of management objectives in stock definition. Biological stocks are agreed to be units worthy of individual conservation, but do not necessarily represent the only conservation objective of management. For example, there is almost no interchange of animals between some feeding grounds of North Atlantic and North Pacific humpbacks (see Item 11.2.2). If all animals on one such feeding ground were eliminated, the feeding ground would not be repopulated over timescales relevant to management. However, since animals from different feeding grounds interbreed on shared wintering grounds, the animals on a feeding ground do not constitute a biological stock. From the viewpoints both of sustainable use and general conservation, any feeding-season-only harvest of this species in the Northern Hemisphere would have to be managed separately by feeding ground, i.e. with management units that do not correspond to biological stocks. The point here is that the option to move beyond the level of biological stocks must be retained in order to allow appropriate management in individual cases. It was stressed that the RMP, although based on the concept of a biological stock, is sufficiently flexible to ensure that conservation objectives can be met at scales below that of a full biological stock if desired.

The humpback whale example above has a straightforward practical solution, but interesting questions arise when structure is less understood or less distinct, in particular about where to draw boundaries for assessment and management. In order to guide decision-making in difficult cases, many members had proposed a clarifying principle (Annex P1), which elaborated the principle agreed by the Committee last year (IWC, 2001a, p.44; but see also Butterworth, 2001). Briefly, the new proposal suggests that management around the concept of avoiding local over-depletions, where 'local' is defined relative to feeding or breeding grounds, would provide a framework from which workable definitions of management stocks could be devised. The proposers noted that scientific understanding of cetacean population structure has improved greatly in recent times and that there were implications for harvesting strategies that should be brought to the attention of managers.

Other members, while sympathetic to the intent of the proposal, were concerned that it might be too constraining as an all-purpose definition (see Annex P2). Possible counter-examples were mentioned and it was suggested that the 'humpback-like' case might not be an appropriate default for all large cetaceans. The issue of the appropriate spatial scale of conservation unit will remain difficult in specific cases.

The Committee recognised that it had made considerable progress in discussing this complex issue. For the moment, issues of stock definition should continue to be dealt with flexibly on a case-by-case basis, so as to ensure sensible and

sustainable management procedures. The Committee **agreed** that it would reconsider the issue next year, with a view to presenting a consensus recommendation, or clear alternatives, to the Commission.

11.8 Work plan

The Committee agreed that items listed below should be considered at next year's meeting.

(1) Further review of terminology.
(2) Review of instances of recovery of cetacean sub-stocks after severe depletion.
(3) Statistical and genetic issues:
    (a) based on archetypes of continuous distribution;
    (b) based on other archetypes;
    (c) concerning the interpretation of multiple evidence on stock structure;
    (d) other primarily methodological issues.
(4) Ways to define stocks for harvested/potentially-harvested cetaceans.

The Convenor would arrange intersessionally for reviews to appear under item (2).

12. ENVIRONMENTAL CONCERNS (SEE ANNEX J)

12.1 Pollution issues

12.1.1 POLLUTION 2000+ research programme

The research programme associated with POLLUTION 2000+ (Research to Investigate Cause-Effect Relationships in Cetaceans) is described in IWC (1999b). The programme was strongly endorsed by the Committee, the Commission, ASCOBANS and the ICES Working Group on Marine Mammal Habitats. Last year, the Commission provided £51,000 for the POLLUTION 2000+ programme. This was considerably less than the figure required for full funding. After some discussion with the Steering Group for POLLUTION 2000+ (SGP2000+) and the Chair of the Committee, a revised budget for activities to be supported by the IWC in 2000/01 was approved. It was agreed that the initially proposed research programme would be pared down to include only two sub-components: (1) a bottlenose dolphin project, where field studies on live animals would be carried out at several possible field sites (Sarasota Bay and Charlotte Harbor, USA; southern Balearic Islands (Mediterranean Sea) and the Bahamas); and (2) a harbour porpoise project, where studies would be based on samples collected from dead animals. These are described further below.

After the discussions at the last annual meeting of the Committee and Commission, the SGP2000+ further developed and refined the research programme. To that end, it worked intersessionally and convened a meeting in Texel, The Netherlands, from 28-30 November 2000. Several key points regarding the research programme were agreed. A detailed progress report on POLLUTION 2000+ is provided in Annex J (Appendix 2). It includes a protocol for sample collection developed by the SGP2000+ in conjunction with a contract report from the University of Barcelona.

A funding request to the IWC for 2001/02 was developed by the SGP2000+. It was recognised that adequate funding to fully support this programme for the next two years was unlikely (Annex J, item 11). It was further recognised that within the list of activities requiring IWC support, full support for one programme might diminish the availability of support for another. Some members of the Committee considered additional support for the POLLUTION 2000+ research programme to be very important and noted the strong support from the Commission and other international organisations for this research. Others had reservations regarding funding for this project by the IWC because they believed that it was not related to the purpose of the IWC.

12.1.2 Progress on Phase 1 validation/calibration studies

The following criteria were used to further assist in selection of potential participating analytical laboratories as identified at the POLLUTION 2000+ Planning Workshop (IWC, 1999b). These included: (1) quality assurance, whether there was a focus on marine mammals, participation in inter-laboratory calibration, quality assurance/control (e.g. within run/daily acceptable variances for duplicates or standards; detection limits for analytes; list of analytes); experience (e.g. based on peer reviewed publications); and storage conditions (space, temperature); and (2) finances and laboratory planning, where costs per sample and turn around time were considered.

Based on the first criteria, a shortlist of laboratories was established (Annex J, Appendix 2). These were asked to provide: (1) quality assurance information; (2) where relevant, a summary of experience with analyses of marine mammal tissue; (3) a list of their most recent, peer reviewed publications; and (4) information on costs per sample. The received information will be compiled and sent to the SGP2000+ members. After receiving their comments, a definite list of acceptable laboratories will be established.

12.1.2.1 BOTTLENOSE DOLPHIN SUB-PROJECT: SARASOTA BAY AND CHARLOTTE HARBOR

Live bottlenose dolphins are being sampled to evaluate potential biomarkers of exposure to organochlorine contaminants and their effects. Two field efforts are underway in Florida waters. Long-term resident dolphins in Sarasota Bay are being sampled and examined during capture-release operations to provide information on contaminant burdens as well as health and body condition, in order to 'ground-truth' the potential biomarkers. The Sarasota Bay research effort provides opportunities to sample individual members of a community that has been monitored for four generations, providing extensive background information on life history, reproductive histories, ranging patterns and health. Organochlorine pollution of Sarasota Bay is considered moderate when compared to other proposed areas of study. Biopsy darts are being used to obtain blubber samples from dolphins in Charlotte Harbor, a less-developed estuary south of Sarasota Bay, to evaluate its utility for comparisons as a relatively less-polluted site.

12.1.2.2 BOTTLENOSE DOLPHIN SUB-PROJECT: MEDITERRANEAN

The western Mediterranean population of bottlenose dolphins was identified as a potential target for the POLLUTION 2000+ biopsy sub-project (IWC, 1999b). However, concern was expressed about the actual feasibility of collecting biopsies from this population. During the meeting of the SGP2000+, it was decided that a feasibility survey would be carried out in the Balearic Islands, where bottlenose dolphins are abundant, to: (1) assess whether the collection of a number of biopsies necessary for the programme is feasible and cost-effective; and (2) establish the order of magnitude of the population's organochlorine pollution levels and see whether it fits the expected gradient. During 19-23 June 2001, a biopsy study was carried out in

the coastal waters of the southern Balearic Islands. Three animals were successfully biopsied during this cruise. The samples are being analysed.

12.1.2.3 HARBOUR PORPOISE SUB-PROJECT

Harbour porpoises are frequently bycaught throughout the North Atlantic area. In order to utilise samples from bycaught animals, it is of basic importance to calibrate for post-mortem times. However, the collection of appropriate and sufficient numbers of samples for post-mortem calibration studies was anticipated to be difficult. After extensive consultation, the SGP2000+ is directing efforts towards contacting possible sources of fresh dead porpoises. Potential sources include Arne Bjørge (Norway), Ursula Siebert (Germany), Rune Dietz (Denmark), Gisli Vikingsson (Iceland), Emer Rogan (Ireland), John Lien (Canadian entanglement rescues), Andrew Read and William McLellan (Bay of Fundy) and Anne Collet (participants in BIOCET). It was suggested that some very fresh carcasses might become available from bycatch in fisheries or mortalities associated with rehabilitation programmes or research. Researchers should be prepared to process these animals in accordance with the POLLUTION 2000+ protocols. Every effort should and will be made to secure the necessary harbour porpoise samples starting in the 2002 summer season.

In several countries, there are on-going investigations on harbour porpoises that are contributing to POLLUTION 2000+. These include: the United Kingdom, Denmark, Germany and Norway. Relevant in this context is the project launched by the German Federal Environmental Agency aiming to investigate the influence of pollutants on the endocrine and immune system of harbour porpoises. Investigations are also being performed on live and dead animals from the North Sea, Baltic Sea and from less polluted waters around Iceland, Norway and Greenland.

12.1.3 The 'mini-symposium'

This year, 13 formal presentations were made to the Standing Working Group on Environmental Concerns (SWG) related to studies supported by the POLLUTION 2000+ programme and other pollution-related issues. Reijnders presented an overview of the POLLUTION 2000+ programme and Aguilar looked at patterns in geographical and temporal variation of organochlorine pollutant concentrations in marine mammals.

The SWG heard reports from Rowles, Krahn, Fujise, O'Hara, Siebert and Wells regarding field studies on the effects of contaminants on the health of bowhead whales, gray whales, minke whales, white whales, harbour porpoise and bottlenose dolphins. The last two form part of the POLLUTION 2000+ programme. Stott, Fossi and Jepson reported on developments in biomarkers and toxicopathology. Simmonds talked on the importance of novel compounds in assessing the risk posed to marine mammals by anthropogenic compounds, whilst Hall discussed the extrapolation of contaminant effects on individuals to population. Abstracts for these talks are given in Annex J (Appendix 2, Adjunct 3).

Following the talks there was a panel discussion and the following conclusions were reached: (1) PCB levels in cetacean tissues will probably increase over the next few decades; (2) PCB exposure is a potential threat to cetacean populations and, therefore, should be monitored worldwide, but health effects due to other contaminants (e.g. heavy metals) could also be important and should also be monitored; (3) exposure levels of contaminants in cetaceans in high latitudes will increase faster than they would worldwide because the volatility of contaminants is reduced in colder areas relative to warmer areas and because of greater net transport of contaminants to higher latitudes; (4) the models needed to carry out risk assessment analysis in epidemiology are probably adequate for evaluating the risk posed by contaminants to cetacean populations using data from several long-term studies (e.g. bottlenose dolphins in Sarasota Bay, USA) and should be tested; and (5) the development of biomarkers for assessing the health status of cetaceans has developed considerably over the last 10 years and can now be carried out with non-invasive or only slightly-invasive techniques.

It was noted that the Standing Working Group on Environmental Concerns considered that the 'mini-symposium' had been an effective way of presenting and discussing these matters.

12.2 SOWER 2000

12.2.1 Progress on IWC-CCAMLR research

SC/53/E9 detailed progress on this research. Using data from the CCAMLR 2000 Krill Synoptic Survey, the authors used generalised additive models to estimate the spatial distribution and abundance of baleen whales in the Scotia Sea and Antarctic Peninsula in relation to krill density and oceanographic variables. No attempt was made to determine the role of oceanographic processes with respect to krill density or whale density. Rather, the models examined large-scale relationships in the survey region. Due to time constraints, the authors adopted a practical approach to the line transect component of the analysis, stratifying by geographic strata and relying on pooling robustness properties of the detection function to account for other factors which cause heterogeneity. A parsimonious model selection procedure was used for the spatial models of baleen whales that attempted to reduce potential problems with over-fitting and confounded explanatory variables. The explanatory oceanographic variables were temperature, salinity and water density at various arbitrary depths. *A priori*, except for surface temperature, no particular relationship between whale distribution and these variables was hypothesised. The authors outline some ways in which the model could be improved, including the use of oceanographic data that better define water mass structure. The use of these data would be expected to provide more definitive results about the relationships between whale distribution and the marine environment. It was also noted that these data were yet to be validated by the IWC Secretariat.

In discussion, some members of the Committee expressed their concern regarding the robustness of the results, given the sightings data were pooled across species due to the relatively small number of sightings for most species.

Noting the high priority assigned to validation of the IWC data from this survey last year, the Committee strongly **recommends** that high priority be given to this task, to enable collaborative analyses to proceed. In addition, the Committee noted that the interdisciplinary approach of cooperative studies between CCAMLR and the IWC benefited both organisations. It was noted that it was very important to maintain this cooperation for the IWC to make sure that the remaining analysis of the large whale data, as well as the data verification, proceeded in a timely manner. Further, it was recognised that the CCAMLR member nations would likely be willing to share the analysis cost with the IWC.

Some members of the Committee stated that this programme should receive low funding priority because of its low relevance to the purpose of the IWC. They expressed concern that funding for this programme had and would reduce the availability of funding for the circumpolar survey cruises. Others noted that IWC-CCAMLR cooperation on marine ecosystem studies in the Southern Ocean represented a unique opportunity to investigate how 'bottom-up' processes affect the distribution and dynamics of large whales and that the relatively small amount of funding contributed by the IWC allowed access to a significantly larger contribution by CCAMLR.

12.2.2 Collaboration with SO-GLOBEC

SC/53/E8 detailed progress made on this matter. The first three cruises in the 'year-round' Southern Ocean GLOBEC series for 2001-2002 were conducted from March – June 2001. It was noted that the IWC contribution to this research project was relatively small in 2001 (i.e. £20,000) and that IWC participation would not have been possible without additional funds provided by the Australian Government and equipment loaned by Thiele. IWC researchers participated in all three cruises (*Gould* LMG 01-03 USA mooring cruise, *Polarstern* AntXVIII5b ship and helicopter based studies Germany, *Nathaniel B Palmer* NBP 01-03 USA survey cruise). A combination of ship, zodiac and helicopter based visual survey, tissue biopsy and photo-identification techniques were used on the vessels by the IWC. Passive acoustic moorings and expendable sonobuoys were deployed by the USA passive acoustic team. The most frequently recorded and abundant baleen whale species in the study area were minke and humpback whales. An initial overview of oceanographic data shows strong patterns of correlation between autumn and early winter baleen whale distribution, the inshore cold Antarctic coastal current and upwelling of this cold water produced by intrusions of the Antarctic Circumpolar Current into Marguerite Bay. Adult krill autumn migration was found to occur into inshore waters associated with complex bathymetry. This indicates that some baleen whale prey is available throughout all seasons. Baleen whales were observed in Marguerite Bay as late as June and it is likely that both humpback and minke whales overwinter in this region.

Data analysis, workshop and conference presentations under this budget are proposed to be conducted by Thiele, Hofmann, Klinck, Friedlaender and Moore in 2001/02, as well as participation in three separate SO-GLOBEC cruises. This group has formed to conduct these analyses due to their participation in planning and conduct of cruises; access to existing models of this ecosystem (primary productivity, krill, oceanography and sea ice models); previous time commitment to driving the collaboration; and long-term commitment to continuing the conduct of baleen whale top predator research within the US SO-GLOBEC and other national programmes (without IWC funds) after this season.

It was noted that funding in 2001/02 to support data analysis and participation in on-going field studies is critical to the continuation of this programme, in part because the 2001/02 field season is the last scheduled field season for the SO-GLOBEC research programme. As was the case for the cooperation between the IWC and CCAMLR, some members of the Committee noted there was considerable benefit to the IWC of being involved at minimum cost (for instance the USA surveys cost the NSF US$20,000,000). Other members commented that this programme should receive low priority because of the low relevance of the programme to the purpose of the IWC. It was noted by several members of the Committee that without IWC funding to show substantial commitment from the IWC to the collaboration, there is little incentive for SO-GLOBEC or GLOBEC to continue to provide ship time and other benefits to the IWC.

12.3 Habitat related issues

12.3.1 State of Cetacean Environment

The intersessional e-mail working group responsible for the State of the Cetacean Environment Report (SOCER) was not successful in securing an adequate response from e-mail working group members to allow for the completion of the SOCER prior to the start of the Scientific Committee meeting. The submitted working paper was upgraded to a full document during the meeting. The importance of this report to the Commission (as expressed in Resolution 2000-7) and the responsibility for its annual production by the Committee was also noted. A working group was established within the SWG and given the mandate to prepare recommendations concerning the preparation of future SOCERs. Its recommendations were adopted by the SWG (Annex J, item 7.1).

In the plenary discussion, appreciation was expressed over the amount of work undertaken by the editors of SOCER. However, concern was expressed about the document in its present form being misinterpreted as representing the Committee's view if it became appended to the Committee's report. The Committee noted the size and complexity of the task represented by the compilation of a report such as SOCER. Given this, it was probably inevitable that members of the Committee had a number of problems regarding its scope, selection of entries, misunderstanding of some papers included, implied priorities, etc. Given these difficulties the Committee **agreed** that the SOCER report should **not** be appended to the Committee's report. In the light of Commission Resolution 2000-7, it agreed that the report should be made available to the Commission as SC/53/E21 under the names of the editors.

Recognising the complexity of the task, the Committee **agreed** that attention should be given to further developing the mechanism by which such a report should be compiled and reviewed, the appropriate style and structure of the report and its frequency. In this regard, it thanked the editors of SOCER for initiating what clearly must be an iterative process.

12.3.2 Workshop on habitat degradation

Annex J, Appendix 3 summarises intersessional progress on this item. An intersessional group met in Rome, Italy in June 2001 and considered several potentially complementary approaches to furthering work on cetacean habitat assessment, with a long-term view to quantification and modelling. A broad focus was recommended that would bring together habitat evaluation and cetacean population demographics. It was recommended by the working group that a three-day workshop of some 25 experts be convened to address the following issues: (1) quantify natural and unnatural environmental parameters and; (2) estimate their significance through a combination of direct assessment and modelling. The methodology used to quantify the relationship between environmental variables and the health of a given cetacean population would include multivariate regression of cetacean life history data and habitat properties, evaluation of specific contaminants on individual life history parameters for a given population and

extrapolation from studies on non-cetacean species. An offer to host the workshop was received from ICRAM (Government of Italy).

