Report of the Scientific Committee

The meeting was held at the Al Bustan Palace Hotel, Muscat, Oman, from 27 April-9 May 1998 under the Chairmanship of J.L. Bannister. A list of participants is given as Annex A.

1. CHAIRMAN'S WELCOME AND OPENING REMARKS

Bannister welcomed the participants to the meeting. He referred to the sad news of the death of Dr Bill Dawbin, who had been prominent in whale research, particularly on humpback whales in the southwest Pacific, for many years. He was well known to many members of the Committee for his pioneering work on whale migrations and his continuing and wide-ranging interests in that and other fields including historical whaling records; he attended his first Committee meeting as representative for New Zealand in 1960. The meeting observed a period of silence in his memory.

The following items had been afforded high priority for this meeting:

(1) continued development of the Aboriginal Subsistence Whaling Management Procedure (AWMP);
(2) bowhead whale assessment;
(3) the Revised Management Procedure (RMP), especially in relation to North Pacific issues.

Bannister noted that while reviewing proposals for Invited Participants (following the new procedure agreed last year) it became clear that the available funding was only some 50% of the amount required to fund all the identified potential participants. As a result, some difficult decisions had had to be made, and, bearing in mind the agreed priorities, it was not possible to fund attendance of persons proposed especially for humpback assessments (Agenda Item 9.3) and mathematically-based techniques for whale recognition (Item 9.9.3). Further consideration of these concerns is included in Item 6.

2. ADOPTION OF AGENDA

The Draft Agenda had been restructured to reflect this year's Committee's priorities. The adopted Agenda is given as Annex B. Statements on two Agenda Items (Items 7 and 13) are given as Annex U.

3. ARRANGEMENTS FOR THE MEETING

3.1 Appointment of rapporteurs

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

3.2 Meeting procedures and time schedule

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

3.3 Establishment of sub-committees

A number of sub-committees were established in addition to the two Standing Working Groups and the Standing Sub-committee. Their reports are given as:

Annex D – sub-committee on the revised management procedure

Annex E – sub-committee on other great whales

Annex F – standing working group on the development of the AWMP

Annex G – sub-committee on aboriginal subsistence whaling

Annex H – standing working group on environmental concerns

Annex I – standing sub-committee on small cetaceans

Annex J – sub-committee on whalewatching.

A number of *ad-hoc* groups were established and their reports are given as Annexes or incorporated under the relevant Agenda Items.

3.4 Computing arrangements

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

4. REVIEW OF AVAILABLE DATA, DOCUMENTS AND REPORTS

4.1 Documents submitted

The list of documents submitted is given as Annex C. Document categories had been revised to reflect the Committee's Agenda more appropriately.

4.2 National progress reports on research

Last year, the Committee agreed new guidelines for national progress reports (IWC, 1998h). The Committee welcomed the provision of the reports in the new format. It reaffirmed its view of the importance of such reports and **recommends** that the Commission urges member nations to submit them following the revised guidelines (and see Item 4.3.4).

4.3 Data collection, storage and manipulation

This item was discussed in relation to the items listed last year (IWC, 1998b, table 5) and the priorities set.

4.3.1 Catches and other statistical material

Table 1 lists data received by the Secretariat since the 1997 meeting.

4.3.2 Progress of data coding projects

Allison reported that coding work had concentrated on data from the International Marking Scheme in the Southern Hemisphere prior to 1940. Those from 1940 and onwards are already in the database. In addition, data from the 1996/97 SOWER sightings cruise had been validated but there had not been time for an analysis to be carried out.

Allison raised the question of Soviet catch data in the IWC database. She was concerned that at present it contains the original (i.e. falsified) Soviet Southern Hemisphere catches, particularly for the 1960s. She sought guidance on the status of the corrected data so far available. A small subgroup (Allison, Bannister (convenor), Brownell, Gambell, Reilly) was established to consider the question. The Committee adopted its conclusions as follows.

Responses to requests for data from the IWC database should not include the falsified catches, and should be accompanied by the information that, in the present incomplete state of the corrected data, they are not available from the IWC. Because revised data are still being collected and analysed by the relevant scientists, a fully revised database is not yet available but is in the process of development. Persons wishing to access the available corrected data should be directed to the relevant scientists[1]. In the meantime, the Scientific Committee will continue to have access to, and use, the available corrected data under the existing conditions, i.e. either as currently published, e.g. in Zemsky *et al.* (1995b), or by reference to the relevant scientists.

Yagi questioned the accuracy of the data presented, asking whether the primary data had been peer-reviewed or made available to other scientists. Mikhalev responded that the information on past USSR catches had been collated by those who had sailed with the Soviet fleets and witnessed the whaling. The Committee agreed that Mikhalev's paper, SC/50/O18 which includes such information as a continuation of earlier compilations, should be considered for publication following the normal review process.

[1] i.e. as in Zemsky *et al.* (1995b).

4.3.3 Progress on program verification projects and other computing tasks

Allison reported on progress with the computing work identified last year (IWC, 1998b, item 18, table 5):

(i) the Common Control Program to implement single stock aboriginal subsistence whaling trials had been amended;
(ii) a program to implement multi-stock aboriginal subsistence whaling trials had been written by Punt;
(iii) Allison had attended an *S-plus* course;
(iv) the existing *CLA* program had been converted to double precision and used in retuning trials (however, the program was too slow for the required tuning precision to be achieved in the time available);
(v) the program for conditioning and running the North Pacific minke whale trials specified in IWC (1997b, pp.246-9) had been developed (however, it had not been possible to finalise this program or conduct trials because some of the specifications were incomplete).

Progress made on the sightings database contract is reported and discussed under Item 7.3.2.

4.3.4 Whale marking, including artificial and natural marks, and biopsy sampling

Information from the progress reports on natural and artificial marks and biopsy sampling is summarised in Annex K.

New information on Soviet recoveries by the *Slava* was presented in SC/50/O18.

5. COOPERATION WITH OTHER ORGANISATIONS

5.1 CMS

Perrin agreed to serve as IWC observer at the next meeting of the CMS Scientific Council in the Netherlands in June.

5.1.1 ASCOBANS

SC/50/SM12 was a progress report on the work of the Agreement on the Conservation of Small Cetaceans of the Baltic and North Seas (ASCOBANS). It welcomed collaboration between the IWC and ASCOBANS and was considered in more detail in Annex I.

The report of the IWC observer at the 2nd Meeting of Parties to ASCOBANS held in Bonn in November 1997 is given as IWC/50/10E. In recognition of the contribution that the IWC Scientific Committee has made to scientific

Table 1

Data and Programs received by the IWC Secretariat since the 1997 meeting.

Date	From	IWC ref.	Comments
Catch data			
3 Feb. 1998	K.H. Kock	E19	Revised *Olympic Challenger* catch data.
30 Mar. 1998	Norway: N. Øien	E20	Individual catch records from the Norwegian 1997 commercial catch.
27 Apr. 1998	Japan		Individual catch records from the Japanese 1997/98 Antarctic Special Permit catch.
27 Apr. 1998	P. Best		Some individual catch records from Namibia 1923-1929 (Walvis Bay).
Sightings data			
16 Dec. 1997	Japan: T. Miyashita	E18	North Pacific sightings data 1995-96. (Access restricted).
23 Mar. 1998	P. Ensor	D164	1997/98 SOWER cruise data (sightings, effort, weather, ice-edge and cruise tracks).
14 Apr. 1998	Iceland: G.A. Vikingsson	E21	Permission for Icelandic shipboard sightings data to be used by Scientific Committee members up to and during the 1998 meeting. 1995 Icelandic NAMMCO data forwarded to IWC by D. Borchers.
Programs			
11 Nov. 1997	Norway: M. Aldrin	E17	Norwegian management program (as reported in SC/49/Mg1).

discussions in ASCOBANS on areas of mutual interest, the Meeting of Parties adopted a resolution that *inter alia* agreed that the IWC should be automatically accorded observer status at both the Meeting of Parties and the meetings of the ASCOBANS Advisory Committee. In conclusion, the observer reported that ASCOBANS recognised the value of cooperation with the IWC on matters of mutual scientific interest and was appreciative of the work of the IWC. Scientific aspects of the observer's report are considered in Annexes H, I and L.

In Annex L, the IWC observer to ASCOBANS and the ASCOBANS observer to the IWC noted that there are two major areas of mutual scientific interest between the IWC and ASCOBANS: the status of the North Atlantic harbour porpoise, and the research programme to examine cause-effect relationships between pollutants and cetacean health. Current cooperation is detailed in Annex L. The Committee particularly welcomed the adoption of a resolution by ASCOBANS endorsing the research programme on pollutants.

The Committee noted that at its 5th meeting in Hel, Poland, held immediately prior to the IWC Scientific Committee meeting, the ASCOBANS Advisory Committee formally requested cooperation with the IWC Scientific Committee.

The Committee thanked Donovan for attending the meeting on its behalf. The Chairman will consult with the Secretariat on an observer for the next Advisory Committee meeting once the dates for that meeting are known.

The Committee welcomed the request for cooperation on a scientific level. It recognised that one way to encourage cooperation was the holding of joint workshops or working groups on matters of mutual scientific interest (Annex L).

In this context, it welcomed the participation of ASCOBANS in the Workshop to develop further the IWC pollution research programme to be held in Barcelona in November 1998 (Annex H). The Committee also **agrees** that it will be valuable to further the scientific work on the status of harbour porpoises in the North Atlantic by holding the joint working group meeting suggested in Annex I and **recommends** that this take place. It emphasised that this meeting will be discussing scientific and not direct management issues. No funding is requested.

Okamoto noted that the ASCOBANS conservation objectives were not necessarily shared by non-ASCOBANS members. He also noted that in some areas, harbour porpoises are subject to directed takes under completely different conservation philosophies, as noted in the 1995 report of the sub-committee on small cetaceans (IWC, 1995c).

5.1.2 ACCOBAMS

The ACCOBAMS agreement has not yet come into force. However, cooperation between the Secretariats continues.

5.2 ICES

The report of the IWC observer at the 1997 ICES Annual Science Conference, Baltimore, USA (85th Statutory Meeting of ICES) is given as IWC/50/10A.

As a result of restructuring, the 1997 meeting was the last meeting of the Marine Mammals Committee. Two new Working Groups have been established that ensure an active presence of marine mammal scientists within ICES. These are:

(1) Working Group on Marine Mammal Population Dynamics and Trophic Interactions (WGMMPD);

(2) Working Group on Marine Mammal Habitats (WGMMH).

It was noted that Donovan had been invited to serve on the latter Working Group but had been unable to attend the first meeting which clashed with the IWC Right Whale Workshop. However, he reported that WGMMH had endorsed the IWC pollution research programme. This is discussed further in Annex H.

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

Butterworth drew attention to an ICES Symposium entitled 'Confronting Uncertainty in the Evaluation and Implementation of Fisheries-Management Systems' being held from 16-19 November 1998 in Cape Town, which had its origins in the 'Management Procedures' developed in the IWC Scientific Committee.