The next annual meeting will be in late April 2002 hence there will be a relatively short intersessional period. In light of this, the Committee **recommends** that: (1) either the habitat degradation workshop be held intersessionally in 2002, if the necessary support can be found, or the merits of supporting the workshop be again reviewed at the 2002 meeting; (2) the IWC be asked to contribute funding to support the participation of 10-25 scientists at the workshop; and (3) an intersessional e-mail group be established to further prepare to convene the workshop.

A working group of the SWG was established to develop a specific proposal for the Committee regarding a workshop on habitat degradation. The proposal is given in Annex J (Appendix 4).

12.3.3 Research relevant to the Arctic

As noted last year, there are several reasons why the Commission and Scientific Committee are particularly interested in large scale research programmes in the Arctic: (1) the predicted impacts of global climate change are intensified in polar regions relative to lower latitudes; (2) most aboriginal subsistence hunting for large whales takes place in the Arctic, where access to cetaceans is critical to the life style of subsistence hunters; (3) the migratory behaviour of large whales in the Arctic requires international cooperation for conservation programmes to be successful; and (4) the extent to which ozone depletion and subsequent increased levels of UV-B radiation is occurring is far more severe in polar climates than it is in the lower latitudes.

Last year, the Committee agreed that limits on funding were such that the development of a new research initiative for the Arctic ecosystem would be unproductive. Rather, the most reasonable approach to improve on the scientific community's ability to conserve large whale populations that are dependent on the marine ecosystem in the Arctic is for cetacean researchers to join forces with on-going studies in the Arctic. Therefore, in an effort to inform whale researchers associated with the IWC regarding the activities of large-scale national and international programmes already in place or planned for the near future, the SWG established an intersessional e-mail working group chaired by Moore. During the intersessional period, the working group developed a summary of ongoing Arctic research programmes that have relevance to cetacean environmental concerns (Annex J, Appendix 5). Several additional papers relevant to this agenda item were discussed by the SWG and are reported in Annex J (item 7.3).

The Committee recognises the importance of this subject. However, as noted last year (IWC, 2001m, p.239), the effectiveness of the Committee will be compromised if the agenda for a given year is too complex and varied. Therefore, the Committee **agreed** that because several major topics are already proposed for next year's SWG agenda, the topic should be reconsidered at the Committee meeting in 2003.

12.3.4 Competition between cetaceans and fisheries

The Committee agreed that there is little doubt regarding the importance of using models to address the questions, 'if we remove or reduce the number of marine mammals from an ecosystem, should we expect greater yields of fish?' and, 'if we reduce fishery yields, should we expect increases in the rate of recovery of depleted stocks of cetaceans?' Rather, the key question is whether the data are adequate to run the models. The Committee noted that there were currently several datasets and models available that could be used to address these questions. In addition, several research programmes have been on-going for over a decade to address this question. It was the conclusion of the Committee that progress toward answering some of the basic multi-species management questions is possible. However, without adequate support from the IWC, progress regarding the relevance of these studies to cetacean ecology will be slow and cooperation among researchers will be less than optimal.

Last year, it was noted that the SWG had requested support from the IWC to cover the costs of analysis and travel for working group members related to preparations for a workshop of scientific experts on the significance of competition between cetaceans and fisheries; however, this request was denied due to a lack of funding. Therefore, Northridge, who was the chair of an intersessional e-mail working group, contacted experts identified at last year's meeting and solicited their opinions regarding: (1) was the proposed workshop worth convening and if so, would they be interested in participating? (2) what key papers are available? (3) was the approach described in the terms of reference for the workshop (IWC, 2001m, p.247) the best way to proceed? and (4) what are the key modelling and data inadequacies?

The Committee **recommends** that:

(1) the SWG and Committee should respond to its failure to attract any funds from the Commission to pursue this project by agreeing to a less ambitious and more focused approach to the proposed workshop, but retain the terms of reference reported in IWC (2001m, pp.247-248);
(2) the focus of the workshop should be to address the question, 'How are changes in abundance of cetaceans likely to be linked (in the short term and the long term) to changes in fishery catches?';
(3) one of the objectives of the workshop should be to define the modelling developments and data requirements that would be needed to achieve the goals identified in the terms of reference agreed by the Committee last year (IWC, 2001m, pp.247-248);
(4) the workshop should be relatively short (i.e. 2-3 days);
(5) an expert on each of the relevant modelling approaches should be invited to present a critique of the current state of development of such models and to explain the merits of their approach;
(6) a list of experts to invite to the workshop should include Yodzis, Aydin, Tjelmeland, Constable, Harwood, Savencoff and Stefansson; and
(7) the workshop should be held between February and the April start of the Scientific Committee meeting in Japan next year.

The following new draft terms of reference are proposed. These are intended as a supplement to the terms of reference approved last year:

(1) review existing modelling approaches that might be used to address the question posed in the previous paragraph;
(2) identify the constraints and data requirements in the existing models or modelling approaches that limit our ability to answer the above question;
(3) describe the advantages and disadvantages of the various approaches, bearing in mind the areas for which they were developed; and

(4) identify those approaches that seem most likely to be able to answer the above question and provide guidelines as to when and where they might be used (e.g. depending on the likely level of data availability).

The Committee **recommends** that funding to support this workshop be made available as soon as possible. A tentative budget to cover the cost of travel and subsistence for up to seven participants to a meeting in St Lucia was estimated at £10,000. Other attendees would need to be self-financed. This cost assumes that there would be no on-site costs to the IWC. Joseph noted that the Government of St Lucia had re-extended its kind offer to host the meeting. Joseph agreed to investigate further the details of the offer.

A Steering Group for the workshop was established, consisting of Northridge (Chair), Walløe, Joseph (assuming the workshop would be held in St Lucia), Tamura, Friday and Donovan. The Committee agreed that, if firm plans to convene the workshop could not be agreed by the second week of October 2001, including the issue of funding, the proposed workshop would be postponed. It was agreed that as soon as funding was secured (if prior to 15 October 2001), the Steering Group would contact the list of experts to determine their availability during the February-April 2002 period.

There was general agreement that there was insufficient time to properly review the contributions related to this agenda item during this meeting. Several papers were considered by the SWG regarding this agenda item. Two of them are highlighted here. SC/53/E3 summarised the efforts of a group of inter-disciplinary scientists at the Alaska Fisheries Science Center (Seattle, USA) that are in the process of refining and updating the 1980s eastern Bering Sea Ecopath/Ecosim model that was described in Trites *et al.* (1999). SC/53/O9 reported the preliminary results of an Ecopath/Ecosim model for the western North Pacific as part of JARPN II research.

12.3.5 Linking environmental measures and cetacean demographics

The Work Plan adopted last year referred to the need to 'investigate correlations between environmental factors and differences between observed cetacean demographic parameter values and their predicted trends in the absence of environmental effects'. This year it was noted that two approaches were useful for linking environmental variables to cetacean demographics: (1) 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; and (2) research is undertaken to understand the underlying environmental processes ultimately responsible for cetacean demographics (IWC, 2001m, p.248). It was agreed that this topic should be on the agenda for the 2001 meeting and members were encouraged to prepare and submit papers for review. However, there were no specific papers received this year. Several papers did include material relevant to this agenda item and these papers are summarised in Annex J (item 7.5).

12.4 Health effects from the consumption of cetaceans

12.4.1 WHO contaminant reporting requirements

The findings of the work of Rowles relating to electronic submission of data on chemical contaminants in food were discussed. For many years the World Health Organisation (WHO)-Global Environment Monitoring System-Food Contaminants Monitoring and Assessment Programme (GEMS/Food) has been tasked with assessing hazardous chemicals in food. The main objectives of this programme are to: (1) collect and evaluate data related to contaminants in food to assess levels and trends to encourage proper food control and resource management; (2) estimate actual intake of the contaminant in food and non-dietary sources; (3) provide technical support to governments wishing to initiate monitoring programmes; and (4) support work to establish international standards. In 1996, the programme initiated a new data structure and protocol for electronic submissions. The protocols involve the encoding and formatting of data in a manner consistent with that maintained at the WHO headquarters in Geneva (this is available from the IWC). Three major classes of contributors were identified: (1) WHO collaborating centres; (2) points of national contact; and (3) participating institutions. The databases are set up to receive cetacean data. In order for the IWC to accomplish this task one should: (1) consider the time and effort needed for transcribing data into the specific format; (2) be sure to prevent duplicate entries; (3) consider only data on tissues consumed; and (4) consider the issue of one international organisation providing national data to another international organisation (resulting in possible regulatory and proprietary conflicts).

The Committee recognised that the high standards for data control and data transfer may complicate the process of data submissions considering the many forms in which the IWC receives contaminants data (SC/53/E1). The Committee also noted that other organisations could be considered for providing advice, as well as data submissions, on the risk of specific consumption rates, including the Arctic Monitoring and Assessment Programme's Human Health Group, the United Nations Environmental Programme (UNEP), Centers for Disease Control (USA) and other nationally based agencies. It was emphasised that the Scientific Committee should not conduct a risk assessment related to the consumption of cetacean products by humans but it was **agreed** that it should try to make data available to those capable of doing so or encourage member nations to provide these data to the appropriate organisations.

12.4.2 Other

SC/53/E1 concluded that before making interpretations and comparisons of chemical contaminants data from various studies, it is essential to have certain information about the animals sampled (e.g. age, sex, reproductive status), sampling procedures (necropsy or biopsy), analytical methods for lipids and contaminants, results of sample analyses (e.g. percent lipid, percent dry weight, contaminant concentrations) and quality assurance results. This paper demonstrates how to reformat the data provided to unify the datasets (e.g. into like units and weight basis) and how to evaluate sampling, analysis and quality assurance information, so that a relevant comparison of the data can be made. As part of the data evaluation, caveats or limits that are based on the comparability of the datasets need to be provided with the interpretations that assess the biological implications.

After some discussion, the Committee **agreed** that the information reported in SC/53/E1 was important to the evaluation of health effects from the consumption of cetaceans. The Committee **recommends** that the guidelines in SC/53/E1 should be followed when reporting information on contaminant levels in cetaceans.

12.5 Work plan

The SWG and the sub-committee on whalewatching proposed to hold a joint session at next year's meeting regarding the issue of noise produced by whalewatching vessels and other vessels and effects on cetaceans being watched.

The following work plan for the Standing Working Group on Environmental Concerns was recommended by the Committee:

(1) Cooperative research in the Antarctic.
  (a) Results from SOWER 2000 cruise (cooperative research with CCAMLR).
  (b) Progress in developing a joint research programme with SO-GLOBEC (including development of a long-term research framework and possible mini-symposium).
(2) Review results from the Workshop on Habitat Degradation.
(3) Review results from Workshop on Marine Mammal-Fisheries Interactions.
(4) POLLUTION 2000+.
  (a) Finish calibration study and field collections for Phase 1.
  (b) Refine planning and execution of Phase 2.
  (c) Review fieldwork progress and results of sampling and analyses.
  (d) Review additional information as it pertains to the impact of contaminants on the health and status of cetacean populations.
(5) Review information regarding whalewatching activities and noise impacts.
(6) Review State of the Cetacean Environment Report (SOCER).

Issues related to funding are discussed under Item 21. Japan believed that all but one of the proposals fall outside the mandate of the IWC and that it was thus inappropriate to allocate a large amount of effort and resources for such activities. Japan therefore expressed reservations against all of the proposals apart from that concerning the marine mammal fisheries competition workshop.

13. SMALL CETACEANS (SEE ANNEX K)

13.1 Dall's porpoise

The Committee has, on several occasions, expressed concern regarding the status of Dall's porpoise stocks impacted by the Japanese hand-harpoon fishery. This concern grew as the number of animals taken increased rapidly during the mid-1980s, reaching catches of more than 40,000 in 1988 (IWC, 1991, p.179). In 1990, the Committee (IWC, 1991, p.179) conducted a review of the status of these stocks and concluded that:

> current takes in the harpoon fishery are not sustainable and … it is urgent that the catch be reduced at least to pre-1986 levels (which themselves may have been too high).

At that time, the Scientific Committee also identified information requirements that would allow a more thorough evaluation of the status of these stocks.

In 1991, the Committee re-examined the status of these stocks (IWC, 1992c, p.212-213). It noted that catch levels had decreased substantially (although not to pre-1986 levels) and acknowledged the response of the Japanese Government to its recommendations. It then reiterated its recommendation that catches be further reduced and provided additional advice regarding the information required to conduct a full assessment of these stocks (IWC, 1992c, p.213).

In 1999, the Commission passed Resolution 1999-9 (IWC, 2000a), in which it noted that the Scientific Committee had offered advice to the Government of Japan on Dall's porpoises in the past and that such advice had led to very positive responses from the Government. It directed the Scientific Committee to review the status of exploited stocks at the 2001 Meeting. The Resolution further encouraged the Government of Japan to make available data for this review and invited that Government to reconsider the level of its domestic quota in the light of concerns previously expressed by the Scientific Committee. The Government of Japan had opposed the Resolution at that time.

At the opening meeting of the Scientific Committee, Morishita reiterated Japan's opposition to Resolution 1999-9 and referred to its comments last year (IWC, 2001s) that it would not collaborate with the IWC on this matter (see Annex V).

Until this year, the Government of Japan has submitted catch statistics of Dall's porpoises to the Committee on an annual basis, together with some information on bycatches in domestic fisheries and harvest quotas. This year, however, these data were not made available. Despite their absence, a considerable body of information was available from previous reviews and published sources, allowing the Committee to review the status of these stocks and make recommendations for future work. Members of the Japanese delegation did not participate in the work of the Standing Sub-committee on Small Cetaceans this year.

13.1.1 Review of available information

Dall's porpoises (*Phocoenoides dalli*) are endemic to the North Pacific, where they inhabit both coastal waters and the open sea. They have been subdivided into two subspecies: *P.d. truei* and *P.d. dalli*, primarily on the basis of colour patterns (Rice, 1998). The Committee identified at least eleven stocks of Dall's porpoises on the basis of previous reviews (IWC, 1991; IWC, 1992c) and other published information (Escorza-Treviño and Dizon, 2000; Escorza-Treviño *et al.*, 2001). Discrimination of these populations has used information on mitochondrial and microsatellite markers, the location of calving grounds, pigmentation patterns, parasite loads and body size.

Multiple stocks of Dall's porpoises exist in the Sea of Japan, Okhotsk Sea and adjacent waters: (1) a *dalli*-type stock that breeds in the northern Okhotsk Sea; (2) a *truei*-type stock that winters off the Pacific coast of Japan and breeds in the central Okhotsk Sea; and (3) a *dalli*-type stock that winters in the Sea of Japan and breeds in the southern Okhotsk Sea. In the Okhotsk Sea, the summer breeding grounds of the two *dalli*-type stocks are separated by that of the morphologically dissimilar *truei*-type stock (Miyashita, 1991). In addition, there is a genetically distinct *dalli*-type stock south and east of the Kamchatka Peninsula (Escorza-Treviño and Dizon, 2000; Escorza-Treviño *et al.*, 2001). Stocks 1 and 2 above and at least one additional stock of unknown identity, are taken in the Japanese hand-harpoon fishery.

The most recent abundance estimate for Dall's porpoises in the Okhotsk Sea was made by Miyashita (1991) who estimated the abundance of the three stocks in the Okhotsk Sea to be: 111,000 (CV = 0.29) for the *dalli*-type stock in the

northern Okhotsk Sea; 226,000 (CV = 0.15) for the *dalli*-type stock in the southern Okhotsk Sea; and 217,000 (CV = 0.23) for the *truei*-type stock in the central Okhotsk Sea (IWC, 1992c). The Committee **recommends** that new abundance estimates be generated for each Dall's porpoise stock in the region, particularly in view of the continued and sustained high level of directed and incidental takes.

Off the coast of Japan, Dall's porpoise stocks undergo seasonal movements. Such seasonal movements result in seasonal variation in the identity of stocks exploited by the hand-harpoon fishery. The *dalli*-type breeding stock from the southern Okhotsk Sea is taken primarily in spring and summer in the northern Sea of Japan, southern Okhotsk Sea and Pacific coast of Hokkaido, but small numbers are also taken in winter on the Pacific coast of northern Honshu, together with larger numbers of *truei*-type animals. The *truei*-type stock is taken throughout its wintering area off the Pacific coast of Honshu. A small number of *dalli*-type animals of unknown origin are taken during winter off the Sanriku coast.

Catch statistics from 1963-1999 are available from Japanese Progress Reports to the Scientific Committee. Catches of the two morphotypes have been reported separately since 1991. The most recent estimate of the total catch in 1999 was 14,807, well above that in any year prior to 1986. There have been reports of a recent increase in the proportion of lactating *dalli*-type females in the porpoises landed at Otsuchi on the Pacific coast of Sanriku. Recent data from the harpoon fishery has shown an increase in the proportion of lactating females (Amano *et al.*, 1998; Perry, 1999), which may reflect a change in fishing tactics. As noted previously (IWC, 1991; IWC, 1992c) there are several problems with the reported catch statistics: (1) some of the older catch statistics of the *dalli*-type may be incomplete; (2) the catch statistics may not be reported accurately on a stock-by-stock basis; (3) struck-and-lost animals are not included in the catch data; (4) no data are reported on the age, sex and reproductive composition of the catch; and (5) there are discrepancies between the reported catch statistics and estimates made by scientists working in fish markets, where small cetaceans and their products are landed. For example, the number of Dall's porpoises observed landed at a single market (Otsuchi) in 1991 and 1992 exceeded the total catch reported by the Government of Japan for all locations (SC/53/SM14). The Committee **recommends** that more accurate estimates of the total catch be reported on a stock-by-stock basis, with information on the catch composition and numbers struck-and-lost.