5.3 IATTC

The report of the IWC observer at the 58th meeting of the Inter-American Tropical Tuna Commission (IATTC) is given as IWC/50/10B.

With respect to scientific matters, IATTC focused primarily on reviewing the tuna-dolphin research programme and progress under the International Dolphin Conservation Program (IDCP). Dolphin mortality fell again in 1996 to 2,547 animals, substantially below levels believed to be sustainable.

The Committee thanked Tillman for attending the meeting on its behalf. It noted the value of continued cooperation and agreed that Tillman should attend the next meeting as IWC observer.

5.4 CCAMLR

The report of the IWC observer to the 16th meeting of the Scientific Committee of CCAMLR is given as IWC/50/10C.

In particular, the CCAMLR Scientific Committee adopted the following terms of reference for a small liaison group to be formed with the IWC Scientific Committee and WG-EMM to further collaboration between the IWC and CCAMLR:

(i) to facilitate communication between CCAMLR and the IWC on all scientific matters of mutual interest;

(ii) to advise the CCAMLR Scientific Committee on the matters relevant to potential collaborative work, e.g. exchange of information, analysis of historical datasets, survey methods, studies of interactions between whales, prey and the environment, and estimation of prey consumption by whales.

The Committee reiterated the great importance it attached to cooperation with CCAMLR. It endorsed the formation of the liaison group. Detailed consideration of this and other CCAMLR-related matters is given under Item 12.2.1.1 and in Annex H.

The meeting thanked Ichii for attending the meeting on its behalf and agreed that he should represent it at the next meeting.

5.5 NAMMCO

The report of the IWC observer at the NAMMCO Scientific Committee meeting is given as IWC/50/10F.

In 1997, the NAMMCO Council had requested its Scientific Committee to undertake an assessment of the status of the Central North Atlantic minke whale stock and to evaluate the long-term effects of past and present removal levels on the stock. The question was dealt with by its

Working Group on Management Procedures, which operated by correspondence and decided to contact relevant experts to summarise results on stock structure and population trajectories. Since stock structure information is not conclusive, population trajectories were run for (1) the Central stock area and (2) the coastal waters of Iceland; both were considered as discrete stocks. In both cases they were found to be close to their pre-exploitation levels; most of the previous harvesting regimes would be sustainable under the model parameters considered most appropriate.

To deal with a request for population status of narwhals and white whales, a Working Group on the population status of narwhals and belugas in the North Atlantic was established with the expectation of meeting in 1999.

At the NAMMCO Scientific Committee a proposal for an international workshop/symposium on harbour porpoises in the North Atlantic was discussed. It was decided to hold a symposium in the latter half of 1999 (preliminary dates 10-14 September); invitations were extended to ICES, ASCOBANS and the IWC to ensure a broad participation. They were sent on 16 April 1998.

In discussion, the (IWC Scientific) Committee noted considerable overlap in the scientific topics being addressed by the two Scientific Committees. For example, aspects of all three topics referred to in the observer's report either had been (central North Atlantic minke whales, harbour porpoises) or would soon be (white whales and narwhals in 1999) discussed in this Committee.

After considerable discussion the Committee agreed that it was desirable to avoid duplication of effort by the two Committees. It was noted that, at present, the Secretariats exchange scientific documents and it was agreed that this should continue. In 1993 (IWC, 1994a), the Committee had agreed that scientific cooperation with the NAMMCO Scientific Committee should be encouraged, where appropriate.

The Committee **requests** that the Commission provide it with advice on whether it should take a more active role in establishing cooperation with the NAMMCO Scientific Committee.

The Committee thanked Øien for attending the meeting on its behalf and agreed that he should continue to represent it at NAMMCO Scientific Committee meetings.

5.6 UNEP

There have been no meetings of the Planning and Co-ordinating Committee of the Marine Mammal Action Plan since that held in Bonn in June 1997 (IWC, 1998b, item 5.8).

5.7 Southern Ocean GLOBEC

The report of the IWC observer at the Southern Ocean GLOBEC Planning Group is given as IWC/50/10G. This issue is directly related to the SOWER 2000 research programme and is discussed in detail in Annex H and Item 12.2.2.1. The Committee reiterated the importance of cooperation with SO-GLOBEC and in particular its planning meetings. It thanked Hammond and Reilly for acting on its behalf and agreed that they should continue to do so.

5.8 FAO/COFI

The Committee agreed that a Japanese scientist would act as its observer at the next session of the Committee on Fisheries of the Food and Agriculture Organisation of the United Nations.

6. COMMITTEE OBJECTIVES AND PRIORITIES

6.1 Amendments to the Rules of Procedure

Last year, the Committee had developed revised Rules of Procedure (IWC, 1998i) and agreed that they should be given final consideration at the 50th meeting. These had been submitted to the Commission last year and in fact formed part of a Commission document (IWC/50/15) that had been pre-circulated to the Commission.

The Committee reviewed the draft Rules, and in particular the experience gained in trying to use the rules developed last year concerning invited participants. It **agrees** to a suggested modification to these to take into account problems encountered. The Committee **agrees** to the following revised rules concerning invited participants:

(a) Convenors will submit suggestions for Invited Participants (including the period of time they would like them to attend) to the Chairman and the Secretariat **not less than four months** before the meeting in question. The Convenors will base their suggestions on the priorities and initial agenda identified by the Committee and Commission at the previous meeting. The Chairman may also consider offers from suitably qualified scientists to contribute to priority items on the Committee's agenda, if they submit such an offer to the Secretariat **not less than four months** before the meeting in question, providing information on the contribution they believe that they can make. **Within two weeks of this,** the Chairman, in consultation with the Convenors and Secretariat, will develop a list of invitees.

(b) The Secretary will then **promptly** issue a letter of provisional invitation to those potential IPs suggested by the Chairman and Convenors. That letter will state that there may be financial support available. Invitees who wish to be considered for travel and subsistence will be asked to submit an estimated airfare (incl. travel to and from the airport) to the Secretariat, **within 2 weeks.** Under certain circumstances (e.g. the absence of a potential participant from their institute), the Secretariat will determine the likely airfare.

(c) At least three months before the meeting, the Secretariat will supply the Chairman with a list of participants and the estimated expenditure for each, based on (1) the estimated airfare, (2) the period of time the Chairman has indicated the IP should be present and (3) a daily subsistence rate based on the actual cost of the hotel deemed most suitable by the Secretary and Chairman*, plus an appropriate daily allowance. [*Footnote: Invited participants who choose to stay at a cheaper hotel will receive the actual rate for their hotel plus the same daily allowance.]

(d) The Chairman will review the estimated total cost for all suggested participants against the money available in the Commission's budget. Should there be insufficient funds, the Chairman, in consultation with the Secretariat and Convenors where necessary, will decide on the basis of the identified priorities, which participants should be offered financial support and the period of the meeting for which that support will be provided. Scientists not supported for the full period, may, with the agreement of the Chairman, attend the remainder of the meeting at their own expense.

(e) **At least two months before the meeting,** the Secretary will send out formal invitations to all the selected scientists, in accordance with the Commission's Guidelines (IWC, 1997a), indicating where appropriate that financial support will be given and the nature of that support.

(f) In exceptional circumstances, the Chairman, in consultation with the Convenors and Secretariat, may waive the above time restrictions.

The letter of invitation will include the following ideas:

Under the Committee's Rules of Procedure, Invited Participants may present and discuss papers, and participate in meetings (including those of subgroups). They are entitled to receive all Committee documents and papers. They may participate fully in discussions pertaining to their area of expertise. However, discussions of Scientific Committee procedures and policies are in principle limited to Committee members nominated by member governments. Such issues will be identified by the Chairman of the Committee during discussions. Invited Participants are also urged to use their discretion as regards their involvement in the formulation of potentially controversial recommendations to the Commission; the Chairman may at his discretion rule them out of order.

In addition, it **agrees** to add a new rule, based on the decision taken in 1980 (IWC, 1981, p.51) with respect to the admission of local scientists:

> A.7 A small number of interested local scientists may be permitted to observe at meetings of the Scientific Committee on application to, and at the discretion of, the Chairman. Such scientists should be connected with the local Universities, other scientific institutions or organisations, and should provide the Chairman with a note of their scientific qualifications and relevant experience at the time of their application.

The Committee also considered its rules for data availability in the light of its discussions under Item 7.

The Committee **recommends** that the Commission be asked to adopt the amended Rules of Procedure given in Annex M and included in IWC/50/15Rev.

6.2 Longer term priorities and directions

At the beginning of the meeting, the Chairman stressed the importance of considering the longer-term priorities and future workload of the Committee. Sub-committees were asked to consider what items they believed should be given priority by the Committee on subjects relevant to their agendas. It was stressed that this should reflect priorities by topic and not necessarily in the context of the present sub-committee structure. These discussions are reflected in the relevant Annexes.

After reviewing the sub-committee reports and a discussion paper prepared for this subject (SC/50/O9), and the revised Rules of Procedure, the Committee considered its longer term priorities taking into account both long- and short-term priorities of the Committee and Commission, and progress made this year.

The Committee developed a list of seven topic areas that it believed were of priority in terms of the advice required by the Commission. These are shown in Fig. 1, together with the perceived links between them. The Committee also arranged the topics in current order of priority. It noted that a major function of the Committee is to review Special Permits in the light of guidelines developed by the Commission. It noted that aspects of this review are covered under several of the priority topics, including the Revised Management Procedure and Environmental Concerns, as reflected in the discussions this year. It also noted that this would also probably be true in the case of any future discussions of Sanctuaries. However it **draws attention** to its request for Commission advice on scientific objectives for the Southern Ocean Sanctuary (see Item 16).

6.3 1998/99 work plan and initial agenda for the 1999 meeting

With the agreement of the Committee, after the close of the meeting the Convenors drew up the following as the basis of an initial agenda for the 1999 meeting. They took into account the priorities recognised under Item 6.2 above, and, within them, the highest priority items agreed by the sub-committees. The Committee noted that the priorities may be revised in the light of Commission discussions. Following the Commission meeting, the revised initial agenda will be circulated to members for information and will form the basis of the draft agenda to be circulated 60 days before the next meeting. As agreed in the Committee's revised Rules of Procedure, it will also provide a framework for determining invited participants to the 1999 meeting.

RMP

1. Completion of *CLA* program revision and tuning.
2. Abundance estimation - general and specific matters relevant to the RMP.
3. North Pacific minke whale trials – review simulation results and new survey data.
4. North Pacific Bryde's whales – develop trials.

AWMP

1. Continue development process including review of trial results.

Aboriginal Subsistence Whaling

1. Annual review of catch limits as instructed in the Schedule.
2. Development of Greenlandic research programme (especially stock structure and abundance) for fin and minke whales.

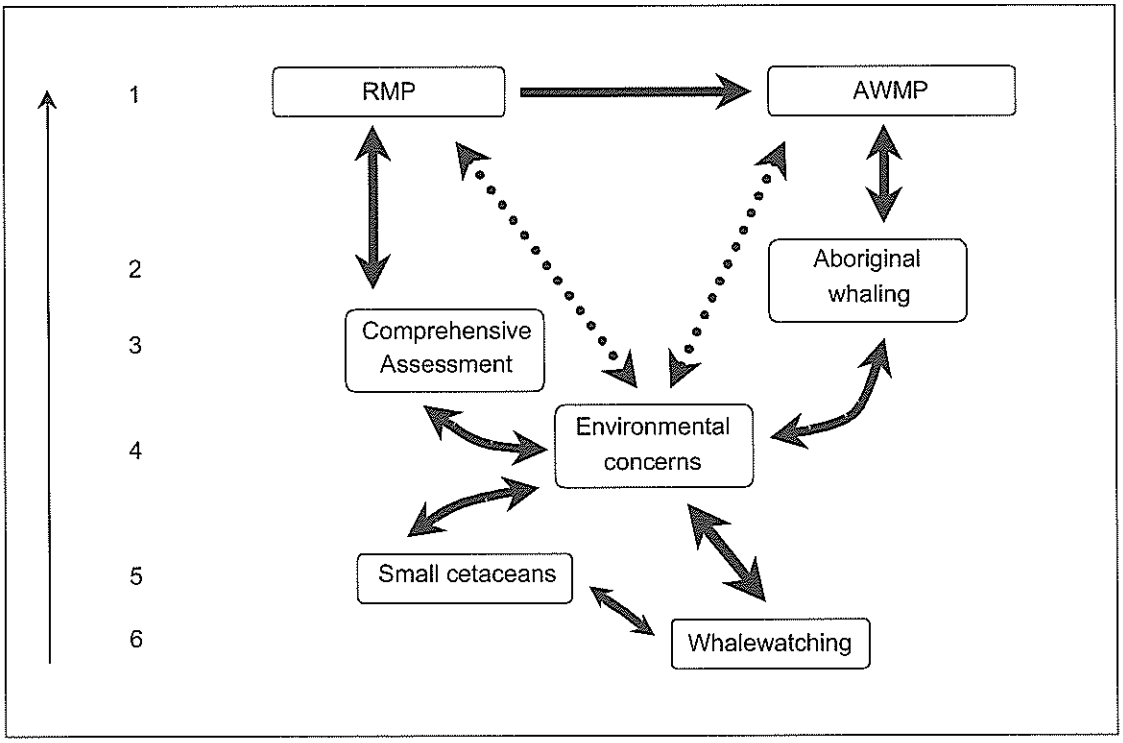

Fig. 1. Seven priority topic areas and their perceived links.

3. Review status of bowhead whale stocks other than the Bering-Chukchi-Beaufort Seas stock.

Comprehensive Assessment of Whale Stocks
1. Southern Hemisphere minke whales – review of JARPA (especially VPA question and abundance).
2. Southern Hemisphere blue whales – differentiation of sub-species; abundance estimation.
3. Western North Atlantic right whales – recent population trends (results of intersessional work and/or workshop).
4. Southern Hemisphere humpbacks – review intersessional work on preliminary assessment.

Environmental Concerns
1. Continue consideration of (a) pollution programme (b) Antarctic SOWER 2000 programme.
2. Arctic matters.

Small Cetaceans
1. White whales and narwhals.
2. By-catch mitigating methods (especially acoustic).

Whalewatching
1. Continue work on five previously identified long term topics.
2. Review progress made by intersessional group.

7. COMPREHENSIVE ASSESSMENT – REVISED MANAGEMENT PROCEDURE (CA/RMP) – GENERAL ISSUES

7.1 *CLA* program and tuning–report of the intersessional Working Group

7.1.1 Tuning

Last year the Committee requested the Secretariat to convert the MANAGE computer program, which calculates catch limits for the RMP, to use double precision arithmetic. The Committee also asked the Secretariat to use this modified program to determine a revised value for the tuning parameter that assures that the median final depletion for the D1 trial is 0.72K (accurately to 10^{-6}K) (IWC, 1998b). Allison reported that the program had been successfully converted, but that it was too slow to allow her to achieve the level of precision specified by the Committee in the time available. The MANAGE program had been originally designed for quickly determining approximate catch limits in simulation trials and had then been adapted for implementation purposes. The numerical integration methods used cannot achieve the required precision because precision does not improve rapidly enough with decreasing integration step size.

The precision specified by the Committee is necessary, in the case of a population as large as one million animals, to guarantee the requirement in the RMP that calculated catch limits are accurate to one whale. It is recognised that this level of precision exceeds the precision of the biological input data. Rather, it ensures that exactly the same catch limit will be obtained regardless of the numerical integration methods used in any computer program that correctly implements the *Catch Limit Algorithm*.

A procedure for determining the tuning parameter was developed that the Committee believed was sufficient to ensure a unique value for the tuning parameter. The steps in this procedure are given in Annex D, Item 3.1.

The Committee **recommends** that these steps be followed to determine a revised value for the tuning parameter. The Committee noted that the first step in this procedure required revision of the *CLA* program.

7.1.2 Revision of program

At last year's meeting (IWC, 1998b, item 7.2.2), the Committee recommended that the Secretariat investigate methods to calculate catch limits under the *CLA* more efficiently. It noted that it would be desirable if the same computer program could be used for calculating catch limits and for simulation studies. The Committee also recommended that this work be completed before the 1998 meeting and that the Secretariat should consider contracting out this task. An intersessional Working Group had been set up to facilitate this (members: Allison, Butterworth, Cooke, Givens, Hammond (Chair), Punt, Smith, Wallløe).

During the intersessional period, the Working Group finalised a specification for computer program structure, documentation, and performance, including specification of a set of test conditions. This is given as Annex D, Appendix 2, and formed the basis of an invitation to bid for a contract to revise the program that implements the *CLA*. The invitation to bid was distributed to the members of the Working Group. One bid was received that substantially exceeded the amount allocated by the Secretariat. Recognising this and after some discussion, the Committee believed that these requirements could be met using a program previously presented by the Norwegian Computing Center (Fenstad *et al.*, 1993). Noting that this program was shown during the last meeting to give the same answer as MANAGE when converted to double precision in at least one case, the Committee **agrees** that, suitably documented, it should meet the above needs.

The Committee **recommends** that the authors of the program be approached about completing the work required to meet the most important requirements of Annex D, Appendix 2, with the expectation that by using that previous coding, and allocating some tasks to the Secretariat, the costs might be more in line with the amount allocated last year (£3,000). Walløe reported that informal discussions with staff of the NCC had indicated that the work required from the NCC could be completed for approximately the amount allocated last year.

Annex D, Item 3.2 describes the most important requirements for the NCC to complete and the remaining aspects that should be addressed by the Secretariat.

7.2 Additional variance

Some years ago the Committee specified that, to improve its basis for drawing inferences from trends from surveys, IDCR sightings data should be extracted on several spatial scales over the time series of the surveys. The task has yet to be completed. The Committee **agrees** that it is still important to complete the work. The required data extraction may require up to two weeks using the DESS computer system. The Committee **recommends** that the task receive high priority during the intersessional period. It noted that the task was included in the list of those to be undertaken in the work of the proposed part-time position at the University of St Andrews (see Item 7.3.2).

7.3 Abundance

7.3.1 Report of intersessional Working Group on statistical estimators

At last year's meeting an intersessional Working Group was re-established to test the performance of abundance estimation procedures over an appropriate range of sighting survey factors. It initiated a simulation experiment at the meeting in which two abundance estimation methods were applied to 25 replicates of 32 sets of data that simulated shipboard line transect two-platform surveys where there

were different types of sighting heterogeneities and $g(0) < 1$. The results were reported to the meeting (Palka and Polacheck, 1997). During the intersessional period, two additional estimation methods (perpendicular distance implementation of the hazard probability model by Skaug and a radial distance implementation of the hazard probability model by Cooke) were applied to the simulation datasets. These results were presented to the Committee this year (Annex D, items 5.3 and 8.3.1.2). In addition, during the intersessional period more sets of simulated datasets with different conditions were created and more replicates of all the datasets were, and continue to be, created so that there will eventually be 100 replicates of each set of data.

The intersessional Working Group also began discussions about topics to be addressed in the near future. It recognised that the remit was broad and so should focus on topics that are the most relevant to abundance estimates that are currently or will in the near future be submitted to the Committee. Priority topics identified are listed in Annex D, Item 5.1.

The Committee re-established the intersessional Working Group under Palka to continue its work of testing the performance of abundance estimation procedures over an appropriate range of sighting survey factors.

7.3.2 IWC-DESS (Database Estimation Software System)

Borchers reported that the work contracted to the University of St Andrews, described in last year's report (IWC, 1998g, annex O, appendix 1), had been completed and the relevant data files transferred to the Secretariat. Some problems were encountered during the transfer; Borchers reported that these were being addressed and would soon be resolved.

The Committee established a Working Group under Donovan to consider the future maintenance, support and development of IWC-DESS. Its report is given as Annex D, Appendix 3.

The report proposes that the best way for the Secretariat to ensure the appropriate maintenance, support and development of DESS is to fund a part-time post at the University of St Andrews. This would have a number of advantages concerning the working environment, flexibility and continuity. The cost to the Secretariat is estimated at approximately £19,000 plus VAT per annum. Routine requests for data from accredited members of the Committee and international organisations would still be handled by the Secretariat. The intention is that items 1-7 under existing relevant tasks in Annex D, Appendix 3 would be completed as soon as possible and that items 1-3 under possible tasks in the near future in Annex D, Appendix 3 would be considered in due course.

The Committee **recommends** that the proposal described in Annex D, Appendix 3 be adopted as a matter of priority.

7.3.3 New information

A number of papers dealing with new developments in abundance estimation methods were presented to the Committee. Details of these papers and discussions of them are given in Annex D, Item 5.3.

7.4 RMP – Documentation for future possible Schedule amendment

This item was included this year, so that in the event that the Commission adopts the RMS, the Committee is in a position to recommend an agreed form of words to be inserted as the formal description of the RMP in a Schedule amendment.

At last year's meeting, an intersessional Working Group was established under Donovan to finalise documentation of the RMP for incorporation into the Schedule. Donovan presented the report of the Working Group, highlighting changes that the Committee had agreed since the RMP specification was last published in full (Table 2).

The Working Group identified some additional minor editorial changes and one more substantial change (and accompanying Annotation) with respect to the definition of *Year*. The change was suggested in the light of the Committee's work on North Pacific minke whales.

The Committee **agrees** to adopt the following amendments (shown in square brackets):

> Years[6] are consecutive periods of 12 months used for the compilation of time series of catches and abundance data for application of the Catch Limit Algorithm. [Neither this definition, nor any statement following, should be construed as precluding the possibility of a regulation that a catch limit calculated in such an application may be taken only during a certain part of the *Year*.]
>
> [[6A]The provision is to make allowance for the fact that mixing between different stocks in a *Small Area* may change during a Year, so the catches from that *Small Area* may be restricted at certain times in the interests of reducing their impact on one of these stocks (IWC, 1997d, pp.203-26).]