The Committee received new information (SC/53/SM15) on the bycatch of Dall's porpoises in the Japanese salmon drift-net fishery that operates in the Russian Exclusive Economic Zone. An observer programme, operating since 1993, has allowed estimation of the number of Dall's porpoises taken on an annual basis from 1993-1999. Between 643 and 3,149 Dall's porpoises were taken annually in this fishery, with a total of 11,973 individuals taken over the entire period. These bycatches are from stocks impacted by the Japanese harpoon fishery and should be considered in any future assessment of Dall's porpoises in this region. The Committee noted that observer coverage has been diminishing in this fishery and **recommends** that the programme continue at a statistically meaningful level. The Committee further **recommends** that the Government of the Russian Federation report bycatches of Dall's porpoises (and other small cetaceans) from the Japanese salmon drift-net fishery operating in the Russian EEZ in its annual Progress Reports to the Scientific Committee.

Large numbers of Dall's porpoises have been taken in the past in other fisheries in this and adjacent regions (see review in Northridge, 1991) and small numbers of Dall's porpoises are reported annually as bycatch in domestic Japanese fisheries. Many fisheries likely to take Dall's porpoises currently operate both outside and inside the Japanese EEZ and the Committee noted that data on fishing activity and effort would be useful in trying to evaluate the extent of the bycatch. The Committee **recommends** that other governments with fisheries in the range of these stocks report bycatches of this species on an annual basis to the Committee. This information should include the age, sex and reproductive condition of all bycaught animals, whenever possible.

13.1.2 Consideration of status and future work

In the absence of published information on the potential rate of increase for this species, the Committee considered the closely-related harbour porpoise with a similar life history, as a proxy. For that species, the Committee has concluded that levels of anthropogenic mortality exceeding 2% of abundance are unlikely to be sustainable (IWC, 1997c). Assuming that all catches of *dalli*-type porpoises were from the relatively large stock that breeds in the southern Okhotsk Sea, directed takes of both forms have exceeded 2% of the most recent abundance estimates for each year (with the exception of the *dalli*-type in 1992) since 1991. In some years, these directed takes have exceeded 4% of estimated abundance. These estimates do not include porpoises struck and lost, bycatches in the Japanese salmon drift net fisheries or other fisheries. In addition, possible effects of the age, sex and reproductive condition of porpoises taken in the hand-harpoon fishery or as bycatch have not been considered.

Based on the review of the available data, the Committee referred to its previous advice on the status of stocks of Dall's porpoises taken by the Japanese hand-harpoon fishery. The Committee reiterated its extreme concern for these stocks. It repeats its previous **recommendation** that catches be reduced as soon as possible to sustainable levels. It is not clear whether the catch levels reported prior to 1986 would be sustainable at present. To determine what levels of catch might be sustainable, the Committee **recommends** that a full assessment of the status of each stock be conducted as soon as possible, including consideration of the factors described above.

The Committee will be unable to complete such an assessment in the absence of the following data:

(1) a recent estimate of abundance for each stock;
(2) improved catch statistics for each stock, including information on age, sex and reproductive status, and numbers struck and lost;
(3) estimates of total bycatches for each stock.

The Committee **requests** that the Government of Japan provides this information to enable it to carry out a full assessment.

Komatsu stated that he believed there were some errors and misunderstandings in the report of the sub-committee. He noted that the Government of Japan was conducting research on Dall's porpoises in Japanese waters, including abundance surveys and monitoring of catches and did not desire the assistance of the IWC in management of this fishery. He noted that the results of this Japanese research programme on Dall's porpoises would be made available outside the IWC.

13.2 Progress on previous recommendations

13.2.1 Status of the baiji

The baiji (*Lipotes vexillifer*) is the most endangered cetacean species (IWC, 2001n, p.276) and last year the Committee requested the Government of China to report progress on its conservation on an annual basis. Unfortunately, no new information was received this year and the Committee **reiterates** its request for updated information on this critically endangered species.

13.2.2 Vaquita Recovery Programme

Rojas-Bracho informed the Committee of a new, integrated framework being developed to implement the recovery plan for the vaquita, as recommended by the International Committee for the Recovery of the Vaquita, or CIRVA (SC/53/SM13). The Committee welcomed this new approach and **reiterates** its endorsement of the primary conclusion of CIRVA – that to ensure the future survival of the vaquita it will be necessary to eliminate all bycatches as rapidly as possible. The future survival of this species, therefore, will require the gradual substitution of gillnet fisheries with other economic activities in the Upper Gulf of California, as recommended in the Recovery Plan drafted by CIRVA. The Committee also noted the potentially adverse effects of the degradation of estuarine habitat in the Upper Gulf of California and agreed that further research on the effects of this degradation is required.

13.2.3 Harbour porpoise

13.2.3.1 IWC/ASCOBANS JOINT HARBOUR PORPOISE WORKING GROUP

At its meeting in 1998, the Committee agreed that a joint IWC/ASCOBANS Working Group should provide scientific advice to the Advisory Committee of ASCOBANS on matters pertaining to the assessment of status of harbour porpoises in the North Sea and adjacent waters (IWC, 1999f, p.215). The Working Group met in St Andrews in March 1999 and outlined a simulation modelling approach that would allow ASCOBANS to develop algorithms to meet their conservation objectives, the results of which were presented at this meeting (Pout *et al.*, 2001). The Committee concluded that the model developed some useful approaches and served to highlight the paucity of data in some areas, particularly in regard to stock structure, bycatch estimates and dispersal rates. Nevertheless, the Committee did not believe that the approach described in the report would provide direct advice that would allow ASCOBANS to meet its management objectives.

The Committee then considered an alternative approach that would develop a relatively simple, but spatially explicit, dynamic model or models. One of the major conservation objectives of ASCOBANS is that populations of small cetaceans should recover to or be maintained at above 80% of carrying capacity. Therefore, it was agreed that such models should deliver two main outputs:

(1) an indication of what reduction in bycatch level is likely to achieve the stated conservation objective, for purposes of evaluating current status; and
(2) the capacity to develop a longer-term management procedure for ensuring that conservation objectives are met.

The model should assume a regular schedule for surveys and generation of bycatch estimates and feedback rules that calculate limits of removals. This approach could be developed along the following framework:

(1) establish conservation goals in quantitative terms (in this case, ASCOBANS has already agreed that harbour porpoise populations should be maintained at or above 80% of *K*);
(2) propose a rule for setting bycatch limits, that can be calculated using available data (for example, some proportion of the abundance estimate);
(3) establish simulations designed to cover a range of plausible scenarios (for example, single stock, two stocks with and without seasonal mixing, etc);
(4) apply the proposed method within the context of the simulation and collect performance statistics on how often the simulated population achieves the conservation goal.

The Committee strongly **endorses** this approach. Reijnders also welcomed this approach on behalf of the Advisory Committee of ASCOBANS. The Committee did not consider the status of harbour porpoises at this meeting, but wished to **reiterate** its previous advice regarding the status of this species in the North Sea and adjacent waters. Throughout this region, in areas where bycatches have been estimated and estimates of abundance are available, the incidental catches are above 2% of abundance and may, therefore, not be sustainable (IWC, 1997c). The Committee **recommends** that such bycatches be reduced to sustainable levels as soon as possible.

13.2.3.2 NORWEGIAN FJORD FEASIBILITY STUDY

Bjørge described the initial results of a feasibility study to derive estimates of harbour porpoise abundance in the complex inshore waters of Norway. Several members of the Scientific Committee offered suggestions to Bjørge regarding survey design. The Committee looked forward to receiving an update on this work at its next meeting.

13.2.4 Survey methodology for freshwater cetaceans

Last year, the Committee recommended that scientists with appropriate analytical skills be directly involved in the design and implementation of surveys for freshwater cetaceans, so that these surveys might result in statistically robust estimates of abundance (IWC, 2001n, p.284). It was also suggested that scientists familiar with techniques of abundance estimation should obtain relevant experience at a range of field sites and make recommendations for appropriate survey and analytical methods. Hedley informed the Committee about proposals that are being developed to involve analysts with studies of freshwater cetaceans in a number of survey sites. The Committee welcomed the development of such proposals and Read agreed to facilitate the development of an e-mail group to promote these initiatives.

13.2.5 Bycatch mitigation

SC/53/E17 reviewed cetacean bycatches in South Africa from 1978-2000. In nets designed to protect bathers from sharks in KwaZulu-Natal, mitigation approaches have included: reductions in fishing effort; trials of alternative fishing techniques; passive reflectors; and acoustic alarms. Trials of these bycatch mitigation measures are continuing and it is envisaged that a more in-depth report will be available next year. The Committee also received information (SC/53/SM9) on the use of acoustic alarms in the California swordfish/thresher shark drift gillnet fishery during 2000. The bycatch rate in this fishery during 2000 was comparable to rates observed in years before pingers

became mandatory, raising questions about the efficacy of these devices. The Committee **requests** further information on this subject at next year's meeting.

13.3 Takes of small cetaceans in 2000

As in previous years, the Scientific Committee noted that the table of recent catches of small cetaceans (Annex K, Appendix 2) is incomplete. The Committee **repeats** its **recommendation** that member nations submit full and complete information on direct and incidental takes in their progress reports; such information should be submitted on a stock-by-stock basis. At its meeting next year, the Committee **agreed** to review current knowledge of the existence of directed and incidental takes by member countries to ensure that such information was available to assist in its deliberations.

13.4 Work plan

The Committee reviewed its existing schedule of priority topics on small cetaceans and identified several new topics for consideration at future meetings. The priority topics currently listed for future meetings are (IWC, 2001n, p.279):

(1) systematics and population structure of *Tursiops*;
(2) status of ziphiids in the Southern Ocean;
(3) status of small cetaceans in the Caribbean Sea.

Last year, the Committee invited the Government of Japan to provide information that would allow it to determine whether sufficient new data exist on Baird's beaked whales to review the status of this species in the year 2002 or beyond. The Committee did not receive any information from the Government of Japan on Baird's beaked whales at this meeting. In light of the position of the Government of Japan on this matter (IWC, 2001s), the Committee has not taken further action on this topic.

The Committee agreed to add the following items to its schedule of future priority topics:

(1) status of small cetaceans (*Phocoena*, *Delphinus* and *Tursiops*) in the Black Sea;
(2) review of the status of *Sousa*;
(3) review of the status of *Pontoporia*.

The rationale for the first additional topic is continuing concern regarding the status of these three species in the Black Sea, given the existence of high levels of directed catches in the past, continuing bycatches and environmental degradation throughout the ocean basin. In addition, the Agreement on the Conservation of Cetaceans of the Black Sea, Mediterranean Seas and contiguous Atlantic area (ACCOBAMS) has recently entered into force and the IWC Scientific Committee may be able to provide scientific advice to that body in the same way that it has with ASCOBANS. The rationale for the second topic is continuing concern regarding the relatively small, localised populations of *Sousa* throughout its range. Several current research efforts are directed at this species and new information should be forthcoming on its status. The rationale for the franciscana is continued concern regarding the effects of long-standing bycatches of this species in coastal fisheries. In addition, a large amount of new information is available (e.g. SC/53/SM1, 4, 5 and 6 at this meeting).

In response to questions, Read noted that the following subjects are typically reviewed by the Committee when considering the status of small cetaceans: distribution and stock structure; abundance; life history; ecology; habitat; directed takes; incidental takes; other; and status. During discussion, Committee members noted that there is a diversity of viewpoints within the Commission regarding the work of the Scientific Committee on small cetaceans. Smith and others noted that, despite this diversity of opinion, past reviews of the status of small cetaceans by this Committee had been extremely useful to member governments and others.

Given the location of the meeting in 2002, the Committee **agreed** that its priority topic next year will be a review of the status of humpbacked dolphins (genus *Sousa*). In addition, the Committee will conduct a review of the existence of directed and incidental takes of small cetaceans in member countries, with a view to requesting data on the magnitude of such takes from member governments in the future. This process is intended to ensure that the table of recent catches of small cetaceans is as complete and useful as possible. The Committee will also review progress on recommendations regarding small cetaceans made at this year's meeting. At its meetings in 2003 and 2004, the Committee **agreed** to review the status of small cetaceans in the Black Sea and the systematics and population structure of bottlenose dolphins, respectively.

14. WHALEWATCHING (SEE ANNEX L)

The Committee had identified three priority topics for discussion this year:

(1) review the work 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 whale and dolphin 'swim-with' programmes.

A representative of Japan drew attention to the following statement (Annex L, 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 is beneficial in order to obtain better understanding of the stocks. 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 the IWC should spend its time and monetary resources discussing other issues that have higher priorities than whalewatching.

14.1 Report of the Intersessional Correspondence Group

The starting point for the Intersessional Correspondence Group had been the deliberations of the 2000 Whalewatching Workshop and Working Group. The Workshop had provided a table of 'data that may be collected from whalewatching platforms' (IWC, 2001o). Three levels of data were identified:

(1) *Level 1* data that any whalewatching operation could be encouraged to collect;
(2) *Level 2* data that all whalewatching operations with the capacity/facilities/resources could be encouraged to collect; and
(3) *Level 3* data relating to whalewatching operations 'when paired with directed, scientific research led by an experienced scientist'.

Last year it had been concluded that there was a need to identify and develop 'critical parameters' and the intersessional group provided the following definitions and a draft table that was discussed, modified and appears in Annex L (Appendix 2).

Definitions
Critical responses are parameters (measurable variables) of biological significance - i.e. likely to relate to impacts or changes at the population level. These can be divided into three categories of Critical Response Parameters (CRPTypes1-3):

CRPT1: relating to *survivorship of individuals* – the underlying assumption being that a negative impact to the survival rate of individuals is likely to affect population status;
CRPT2: relating to *reproduction* – i.e. an effect not on the survival of individuals but on reproductive potential (e.g. masking of communications between mothers and calves or of mating calls or factors causing physical separation of otherwise breeding animals); and
CRPT3: relating to factors seen to have a *widespread impact* – i.e. affecting a number of whales (e.g. prey depletion or displacement of many animals from important habitat areas).

There are overlaps between the CRPTs (and there are also likely to be synergies), but they are intended to provide a practical framework to aid further discussion. The detection of CRPTs presents a series of difficult methodological problems. To identify biologically significant behavioural responses from cetaceans to a stimulus requires that: (1) normal behaviours be well-categorised; and (2) changes to them be measurable.

There was considerable discussion on this item in the sub-committee as related in Annex L (item 5).

SC/53/WW2 included a draft master form for data collection on whalewatching platforms. The form is designed for different levels of data recording, varying from basic data collection to data collected by experienced scientists onboard whalewatching vessels. The form presented includes all topics relevant to scientists that use whalewatching boats as platforms of opportunity for research. The form was discussed at length by the sub-committee (Annex L, item 5), modified and appears as Appendix 3 of Annex L.

The sub-committee also reviewed mandatory log sheets for commercial whalewatching operators in South Africa. One of the main aims of the log sheets is to provide basic scientific information (e.g. whale movements and avoidance behaviour) that could assist scientists when they have to provide scientific advice on the management of whalewatching in South Africa. The data could be primarily analysed by graduate students. In discussion, the sub-committee noted the importance of analysing, not just collecting, data and using data input programs that are user-friendly.

When the sub-committee agreed on the master form, one member made a statement concerning the main objective of the form, the quality and value of data obtained through whalewatching and the conditions and circumstances under which the data could be collected (Annex L, item 5).

The Committee **agreed** that the master form from SC/53/WW2 should be appended to the report (Annex L, Appendix 3) and **recommends** that an Intersessional Data Collection Correspondence Group (see Annex U) be established to:

(1) develop instructions for and further develop the data collection forms;
(2) receive information from any pilot projects using the data collection forms; and
(3) report back on revisions arising from field-testing.

It was suggested that this group should consider the value of developing separate (and thus smaller and more practical) forms aimed at specific objectives.

14.2 Review information on noise from whalewatching vessels and aircraft, and potential effects on cetaceans
Erbe (2001) considered the underwater noise from whalewatching boats in the popular killer whale watching regions of British Columbia and northwestern Washington State. Erbe modelled the noise of fast boats and found that it was: audible to killer whales over 16km; masked whale calls over 14km; was received at 120dB re 1μPa rms over 200m from the whale (therefore intense enough at 200m to potentially elicit behavioural responses); and caused a temporary threshold shift in hearing of 5dB over 450m. The zones were smaller for boats cruising at slower speeds. Erbe had also commented that the 'superimposed' noise levels of a number of boats near the whales was close to the critical response level assumed to cause permanent hearing loss over long exposure.

Last year, it had been recommended that visual monitoring studies be combined with acoustic monitoring. Au and Green (2001) present such a study. The study looked at noise produced by five representative whalewatching boats. The authors conclude that vessels abiding by US National Marine Fisheries Service stand-off distances of 91.5m will probably not cause grave effects to the auditory system of humpback whales, but the assessment of behavioural changes induced by the presence of the boats is open to interpretation. Several members commented that studies and methodologies such as those of Au and Green (2001) should be encouraged in other areas and that ambient sound should be considered in any study of noise impacts on cetaceans.

A pilot 'quality' whalewatching enterprise was started in 1997 by a private operator in Imperia, within the area of the Sanctuary for Cetaceans of the Ligurian Sea. It has voluntarily adopted basic rules of conduct with the aim of preserving the resource (cetaceans) within its operational area. Voluntary measures to minimise the impact of noise and chemical pollution derived from the vessel are undertaken routinely by the skipper and a concise data-sheet is filled in at every sighting. Positive results include: (1) strong educational values for both the public and fellow-operators; and (2) some valuable scientific findings on the presence and distribution of a rare cetacean (Cuvier's beaked whale).

SC/53/WW1 provided evidence on disturbance by whale and dolphin watching boats to resident populations of short-finned pilot whales and bottlenose dolphins in a Special Area of Conservation (SAC) designated under the EU Habitats Directive off the southwest Tenerife coast (Canary Islands, Spain). The most important factors found to elicit short-term behavioural responses were the increasing number of boats and their proximity to the animals. There are significant interspecific differences in the reactions to the same stimuli and also intraspecific differences depending on the presence of calves and mature males in the cetacean groups. Avoidance responses were recorded even though exposure of the resident populations to whalewatching started in 1985 and may have had some habituation effect.

There was no compliance with local distance regulations 82.5% of the time, while 21.8% of the time vessels violated the maximum number of boats allowed in a 200m circle around the animals.

All factors (e.g. habitat degradation, whalewatching, high-speed ferries) should be taken into account in evaluations of the management of the SAC, particularly in order to define a maximum number of whalewatching licenses, as local whalewatching areas are often potentially critical habitat for the cetacean populations. Whalewatching activity in the area now requires improved public awareness and the proper application of local regulations. Many participants agreed with the concerns voiced about the poorly controlled development of whalewatching in the Canary Islands.

The Committee **agreed** that studies on noise and acoustic impacts on cetaceans (such as Au and Green, 2001) should be encouraged and **recommends** that:

(1) information on such studies be collated and presented at next year's meeting; and
(2) a joint session on noise be held with the Standing Working Group on Environmental Concerns at next year's annual meeting.

14.3 Review research on effectiveness of and compliance with whalewatching guidelines and regulations

Two papers were presented relating to behavioural responses of northern resident killer whales to whalewatching boats in British Columbia, Canada. Williams *et al.* (2001) described results from a 1995-96 study testing the relevance of voluntary guidelines that ask boaters not to approach whales closer than 100m. The study used shore-based theodolite tracking of identifiable focal animals in the absence of boats and during approaches by a 5.2m motorboat that paralleled each whale at 100m. Whales responded to experimental approaches by adopting a less predictable path than observed during the preceding, no-boat period, although males and females employed subtly different avoidance tactics. Females responded by swimming faster and increasing the angle between successive dives, whereas males maintained their speed and chose a smooth, but less direct, path. Canonical correlations between whale behaviour and vessel proximity are consistent with these conclusions, which suggest that weakening whalewatching guidelines, or not enforcing them, would result in higher levels of disturbance.

These results were compared with data from 1985, 1997 and 1998 in SC/53/WW3, to see whether killer whales may be habituating to boat traffic over time. This exercise represents an extremely rare opportunity to measure relationships between boat traffic and behaviour of individuals for which life-history parameters and annual exposure to whalewatching traffic are known. Under comparable high-traffic conditions, whales' paths were more erratic in 1985 than in the 1990s. Plausible explanations include: partial habituation by whales to boats; changes in vessel operation practices to minimise changes in whale behaviour; development of alternative strategies by whales for responding to boats; and environmental changes. Persistence of behavioural responses to vessels after more than 20 years of close contact indicates that while behavioural consequences may be reduced over time, habituation is likely to be a slow process. Several members commented that long-term, longitudinal studies such as these should be encouraged.

SC/53/WW5 was received by the Scientific Committee and relevant parts are summarised in Annex L (Appendix 5). The remainder of the paper was not discussed as it was outside of the terms of reference of the Committee.

SC/53/WW6 investigated whalewatching codes of conduct and guidelines in West Scotland. Eighty-six percent of West Scotland whalewatching operators referred to a code of conduct or guidelines; the most popular code was one produced by a marine wildlife tour operators association that is not cetacean specific. Only 27% of the operators had heard of official governmental guidelines and none of the operators actually used or referred to them during their operations. Operator-led guidelines were more readily accepted (i.e. 'bottom-up management'). It was therefore recommended that tour operator associations in West Scotland be encouraged to take a leading role in the monitoring and management of their industry with appropriate advise and input from statutory and scientific bodies. Furthermore, codes of conduct should be underpinned by legislation and enforcement.

One member noted that few of the guidelines were substantiated by scientific studies and that the Committee should encourage studies to evaluate their effectiveness. While agreeing, another member cautioned that in the absence of scientific evidence, the 'Precautionary Principle' must be applied. It was noted that land-based studies and whalewatching should be encouraged where possible.

SC/53/WW7 provided information on an outreach programme to the recreational boating public in Massachusetts. As US (and other national) whalewatching guidelines and regulations are largely targeted to commercial whalewatching operators, the International Wildlife Coalition and the Stellwagen Bank National Marine Sanctuary are working to establish an outreach programme to teach recreational boaters how to behave around whales (including right and humpback whales) in the waters off Massachusetts. This programme includes signs and posters at marinas, docks and shops, slide show presentations and pamphlets and 'tide cards' with the programme's four 'slogan' rules written on the back. These rules are based on the US whalewatching guidelines and address boat speed, approach behaviour, coordination of effort with other whalewatchers and distance. The paper addressed a recognised gap in many national whalewatching guidelines, which usually apply only to commercial whalewatching vessels. In many areas, recreational vessels greatly outnumber commercial ones. Several members commented that the programme was important as it highlights the fact that whalewatching must be regulated for recreational as well as commercial vessels.

The Committee **agreed** that recreational whalewatching, when undertaken in combination with commercial, boat-based whalewatching, could be problematic and **recommends** that:

(1) responsible agencies, in areas where there are regulations, should be encouraged to enforce the regulations when possible; and
(2) the sub-committee continues to review and monitor this item.

14.4 New information on previously discussed topics

14.4.1 Dolphin feeding programmes

Last year, Australia presented a review of dolphin feeding programmes (Rafic, 2001). Since last year, an Australian Commonwealth ban on feeding programmes has been established but no State ban. Commonwealth and State are working together to reach an agreement. Updates on the following programmes were received and detailed in Annex

L, item 8.1: Monkey Mia, Western Australia; Bunbury, Western Australia; Tangalooma, Queensland; and Tin Can Bay, Queensland.

In discussion, the Committee noted that feeding programmes continue in several areas. One member noted that illegal feeding of dolphins off Florida is an enforcement, not an education, issue.

The Committee **agreed** that feeding does not follow the IWC's suggested Principles for Whalewatching. Although it is recognised that feeding is legal in some areas, the Committee continues to express concern about the continued feeding of wild cetaceans and **recommends** that governments be encouraged to phase out existing feeding programmes as soon as possible and not allow the development of new ones.

14.4.2 Whale and dolphin swim-with programmes

No new information was received. The importance of this as a management issue was emphasised, as swim-with dolphin programmes are rapidly growing in number. The Committee **agreed** that it should be more proactive on this issue and **recommends** that swim-with programmes be monitored and further evaluated.

14.4.3 National Guidelines and Regulations

SC/53/WW4 is an ongoing compendium of national guidelines and regulations from 32 countries and territories. Last year, the Committee recommended that consideration be given to placing the compendium on the internet. It was agreed that Carlson and Donovan should work during the intersessional period to determine the most effective way to achieve this.

It was noted that the compendium would be useful in areas such as the Turks and Caicos where parallel regulations to the guidelines are being established.

Recent changes in regulations were noted in both the UK and USA. In the UK, regulations state that 'reckless' as well as 'deliberate' disturbance of cetaceans is an offence in England and Wales; the law has not been so amended in Scotland. This applies to all potentially disturbing activities and not just whalewatching. Enforcement aspects are still being developed. In the USA, the National Marine Fisheries Service has recently published final regulations governing approach distances to humpback whales in Alaska. Boats are required to stay 100 yds (91m) from whales while within 200 miles of Alaska's coastline (this corresponds to the USA EEZ). Guidelines governing boat behaviour around whales, specific speed limits and other aspects of whalewatching continue as guidelines. The decision not to formalise all the guidelines into regulations appears to have been motivated by enforcement concerns.

The Committee **agreed** on the importance of information on guidelines and regulations and **recommends** that the Committee continue to collect this information and place the compendium on a website.

14.4.4 Other information

SC/53/E10 presented information on the spatial and temporal distribution of minke whales in relation to undersea topography and seabed sediment off the Isle of Mull, Scotland. It is as an example of the type of analysis that is possible using data collected systematically from a whalewatching platform. The authors concluded that the distribution of minke whales throughout the area and over the nine months of the whalewatching season changed in response to changing prey distribution and availability.

It was noted that new technical methodologies for data collection (including laser range finders) were evident in several papers. These are summarised in Annex L (Appendix 4).

During general discussion in the Committee, the scientific value of carefully collected data from whalewatching operations was stressed, as were the limitations of studies based on whalewatching vessels. As is always true in science, it is important to first decide the question to be addressed and then select the appropriate research methodology.

14.5 Work plan

A proposal for an intersessional working meeting and correspondence group to develop whale and dolphin watching management plan guidelines was presented to the Committee. The correspondence group would identify relevant management regimes and topics that should be included in these guidelines. The workshop/meeting would involve all stakeholders (e.g. scientists, managers, regulators and relevant NGOs). The management guidelines would assist management bodies who wish to develop whalewatching industries in their countries, or who already have developed but unregulated whalewatching industries, to select suitable management regimes.

There were varying views on the proposed meeting and how it should be arranged (Annex L, item 10). Several members supported the proposal. One member stated that whalewatching is outside of the competence of the IWC. The Committee **agreed** that an Intersessional Correspondence Group (see Annex U) be established to further discuss the issue of developing whale and dolphin watching management plan guidelines.

The Committee **agreed** on the following work plan:

(1) review the reports of the Intersessional Whalewatching Correspondence Group, Data Collection Correspondence Group, Whalewatching Management Correspondence Group (and a report of a meeting if one is held intersessionally);
(2) review information on the significance of noise produced from vessels and aircraft in a joint session with the Standing Working Group on Environmental Concerns;
(3) review of research on the effectiveness of and compliance with national whalewatching guidelines and regulations;
(4) review of new information on whale and dolphin swim-with programmes.

Other work:

(1) review of national guidelines and regulations for whalewatching;
(2) review of new information on dolphin feeding programmes.

Prioritisation of this work is considered further under Item 19.

15. SCIENTIFIC PERMITS (SEE ANNEX Q)

Towards the end of the Committee's deliberations under Items 15.2 and 15.3, the Chair of the Committee noted that there are logistical difficulties in the way that the review of the results from scientific permits and the review of new proposals are handled in the Committee. In order to consider this further, she appointed an intersessional group (Walløe, (Chair), Brownell, Childerhouse, Hatanaka and Kell) to

develop a proposal to improve the review procedure within the Committee. The group should *inter alia* consider such factors as the timing of submission of proposals and reports and the frequency of reviews. The group will submit its report by the end of 2001 for circulation to the full Committee.

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

Last year, the Committee had agreed a general principle that when addressing the question of the effect of scientific permit catches on stocks, 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.

The Intersessional Steering Group on the impact of JARPA on the stock had been asked to use the BALEEN II model and a variant thereof (in which carrying capacity changes over time) to examine the issue of how the Committee can best address the task of providing advice on the effect of scientific permit catches on the stocks. This group had difficulty interpreting its task and two views emerged. Some members believed that HITTER runs using BALEEN II were sufficient, but other members did not believe that the results of a single method (HITTER runs) could address the question of how *best* to address the question of the effect of scientific permit catches on the stocks. The group therefore identified a list of topics that would be potentially of value in addressing the question (SC/53/O12). An agreed set of HITTER runs was specified to be conducted by the Secretariat, although the group did not reach agreement on the value of such runs.

In considering these runs, the Committee agreed that the exercise had provided a useful example of an approach to providing advice on the effect on stocks of scientific permit catches. However, it noted that further modelling approaches need to be examined and abundance estimates agreed before specific advice on the effect of JARPA on Antarctic minke whale stocks can be provided (and see the discussion under Item 15.3 below).

15.2 Review of results from existing permits

15.2.1 Japan – Southern Hemisphere minke whales

SC/53/O11 summarised the 14th field season of the JARPA programme. Research was conducted in Area V and the western part of Area VI from 11 December 2000 to 20 March 2001 (a 99-day research period).

The sightings vessel covered almost 6,000 n.miles and the three sighting and sampling vessels (SSVs) covered about 4,800 n.miles each. The method of designing the cruise track was the same as in previous years. A total of 1,881 (4,903 individuals) primary sightings of minke whales was made. Antarctic minke whales accounted for 61.5% of all the sightings and were widely distributed throughout the research area. Sightings were most concentrated, however, in the East-South stratum of Area V and near the pack ice. 'Like' minke whale sightings totalled about 3% of the number of Antarctic minke whale sightings. The total number of sightings of Antarctic minke whales (2,079 schools/5,393 individuals) was the highest number since the beginning of JARPA. Area VIW and the eastern part of Area V accounted for 80% of these sightings.

There were 27 schools (27 individuals) of dwarf form minke whales seen (including one secondary sighting) – the largest number seen on any JARPA cruise. These sightings were concentrated in the West-North stratum in Area V, where relatively few Antarctic minke whales were seen. The sea surface temperature in the northern part of the West-North stratum of Area V was higher than in any other strata. This suggests that Antarctic minke whales might avoid areas of high surface water temperature and might explain why the distribution pattern of the Antarctic minke whales in the West-North stratum in this survey is different from previous cruises.

Of 1,268 schools (2,915 individuals) sighted by the SSVs, 477 schools/835 individuals were targeted and 440 individuals were taken (110 in Area VIW and 330 in Area V). Of the 440 animals, 248 were males and 182 were females.

A total of 64 humpback, blue and right whales were photographed and 49 skin samples were collected by biopsy from humpback, blue and fin whales. XCTD and CTD castings were conducted at 116 and 166 locations in the research area. EPCS and hydro-acoustic surveys were also conducted.

Apart from minke whales, blue, fin, sei, humpback and right whales were seen with humpback and fin whales predominating. The latter were found throughout the research areas apart from the East-South and West-North strata in Area V. A total of 15 schools (25 individuals) of blue whales was seen in Area V. Most sightings were limited away from the ice-edge at the eastern edge of the East-North stratum and the centre of the East-South stratum.

Odontocetes seen included sperm and southern bottlenose whales (which were widely distributed apart from the East-South stratum) and killer whales, whose distribution was similar to that of minke whales.

Progress on JARPA tasks and other studies using JARPA samples are presented in documents SC/53/IA7, 12, 13, 16, 17, 18 and SC/53/O8 and 11. These were presented in the relevant sub-committees and working groups.

15.2.2 Japan – North Pacific

SC/53/O10 presented the report of the cruise of the second phase of the Japanese Whale Research Program under Special Permit in the North Pacific (JARPN II). It also included information on the progress of associated studies including surveys for prey species and preliminary ecosystem modelling. As noted in the Committee's report last year (IWC, 2001m, pp.249-251), the primary aims of this research are to: (1) study the feeding ecology and ecosystem of common minke, Bryde's and sperm whales and their prey species; (2) study the stock structure of these whales; and (3) study environmental effects. Further details can be found in IWC (2001d, pp.101-102; 2001a, pp.61-65; 2001q) and (Government of Japan, 2000).

The first feasibility survey of the JARPN II was conducted in sub-areas 7, 8 and 9 from 29 July to 21 September 2000, using three sighting/sampling vessels (SSVs), one scientific echo-sounder survey vessel, one trawl survey vessel and one research base ship. The scientific echo-sounder survey vessel also acted as a dedicated sightings vessel. The total searching effort by the SSVs was 7,284 n.miles during which 68 common minke, 188 Bryde's and 400 sperm whales were sighted. The number of individuals sampled was 40 common minke, 43 Bryde's and five sperm whales. The whales sampled were examined on board the research base ship. Prey species found in the stomachs were Japanese anchovy, walleye pollock and Japanese common squid in common minke whales; Japanese anchovy and krill in Bryde's whales and deep-sea squid and some fishes in sperm whales. The possibility of direct and indirect competition between these whale species and commercial fisheries was discussed.

As there were no changes to the two-year feasibility study that had been reviewed by the Committee last year (the Commission's attention is drawn to IWC, 2001a, pp.61-4), no new proposal for 2001 had been presented.

In discussing this Item, the Chair of the Committee referred to last year's discussions and asked that working papers be submitted that provided new comments on the results of JARPNII and responses to those comments. These are given as Annexes Q1 and Q2. Walters commended the programme which he believed would also provide useful information for managing fishery resources in the Caribbean and the wider international community.

The Committee also considered Annex Q3 (formerly SC/53/RMP25) under this item. The authors questioned the need for lethal sampling of minke whales in the North Pacific in the context of stock structure. They highlighted what they believed to be the remaining important questions on this topic and concluded that biopsy sampling is the most appropriate method to address these questions. Counter arguments to this are given in Annex Q4. Annexes Q5 and Q6 consider ecosystem modelling and the JARPN II programme.

15.3 Review of new or revised proposals

15.3.1 Japan – Southern Hemisphere minke whales

SC/53/O1 outlined the JARPA survey plan for the 2001/2002 field season. The objectives, survey items and methods are the same as last year. The survey for the coming season will cover the eastern half of Area III and all of Area IV. The objectives of the programme have been elucidated previously and include the better determination of structure and the collection of samples suitable for catch-at-age analyses. The expansion to Area III was to allow for the testing of new hypotheses on stock identity (Government of Japan, 1995).

The schedule for the 2001/2002 JARPA survey is as follows:

(1) research vessels will leave Japan at the beginning of November and return in the middle of April 2002;
(2) the sample size is 300 ordinary form minke whales in Area IV and 100 ordinary form minke whales in Area III with 10% allowances;
(3) the type and number of vessels are the same as in the previous years – one research base vessel, three sighting and sampling vessels and one dedicated sightings vessel.

In addition, it is planned to examine the extent of the yearly variation of stock distribution patterns using other available sources of information (i.e. environmental correlates). Therefore, data will also be collected on prey species availability and on the nutritional condition of sampled whales.

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 on this matter (IWC, 1998a).