The Committee also **agrees** to slightly amend Annotation 16 to clarify issues related to 'indirect' catches. The revised wording (shown in square brackets) is:

> (16) The population model used in the *Catch Limit Algorithm* (see Section 4) effectively assumes that all whales that die from causes other than those resulting from natural mortality are included in the catch history. Thus, known [or estimated] 'indirect' catches, e.g. whales killed through entanglement in fishing gear [(including those that subsequently strand)], should also be included in the catch history, in addition to whales caught or struck and lost in direct whaling operations. On the other hand, stranding is assumed to be part of the process of natural mortality, and numbers of whales stranded [due to natural causes] should not be included in the catch history.

The Committee **recommends** that these amendments be adopted by the Commission. The revised full specification is given as Annex N (Note: the value for the lower percentile of the marginal posterior distribution of L_T, cannot be included until the work outlined under Item 7.1 is completed).

Table 2

History of RMP specifications and amendments.

Item	Year	Reference
First agreed version.	1992	*Rep. int. Whal. Commn* 43: 146ff
Final published full version (incl. amendments concerning: overall consistency and clarity process error; *Catch Limit Calculation*; Implementation; Implementation Review; phase-out rule).	1993	*Rep. int. Whal. Commn* 44: 44-8, 145ff
Minor amendments to Annotations: 9 (*Implementation Simulation Trials*); 12 (reference change); 23 (style change).	1994	*Rep. int. Whal. Commn* 45: 64-68, 214
Carry-over of catches.	1997	*Rep. int. Whal. Commn* 48: 64

The Working Group also suggested that Annotation 17 may need some discussion in the future. This would be to examine cases where a series of abundance estimates containing both absolute and relative estimates based on sightings (c.f. bowhead whales) is available. Any eventual changes would consequently need to be reflected in the last sentence of Annotation 21.

Finally, in the Committee, there was some discussion over the question of the timing of surveys (every six years) and of *Implementation Reviews* (at least every five years). It was noted that there is no requirement for these to be synchronous and that in fact the phase-out rule does not come into effect until eight years have elapsed since a new abundance estimate has been agreed. The Committee **agrees** to keep this under review, along with the question related to Annotation 17.

7.5 Stock identity

It was suggested that it may be useful for the Committee to reconsider its definitions of the term stock. The importance of the stock definition, or population subdivision, for the purposes of management and conservation of whale resources by the IWC is obvious. For exploited species, an understanding of stock boundaries is critical for estimating abundance, setting catch limits and interpreting life-history parameters. For protected species, stock boundaries are important for assessing population trends, establishing territorial jurisdiction and identifying critical habitats (Baker *et al.*, 1994).

Under the New Management Procedure (NMP), the IWC managed the different whale species using specific 'management units' (see Donovan, 1991). An example of these 'management units' is the six management Areas in the Southern Hemisphere used by the IWC to manage the baleen whales species (except Bryde's whale). Under this scheme, the 'management stock' was defined as the group of whales occurring within a specific geographical boundary which is actively or potentially exploited by IWC member countries. These are the individual stocks whose status is assessed by the Committee (Hoelzel and Dover, 1989).

To date, most studies on stock identity of large whale species have attempted to test hypotheses that IWC management units (management stocks) correspond to biologically defined entities (biological stocks). For that purpose, different techniques such as genetics, morphology, 'Discovery' marks, ecological markers, sighting pattern and catch distribution have been used. In recent Committee discussions on the stock identity issue, however, difficulty in interpreting genetic data has been evident.

There has been substantial development in techniques useful for determining stock structure in recent years, especially genetics-based methods. The Committee **agrees** that, given this development, it would be useful to undertake a review with the goal of establishing more useful definitions of the term stock.

An *ad hoc* Working Group was established under DeMaster to develop terms of reference for such a review, and to outline the tasks that it may be useful to address overall in such a review, including identifying specific steps that can be taken intersessionally in preparation for a more comprehensive discussion during the next meeting. The report of the Working Group is given as Annex D, Appendix 4.

The Committee **agrees** that the Steering Group on Stock Definition identified in Annex V should work intersessionally to progress the work and present an update to the next meeting of the Committee. An intersessional workshop was proposed and may be necessary after the next meeting.

In response to last year's Committee recommendation, SC/50/RMP6 presented a list of tissue samples of southern minke whales preserved at the National Research Institute of Far Seas Fisheries, which were collected under past commercial whaling. The Committee welcomed submission of the list but no time was available to review it.

8. CA/RMP – PREPARATIONS FOR IMPLEMENTATION

8.1 Questions relating to implementation trials

Implementation Simulation Trials involve:

> 'identifying the range of plausible hypotheses relevant to recommending an *Implementation* or *Implementation Review* for the RMP and formulating simulation models which conform with these hypotheses' (IWC, 1995d, p.214).

Annex D, Appendix 5 provides a structured approach to the development of *Implementation Simulation Trials* in cases in which there is uncertainty about stock structure. The need for addressing each of the issues in Annex D, Appendix 5 sequentially was emphasised because, for example, assumptions regarding choices of sub-Areas depend on hypotheses about the number of stocks and how they migrate. The Committee thanked Butterworth for completing this task which it had requested at last year's meeting.

8.2 North Pacific minke whales

At its 1996 meeting, the Committee developed a set of *Implementation Simulation Trials* for North Pacific minke whales and recommended that the Secretariat develop a computer program to implement these trials and then conduct them (IWC, 1994a, p.70). The trials involve 13 sub-Areas in the North Pacific and consider two hypotheses regarding the number of breeding stocks of minke whales in the North Pacific: (1) that there are three stocks, the J stock ('home' area - Sea of Japan and perhaps also the Yellow Sea and East China Sea), the O stock ('home' area - the Okhotsk Sea, the east coast of Japan) and the W stock (West Pacific); (2) that there are only the two stocks, J and O.

During its 1997 meeting, the Committee had reviewed recent information on stock identity and catches and made some revisions to the trials.

8.2.1 Progress during intersessional period

Allison reported that she had developed most of the program to implement the trials. However, she had been unable to complete this task and conduct the trials because some of the specifications were incomplete. At this year's meeting, the sub-committee on the Revised Management Procedure established a Working Group under Allison to finalise the specifications for the trials, taking into account discussions during the meeting.

8.2.2 Uncertainty over catches

IWC (1994b, p.150) states that 'known 'indirect' catches, e.g. whales killed through entanglement in fishing gear, should also be included in the catch history' in the RMP. This issue is discussed further under Item 7.4. The

Committee noted that *Implementation Simulation Trials* should include estimates of all non-natural removals. Some of the currently specified trials are used to examine the implications of alternative assumptions about catches. At last year's meeting, the Committee had agreed to modify the trials to include incidental catches of minke whales by Korea and Japan (IWC, 1998b).

In response to a request at last year's meeting, Kim presented new information about incidental catches of minke whales off Korea (Annex D, Appendix 7). In response to a question, he indicated that the increase in incidental catches during 1996 was related to unusual environmental conditions that also led to substantially increased fish catches. Information about fishing effort and catches for the years before 1996 is not available due to the lack of a systematic recording system. Kim suggested that examination of further information including prices in the market could be used to provide estimates of earlier catches. He indicated that incidental catches off Korea had increased following the cessation of whaling in 1986 and suggested that this may be because of an increase in the abundance of minke whales in the inshore waters off Korea.

At last year's meeting, it was agreed to include variants of the four base-case trials in which an incidental catch of 150 whales per annum is taken from sub-Area 6 (IWC, 1998b, item 8.1.2.2). This means that the incidental catch does not respond to changes in abundance. The Committee **agrees** to retain these trials but also to include incidental catches off Korea (sub-Area 6) in all the other trials. Details are given in Annex D, Item 8.2.2.

At last year's meeting, a Working Group was established to consider all the information on incidental catches in Japanese fisheries (estimated and observed) and to specify a time series of total incidental catches. Brownell reported that no agreement had been reached. He also noted that the incidental catches reported in the Japanese Progress Reports are notably lower than the estimates in Tobayama *et al.* (1992). While it is likely that the reported incidental catches are under-estimates, it is unclear whether the extrapolations made by Tobayama *et al.* (1992) are appropriate. Intersessionally, Brownell and Yagi had discussed the issues of what correction factors to apply to the reported estimates of incidental catch and how to collect better data in the future. Yagi reported that a project had been initiated to examine the first of these issues but it had not yet been completed. It was agreed that completion of this work was necessary before the Commission could actually apply the RMP to this stock. In the meantime, it was also agreed that plausible scenarios on incidental catch should be used for the purpose of *Implementation Simulation Trials*.

The Committee agreed that two scenarios should be considered in trials: (a) the incidental catches are taken to be those in the Japanese Progress Reports; and (b) the incidental catches should be based on the values reported in Tobayama *et al.* (1992). These trials include cases where the true removals are the larger incidental catches as defined under (b) but the RMP assumes that the smaller catches as defined under (a) are taken. Specifications incorporating these bycatches are given in Annex D, Appendix 6, Section D.

Although it was generally agreed by the Commission last year that, as far as possible, the *CLA* should be used 'to determine the allowable removals and then take account of all known human-induced mortalities', other views were also expressed. The Committee therefore **agrees** that trials should be conducted in which (a) the incidental catches are taken over and above commercial catches as set by the RMP and (b) in which the removals from each sub-Area are the maxima of the incidental catches and the catches set by the RMP. This last case corresponds to the assumption that the RMP catch limits cover all non-natural removals.

8.2.3 Sightings survey planning - report of intersessional Working Group

Last year, an intersessional North Pacific Sighting Survey Steering Group (NPSSSG) was established and assigned five tasks (Annex D, Appendix 8). The Steering Group was able to address several of these, and additional material was presented to the Committee relative to the remaining tasks.

SC/50/RMP4 described the revised version of the sighting survey plan which took into account recommendations made by the NPSSSG. It outlined the key features proposed for the conduct of the survey; the expected number of sightings if the survey were conducted in the area proposed would be 80.

In discussion, it was clarified that although this is a feasibility study, it was intended that, if the survey is successful, estimates of abundance using the data were intended to be used both in *Implementation Simulation Trials* and, potentially, in actual implementation of the RMP. It was suggested that because the applicability of the proposed methodology was not known, and because of concerns that some had raised about possible biases due to whale responsive movement (Annex D, Item 5.3), it would be useful to include in the design the possibility of using an alternate estimation method. One possibility would be to use standard line transect analysis methods assuming $g(0) = 1$. The possibility of using the method employed during the SCANS survey, due to Buckland and Turnock (1992) was discussed. It was noted, however, that the latter two methods require different searching patterns and that the observers would be required to adopt different search patterns, so that simultaneous application of both methods is not practical.