Givens recommended one approach for providing advice on the effect of these scientific permit catches (SC/53/O12, Appendix C). In this case, a 'trade-off' analysis would be performed between the benefits of improving precision in estimating parameters of interest and the risks of increased catches to the population being sampled. Givens further noted that such an approach would hopefully help investigators to improve and strengthen their proposals.

Punt commented that similar work had already been carried out in order to determine the ability of information from scientific permit catches to estimate certain management-related parameters (e.g. Butterworth *et al.*, 1996; Tanaka *et al.*, 1992) and that this information has been discussed in connection with Scientific Permit catches in the past (e.g., IWC, 1992a, p.73). He also noted that scientific permits could be issued to address 'critically important research needs' that need not necessarily result in estimates of management-related parameters. Several members, although agreeing with the concept behind Givens' proposal, noted that in practice the approach might prove unworkable due, *inter alia*, to the required workload associated with it.

Recognising that scientific benefits are only one of several criteria given by the Commission to evaluate proposals, it was **agreed** to establish an intersessional steering group to: generate a list of approaches potentially useful for quantifying the scientific benefit of research catches and the features of a proposal needed for such analyses. The group will comprise Givens (Chair), Butterworth, Cooke, DeMaster, Kawahara and Smith.

Following discussions in the sub-committee on the RMP, Childerhouse raised the issue of the need for improvements in survey design of the JARPA research programme related to the lack of randomness in the manner in which sightings data and whales were collected. He noted that avoiding bias in parameter estimation caused by non-random sampling is important in meeting the first two objectives of JARPA, i.e. (1) estimation of biological parameters of minke whale stock; and (2) elucidation of the role of whales in the Antarctic ecosystem. Fujise responded that the Government of Japan welcomed constructive comments on the survey design of JARPA. He added that the survey design of JARPA involved random sampling at both the level of sighting and sampling and had been thoroughly reviewed in 1997 by the Scientific Committee (IWC, 1998a). Based on the conclusions of the 1997 review of JARPA, the Government of Japan considered the survey design adequate for meeting the stated objectives of the research programme.

Donoghue recalled that the JARPA review (IWC, 1998a) had concluded that it was not required for the management of Southern Hemisphere minke whales. He was disappointed that the proposal did not include a cruise track and that there was no revised consideration of the effects of lethal takes on the stock.

Hatanaka responded that selective quoting from the Scientific Committee's report was unhelpful, as the Committee itself had previously stated (IWC, 1999c, pp.44-45). In fact, the Committee had agreed (IWC, 1998a) that

> …the results of the JARPA programme, while not required for management under the RMP, have the potential to improve the management of minke whales in the Southern Hemisphere…

He further explained that precise details of the tracklines are not included for safety reasons, given the dangerous tactics previously employed by certain protest groups. Finally Japan's views on lethal versus non-lethal techniques are well known and have not changed this year.

16. WHALE SANCTUARIES (SEE ANNEX R)

16.1 South Atlantic whale sanctuary

The Committee has been asked to comment on the scientific aspects of the proposal submitted by the Government of Brazil to the Commission this year to create a sanctuary for great whales in the South Atlantic (IWC/53/7).

The Committee **agreed** that it would not discuss legal, political or economic issues regarding the South Atlantic Sanctuary proposal. These issues included questions of interpretation of the Convention, the level of support for the proposal amongst nations of the South Atlantic region and relative merits and compatibility of whalewatching versus direct exploitation. Such matters were raised in some working papers submitted to the Committee but were not discussed.

Palazzo introduced IWC/53/7. The proposed sanctuary is shown in Fig. 2. Its longitudinal range encompasses Areas I, II and III. It is contiguous with the Southern Ocean Sanctuary in this band. The proposal states that irrespective of stock status, there will be no commercial whaling within the proposed sanctuary area. Ten 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; and pygmy right whale. Almost all of these have been harvested commercially at some point in the past. The blue, fin, right and humpback whale populations 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. Information on the location of breeding grounds and migratory routes of the whales in the region is generally inadequate, apart from for the information available for humpback and right whales. The proposed sanctuary would include all known breeding grounds of the great whales in the South Atlantic. Humpback whale and right whale populations are probably the best studied compared to the others in the South Atlantic. Generally more is known of the mysticete species on their feeding grounds in the Antarctic than on the wintering grounds in the South Atlantic. There is no commercial or aboriginal/subsistence whaling in the area at the present time. Only minke whale populations have been considered in the context of the RMP. There is little information on the nature and magnitude of bycatches of large whales occurring incidental to commercial fishing within the area proposed for a South Atlantic Sanctuary.

The Committee **agreed** that the major points made during last year's Scientific Committee meeting (IWC, 2001a, pp.65-66) regarding general arguments in favour of sanctuary proposals and general arguments not in favour of sanctuary proposals were pertinent to this agenda item. The major arguments from last year's meeting are summarised below.

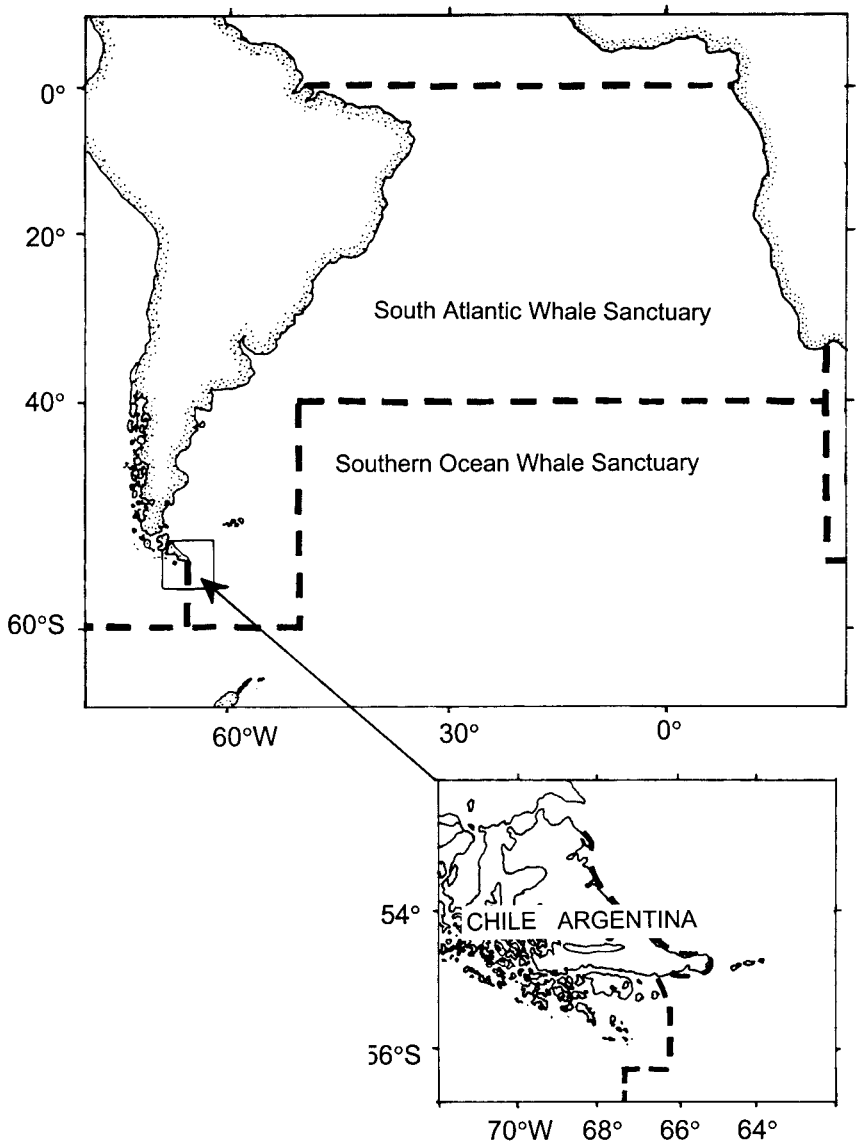

Fig. 2. Limits of the South Atlantic Whale Sanctuary, as defined in the Schedule amendment text proposed by Brazil. The inset shows detail of the western boundary.

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 unforseen 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 views were expressed and these are included in Annex R. The Committee was unable to reach a consensus view. The Committee also noted that it had not received guidance from the Commission on factors of interest to the Commission in reviews of sanctuary proposals. As last year, the Committee **agreed** that advice from the Commission with respect to reviews of sanctuary proposals would be useful in the future.

16.2 Other

The Chair noted that a new document regarding the South Pacific Sanctuary proposal had been submitted to the Commission, but the Scientific Committee had not been asked to review it. She had read the document and found no new information that would change the Committee's evaluation of the proposal as submitted last year. The Committee **agreed** that no further discussion of the South Pacific Sanctuary proposal was necessary.

The Chair noted that the Commission expects a thorough review of the Indian Ocean Sanctuary in 2002 and of the Southern Ocean Sanctuary in 2004. SC/53/O6, which provided a preliminary review of cetaceans in the Indian Ocean Sanctuary, was not discussed this year as the Chair believed it was more appropriate to consider it during next year's review.

The Commission has provided only limited guidance as to what it expects from these Scientific Committee reviews, (IWC, 1995a, pp.27-28; IWC, 1995b, pp.45-46; IWC, 1999a, p.42). The Chair therefore appointed an intersessional Steering Group (Zerbini (Chair), Bjørge, Butterworth, Childerhouse, Donovan, Kell, Kock, Morishita and Thiele) to plan for these reviews. The Terms of Reference for the group are to develop:

(1) a process by which the Committee will complete a review; and
(2) evaluation criteria for the reviews, taking into account the Commission's previous comments and any further advice that might be offered by the Commission this year.

It was agreed that the process and evaluation criteria referred to in the previous paragraph will be used by the Committee next year in its review of the Indian Ocean Sanctuary.

17. RESOLUTION ON DNA TESTING AND SUBSEQUENT DISCUSSIONS (SEE ANNEX N)

The sub-items under this agenda item provide the annual report on progress requested by IWC Resolution 1999-8 (IWC, 2000b). Norway and Japan stated during the opening plenary session of the Committee that they would not participate in discussions relating to reference databases, standards for a diagnostic register of DNA profiles or dialogue with the Commission.

17.1 Progress on genetic methods for species, stock and individual identification

SC/53/SD9 reported on development and testing of a multiplex PCR approach for coincident sex and species determination for use with cetacean specimens from biopsies, strandings and market products including a variety of tissue types. Details of the method are given in Annex N. It accurately identified known-sex samples from 5 dolphin, 2 porpoise and 3 baleen whale species that were tested. The author recommended testing with known-sex individuals of additional species to confirm the general applicability of the method.

SC/53/SD6 described the development of a new website that will soon be available to the public, *www.DNA-surveillance.com*. This website will host a suite of analytical programs in a user-friendly interface that steps the user through the phylogenetic species identification procedure for cetaceans as described by Baker *et al.* (1996). With this program, a DNA sequence of questionable origin can be submitted from anywhere in the world and matched to a comprehensive database of cetacean sequences. An important attribute of the reference database is that it will contain only sequences that are 'validated' following the criteria arising from a 1999 workshop (Dizon *et al.*, 2000). The web-based program also addresses several recommendations arising from the workshop.

17.2 Progress on collection and archiving of samples from catches and bycatch

No new information was available on this subject in the documents reviewed by the Working Group on DNA Identification and Tracking of Whale Products. However, it was noted that some relevant information is contained in Annexes D and M.

17.3 Reference databases

Further progress on the development of validated databases for mysticete whales was reported in SC/53/SD6, particularly with reference to Bryde's whales as described by Yoshida and Kato (1999). Progress on development of validated databases for small cetaceans is reported in SD/53/SM7. The high taxonomic diversity of market products found in one study reported in these papers, a minimum of 25 of the 79 described species of the order Cetacea, indicates the need for a comprehensive catalogue of validated sequences for unambiguous identification.

The Committee noted that public databases such as GenBank are an extremely valuable resource for population and forensic research and that increased validation of the banked sequences will contribute to their utility. It encouraged researchers in the IWC community to contribute sequences, with emphasis on submission of correlated data that will validate their origin and to notify contributors to GenBank of errors they discover in posted contributions and potential useful amendments.

Morishita and Walløe expressed concern on two aspects of this item. Firstly, since small cetaceans are outside the mandate of the IWC, it is not appropriate to include such information. Furthermore, small cetaceans are irrelevant under this item because it pertains to the RMP which deals with large baleen whales. Secondly, they believed that the discussion on reference databases is increasingly moving towards establishment of an international whale meat market surveillance system. This is clearly outside of the mandate of the IWC and would interfere with the existing domestic market management measures of member countries.

Cipriano and Lento disagreed with the first concern, noting that Resolution 1999-8 (IWC, 2000b) specifically requests annual reports on 'genetic methods for identification of species' as well as stocks and individuals. A reference database of DNA sequences including small cetaceans is essential for the purpose of ruling out small cetacean species as candidates in the identification process. They further noted that Morishita's second concern ignores the instruction in Resolution 1999-8 which directs the Committee to provide advice 'on the development and implementation of a transparent and verifiable system of identification'.

17.4 Standards for a diagnostic register of DNA profiles

Lento described progress made on specifications for a diagnostic DNA registry (Annex N, Appendix 3). These specifications are the result of recommendations made at an international symposium on the identification of cetaceans held in 1999 (Dizon *et al.*, 2000) and of discussions in the Committee last year (IWC, 2001p). The information includes the currently-accepted definition of the elements required for a composite DNA profile including three genetic markers: mtDNA sequence data for species identification, a series of microsatellite loci for individual identification and sex-specific genetic marker. She also described a Laboratory Information Management System database specifically designed to house the sample information and DNA data required for a Central Tissue Archive and diagnostic DNA registry (in use at the Smithsonian Institution, the US National Cancer Institute and the Max-Planck Institute for Evolutionary Anthropology). She provided further information about the web-based programs mentioned under Item 17.1. The web site is functional for species identifications based on mtDNA and is under development to incorporate analytical tools for matching microsatellite profiles against a registry.

It was agreed that the specifications described are useful examples of what is required for establishment of a diagnostic registry. In response to a question about how microsatellites would be scored given the difficulties relating to standardisation, Lento replied that in the system she described, matches would be made only after laboratories using the system had standardised their data generation using various methods such as those discussed previously (IWC, 2001p). The programs for standardisation of microsatellite profiles are under development. The Committee encouraged Lento to report on further progress at next year's meeting.

Baker expressed his appreciation to Prof. Lars Walløe, Prof. Olaisen and Dr. Berit Dupuy for providing aliquots of reference samples for North Atlantic minke whales. This will allow standardisation among laboratories of allele sizes for microsatellite genotyping (DNA profiling). Walløe noted that this access was granted under a bilateral arrangement and did not involve the IWC.

17.5 Dialogue with Commission

The Committee noted that in the absence of further direction from the Commission, future annual progress reports are likely to be similar to this year's report in their content and brevity.

17.6 Work plan

The Working Group will next year again address the tasks assigned by IWC Resolution 1999-8 (IWC, 2000b) and consider any new documents submitted that relate to these tasks.

18. RESEARCH AND WORKSHOP PROPOSALS

18.1 Review research results from 2000/2001

The Committee received a penultimate report of the contract 'Genetic identification of parent offspring relations in cetacean populations' (SC/53/NAH9).

18.2 Review proposals for 2001/2002

Six proposals were reviewed by the Intersessional Review Group (IRG) and outside reviewers. As shown in Table 8, seven criteria were used to review each of the proposals that requested funding, provided they were considered suitable for review. Comments that proposals were considered appropriate for funding are subject to the Committee's overall research budget priorities (see Item 21).

The IRG decided that given the extensive documentation associated with these proposals and their review, it was preferable to make the proposals available on request from the Secretariat rather than distribute them to the full Committee.

SC/53/RP1 (Harrison *et al.*) proposed to conduct acoustic and genetic research on North Pacific and North Atlantic fin whales. It received a medium-high overall score and was considered appropriate for funding by the Committee. This proposal received the highest score of the six proposals.

SC/52/SM34 (Van Waerebeek *et al.*) proposed to conduct research on common dolphins in the Pacific off the coast of South America. It received a medium score and was considered appropriate for funding by the Committee. It was noted that this proposal qualifies for funding from the Small Cetaceans Fund and this was agreed.

Table 8

Requested funding and evaluation criteria scores of Research Proposals reviewed in detail by the Intersessional Review Group. The Principal Investigator (PI) for each proposal is named in the text. H – High, MH – Medium High, M – Medium, ML – Medium Low, L – Low. (Amounts are in £ sterling.)

	RP1	SM34	RP2	RP6
Total Amount Requested	15,345	3,200	8,717	34,464
Evaluation Criteria Scores				
(1) Relevance to work with SC	H	M	M	M
(2) Scientific quality of project	H	M	L	M
(3) Chance of success	M	M	M	M
(4) Scientific competence of PI's	H	H	M	M
(5) Feasibility of work schedule	M	M	M	M
(6) Reasonableness of budget	M	M	M	L
(7) Multinational context	L	H	H	M
Overall Score	MH	M	M	M

SC/53/RP2 (Hucke-Gaete and Findlay) proposed to study blue whales in the coastal waters of Chile. It received a medium score and was considered appropriate for funding by the Committee.

SC/53/RP3 (Olavarria *et al.*) requested samples from SOWER cruises to carry out genetic research to assign Southern Hemisphere humpback whales to their associated breeding grounds. The proposal did not request funding and was not reviewed in detail other than to determine that the proposal was considered of sufficient merit to recommend that tissue samples be provided to the principal investigator, if possible.

SC/53/RP4 (Hoelzel) requested samples from SOWER cruises to carry out research on the global phylogeneography of killer whales. The proposal did not request funding and was not reviewed in detail other than to determine that the proposal was considered of sufficient merit to recommend that tissue samples be provided to the principal investigator, if possible.

SC/53/RP5 (Thangaraja *et al.*) proposed to monitor cetaceans in Omani waters. The proposal and associated budget request lacked sufficient scientific rigour to warrant a full scientific review by the IRG. The Committee cannot therefore recommend funding this proposal.