The Committee noted that the proposed determination of dive times using visual observations was not recommended as it is difficult to be confident about tracking individual animals as some surfacings may be missed. The Committee **recommends** the use of other approaches such as monitoring diving using VHF telemetry. While it was noted that such observations would most desirably be made during the survey, as proposed for the visual observations, it would be acceptable if they were made at appropriate different times and even locations as was the case for abundance estimates in the northeast Atlantic (Schweder *et al.*, 1997). It was also suggested that if visual observations are attempted, they might be compared with observations using VHF or other more direct methods to determine the degree of bias in the visual observations.

The use of binoculars for searching and distance estimation was discussed. The Committee **recommends** that the experiments and testing of estimation of angles and distances should be conducted using the same methods as in the actual survey. The possibility of using binoculars for searching if the Buckland and Turnock method were adopted was noted.

Miyashita thanked the NPSSSG for its helpful assistance, and requested that it continue to function as the preparations are made for this survey and that for Bryde's whales (see Item 8.4.2). The Committee agreed and re-established the Steering Group under Smith (for members see Annex V).

The Committee considered the requirements for participation of a member of the Scientific Committee in this survey. It **agrees** that Scientific Committee representation on the planned survey should take the form of participation of a

scientist with active experience of surveys of the type proposed (hazard probability approach) and other methods that may be incorporated (such as the Buckland and Turnock method). The Committee noted that Miyashita (who has participated in Norwegian surveys using the hazard probability approach) would participate in the survey and agreed that he was an appropriate scientist to represent the Committee.

The Committee reiterated from last year its **strong recommendation** that the survey includes waters within the Russian EEZ in order to provide the necessary coverage. It **recommends** that the Commission requests the relevant authorities of the Russian Federation to grant permission for the vessels to operate in their EEZ. The Committee **agrees** that, if permission is not granted, additional trials should be specified to represent a worst case scenario that no surveys would be conducted in, and no future catches would be taken from, the Russian EEZ in this sub-Area. More generally, the Committee **agrees** that this recommendation should apply to all relevant countries in similar situations for all such surveys in the future.

8.2.4 Revision of trials specification

The Committee considered the new information regarding stock structure for North Pacific minke whales in the context of whether it implied that changes had to be made to the specifications of the *Implementation Simulation Trials*. Details of the papers presented (SC/50/RMP7, 8, 12, 15 and SC/50/O8) are given in Annex D, Item 8.2.4.

Yagi recalled that, when papers similar to SC/50/RMP15 and SC/50/O8 were presented by Baker last year to the Committee, 'some members noted that these reports did not provide information that could be used to evaluate stock structure as the geographic location of the samples referred to was unknown' (IWC, 1998b). This year's documents, SC/50/RMP15 and SC/50/O8, had exactly the same problem and he believed that they did not contain new information relevant to specifying *Implementation Simulation Trials*.

In discussion in the sub-committee (Annex D, Item 8.2.4), Baker, Brownell and Wade stated that they believed that the analysis of mtDNA control region sequences in SC/50/RMP7 provided valuable new information on the question of stock differences or mixing between the J and O stocks. In particular, it allowed the comparative identification of previously defined RFLP haplotypes 2/5 using the direct sequencing methods of Baker *et al.* (1996) as applied specifically to the Japanese and Korean markets (SC/50/RMP15). The 2/5 types account for 76.7% of the samples representing the J stock (i.e., sub-Area 6) and only about 4% of the O stock (i.e., sub-Areas 7, 8 and 9), except in sub-Area 11 where seasonal mixing results in about 13.7% of types 2/5 (table 4 of SC/50/RMP7). However, the large majority of whaling since 1994 has been in sub-Areas 8 and 9. Only 30 whales were killed in sub-Area 11 (Pastene *et al.*, 1998) of the total of nearly 300 from 1994-97. For these reasons, the frequency of type 2/5 products, representing J stock whales, should be low in Japan, perhaps 6%.

Baker noted further that information in SC/50/RMP7 showed that a 'G' in position 298 of the control region identified all 21 of the type 5 sequences and one of the two type 2 sequences (table 8, SC/50/RMP7). Only one of the other 124 sequences from sub-Area 7 and 9 was characterised by this 'G', suggesting a potential misclassification error of about 0.8% for non-type 2/5 sequences. Based on this information, a review of figs 1 and 2 of SC/50/RMP15 showed that 7 (28%) of the 25 Japanese North Pacific minke whale products purchased from 1993-97 were type 2/5. Baker noted that unpublished data also showed that 6 (40%) of the 15 North Pacific minke whale products purchased in late 1997 and early 1998 were type 2/5. Overall, type 2/5 products accounted for 32.5% of the 40 North Pacific minke whale products purchased in Japan from 1993-98. Baker believed that this is difficult to reconcile with the expectation of a small percentage of J stock whales in the Japanese markets and supports the need to address uncertainty about stock structure or mixing rates in the *Implementation Simulation Trials*.

Yagi stated that there was no reason to assume that the difference between 32.5% and 6% of the frequency of type 2/5 samples reflects uncertainty about stock structure or mixing rate. Rather the difference could be explained by the different nature of the two datasets: Baker's value of 32.5% was calculated using samples of unknown origin while the value of 6%, which was estimated using data from SC/50/RMP7, came from samples of known origin. Thus, he saw no reason to reconcile this difference.

The Committee noted that the location of the samples in SC/50/RMP15 and SC/50/O8 was unknown. Some members believed that because of this SC/50/RMP15 and SC/50/O8 did not provide information that could be used to evaluate stock structure. Hatanaka noted that some of the animals could have been taken incidentally from the Sea of Japan, and that substantial quantities of frozen meat remained. Other members believed that the information in these papers was useful and might necessitate changes to the assumptions regarding stock structure and the values in the mixing matrices.

The Committee noted that the number of samples from sub-Area 6 that had been genetically analysed in SC/50/RMP7 and previous papers was small (30) and had been collected from a limited area over a very short period (September–October 1982). It agreed that additional samples from animals stranded in Japan and from the incidental catches off Korea would further its understanding of stock structure in the Sea of Japan. Kim stated that he would contribute morphological and genetic samples from bycatches to improve understanding of stock structure in the region.

The Committee agreed that an additional set of trials based on the four base-case trials would be developed that include the fraction of the type 2/5 haplotypes in the Japanese market in the conditioning (Section F (g) of Annex D, Appendix 6) assuming that the product available in the market each year is selected randomly from catches during that year. It was recognised that this last assumption was extreme because of the unknown locality of the samples. The values for the coefficients in the mixing matrices (e.g. the fraction of J stock animals in sub-Area 7) would be chosen to mimic this fraction as well as to be consistent with the other information used for conditioning. It was agreed that this overall issue would be considered further when additional genetic samples from the incidental catches off Korea and from strandings and incidental catches in Japan are analysed.

Allison presented the revised specification for North Pacific minke whale *Implementation Simulation Trials* (Annex D, Appendix 6). She drew attention to those aspects that had changed since the specification had last been published (IWC, 1997d, pp.216-225). Details of these are given in Annex D, Item 8.2.4.

Several members expressed reservations about the plausibility of Option J(ii) in the trials concerning incidental catch in Japan as an independent review of this issue is ongoing. Nevertheless they accepted that this option should

be included in the *Implementation Simulation Trials* at this time. Brownell expressed reservations about the plausibility of option J(i).

In respect of the status of the trials specified in Annex D, Appendix 6, Butterworth drew attention to the Report of the Working Group on North Pacific Minke Whales held in 1996 (IWC, 1997d) which stated:

> The basis used to select the trials was by and large that used in the past, *viz.* concentrating on cases with MSYR(mature) = 1% and factors likely to render the trials more difficult with regard to meeting risk criteria. The Group agreed that the relative plausibility of the different trials needed to be taken into account, but that this could not be done in the absence of considerations of the risk associated with the results for each. There was insufficient time for a full discussion of this issue, and it was agreed that it should be debated further in conjunction with a review of the results of the trials.

Butterworth and Punt believed that the intent of the statement by the Working Group in 1996 related purely to considerations of efficiency. If initial trials showed that certain hypotheses correspond either to small risk, or little difference in risk compared to other hypotheses, this obviated the need to spend considerable time discussing their relative plausibilities as this then became irrelevant.

Hammond and Smith believed that determining relative plausibility should not take into account the risk associated with trial results. They believe that pursuing Butterworth and Punt's interpretation of the 1996 Working Group's statement could confound the RMP implementation process by allowing one's perceptions of plausibility of a hypothesis to be influenced by the level of risk associated with it. This could decrease the ability of an *Implementation* of the RMP to meet conservation objectives. Furthermore, this approach is iterative, and thus potentially lengthy.

Butterworth and Punt agreed that the relative plausibility accorded to a trial should be based on biological considerations and be independent of the risk associated with the corresponding results. They also recalled the key role of new data as a basis for revising hypotheses during the process of conducting *Implementation Simulation Trials*. Nevertheless, they considered, on the basis of their experiences with such trials for management procedures for many different fisheries, that using trial results to concentrate subsequent computations around the scenarios to which risk was most sensitive was the only practical way forward.

The Committee **agrees**, as a matter of expediency, to use the results of trials for North Pacific minke whales to limit the extent of future trials in this manner. The Committee noted that it has not finalised discussion on the relative plausibility of the hypotheses underlying the trials. It also **agrees** that further discussion would be needed of how results of trials were best evaluated for scenarios with differing relative plausibilities (e.g. see IWC, 1996b, pp.109-10) and for those for which there were differences of opinion about plausibility, when the results became available.

The Committee **agrees** to adopt the revised specification for North Pacific minke whale *Implementation Simulation Trials* as given in Annex D, Appendix 6 and **recommends** as a high priority that the Secretariat conduct the trials during the intersessional period and report the results to next year's meeting.

Two years ago the Committee had established a Steering Group to consider and resolve any inconsistencies that remained when the trials were conditioned and run and to make decisions about the choices specified in Annex D, Appendix 6. It re-established this Steering Group with membership of Allison, Butterworth (Chairman), Hatanaka, Kawahara, Punt, Smith and Taylor, with the following terms of reference:

(i) review results of the specified initial trials intersessionally by correspondence;
(ii) advise the Secretariat of those trials that need not be carried out if the initial results are not sensitive to the differences among the associated hypotheses being tested;
(iii) effect minor amendments to the specifications in Annex D, Appendix 6, as may be necessary to match the conditioning requirements therein.

8.3 North Atlantic minke whales

8.3.1 Northeastern stock

8.3.1.1 PROGRESS DURING INTERSESSIONAL PERIOD

Two years ago it was agreed that additional analyses should be undertaken with respect to the estimates of abundance for northeast Atlantic minke whales from the NASS 1989/90 and NILS-95 surveys. The identified analyses were (IWC, 1997b, p.76):

(1) additional simulation tests to more fully explore the statistical properties of the Norwegian Computing Center (NCC) estimator and to further confirm that software was adequately verified;
(2) to reconcile any differences between comparable estimates obtained from the NCC and Cooke implementations by identifying the main causes of any such differences;
(3) to further assess the implications, in terms of possible bias in the NCC estimates, of the lack of model fit to the Bernoulli data, with respect to the marginal distributions of radial distances.

An intersessional Steering Group was established to undertake the above analyses but although significant progress was made by that Group at last year's meeting, definitive answers were not reached. Consequently, the Steering Group was asked to continue work on these issues intersessionally and to 'define and pursue a course of analysis that in its judgement would allow definitive answers to these questions to be available at the next Annual Meeting'. The work of the Steering Group is described in Annex D, Item 8.3.1.1. It was unable to complete a review of the three analyses in the time available.

8.3.1.2 REVIEW OF NEW INFORMATION

Papers that provided new information to address the three analyses listed in Item 8.3.1.1 (SC/50/RMP1, 2, 3, 20, 21 and 22) were presented and discussed by the sub-committee on the Revised Management Procedure. Details are given in Annex D, Item 8.3.1.2.

The Committee **agrees** that the large amount of new information available at this meeting provided a sufficient basis for resolving the three outstanding issues (IWC, 1997b) with respect to the Schweder *et al.* (1997) abundance estimates for northeast Atlantic minke whales from the NASS 1989/90 and NILS-95 surveys. The Committee agreed that it was the estimates that needed to be validated and not the estimator. The Committee also agreed with the approach taken by the Intersessional Steering Group to compare the estimates from the NCC implementation with estimates produced by the implementation, and the methods

in SC/50/RMP1 and SC/50/RMP22, as a sufficient basis for validating the NCC estimates with respect to the above three issues. The Committee noted that the comparable estimates from these alternative approaches were either quite similar or, when the discrepancies were greater, the NCC estimate was always the smaller estimate. In these latter cases, potential reasons had been identified that could be introducing positive biases in the alternative implementations. The Committee noted that in terms of implementation within the RMP the primary concern is to avoid positively biased estimates. In this context, the comparative results provide no indication of a positive bias in the NCC estimates.

The new information available this year contained results which dealt directly with each of the three outstanding issues. With respect to the first issue, the additional simulation results in SC/50/RMP20 provided additional information on the statistical properties of the general hazard probability approach and indicated general agreement between the *estimated strip half width* using this approach and the 'true' value within the simulated datasets. The question of software verification had been resolved at last year's meeting. With respect to the second issue, the results in SC/50/RMP22 provided comparable estimates from the NCC and Cooke implementations which provided no indication of any positive bias in the NCC estimates. With respect to the third issue, reconsideration of the statistical test performed at last year's meeting suggested that the test, as performed, was inappropriate. The test in SC/50/RMP3 appeared not to indicate significant lack of fit to the Bernoulli data in the NCC implementation, although the power of the test is limited. SC/50/RMP22 also found no lack of fit in its implementation and SC/50/RMP19 indicates that the apparent lack of fit in the NCC implementation could be the result of not having taken into account the rounding error. Taking all of these factors into consideration, the Committee agreed that the model fit appeared to be acceptable.

Overall, the Committee **agrees** that the comparative results from the different implementations combined with the other additional new information means that the task of undertaking additional analyses with respect to the NCC estimates of abundance for northeast Atlantic minke whales from the NASS-89/90 and NILS-95 survey as defined at the 48th Annual Meeting has now been completed. The Committee further **agrees** that the results from these analyses do not indicate any problem with the estimates in terms of the issues that had been raised at the 48th Annual Meeting and supported the Committee's previous conclusion that the abundance estimates in Schweder *et al.* (1997) are adequate for use in the RMP.

The Committee expressed appreciation to Polacheck for chairing discussions on this subject over the last several years and steering the work to its conclusion.

8.3.2 Central Stock

8.3.2.1 RECONSIDERATION OF EARLIER ESTIMATES

CIC Small Area. Last year, the Committee had noted an apparent discrepancy between the previously accepted abundance estimate for the NASS-87 Icelandic aerial survey block (Hiby *et al.*, 1989), and a recent reanalysis of these data (Borchers *et al.*, 1997).

SC/50/RMP14 reported an investigation into the source of this discrepancy. The effective search area estimated by Borchers *et al.* (1997) was about half that estimated by Hiby *et al.* (1989). The major discrepancy resulted from the use of a peaked detection function, without correction for error in distances estimation, by Borchers *et al.* (1997) versus a detection function with a wider shoulder, in combination with correction for error in distance estimation, used by Hiby *et al.* (1989). Further details are given in Annex D, Item 8.3.2.1.

In discussion, it was noted that these data alone are insufficient to distinguish between detection functions which are peaked or flat near the origin and there was some inconclusive discussion as to whether a peaked or flat detection function might be expected *a priori.*

In conclusion, the Committee **agrees** that the previously accepted estimate should remain so (pending resolution of the matters raised above). The Committee noted that the data from this survey had been provided for use during the current meeting. However, no arrangements were in place for continuing access. The Committee **agrees** that if the estimate is to be used in the implementation of the RMP then the data would need to be available on a continuing basis in accordance with the Requirements and Guidelines for Conducting Surveys and Analysing Data within the Revised Management Scheme (IWC, 1997e, pp.227-28). This was considered critical in order that issues such as those raised in the discussion could be examined further when necessary. The question of data availability was considered further under Item 8.3.2.2.

CM Small Area. The Committee had previously calculated an abundance estimate from the NASS-87 data for this area from an *ad hoc* proration of the estimates from Norwegian and Icelandic surveys, based on the number of sightings in the area (IWC, 1993a, p.66).

SC/50/RMP17 presented a reanalysis of the NASS-87 data for this area.

In discussion, three concerns were raised about the analysis. First, no smearing of the line transect data had been carried out. Second, data were pooled across Icelandic and Norwegian vessels. Third, survey block B2 contributed over 50% to the total abundance estimate, yet survey coverage in this block was very low. Further details are given in Annex D, Item 8.3.2.1.

The authors of SC/50/RMP17 indicated that they would undertake to reanalyse the data to address the concerns raised. The Committee noted that the data from this survey were also available only during the current Annual Meeting. The Committee emphasised that if the abundance estimates from these data are to be used as input to RMP implementation, the data will need to be available on a continuing basis (see Item 8.3.2.2).

SC/50/RMP10 analysed minke whale sightings data collected in the NVS stratum of the CM *Small Area* from Icelandic vessels in the NASS-95 survey. An estimate of 5,869 minke whales (CV = 0.427) was obtained using standard line transect methodology assuming $g(0) = 1$. The estimate for the NVS stratum was added to estimates for the NVN and JMC strata of the CM *Small Area* obtained from the NILS-95 survey using different methodology (Schweder *et al.*, 1997) to yield a total abundance estimate of 12,043 minke whales (CV = 0.277) for the whole CM area in 1995.

The Committee had a number of questions concerning the conduct of the survey and the field protocols followed, such as whether there had been experiments to test distance estimation and how duplicate sightings had been identified. Details are given in Annex D, Item 8.3.2.1.

Because this survey had been conducted recently, the Committee considered the extent to which it had met the Requirements and Guidelines for Conducting Surveys under

the RMP. To facilitate this a checklist was developed summarising the extent to which these were met. The checklist is given in Annex D, Appendix 9 and possible implications for future use of estimates from these data in implementing the RMP are discussed under Item 8.3.2.2.

8.3.2.2 DATA AVAILABILITY

Last year the Committee posed four general questions (IWC, 1998b, item 8.2.2) arising out of specific discussion about the availability of sightings survey data for estimates that it might review for suitability under the RMP. These questions arose out of the specific issue of the suitability of abundance estimates from the CM area that were based in part on data collected by a non-member state and for which the Committee did not have access to the primary data.

In general discussion of data availability issues the Committee recalled that these questions had arisen out of the Requirements and Guidelines for surveys under the RMP (IWC, 1996d, p.211) and that these requirements and guidelines pertain strictly to data for estimates to be used in an implementation of the RMP. The Committee **agrees** that availability means that the data need to be lodged with the Secretariat on a continuing basis and that they are freely available to all accredited members of the Committee without restriction. Data availability in this context does not extend to public access nor does it allow for further redistribution of the data by members of the Scientific Committee.

The Committee noted the desirability of having access to data from abundance surveys that were conducted by non-members states on stocks of interest to the Commission. The Committee **recommends** that the Commission request non-member states to cooperate in the work of the Committee by providing information on abundance surveys that they conduct on stocks of interest to the Commission and to make the data from such surveys available.

Requirements for data used by the Committee to address other issues do not fall under these same requirements. The Committee recognised that results from various other analyses (such as genetic analyses to inform decisions on stock structure and assessments of stocks subject to aboriginal subsistence whaling) were used to provide management advice to the Commission for which the data were not available to the Scientific Committee. Some members considered that the question of data availability for these other analyses needed to be addressed. The Committee noted that this issue is being addressed in the development of the Aboriginal Whaling Management Procedure.

Discussion then focused on the following four questions posed last year.

(1) REQUIREMENTS FOR CONTINUING AVAILABILITY OF DATA FROM ABUNDANCE SURVEYS

The Committee noted the critical importance of having continuous access to data from abundance surveys. Such access is essential in order to be able to verify estimates when questions arise and to update previous analyses in response to methodological improvements and developments. In addition, a key component of the RMP is the requirement to periodically review the definition of *Small Areas* used in any particular implementation and to redefine these areas in light of additional information. Unless the data used to estimate abundance are available, it would not be possible to re-calculate appropriate abundance estimates that corresponded to redefined *Small Areas*.

The Committee **recommends** that, as a minimum requirement, data from abundance surveys be available on a continuing basis if abundance estimates from such surveys are to be used in an implementation of the RMP.

The Committee further **recommends** that it should not review such estimates under the terms of the RMP unless there are assurances of such access.

(2) ACCESS TO DATA SUPPLIED BY A COUNTRY SUBSEQUENTLY LEAVING THE COMMISSION

The Committee noted the discussion above about the necessity to ensure continuous availability of data for abundance estimates when such estimates are for use in the RMP. If data access were lost in the event that a member state subsequently left the Commission then the continued implementation of the RMP could be compromised. As such, the Committee **recommends** that the Commission develop appropriate provisions that ensure that any data supplied by a member country for use under the RMP remain available to the Scientific Committee in the event that a member country withdraws from the Commission.

(3) POSSIBILITY OF ALLOWING 'SLIGHTLY MORE LIMITED RESTRICTIONS' WHERE DATA OF GREAT INTEREST TO THE COMMITTEE ARE OWNED BY A NON-MEMBER NATION

Last year the Committee agreed 'that it would be useful to attempt to make an estimate for the entire CM area (for North Atlantic minke whales) for 1995.' At this year's meeting, abundance estimates for the CM area that incorporated data collected by Iceland were presented to the Committee. The data were available to the Committee during the meeting, but no arrangements had been made for continuing access. The Committee recognised that Iceland was not currently a member of the IWC and, as such, was under no obligation to supply data or meet other requirements and guidelines when conducting surveys.