SC/53/RP6 (Baldwin *et al.*) proposed to conduct research on cetaceans in waters off the coast of Oman. It received a medium score and was considered appropriate for funding by the Committee.

The Committee **agreed** with the IRG's evaluation of the proposals and considered these proposals further under Item 21.

18.3 Report of planning group for Workshop on Methods for Whale Research

During the intersessional period, the Commissioner's of Japan and the USA had made a formal request to the Chair of the Scientific Committee to add this item to the Committee's agenda. The proposed workshop would critically review recent advances in both lethal and non-lethal methodologies and technologies for whale research. A focus on tools available for assessing stock structure, population dynamics and cetacean health was suggested. The Commissioners also suggested that the workshop should compare lethal and non-lethal techniques and examine the relative practicability and costs associated with conducting the research and collecting samples.

The Chair had asked Hatanaka and Smith to chair an intersessional correspondence group to begin planning in response to the Commissioners' request. The co-chairs produced a working paper to provide a framework for an initial discussion of the workshop. During discussion, several members expressed the view that feeding ecology should be one of the areas for which lethal and non-lethal research tools should be compared. A small group under the co-chairs worked during the meeting to refine the terms of reference, draft agenda, budget and logistical details for the workshop. In presenting the revised draft plan, Smith noted that the workshop would provide a way to systematise Committee discussions and thinking on these matters.

The Committee commented further on receiving the revised draft plan. Some members of the Committee agreed that the workshop would be useful, while others gave it low priority. It was agreed that the plan was very ambitious and would require a large number of invited participants. However, the Committee could not agree on particular research areas that should be deleted. The small group continued to work on the draft plan and reported at the end of the meeting that they had reached agreement on the plan given as Annex T. They expected that ten invited participants would be sufficient, Norway would probably host the meeting, the USA and Japan would provide some support and the total cost would be around £20,000. Read agreed to chair a steering group, with Hatanaka, Smith and Donovan as members.

19. COMMITTEE PRIORITIES AND INITIAL AGENDA FOR THE 2002 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 2002 meeting. They took into account:

(1) the priority items agreed by the Committee last year and endorsed by the Commission and, within them, the highest priority items agreed by the Committee on the basis of sub-committee discussions;
(2) 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;
(3) 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 2002 meeting.

It was agreed that suggestions for future in-depth assessments must be accompanied by thorough written reviews of the available information and an outline of the work that would need to be undertaken to complete an assessment.

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. Items of lower priority will only be discussed if time allows. It is stressed that papers considering anything other than priority topics may not be addressed.

RMP (Convenor – Bannister)
As last year, this sub-committee would concentrate on two areas:

(a) General issues
Priority topics will be:

(1) adjustment of the convergence criteria for the CATCHLIMIT program;
(2) consider results from the Intersessional Working Group on Abundance Estimation;
(3) consider implications of choice of component of population to which MSYR, MSYL and density-dependence apply in RMP trials.

(b) Preparations for Implementation
The priority topics will be:

(1) completion of North Pacific minke whale implementation (including review results of intersessional meeting);
(2) North Atlantic minke whales *Implementation Review*.

It may also discuss western North Pacific Bryde's whales (review of progress on trials and results of sightings surveys).

BC (Convenor – Berggren)
This Working Group will (in the context of the RMP) review the estimation of anthropogenic removals.
The priority topics will be:

(1) bycatch based on fisheries data and observer programmes;
(2) bycatch based on genetic data:
    (a) the feasibility of developing a workshop;
    (b) analytical tests for assignment to stocks and/or areas;
(3) further review of information and methods to estimate mortality from ship strikes.

It may also discuss methods for estimating additional human induced mortalities.

AWMP (Convenor – Donovan)
This Standing Working Group will continue the development process and will have had an intersessional workshop in Seattle. It will also review results and progress on the Greenlandic Research Programme. Priority topics will be:

(1) selection of an *SLA* for Bering-Chukchi-Beaufort Seas bowhead whales and presentation to the Commission (including management advice);
(2) *SLA*(s) for eastern North Pacific gray whales;
(3) progress on development of potential *SLA*s for Greenland fisheries;
(4) review of results from Greenlandic Research Programme and revise programme if necessary;
(5) scientific aspects of an Aboriginal Whaling Scheme;
(6) annual review of catch data and management advice for minke and fin whales off Greenland.

Humpback whales (Convenor – Hammond)
Priority topics will be:
(1) completion of the Comprehensive Assessment of North Atlantic humpback whales;
(2) review of progress on the Comprehensive Assessment of Southern Hemisphere humpback whales (this will be undertaken by a separate working group);
(3) annual review of catch data and management advice for humpback whales off St Vincent and The Grenadines.

Bowhead, right and gray whales (Convenor – Walløe)
Priority topics will be:

(1) an in-depth assessment of gray whales (eastern and to the extent possible western);
(2) a new abundance estimate for B-C-B bowhead whales;
(3) review of progress on previous recommendations.

In-Depth assessments (Convenor – Palka)
Priority topics will be:

(1) issues relating to the abundance estimation of Southern Hemisphere minke whales (and, where relevant, other species within the same datasets). 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 review of data from the 2001/02 SOWER circumpolar cruise and plans for future cruises.

It will also devote limited time to planning for an assessment of Southern Hemisphere blue whales (including reviewing progress on the issue of sub-species differentiation).

Stock definition (Convenor – Bravington)
Priority topics will be:

(1) complete consideration of clarification of management objectives relative to the term stock;
(2) review of instances of recovery of cetacean sub-stocks after severe depletion;
(3) statistical and genetic issues (including reviewing reports from intersessional working groups).

Environmental concerns (Convenor – DeMaster)
Priority topics will be:

(1) cooperative research in the Antarctic;
(2) results from SOWER 2000 cruise (cooperative research with CCAMLR);
(3) progress in developing joint research programme with SO-GLOBEC (including development of long-term research framework and possible mini-symposium);
(4) review results from workshop on marine mammal-fisheries interactions.

It will also devote limited time to:

(a) steering group report on POLLUTION 2000+;
(b) review of results from the workshop on habitat degradation (if held);
(c) review information regarding whalewatching activities and noise impacts;
(d) consideration of form of State of the Cetacean Environment Report (SOCER).

DNA (Convenor – Zeh)
This working group will provide the annual progress report to the Commission required by Resolution 1999-8.
Priority topics will be:

(1) genetic methods for species, stock and individual identification;
(2) collection and archiving of tissue samples from catches and bycatches;
(3) reference databases and standards for diagnostic DNA registries.

Small cetaceans (Convenor – Read)
Priority topics will be:

(1) review of the status of humpbacked dolphins (genus *Sousa*);

(2) review of the existence of directed and incidental takes of small cetaceans in member countries, with a view to requesting data in the future;
(3) review of progress on previous recommendations.

Whalewatching (Convenor – Kato)
Priority topics will be:

(1) review the reports of Intersessional Working Groups;
  (a) data collection;
  (b) whalewatching management;
(2) review information regarding whalewatching activities and noise impacts;
(3) review of research on the effectiveness of national whalewatching guidelines and regulations;
(4) review of new information on whale and dolphin swim-with programmes.

It may also discuss review of national guidelines and regulations for whalewatching and review of new information on dolphin feeding programmes.

20. DATA PROCESSING AND COMPUTING NEEDS FOR 2001/2002

The Committee identified the requests for intersessional work by the Secretariat given in Table 9. In the light of its discussions on Committee priorities (Item 24), the Committee **agreed** that the work identified for furthering the AWMP and the first three 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 9 before next year's Scientific Committee meeting unless many additional trials were developed at the intersessional meeting on North Pacific minke whales. The Chair reminded the Committee that it must be feasible for work on North Pacific minke whales to be completed by the 2002 meeting and not to be open-ended. The Committee recognised that a final decision on priorities would need to be made after the Commission meeting to take into account Commission deliberations. The Committee **agreed** that Allison will liase with the Chair of the Scientific Committee and the Convenors of the relevant sub-committees to decide if priorities need to be changed in the light of Commission decisions and to review progress during the year.

The Committee **agreed** to set up an intersessional steering group to advise and oversee work on validation of the IWC/CCAMLR and SO/GLOBEC cruise data.

The Committee noted that work on population assessment models of North Atlantic humpback whales would be conducted in the intersessional period (see Item 10.6.7.1), but that this did not involve the Secretariat.

21. FUNDING REQUIREMENTS FOR 2001/2002

Table 10 summarises the complete list of recommendations for funding made by the Committee. The total required to meet its preferred budget is £495,108. The Committee **recommends** all of these proposed expenditures to the Commission. However, it understood that the amount available for these discretionary funding requirements is £203,200. It therefore reviewed the full list, taking into account its work plan, priorities and the possibility that some of the work requiring funding could be postponed to a future year while other items represented unique opportunities that would not be available again. Should the Commission be unable to fund the full list of items in Table 10, the Committee **agreed** that the final column given in the table represents a budget that will allow progress to be made by its major sub-committees and working groups. Progress will not be possible in some important areas, as outlined below and the Committee **requests** that the Commission or individual member governments provide additional funding in these areas. The Committee **strongly recommends** that, at a minimum, the Commission accept its reduced budget of £203,200.

A summary of each of the items is given overleaf. Full details can be found under the relevant Agenda Items and Annexes as given in the table.

Table 9
Computing tasks/needs for 2001/2.

Task:	Estimated time
AWMP	
Minor amendments to Fishery type 2 (bowhead) control program (see Agenda Item 8.2.3.4)	2 weeks
Prepare tables and graphs for the Intersessional meeting as required	1 week
Additional work arising from the Intersessional meeting	??
Complete coding of control program to implement *Initial Evaluation* and *Robustness Trials* for Eastern North Pacific gray whales and create trial input datasets	1-2 month
RMP	
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 5.2).	1 month
Adjust the convergence criteria in the new CATCHLIMIT program to be robust when less precise integration is used.	2 weeks
Amend the control program and investigate the conditioning output for the North Pacific minke whale *Implementation Simulation Trials*, including resolving any inconsistencies remaining as specified in Annex D, Appendix 15 (see Agenda Item 6.5). Conduct the final set of *IST*s as specified at the Intersessional Meeting.	3 + months
Write the control program and create input data sets for the *Implementation Simulation Trials* for western North Pacific Bryde's whales as specified in IWC (2000 pp.118-123); (see Agenda Item 6.3).	2-6 months
Other	
Validation of the 1999/2000 and 2000/01 SOWER cruise data and incorporation into the sightings database.	8 months
Validation of the 1999/2000 joint IWC/CCAMLR cruise data	?
Validation of the 2000/01 joint IWC/SO GLOBEC cruise data	?
Encode the basic individual records from the revised Soviet catch data and document inconsistencies in the data. The earliest data will be coded first. (The detailed biological data will not be encoded in this first phase).	8 months
Encode any outstanding North Pacific gray whale catch data	1 month

Table 10

Scientific Committee recommendations for research expenditure, 2001-2002 (Amounts in £ sterling.)

Item	For	Reference	Preferred budget	Reduced budget
AWMP*				
Intersessional workshop	Invited Participants	Item 8.8 and Annex E	12,000	12,000
RMP				
Intersessional meeting	Invited Participants	Item 6.5 and Annex D	2,600	2,600
IA				
SOWER circumpolar cruise	Cruise leader, senior scientist, observers	Item 10.1.2.2 and Annex G (Appendix 3)	101,200	85,000
Intersessional Workshop	Invited Participants	Item 10.2.4.2 and Annex G	4,000	4,000
Analysis fund	Analysts	Item 10.2.4.2 and Annex G (Appendix 10)	26,000	16,000
E				
POLLUTION 2000+ research programme	Research on biological effects of contaminants in cetaceans	Item 12.1 and Annex J	103,000	8,200
SO-GLOBEC related research	Planning meeting, cruise support, analysis	Item 12.2.2 and Annex G & J	107,582	60,000
Fishery-cetacean competition workshop	Invited Participants	Item 12.3.4 and Annex J	15,000	10,000
Habitat degradation workshop	Invited Participants	Item 12.3.2 and Annex J	31,000	
IWC-CCAMLR data analysis and meeting participation	Analysts, contract support	Item 12.2.1 and Annex J	20,000	
NAH				
Assessment model development	Analysts	Item 10.6.7.1 and Annex H	3,000	3,000
Cape Verde Islands humpback whale research	Field sampling, genetic analysis	Item 10.6.7.3 and Annex H (Appendix 6)	8,000	2,400
Unsolicited research proposals				
SC/53/RP1	Field sampling, genetic analysis - fin whale	Item 18.2	15,345	
SC/53/SM34	Research on common dolphin in S. America	Item 18.2	3,200	
SC/53/RP2	Research on blue whales in Chile	Item 18.2	8,717	
SC/53/RP6	Research on cetaceans off Oman	Item 18.2	34,464	
Total			495,108	203,200

* Note that £8,000 required for the Developers Fund comes under a different item in the Commission's provisional budget.

(a) Items recommended for full funding under the reduced budget

Aboriginal Whaling Management Procedure

(1) AWMP INTERSESSIONAL WORKSHOP

The intersessional workshop held last year had been the key to allowing the Committee to meet its 'ideal' workplan at this year's meeting and to choose two preferred *Strike Limit Algorithms* (*SLA*s) for bowheads from among five candidates. In order to incorporate feedback from the Commission during its 2001 meeting and to evaluate the results of intersessional work carried out by the developers in response to suggestions made this year, another intersessional meeting is essential. The preferred candidate would be selected at this intersessional meeting, allowing completion of work needed before presentation of the chosen *SLA* to the Commission next year. The US NMFS National Marine Mammal Laboratory has again offered to host the workshop, so the only cost to the Commission is for invited participants.

(2) AWMP DEVELOPERS FUND

The developers fund has been invaluable in ensuring fast completion of AWMP trials and other essential tasks of the Standing Working Group. The Committee noted that this is included as a separate item of expenditure in the Commission's provisional budget[8].

Revised Management Procedure

(3) RMP INTERSESSIONAL MEETING

The Committee was concerned about the length of time taken to complete the *Implementation* for North Pacific minke whales. It believed that the proposed intersessional meeting would allow it to complete this *Implementation* at its next annual meeting. The intersessional meeting is needed to provide oversight for the *Implementation Simulation Trials* and associated analyses. The modest budget request is based on the assumption that the RMP intersessional meeting would be held in conjunction with the AWMP intersessional workshop since many of the invited participants would be the same as for that workshop.

In-depth Assessments

(4) INTERSESSIONAL MEETING ON ESTIMATION OF ANTARCTIC MINKE WHALE ABUNDANCE

Last year, the Committee had recommended an intersessional workshop to consider estimation methods and estimates of Antarctic minke whale abundance and trends. The Commission had been able to fund only a meeting of less than two days at the start of this year's annual meeting. The Committee agreed that a full two days immediately prior to its 2002 meeting should be set aside to continue this work if the review of Antarctic minke abundance and trends is to be completed in the near future.

(5) RENEWAL OF DESS CONTRACT

The Committee **recommends** that the DESS three-year, half-time rolling contract with the Research Unit for Wildlife Population Assessment (RUWPA) at the University of St Andrews be renewed. It was agreed that the work conducted under the contract will be determined, in consultation with RUWPA, by a Steering Group comprising Zeh, Borchers, Palka (Chair), Butterworth, Donovan and Allison. Possible tasks include:

(i) updating and maintenance of DESS;
(ii) entry of new datasets into DESS;

[8] Note that the £8,000 required for the Developers Fund comes under a different item in the Commission's provisional budget.

(iii) support to the Secretariat in the use of DESS;
(iv) routine analyses of the new IDCR/SOWER datasets;
(v) assistance with the validation of the 2000 IWC/CCAMLR sightings data; and
(vi) completion and/or assistance with various tasks listed in Appendix 10 of Annex G.

Renewal of the contract is due for consideration every second year, so that its next renewal will be in 2003.

North Atlantic Humpbacks

(6) ASSESSMENT MODEL DEVELOPMENT

The assessment model used by the Committee this year did not provide a satisfactory fit to the available data. In order to complete the Comprehensive Assessment of North Atlantic humpback whales in a timely manner, the model and the software implementing it require further development as detailed under Item 10.6.7.1.

(b) Items recommended for partial funding under the reduced budget

In-depth Assessments

(1) SOWER CIRCUMPOLAR CRUISE

Only Area V remains unsurveyed in the third circumpolar set of cruises and completion of this set is essential to the work of the Committee, in particular to complete in-depth assessments of Antarctic minke and blue whales. The Government of Japan has kindly offered the use of two research ships in 2001/2002 and the preferred budget in Table 10 reflects the remaining costs of the cruise (Appendix 3 of Annex G). The Committee agreed that the reduced budget in Table 10 is the minimum required if the cruise is to take place. This would require the Government of Japan or some other member to fund one of the researchers, the *Larsen* gun for biopsies and the binoculars listed in Appendix 3 of Annex G.

(2) ANALYSIS FUND

Item 10.2.4.2 details the costs of methodological work needed for completion of the review of minke whale abundance estimates, comprising the preferred budget for this item. The Committee agreed that at least the reduced budget was required if progress was to be made before next year's meeting.

Environment

(3) POLLUTION 2000+ RESEARCH ON BIOLOGICAL EFFECTS OF CONTAMINANTS IN CETACEANS

The POLLUTION 2000+ programme is an important and fundamental research programme that has been given high priority in the past by both the Committee and the Commission. It is with reluctance that the Committee gives it greatly reduced funding this year. This is partially a function of the higher priority given last year to this programme over the SOWER 2000/SO-GLOBEC collaboration and partially because of the one-off opportunity that the latter represents this year. A combination of the remaining funds from the previous year and the £8,200 available this year still falls far below the budget that will allow both the bottlenose dolphin and the harbour porpoise sub-projects to proceed as previously recommended and the Committee **urges** individual member nations to contribute to this effort. The total money available will allow completion of the Sarasota Bay bottlenose dolphin sub-project and some limited field collection and urgent analyses from the harbour porpoise sub-project.