The Committee recognised that in both the case of the use of an estimate under the RMP and the use of an estimate to address other issues of interest to the Committee, limitations on the use of such data for analyses beyond that required for the RMP or the issue for which they were supplied might be considered. Such restrictions might include ensuring that the rights of collectors for the first use of the data for their own purposes are safeguarded. Such restrictions might be included as a part of the conditions under which the data would be provided to the IWC. The Committee considered that such restrictions should not necessarily preclude the use of abundance estimates from such data as long as there was adequate access to the data for use in the RMP. The Committee stressed that within the RMP context such data would need to be available without restriction to accredited scientists. However, the publication of results of analyses not clearly and directly related to implementation issues, without the agreement of and/or collaboration with the data collectors, could be forbidden.

The Committee **recommends** that a set of guidelines be developed for the types of availability restrictions that it would consider acceptable if a non-member country, individual scientist, or international organisation were to provide data for use in the RMP. In developing such guidelines, consideration should be given both to the needs for ensuring continuing adequate implementation of the RMP and the limitations on data uses that would facilitate and encourage the provision of such data. Smith agreed to present a proposal for a set of guidelines to next year's meeting.

(4) COMMITTEE POLICY ON REVIEWING PUBLISHED ESTIMATES IF THE RAW DATA ARE NOT AVAILABLE

The Committee **recommends** that it should not review estimates for use in an application of the RMP based on data that it judges do not adequately meet its requirements and guidelines. However, the Committee also **recommends** that it should consider the specifics of any data set in terms of its requirements and guidelines. It should evaluate the degree to which the data are adequate for use in the RMP and should judge the relative importance in terms of the behaviour of the RMP in those areas where the requirements were not met and guidelines were not followed. In particular, some aspects of the guidelines dealing with prior notification and timing of data provision, etc., may be inappropriate or irrelevant depending upon the situation under which the survey was conducted by a non-member country.

In the case of the 1995 Icelandic data for the CM area, Annex D, Appendix 9 provides an evaluation of these data in terms of the RMP requirements and guidelines. It was noted that several members of the Committee had participated in the planning meeting in Tromsø for this survey. In addition, the methodology and procedures were similar to those used in the previous NASS-87 and 89 surveys. Moreover, results of analyses in SC/50/RMP10 suggested that if a standard line transect estimator was used with these data the resulting estimate would be negatively biased. With the exception of the issue of data availability, the Committee did not identify any issues in its review of SC/50/RMP10 and the supplemented information provided in Sigurjónsson *et al.* (1996) that would have precluded the use of the abundance estimate in SC/50/RMP10 for use within the RMP. However, members of the Committee may wish to conduct additional analyses to verify the acceptability of the estimate for use in the RMP if the data become permanently available.

8.4 Western North Pacific Bryde's whales

8.4.1 Specification of Implementation Simulation Trials

The Scientific Committee completed the Comprehensive Assessment of North Pacific Bryde's whales at its 1996 meeting and recommended development of *Implementation Simulation Trials*; this recommendation was accepted by the Commission (IWC, 1997a, p.32). At last year's meeting, the Committee considered information about stock identity and historical catches of North Pacific Bryde's whales. It identified seven tasks which, if completed during the intersessional period, would assist in the development of *Implementation Simulation Trials*. An intersessional e-mail correspondence group chaired by Punt was established to facilitate completion of these tasks.

8.4.1.1 PROGRESS DURING INTERSESSIONAL PERIOD

The report of the Intersessional Working Group on the Specification of *Implementation Simulation Trials* for the Western North Pacific Bryde's Whales is given in Annex D, Appendix 10.

8.4.1.2 DEVELOPMENT OF TRIALS

The Committee considered the new information regarding stock structure for North Pacific Bryde's whales.

Details of the papers presented (SC/50/RMP9, 11, 13, 18; SC/50/CAWS6 and 13) and discussion of them are given in Annex D, Item 8.4.1.2.

The Committee discussed the limits to the distribution of the local form of Bryde's whale in the western North Pacific. On the basis of inferences from where the local form has been shown to occur, historical commercial catches, sightings from research surveys, and observations based on whalewatching, as described in Annex D, Appendix 11, Hatanaka argued that any Bryde's whales around the Hawaiian Islands, Midway Island, the Kiribati Group, the Caroline Islands, and the Northern Marianas should be considered to be of the ordinary form. Perrin disagreed, noting that no surveys had been conducted near the Hawaiian Leeward Islands and that just because ordinary form Bryde's whales are found near an island does not imply that the local form cannot also occur there. Brownell commented that the situation for Midway Island and the Hawaiian Islands may be quite different from that for the islands in the Indo-Pacific including the other island groups noted by Hatanaka.

Three hypotheses had been proposed concerning the local form of Bryde's whale (SC/50/RMP11): (1) only the ordinary form is found in stock division (b), as defined in the 1996 Comprehensive Assessment (IWC, 1996c); (2) animals of the local form are found around oceanic islands within this division; and (3) Southern Hemisphere Bryde's whales move into division (b) occasionally. Several members raised concerns, described in Annex D, Appendix 12, over the assumption that the local form is not found around oceanic islands and that Southern Hemisphere Bryde's whales never migrate into the North Pacific. Kato noted that previous whaling operations around the Bonin Islands mainly occurred some 150-200 n.miles east of the islands. He further noted that although information from whalewatching can never be equivalent to a systematic survey, the whalewatching association of the Bonin Islands (OWA) has conducted seasonal surveys, which were organised more systematically than most whalewatching operations, in cooperation with the National Research Institute of Far Seas Fisheries. Whalewatching effort now extends to summer and autumn for sperm whales in addition to that in spring for humpback whales. However, no Bryde's whales had ever been seen around the coast of the Bonin Islands during surveys or whalewatching operations.

The Committee was informed that future catches are not envisaged in the following areas: 200 n.mile zones of countries other than Japan; within 20 n.miles of the coast of southern Japan (west of 36ºE, including the Kochi area and Ryukyu Islands); and south of 10ºN (Annex D, Appendix 10, Adjunct 1). This will have the effect of limiting or even eliminating any possible catches of local form Bryde's whales. However, stock structure hypotheses concerning local form Bryde's whales are still important because sightings surveys are planned to include 200 n.mile zones of countries other than Japan. It was also noted that in the event that catches within these areas are subsequently proposed, the *Implementation Simulation Trials* may need to be modified or repeated to take account of any revised assumptions about the location of future catches.

There was neither sufficient time to complete discussion of the plausibility of the three hypotheses given in SC/50/RMP11, nor, therefore, to finalise agreement on how to model the structure of inshore and offshore Bryde's whales in and around major island groups.

The Committee then discussed plausible stock structure hypotheses for offshore Bryde's whales in the western North Pacific from a starting point of the stock area proposed by the Comprehensive Assessment and modified to exclude the area south of 10ºN (Annex D, Appendix 10, Adjunct 1).

Smith and Polacheck expressed a number of concerns based on the available information on catch distribution, and genetic and marking data. First, they queried why there was a gap in the catch distribution between 150° and 160°E. Second, they noted that there were large areas of ocean to the

east of the proposed stock area for which there were no data. Third, having examined changes in catches over time in the area of pelagic whaling, they pointed out that downward trends in catches had occurred at a small spatial scale (5° × 5° block) over short (up to five year) periods of time. This raised concerns about local depletion and the possible desirability of incorporating within-stock spatial structure in the trials.

Hatanaka responded to these three issues. First, he pointed out that the gap in catch distribution between 150°-160°E was a result of catch regulations; the western boundary to pelagic whaling set by the Government of Japan at that time was 159°E and the eastern extent of coastal whaling was restricted by distance from the land station. Second, he noted that although there were no genetic or marking data in the area to the east of 170°E, there were large catches; analyses of biological data had indicated no difference between whales taken by coastal and pelagic whaling. Third, he believed that it was clear from all the available data that there was no within-stock spatial structure latitudinally or longitudinally. Ohsumi added that the observed trends in catches identified by Smith and Polacheck were a result of operational factors such as changes in the range of pelagic whaling grounds and catch quotas.

After considerable discussion of the available data and the areas to which they pertained (summarised in Annex D, Appendix 14), the Committee **agrees** that an appropriate boundary for the western stock of North Pacific Bryde's whales for the purposes of the RMP is as described in Annex D, Appendix 14. This specifically excluded the area to the south of the Hawaiian Islands and east of 180° from which there were no data. The Committee further **agrees** that there should be two sub-Areas in this stock area divided at 180° which would allow the testing of two alternative stock hypotheses:

(1) there is only one offshore stock of Bryde's whales in the western stock area;
(2) there are two offshore stocks present in the sub-Area to the east (sub-Area 2 in Annex D, Appendix 14): the western stock and an eastern stock.

The Committee noted that it was planned that future sightings surveys would cover the entire western stock area as defined over a four year period.

Key questions concerning stock structure that remained include: how to model the interchange between inshore and offshore Bryde's whales in the areas around islands, including the plausibility of the proposed hypotheses; and whether or not operational factors can explain the observed trends in catches at small spatial scales and, if not, whether within-stock spatial structure needed to be considered.

Concerning catch data, key issues that require resolution are: the disagreement last year about how to treat Soviet catches (IWC, 1998b) in the trials; and the proposed locations of future catches. These would need to be resolved after sub-Areas had been fully defined.

To address these and other questions relating to the specification of the simulation trials, the intersessional Working Group from last year was re-established under Punt to work by e-mail and to report to next year's meeting. Hatanaka further proposed that to ensure good progress a workshop should be held before next year's meeting. This had been considered last year but no workshop had been held. The Committee **agrees** that the detailed work of specifying trials is best conducted at a separate meeting and **recommends** that such a meeting take place intersessionally.

8.4.2 Sightings survey planning - report of the intersessional working group

The Report of the North Pacific Sighting Survey Steering Group (NPSSSG), is given in Annex D, Appendix 8. The Steering Group was able to address several of the nine tasks assigned to it and additional material was presented to the Committee relative to the remaining tasks.

SC/50/RMP5 described the revised version of the four year sightings survey plan which took into account recommendations made by the NPSSSG. It outlined the key features proposed for the conduct of the survey. There will be three vessels used and the expected number of sightings is 30 per vessel. One of the vessels will have the capability of an independent observer platform, which will be used in a feasibility study to determine if $g(0)$ is close to one or not.

In discussion, it was clarified that the data being collected are intended for use in both *Implementation Simulation Trials* and implementation of the RMP for North Pacific Bryde's whales. It was suggested that the initial estimate of school size, at the time of sighting, be recorded as well as the actual estimate after closing in order to obtain data for correcting school size estimates during passing mode. Although previous experience with this approach for Southern Hemisphere minke whales was noted to have been unsatisfactory, a further attempt was suggested by some as being worthwhile. Covering an entire latitudinal band in one year was noted to be a good approach.

The Committee considered the requirements for participation of a member of the Scientific Committee in this survey and agreed that Committee representation on the planned surveys should take the form of participation of a scientist with active experience of surveys of the type proposed. The Committee noted that Shimada (who has the relevant experience) will participate in the survey and **agrees** that he is an appropriate scientist to represent the Committee.