(4) SO-GLOBEC RELATED RESEARCH

Item 12.2.2 describes the Committee's collaboration with SO-GLOBEC. The field studies to be supported represent a unique opportunity in the coming year to conduct research on Southern Ocean whales and their ecosystem as mandated by IWC Resolutions 1998-3 and 1998-6. The cost of this collaboration to the IWC is minimal compared, for example, to USA government funding of this research at around $20 million. It was noted that an IWC commitment of at least the level given in the reduced budget was required if SO-GLOBEC was to continue to provide ship time and other benefits. The Committee's preferred budget included funding for observers on all planned SO-GLOBEC cruises between summer 2001 and summer 2002, equipment purchases and attendance of researchers at planning and data analysis meetings and workshops. The reduced budget covers only the minimum number of IWC-funded observers (two per cruise) required for IWC participation.

(5) FISHERY-CETACEAN COMPETITION WORKSHOP

This Workshop was recommended for funding last year. Its primary objective is to begin to consider how to answer the question '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 budget will cover the cost of travel and subsistence for up to seven participants. Other attendees would need to be self-financed. This cost assumes that there would be no on-site costs to the IWC, and the Government of St Lucia has re-extended its kind offer to host the meeting although the details are not yet known.

North Atlantic humpbacks

(6) CAPE VERDE ISLANDS HUMPBACK WHALE RESEARCH

The Committee (Item 10.6.7.3) agreed that the highest priority for future data collection to complete the Comprehensive Assessment of North Atlantic humpbacks was obtaining additional photographic and genetic samples from the Cape Verde Islands to elucidate the question of stock identity of the animals which breed there. Appendix 6 of Annex H details the work expected to be possible under the preferred budget of Table 10. The Committee believed that a useful part of that work could be carried out with the reduced budget and that other funding sources might be found to cover the remaining work.

(c) Items not recommended for funding at this time under the reduced budget

Environment

(1) HABITAT DEGRADATION WORKSHOP

The Commission (Resolution 2000-7) has encouraged work in this area. Progress on the conceptual framework that the workshop would consider was made at an intersessional meeting (Annex J, Appendix 3) and a new workshop proposal was subsequently produced (Annex J, Appendix 4). ICRAM in Italy has offered to host the meeting, so the item in the Committee's preferred budget is needed only for invited participants. Sufficient outside funding to support the meeting might be found if the IWC could contribute £10,000 towards the cost of invited participants.

(2) IWC-CCAMLR DATA ANALYSIS AND MEETING PARTICIPATION

The Committee noted that validation of IWC-CCAMLR data would be accomplished under existing contracts. It also noted that the interdisciplinary approach of cooperative studies between CCAMLR and the IWC benefited both organisations and that the remaining analyses of the large whale data needed to proceed in a timely manner. It hoped

that CCAMLR member nations would contribute to the analysis costs not able to be funded by IWC under the reduced budget.

Unsolicited research proposals

These proposals, described in more detail under Item 18.2, were considered worthy of funding. However, none were sufficiently important to the Committee's work, relative to the other items included in the reduced budget, to merit funding if the full amount of the Committee's preferred budget is not available. The Committee agreed that the support requested in SC/52/SM34 could come from the Small Cetaceans Fund.

22. WORKING METHODS OF THE COMMITTEE

22.1 Changes to increase transparency and reduce workload

Last year, at the end of the meeting, 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 and had suggested possible changes to the Committee's Rules of Procedure (Berggren *et al.*, 2001). The Committee had agreed to put the item on its Agenda for 2001 and members were encouraged to develop and submit further ideas on this general topic.

The Committee discussed this Item earlier in the meeting this year and considered the issue without the pressure of time constraints. The Committee recognised the importance of retaining flexibility in its procedures to the extent possible, as well as the need to enable new members to gain experience in the Committee's organisation. One of last year's proposals had been to consider the election of vice-chairs to each group. Past and present Convenors noted that they obtained advice from a number of different sources, particularly noting the valuable role that can be played by rapporteurs. A feature of the views expressed was that it was important to allow individual Chairs to decide upon the most efficient way of working, which may vary from group to group. Similarly, it was recognised that whilst it was important to ensure a broad representation in the Convenors' group, the efficiency of that group would be diminished if it became too large. It was recognised that should a Chair of a group decide to have a vice-chair, that person could be nominated to attend Convenor's group meetings instead of the Chair, should the Chair of that group so wish. Similarly, Chairs of groups were at liberty not to choose vice-chairs.

Consequently, the Committee **agreed** that it was not appropriate to consider amending its Rules of Procedure at this stage. The Committee also recognised the value of using intersessional groups as a means to broaden participation and increase expertise and the importance of ensuring that scientists whose first language was not English were fairly represented.

22.2 Increasing participation of developing country scientists

The Committee had been invited to discuss the Scientific Committee-related aspects of IWC/53/F&A3, which reported on the preliminary outcome of the consultation on enhancing participation of developing countries at the IWC. This had been initiated at the request of Brazil at the Commission meeting last year. In this regard the Committee considered a presentation by De Lima and Palazzo (Annex S) that commented on the proposals in IWC/53/F&A3 and suggested ways to make progress.

The Committee **agreed** that the proposal that scientists from developing countries could, after being selected following the normal Invited Participant selection process, be granted national delegation status, showed considerable promise. A Rule of Procedure to account for this suggested by the authors is given in Annex S. The Committee **agreed** that whilst this was fundamentally a Commission decision, it was workable provided that: (1) the Committee retained the right of selection as the proposal suggested; and (2) IPs could decide that they did not wish to become national delegates. Annex S suggested two possible financial mechanisms whereby this might be achieved.

The Committee also **agreed** with the proposal in Annex S that further consultation should take place on the best way in which developing countries can indicate which topics of the Committee's work are of greater interest to their scientists, particularly in relation to the question of allocation of research funds to projects in developing countries. The Committee recognised the importance of this issue and looked forward to receiving information on the results of the consultation exercise.

The Committee expressed support for: (1) the use of the Commission's website to facilitate cooperation between scientists, particularly with respect to Scientific Committee activities, and distribution of information and reports; (2) the donation of sets of Commission publications to specified national institutes. The *Journal* already places special emphasis on assisting scientists from developing countries to produce papers of publication standard both by assistance in writing and analysis.

Discussion broadened into the need to consider the most efficient ways to help scientists in developing countries gain the necessary expertise to address conservation and management issues in their own countries. The Committee believed that this is an important issue and had a preliminary discussion on a number of ways this might be achieved. For example, it recognised that merely bringing one or two scientists to a Scientific Committee meeting is probably not the most efficient way to achieve this. Suggestions included the IWC: (1) funding relevant Scientific Committee members to hold practical workshops in developing countries; and (2) funding scientists from developing countries to appropriate specialist workshops/courses such as those regularly held at the University of St Andrews on distance sampling. It was also noted that national laboratories and other institutions could consider either remote or in-house training and that this could be facilitated by the IWC. The Committee **agreed** that it would discuss these topics further next year.

22.3 Role of the IWC website

The Secretariat is exploring ways of using the IWC website (or a subset of this) to facilitate the Committee's work. It is planned this year, for example, to establish pages that: (1) summarise the recommendations of the Committee, the intersessional work plan and associated deadlines; and (2) provide details (terms of reference, names, but not e-mail addresses) of the intersessional correspondence groups and also provide an option for chairs of those groups to voluntarily report any progress made.

Technical issues have now been resolved and after this meeting, subject to approval from the authors, national progress reports (on a rolling three-year basis) will be available on the website.

The Secretariat is considering ways to facilitate the distribution of meeting papers without prejudicing people's right to publish and will report back to the Committee on this next year.

22.4 Procedural aspects related to intersessional groups

The Committee considered a working paper relating to practical difficulties that have arisen in recent years in certain intersessional working groups. It was recognised that some of these difficulties arise out of the fact that the Committee does not always have time at the end of meetings to ensure that adequate terms of reference have been defined.

The Committee recognised that there are at least two differing types of intersessional groups: (1) those that are given rather broad mandates to explore issues that have proved intractable during the meeting with a view to proposing ways forward at the following meeting; and (2) those that have been assigned rather specific tasks and require considerable progress (and work commitments by members) to allow the Committee to move forward at its next meeting.

In all cases the Committee agreed that it should pay greater attention to drafting unambiguous terms of reference that reflected the degree of flexibility it intended. The Committee **agreed** that in the second case it would be useful to have a mechanism whereby the Chair of the intersessional group could call upon an authoritative body for advice and if necessary, a ruling of how to proceed. Under such circumstances it was **agreed** that the Chair of the intersessional group should request advice from the Chair of the Scientific Committee, who would consult with the relevant Convenor(s).

22.5 Proposed amendments to the Rules of Procedure

The Committee considered draft proposals for changes in its Rules of Procedure (IWC/53/F&A7). It suggested modifications to these to remove possible misunderstandings and **agreed** that the Secretariat should forward its suggested wording to the relevant Commission body.

23. ELECTION OF OFFICERS

In the absence of specific recommendations arising out of Item 22.1, there was no business to cover under this item this year.

24. PUBLICATIONS

Donovan reported on the new *Journal for Cetacean Research and Management.* Some 74 papers covering all the major subjects of interest to the Committee had been published. Authors from over 20 countries were involved. The second special issue *Right Whales: Worldwide Status* has been completed and should be sent to members shortly after the close of the meeting. The gray whale volume is also near completion. Donovan reminded 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*.

25. OTHER BUSINESS

An invitation to a fishery symposium was noted. The Chair asked any member of the Committee who might wish to attend as an IWC representative to notify the Secretariat.

The Chair thanked the Secretary, Nicky Grandy, the rapporteur and the Secretariat staff for their hard work and efficiency. The Committee noted that this meeting had gone particularly smoothly.

26. ADOPTION OF REPORT

The report was adopted at 17:30 on 16 July 2001. The meeting was then adjourned.

REFERENCES

Amano, M., Amano, A., Oizumi, H. and Marui, M. 1998. Landing of porpoises and dolphins at Otsuchi fish market, April 1992 through April 1996. pp. 1-32. *In:* N. Miyazaki (ed.) *Report of Contract on Population of Dolphins and Porpoises*. Ocean Research Institute, University of Tokyo, Tokyo. 242pp. [In Japanese with tables and figures in English].

Au, W.W.L. and Green, M. 2001. Acoustic interaction of humpback whales and whalewatching boats. *Mar. Environ. Res.* 49:469-81.

Baker, C.S. and Medrano-González, L. 2001. World-wide distribution and diversity of humpback whale mitochondrial DNA lineages. p. 84-99. *In:* C.J. Pfeiffer (ed.) *Molecular and Cell Biology of Marine Mammals*. Krieger Publishing Co., Melbourne, FL 2002.

Baker, C.S., Cipriano, F. and Palumbi, S.R. 1996. Molecular genetic identification of whale and dolphin products from commercial markets in Korea and Japan. *Mol. Ecol.* 5:671-85.

Baker, C.S., Dalebout, M.L. and Lento, G.M. 2002. Gray whale products sold in commercial markets along the Pacific coast of Japan. *Mar. Mammal Sci.*: 18(1): 295-300.

Barlow, J. and Clapham, P.J. 1997. A new birth-interval approach to estimating demographic parameters of humpback whales. *Ecology* 78(2):535-46.

Berggren, P., Bjørge, A., Borsani, F., Brownell, R., Carlson, C., Childerhouse, S., Kock, K.-H., Lento, G., Palazzo, J., Read, A., Reijnders, P., Rogan, E., Rojas-Bracho, L., Swartz, S., Simmonds, M., Slooten, E. and Thiele, D. 2001. Report of the Scientific Committee. Annex W. Changes to Scientific Committee Organisation to Increase Transparency and to Reduce Work Load. *J. Cetacean Res. Manage. (Suppl.)* 3:369.

Borchers, D.L., Butterworth, D.S. and Kasamatsu, F. 1990. Southern Hemisphere whale abundance estimates south of 30°S derived from IWC/IDCR survey and Japanese scouting vessel data. Paper SC/42/SHMi18 presented to the IWC Scientific Committee, June 1990 (unpublished). 42pp. [Paper available from the Office of this Journal].

Branch, T.A. and Butterworth, D.S. 2001a. Estimates of abundance for frequently sighted cetacean species based on the 1978/79 to 1997/98 IWC/IDCR-SOWER sighting surveys. *J. Cetacean Res. Manage.* 3(3): 251-270.

Branch, T.A. and Butterworth, D.S. 2001b. Southern Hemisphere minke whales: standardised abundance estimates from the 1978/79 to 1997/98 IDCR-SOWER surveys. *J. Cetacean Res. Manage.* 3(2):143-174.

Butterworth, D.S. 2001. Report of the Scientific Committee. Annex V. Minority Statement with Respect to the Report of the Stock Definition Working Group. *J. Cetacean Res. Manage. (Suppl.)* 3:368.

Butterworth, D.S., Punt, A.E., Geromont, H.F., Kato, H. and Miyashita, T. 1996. An ADAPT approach to the analysis of catch-at-age information for Southern Hemisphere minke whales. *Rep. int. Whal. Commn* 46:349-59.

Calambokidis, J., Darling, J.D., Deeke, V., Gearin, P., Gosho, M., Megill, W., Tombach, C.M., Goley, D., Toropova, C. and Gisborne, B. In press. Abundance, range and movements of a feeding aggregation of gray whales from California to southeastern Alaska. *J. Cetacean Res. Manage.*:Submitted.

Calambokidis, J., Steiger, G.H., Straley, J., Herman, L.M., Cerchio, S., Salden, D., Urbán R, J., Jacobsen, J.K., von Zeigesar, O., Balcomb, K.C., Gabriele, C.M., Dahlheim, M.E., Uchida, S., Ellis, G., Miyamura, Y., Ladrón de Guevara P, P., Yamaguchi, M., Sato, F., Mizroch, S.A., Schlender, L., Rasmussen, K. and Barlow, J. 2001.

Movements and population structure of humpback whales in the North Pacific. *Mar. Mammal Sci.*: 17:769-794.
Chariff, R., Clapham, P.J., Gagnon, W., Loveday, P. and Clark, C.W. 2001. Acoustic detections of singing humpback whales in the waters of the British Isles. *Mar. Mammal Sci.* 17:751-768.
Clapham, P.J. 1992. Age at attainment of sexual maturity in humpback whales, *Megaptera novaeangliae*. *Can. J. Zool.* 70(7):1470-2.
Clarke, E.D., Burt, M.L. and Borchers, D.L. 2000. Investigation of bias in GAM-based abundance estimation methods and their suitability for JARPA survey data. Paper SC/52/IA19 presented to the IWC Scientific Committee, June 2000, in Adelaide, Australia. [Paper available from the Office of this Journal].
Dereksdóttir, E.H. and Magnússon, K.G. 2001. Investigations of an Aboriginal Whaling Management Procedure using Adaptive Kalman Filtering (AKF). *J. Cetacean Res. Manage.* 3(2): 109-116.
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. [Available from: *http://www.nmfs.gov*].
Erbe, C. 2001. Underwater noise of whale-watching boats and potential effects on killer whales (*Orcinus orca*), based on an acoustic impact model. Report for Fisheries and Oceans, Canada, 16 April 2001. 27pp. [Available from the author, *erbe.c@yahoo.com*].
Escorza-Treviño, S. and Dizon, A.E. 2000. Phylogeography, intraspecific structure and sex-biased dispersal of Dall's porpoise, *Phocoenoides dalli*, revealed by mitochondrial and microsatellite DNA analyses. *Mol. Ecol.* 9:1049-60.
Escorza-Treviño, S., Pastene, L. and Dizon, A.E. 2001. Phylogenetic analysis of the *truei* and *dalli* morphotypes of Dall's porpoise (*Phocoenoides dalli*). *J. Mammal.*: In press.
Garrigue, C., Forestell, P., Greaves, J., Gill, P., Naessig, P. and Baker, C.S. 2000. Migratory movement of humpback whales (*Megaptera novaeangliae*) between New Caledonia, East Australia and New Zealand. *J. Cetacean Res. Manage.* 2(2):101-10.
Givens, G.H. 1999. Multicriterion decision merging: competitive development of an aboriginal whaling management procedure. *J. Am. Stat. Assoc.* 94:1003-4.
Government of Japan. 1995. The 1995/96 Research Plan for the Japanese Whale Research Program under the Special Permit in the Antarctic. Paper SC/47/SH3 presented to the IWC Scientific Committee, May 1995 (unpublished). 9pp. [Paper available from the Office of this Journal].
Government of Japan. 2000. Research plan for cetacean studies in the western North Pacific under special permit (JARPN II)(feasubility study plan for 2000 and 2001). Paper SC/52/O1 presented to the IWC Scientific Committee, June 2000, in Adelaide, Australia. [Paper available from the Office of this Journal].
Hatanaka, H., Ohsumi, S., Kato, H. and Miyashita, T. 1999. Report of the Scientific Committee, Annex D. Appendix 11. Consideration of the form of Bryde's whales around oceanic/isolated islands, especially in the Leeward Hawaiian islands area. *J. Cetacean Res. Manage. (Suppl.)* 1:106-7.
Haw, M.D. 1991. Estimation of minke whale abundance from the 1989/90 IWC/IDCR Antarctic assessment cruise in Area I. Paper SC/43/Mi1 presented to the IWC Scientific Committee, May 1991 (unpublished). 18pp. [Paper available from the Office of this Journal].
Hunt, G.L., Jr., Kato, H. and McKinnell, S.M. 2000. Predation by marine birds and mammals in the sub-Arctic North Pacific ocean. PICES Scientific Report No. 14, North Pacific Marine Science Organization, PO Box 6000, Sidney, BC Canada. [http://*pices.ios.bc.ca*].
Ingebrigtsen, A. 1929. Whales caught in the North Atlantic and other seas. *Rapp. P-V Réun. Cons. Int. Explor. Mer* 56(2):1-26.
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 Whaling Commission. 1991. 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. 1992a. Report of the Scientific Committee. *Rep. int. Whal. Commn* 42:51-86.
International Whaling Commission. 1992b. Report of the Scientific Committee [Including Annexes]. *Rep. int. Whal. Commn* 42:51-270.
International Whaling Commission. 1992c. Report of the Scientific Committee. Annex G. Report of the sub-committee on small cetaceans. *Rep. int. Whal. Commn* 42:178-234.
International Whaling Commission. 1993. Report of the Scientific Committee. Annex D. Report of the sub-committee on management procedures. *Rep. int. Whal. Commn* 43:93-103.
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 H. The Revised Management Procedure (RMP) for Baleen Whales. *Rep. int. Whal. Commn* 44:145-52.
International Whaling Commission. 1995a. Chairman's Report of the Forty-Sixth Annual Meeting. *Rep. int. Whal. Commn* 45:15-52.
International Whaling Commission. 1995b. Chairman's Report of the Forty-Sixth Annual Meeting, Appendix 8. Recommendations to the Commission by the Norfolk Island Intersessional meeting of the Working Group on a Sanctuary in the Southern Ocean. *Rep. int. Whal. Commn* 45:45-6.
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 H. Report of the sub-committee on small cetaceans. *Rep. int. Whal. Commn* 46:160-79.
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 H. Report of the sub-committee on small cetaceans. *Rep. int. Whal. Commn* 47:169-91.
International Whaling Commission. 1997d. 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 S. Modified Guidelines for Progress Reports. *Rep. int. Whal. Commn* 48:292-5.
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* 48:170-182.
International Whaling Commission. 1999a. Chairman's Report of the Fiftieth Annual Meeting. Appendix 4. IWC Resolution 1998-3. Resolution on the Southern Ocean Sanctuary. *Ann. Rep. Int. Whaling Comm.* 1998:42-3.
International Whaling Commission. 1999b. Planning Workshop to Develop a Research Programme to Investigate Pollutant Cause-Effect Relationships in Cetaceans - 'POLLUTION 2000+'. *J. Cetacean Res. Manage.* (special issue) 1:55-82.
International Whaling Commission. 1999c. Report of the Scientific Committee. *J. Cetacean Res. Manage. (Suppl.)* 1:1-52.
International Whaling Commission. 1999d. 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. 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 I. Report of the Standing Sub-Committee on Small Cetaceans. *J. Cetacean Res. Manage. (Suppl.)* 1:211-25.
International Whaling Commission. 1999g. Report of the Scientific Committee. Annex P. Proposal for Developing a Cooperative Research Programme to Address Critical Research Needs for the Greenland Stocks. *J. Cetacean Res. Manage. (Suppl.)* 1:262.
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 9. IWC Resolution 1999-8.

Resolution on DNA testing. *Ann. Rep. Int. Whaling Comm.* 1999:55.

International Whaling Commission. 2000c. 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. 2000d. 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. 2000e. 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. 2001a. Report of the Scientific Committee. *J. Cetacean Res. Manage. (Suppl.)* 3:1-76.

International Whaling Commission. 2001b. Report of the Scientific Committee. Annex D. Appendix 10. Specifications of the North Pacific minke whaling trials. *J. Cetacean Res. Manage. (Suppl.)* 3:114-25.

International Whaling Commission. 2001c. Report of the Scientific Committee. Annex D. Appendix 11. Terms of reference for an intersessional steering group for North Pacific minke whale *Implementation Simulation Trials*. *J. Cetacean Res. Manage. (Suppl.)* 3:125.

International Whaling Commission. 2001d. Report of the Scientific Committee. Annex D. Report of the Sub-Committee on the Revised Management Procedure. *J. Cetacean Res. Manage. (Suppl.)* 3:90-125.

International Whaling Commission. 2001e. Report of the Scientific Committee. Annex D. Report of the Sub-Committee on the Revised Management Procedure. Appendix 2. Report of the Working Group on total catches over time. *J. Cetacean Res. Manage. (Suppl.)* 3:105.

International Whaling Commission. 2001f. Report of the Scientific Committee. Annex D. Report of the Sub-Committee on the Revised Management Procedure. Appendix 3. Report of the Working Group on *MSYL*, *MSYR* and density-dependence trials. *J. Cetacean Res. Manage. (Suppl.)* 3:106.

International Whaling Commission. 2001g. Report of the Scientific Committee. Annex E. Report of the Standing Working Group (SWG) on the Development of an Aboriginal Subsistence Whaling Management Procedure (AWMP). *J. Cetacean Res. Manage. (Suppl.)* 3:126-60.

International Whaling Commission. 2001h. Report of the Scientific Committee. Annex F. Report of the Sub-Committee on Aboriginal Subsistence Whaling. *J. Cetacean Res. Manage. (Suppl.)* 3:161-76.

International Whaling Commission. 2001i. Report of the Scientific Committee. Annex G. Report of the Sub-Committee on the Comprehensive Assessment of Whale Stocks - In-depth Assessments. *J. Cetacean Res. Manage. (Suppl.)* 3:177-208.

International Whaling Commission. 2001j. Report of the Scientific Committee. Annex G. Report of the Sub-Committee on the Comprehensive Assessment of Whale Stocks - In-depth Assessments. Appendix 7. Report of the intersessional steering group for the 2001 Southern Hemisphere minke whale abundance review. *J. Cetacean Res. Manage. (Suppl.)* 3:199.

International Whaling Commission. 2001k. Report of the Scientific Committee. Annex G. Report of the Sub-Committee on the Comprehensive Assessment of Whale Stocks - In-depth Assessments. Appendix 11. Tasks identified for work plan. *J. Cetacean Res. Manage. (Suppl.)* 3:205.

International Whaling Commission. 2001l. Report of the Scientific Committee. Annex H. Report of the Sub-Committee on the Comprehensive Assessment of Whale Stocks - Other Stocks. *J. Cetacean Res. Manage. (Suppl.)* 3:209-28.

International Whaling Commission. 2001m. Report of the Scientific Committee. Annex J. Report of the Standing Working Group on Environmental Concerns. *J. Cetacean Res. Manage. (Suppl.)* 3:239-62.

International Whaling Commission. 2001n. Report of the Scientific Committee. Annex K. Report of the Standing Sub-Committee on Small Cetaceans. *J. Cetacean Res. Manage. (Suppl.)* 3:263-91.

International Whaling Commission. 2001o. Report of the Scientific Committee. Annex M. Appendix 3. Potential data collected from whalewatching platforms. *J. Cetacean Res. Manage. (Suppl.)* 3:306-7.

International Whaling Commission. 2001p. Report of the Scientific Committee. Annex O. Report of the Working Group on DNA Identification and Tracking of Whale Products. *J. Cetacean Res. Manage. (Suppl.)* 3:316-23.

International Whaling Commission. 2001q. Report of the Scientific Committee. Annex P. Scientific Permits. *J. Cetacean Res. Manage. (Suppl.)* 3:324-38.

International Whaling Commission. 2001r. Report of the Scientific Committee. Annex T. Report of the Working Group on the Greenland Research Programme. *J. Cetacean Res. Manage. (Suppl.)* 3:361-2.

International Whaling Commission. 2001s. Report of the Scientific Committee. Annex X. Statement on the Agenda. Statement by the Japanese Delegation Concerning Small Cetaceans. *J. Cetacean Res. Manage. (Suppl.)* 3:370.

International Whaling Commission. 2001t. Summary of Decisions and Required Actions from the 52nd Annual Meeting. *Ann. Rep. Int. Whaling Comm.* 2000:7-10.

Jenner, K.C.S., Jenner, M.-N.M. and McCabe, K.A. 2001. Geographical and temporal movements of humpback whales in western Australian waters. *APPEA Journal 2001* :749-765.

Kasamatsu, F., Matsuoka, K. and Hakamada, T. 1998. Spatial structure of whale community in the Antarctic feeding grounds with special reference to the interspecific relationships - preliminary report. Paper SC/50/E2 presented to the IWC Scientific Committee, April 1998 (unpublished). 24pp. [Paper available from the Office of this Journal].

Kasuya, T. 1999. Examination of the reliability of catch statistics in the Japanese coastal sperm whale fishery. *J. Cetacean Res. Manage.* 1(1):109-22.

Kasuya, T. and Brownell, R.L., Jr. 1999. Additional information on the reliability of Japanese coastal whaling statistics. Paper SC/51/O7 presented to the IWC Scientific Committee, May 1999, Grenada, WI (unpublished). 15pp. [Paper available from the Office of this Journal].

Kraus, S., Quinn, C. and Slay, C. 2000. A Workshop on the Effects of Tagging on North Atlantic Right Whales. 15pp. [Report available from the New England Aquarium, Boston, MA; web-site: *www.neaq.org*].

Laist, D.W., Knowlton, A.R., Mead, J.G., Collet, A.S. and Podesta, M. 2001. Collisions between ships and whales. *Mar. Mammal Sci.* 17(1):35-75.

Lake, J., McKinney, R., Haebler, R., Clapham, P., Mattila, D. and Weinrich, M.T. 2001. Chlorinated organic compounds in humpback whales and sandlance from the Northeast Coast of the United States. Unpublished final report of the RARE Project. US Environmental Protection Agency, Narragansett, RI. AED Contribution Number 1944. 35pp. [Available from: http://*www.epa.gov*].

Leaper, R. and Gordon, J. 2001. Application of photogrammetric methods for locating and tracking cetacean movements at sea. *J. Cetacean Res. Manage.* 3(2): 131-141.

LeDuc, R.G., Perryman, W.L., Gilpatrick, J.W.J., Hyde, J., Stinchcomb, C., Carretta, J.V. and Brownell, R.L.J. 2001. A note on recent surveys for right whales in the southeastern Bering Sea. *J. Cetacean Res. Manage.* (special issue) 2:287-9.

Malme, C.I., Miles, P.I., Clark, C.W., Tyack, P. and Bird, J.E. 1983. Investigations of the potential effects of underwater noise from petroleum industry activities on migrating gray whale behaviour. Report No. 5366, prepared by Bolt, Beranek and Newman Inc., Cambridge, MA, for the Minerals Management Service, Anchorage, AK. 325pp. [Available from: http://*www.mms.gov*].

Mate, B.R., Nieukirk, S.L. and Kraus, S.D. 1997. Satellite-monitored movements of the northern right whale. *J. Wildl. Manage.* 61(4):1393-405.

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. 1991. Stocks and abundance of Dall's porpoises in the Okhotsk Sea and adjacent waters. Paper SC/43/SM7 presented to the IWC Scientific Committee, Reykjavik, Iceland, May 1991 (unpublished). 23pp. [Paper available from the Office of this Journal].

Noad, M.J., Cato, D.H., Bryden, M.M., Jenner, M.N. and Jenner, K.C.S. 2000. Cultural revolution in whale songs. *Nature, Lond.* 408:537.

Northridge, S.P. 1991. Driftnet fisheries and their impacts on non-target species: a worldwide review. FAO Fisheries Technical Paper 320. Food and Agriculture Organisation, Rome. 115pp. [Available from: *http://www.fao.org*].

Northridge, S.P. 1996. A review of marine mammal bycatch observer schemes with recommendations for best practice. JNCC Report, Joint Nature Conservation Committee, Aberdeen, UK. 42pp. [Available from *s.northridge@st-andrews.ac.uk*]

Pastene, L.A., Goto, M., Abe, H., Nishiwaki, S. and Palsbøll, P. 2000. Genetic diversity of humpback whales in the Antarctic feeding ground examined by mitochondrial DNA and microsatellite. Paper SC/52/IA4 presented to the IWC Scientific Committee, June 2000, in Adelaide, Australia (unpublished). [Paper available from the Office of this Journal].

Perrin, W., Baker, S., Berggren, P., Best, P., Brownell, R., Kasuya, T., Slooten, E. and Thiele, D. 1999. Report of the Scientific Committee, Annex D. Appendix 12. Comments on SC/50/RMP11. *J. Cetacean Res. Manage. (Suppl.)* 1:107-8.

Perry, C. 1999. Status of the Dall's porpoise (*Phocoenoides dalli*) in Japan. Paper SC/51/SM46 presented to the IWC Scientific Committee, May 1999, Grenada, WI (unpublished). 9pp. [Paper available from the Office of this Journal].

Polacheck, T., Palka, D., Borchers, D., Cooke, J.G., Skaug, H.J. and Dixon, C. 2000. Simulation comparison of different methods for estimating whale density from double-team line transect data. Paper SC/52/RMP18 presented to the IWC Scientific Committee, June 2000, in Adelaide, Australia (unpublished). [Paper available from the Office of this Journal].

Pout, A.C., Borchers, D.L., Northridge, S.P. and Hammond, P.S. 2001. Modelling fishery impacts on the North Sea harbour porpoise populations. Draft Final Report to Department of Environment, Food and Rural Areas, London, UK. [Available from: *http://www.maff-.gov.uk*].

Rafic, M. 2001. Report of the Scientific Committee, Annex M. Appendix 2. Review of dolphin feeding programmes in Australia. *J. Cetacean Res. Manage. (Suppl.)* 3:306.

Reeves, R.R., Swartz, S.L., Wetmore, S.E. and Clapham, P.J. 2001. Historical occurrence and distribution of humpback whales in the eastern and southern Caribbean Sea, based on data from American whaling logbooks. *J. Cetacean Res. Manage.* 3(2): 117-129.

Rice, D.W. 1998. *Marine Mammals of the World. Systematics and Distribution.* Special Publication No. 4. The Society for Marine Mammalogy, Lawrence, Kansas. 231pp.

Rosenbaum, H.C., Best, P.B., Findlay, K.P., Engel, M.H., Pomilla, C., Razafindrakoto, Y., Morete, M.E., Vely, M., Freitas, A.C., Baker, C.S., Jenner, C., Jenner, M.-N. and Bannister, J. 2000. Mitochondrial DNA variation among humpback whales from the wintering grounds in the South Atlantic and southwestern Indian Oceans. Paper SC/52/IA11 presented to the IWC Scientific Committee, June 2000, in Adelaide, Australia (unpublished). [Paper available from the Office of this Journal].

Sigurjónsson, J. 1988. Operational factors of the Icelandic large whale fishery. *Rep. int. Whal. Commn* 38:327-33.

Smith, T.D., Allen, J., Clapham, P.J., Hammond, P.S., Katona, S., Larsen, F., Lien, J., Mattila, D., Palsbøll, P.J., Sigurjónsson, J., Stevick, P.T. and Øien, N. 1999. An ocean-basin-wide mark-recapture study of the North Atlantic humpback whale (*Megaptera novaeangliae*). *Mar. Mammal Sci.* 15(1):1-32.

Swartz, S.L., Cole, T., McDonald, M.A., Hildebrand, J.A., Olesen, E.M., Martinez, A., Clapham, P.J. and Barlow, J. 2002. A combined acoustic and visual survey of humpback whales (*Megaptera novaeangliae*) in the eastern and southern Caribbean Sea. *Caribb. J. Sci.*: In press.

Tanaka, S., Kasamatsu, F. and Fujise, Y. 1992. Likely precision of estimates of natural mortality rates from Japanese research data for Southern Hemisphere minke whales. *Rep. int. Whal. Commn* 42:413-20.

Tiedemann, R., Hardy, O., Vekemans, X. and Milinkovitch, M.C. 2000. Higher impact of female than male migration on population structure in large mammals. *Mol. Ecol.* 99:1159-63.

Trites, A.W., Livingston, P.A., Vasconcellos, M.C., Mackinson, S., Springer, A.M. and Pauly, D. 1999. Ecosystem considerations and the limitations of ecosystem models in fisheries management: insights from the Bering Sea. pp. 609-19. *In: Ecosystem Approaches for Fisheries Management*. Alaska Sea Grant College Program, University of Alaska, Fairbanks, Alaska, AK-SF-99-01.

Urban R, J., Jaramillo, A., Aguayo, L., Ladron de Guevara, P., Salinas, M., Alvarez, C., Medrano, L., Jacobsen, J., Balcomb, K., Claridge, D., Calambokidis, J., Steiger, G., Straley, J., von Ziegesar, O., Wate, M., Mizroch, S., Dahlheim, M., Darling, J. and Baker, S. 2000. Migratory destinations of humpback whales wintering in the Mexican Pacific. *J. Cetacean Res. Manage.* 2(2):101-10.

Williams, R.M., Trites, A.W. and Bain, D.E. 2001. Behavioural responses of killer whales (*Orcinus orca*) to whale-watching boats: opportunistic observations and experimental approaches. *J. Zool., Lond.*: in press.

Witting, L., Villum, V., Dueck, L., Numminem, L. and Heide-Jorgensen, M.P. 2000. A feasibility study on tagging and biopsy sampling of West Greenland minke and fin whales. Paper SC/D2K/AWMP5 presented to the Third Workshop on the Development of an Aboriginal Subsistence Whaling Management Procedure (AWMP), December 2000, Seattle. [Paper available from the Office of this Journal].

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.

Zemsky, V.A., Berzin, A.A., Mikhalev, Y.A. and Tormosov, D.D. 1995a. Report of the sub-committee on Southern Hemisphere baleen whales. Appendix 3. Soviet Antarctic pelagic whaling after WWII: Review of actual catch data. *Rep. int. Whal. Commn* 45:131-5.

Zemsky, V.A., Berzin, A.A., Mikhaliev, Y.A. and Tormosov, D.D. 1995b. *Soviet Antarctic Whaling Data (1947-1972)*. 1st Edn. Center for Russian Environment Policy, Moscow. 321pp.

Zemsky, V., Mikhaliev, Y. and Berzin, A. 1996. Report of the Scientific Committee. Annex E, Appendix 5. Supplementary information about Soviet whaling in the Southern Hemisphere. *Rep. int. Whal. Commn* 46:131-8.