The Committee **strongly recommends** that the surveys include waters within the EEZs of the Federated States of Micronesia, the Republic of the Marshall Islands and the USA in order to provide the necessary coverage. The Secretary informed the Committee that he had received a letter from the government of the Marshall Islands granting permission to conduct surveys in their waters. Tillman informed the Committee that the government of the USA had informed the government of Japan that it welcomed the planned surveys and had granted permission for Japan to work in US waters until June 2000. A permit to take biopsies in US waters was required and the government of Japan had been encouraged to submit an application for such a permit. US authorities would assist as required to ensure that this permit could be granted in timely fashion. The Committee **recommends** that the Commission requests the relevant authorities of the Federated States of Micronesia to grant permission for the vessels to operate in their EEZ.

9. COMPREHENSIVE ASSESSMENT OF WHALE STOCKS

9.1 Southern Hemisphere blue whales

9.1.1 Assessments

The Committee noted that it had not been possible to develop revised estimates of blue whale abundance from the IDCR/SOWER cruise programme in time for this meeting. It looked forward to receiving such estimates at its next meeting.

SC/50/CAWS14 reported historical data on blue whales off Namibia. Catches of blue whales off Walvis Bay in the 1920s had been substantial, and size composition data indicated that these were probably true blue whales. Catches peaked strongly in July/August. There were at least six apparent cow-calf pairs included in the catch, and the region had the reputation of being resorted to by particularly large, fat females. If the area is a winter 'breeding ground' for true blue whales, this would offer new opportunities for monitoring their status and could be considered in planning future SOWER cruises. However, assessing the status of blue whales on a breeding ground might not be straightforward, and would have to take into account possible structuring and segregation by sex or reproductive condition.

SC/50/CAWS23 suggested that blue whales seen in the vicinity of the Galapagos Islands during the austral winter or spring might be Southern Hemisphere animals on their wintering grounds. Kato had examined photographs of animals from the Galapagos region, including a sequence showing surfacing behaviour, and, from morphological and behavioural characters, had concluded that these whales resembled true blue whales.

Incidental sightings of more than 60 blue whales from a ferry in a fjord in southern Chile, some apparently feeding at a frontal zone between oceanic and glacial meltwater, were made in January 1998 (SC/50/Rep2). The observers (who had just participated in the blue whale cruise) believed the animals looked similar to the blue whales seen on that cruise and identified as pygmy blue whales by the boatswains.

The Committee stated its concern that reliable distinction between 'true' and pygmy blue whales in the field was becoming increasingly important, given that the results of the 1996/97 SOWER cruise had indicated that the simple geographical separation of the two forms in summer previously used may no longer be entirely valid. This means that sightings estimates in high latitudes in summer may contain some proportion of pygmy blue whales.

The surfacing behaviour of putative 'true' and pygmy blue whales had been recorded on the first two (1995/96 and 1996/97) blue whale cruises, using high-resolution digital video recording. SC/50/CAWS1 analysed 12hrs 56mins of these recordings, representing 4 surfacings by 4 'true' blue whales and 103 surfacings by 45 pygmy blue whales. Seven patterns of surfacing were identified. Although the sample size of 'true' blue whales was small, there appeared to be a difference in surfacing behaviour between 'true' and pygmy blue whales. Whereas pygmy blue whales never exposed the caudal keel (and rarely their dorsal fin), 'true' blue whales seemingly always exposed both. The authors recommended that more data should be collected from 'true' blue whales, that the biological context of different surfacing behaviours should be investigated, and that other morphological features (especially those involving the nasal region of the skull) should be examined.

The Committee welcomed this analysis as an objective approach to investigating behavioural differences between the two forms of blue whale, and looked forward to a fuller analysis next year, in which the results of the 1997/98 blue whale and SOWER cruises would be included. This would *inter alia* increase the sample size for 'true' blue whales. Concern was expressed, however, that the process of closing with the whales to obtain video footage may be altering surfacing behaviour, so that the difference in behaviour seen between the two forms might be partly a result of the 'true' blue whales having been filmed at a greater distance from the vessel. Brownell reported that blue whales in the Maldives, believed to be pygmy blue whales, fluked frequently, even during boat approaches.

SC/50/CAWS29 reported an analysis of sounds recorded in the vicinity of blue whales off Chile on the 1997/98 blue whale cruise. During 8 of 13 approaches to blue whales for biopsy attempts that were acoustically monitored, a total of 20 very low frequency calls was recorded. All were typical of blue whale vocalisations, but were unique in the consistency of the fundamental harmonic and the production of multiple harmonics, creating a harsh, growly quality. Such calls were only recorded on closing for biopsy, and were characteristic of calls made by other animals in a threatening context.

A summary of information from IDCR/SOWER cruises to date on the acoustic distinction between 'true' blue and pygmy blue whales was provided by Clark. All the recordings made in the Antarctic in 1996/97 in the vicinity of putative 'true' blue whales differed greatly from anything recorded on the cruises off Australia in 1995/96, south of Madagascar in 1996/97 or off Chile in 1997/98. Preliminary reports from the 1997/98 Antarctic SOWER cruise suggested that calls similar to those recorded in the Antarctic in 1996/97 had been heard. It therefore appeared that 'true' blue whales may produce different vocalisations from pygmy blue whales. The best documented comparison was between pygmy blue whales sampled south of Madagascar in November/December 1996 and blue whales recorded in the Antarctic the same summer (IWC, 1998d; Ljungblad *et al.*, 1998). These were as distinct as the calls of North Atlantic or North Pacific populations of blue whales. However, Clark had not had access to all the recordings, and a full comparison had not been made. A small group under Clark provided a report (Appendix 2 of Annex E) describing the current situation regarding the quantity, availability and disposition of acoustic recordings from the blue whale and SOWER cruises, and the state of their analyses.

The Committee **recommends** that all blue whale recordings from these cruises should be gathered in one place and put in a format that makes them accessible to researchers. It **agrees** that a working group under Clark would be set up to coordinate the process, which should involve all the stake-holders in the blue whale recordings made to date. The aim would be to provide a properly archived and annotated series of sounds, the analysis of which would be presented at the Committee's next meeting. It was estimated that a sum of £2,000 would be required to cover the costs of analysis, and a total of £2,000 for editing and archiving the sounds onto CD-ROM.

The Committee **agrees** that discrimination between 'true' and pygmy blue whales should be a major topic at the Committee's next meeting. Papers on not only acoustic differences but also genetic differences from biopsy and museum samples and differences in morphology and behaviour as determined from descriptions by topmen and still and video photography would be welcomed.

9.1.2 Reports of the SOWER cruises

The Committee reviewed SC/50/Rep2, the Report of the 1997/98 IWC/SOWER Blue Whale Cruise, the third to be undertaken as part of the IWC's research programme on Southern Hemisphere blue whales. The cruise was conducted in the southeastern Pacific Ocean in identified summer concentration areas off the coast of Chile, during December 1997 and January 1998. The objective of the cruise was, as in the two previous cruises, to obtain scientific information relevant to developing onboard identification

methods for distinguishing between 'true' and pygmy blue whales. Two vessels, *Shonan Maru* and *Shonan Maru No.2*, were used. A total of 389hrs 58mins of searching was carried out by both vessels combined, during which some 4,454 n.miles of trackline were surveyed. In total, 39 sightings of 47 blue whales (and 1 sighting of 1 like-blue whale) were made, of which 37 sightings of 45 animals were identified as pygmy blue whales and 2 sightings of 2 animals as 'undetermined' blue whales. Experimental work included collecting 19 biopsies from blue whales; 462 still photographs and 180.11mins of video footage of blue whales were exposed for individual identification, morphological and behavioural analysis. Dive-time experiments were undertaken for 20 blue whales for a total of 16hrs 20min, and 225hrs 13min of acoustic monitoring was carried out: blue whale calls recorded ranged in frequency from 9 to 44Hz and from 1 to 32 seconds in duration. A list of recommendations for future blue whale cruises is included in SC/50/Rep2.

Identifications of blue and pygmy blue whales on the cruise were provisional and had been made by the topmen. The criteria they had used (e.g. blowhole shape, head shape, etc.) had been systematically recorded on the sightings data sheet. The boatswains on both vessels had also had previous experience with chasing and catching pygmy blue whales before protection. The Committee **recommends** that a paper be submitted to next year's meeting, documenting the criteria used on each of the three blue whale cruises for identifying the two blue whale forms, listing the results and the personnel responsible for making the identifications, and providing an analysis of the photographic and video material in support of the criteria used. It was pointed out that much of this had already been done for the first two cruises (SC/50/CAWS1), and that the 1997/98 cruise material had been preliminarily evaluated.

Blue whale research was also conducted during the 1997/98 IWC/SOWER cruise to Area IIW (SC/50/Rep1) although the primary objective of this cruise had been to estimate the abundance of minke whales. Two of the 30 available research days had been allocated for research on blue whales. Eleven sightings of 18 blue whales were made in the research area; eight of these sightings (14 animals) were identified as 'true' blue whales, two sightings (3 animals) as pygmy blue whales and one sighting (1 animal) as an 'undetermined' blue whale. Research was conducted on 10 groups of blue whales for a total of 14.42hrs, during which time biopsies were obtained from 3 'true' blue and 3 pygmy blue whales, acoustic monitoring was carried out for 13hrs 25mins, dive-time experiments were run for 2.83hrs, there was video-taping of surfacing behaviour for 26mins 47secs, and 8 'true' blue and 2 pygmy blue whales were photographed for identification purposes.

9.1.3 Other

Following problems experienced on previous blue whale cruises with obtaining biopsies from whales that were difficult to approach, Larsen had received IWC funding to develop a more powerful delivery system based on a Remington Rolling Block System rifle, adapted to fire darts of a diameter of 26mm using 9mm blank ammunition (SC/50/O15). The gun also carried an electronic aiming device and a valve for adjusting gas pressure. Field trials on humpback whales off Provincetown had been promising, but it had not been possible to get the gun to Chile in time for the 1997/98 blue whale cruise. The question of using this new system on future blue whale cruises was referred to the Planning Group (see Item 9.9.1).

9.2 Right whales

9.2.1 Report of the Cape Town workshop

The Committee received the report of the Special Meeting on the Comprehensive Assessment of Right Whales that was held in Cape Town in March 1998 (SC/50/Rep4). Bannister, who had chaired the Workshop, provided a summary (Appendix 3 of Annex E) and presented a compilation of the most important recommendations to the Committee. The Committee commended the organisers of the meeting and considered its recommendations. General comments are given in Annex E and incorporated, where appropriate, under Item 9.2.2 below.

9.2.2 Action arising

The Committee **agrees** to endorse all the recommendations contained in the report of the right whale meeting (SC/50/Rep4). However, it gives highest priority to the items listed within the two categories, A and B, below.

A. RECOMMENDATIONS WITH MANAGEMENT IMPLICATIONS

These are particularly important for those stocks for which the Workshop has expressed concern over status. The Committee identified ship strikes and incidental entanglements in fishing gear as the most significant causes of human-induced mortality of right whales.

The Committee's specific recommendations with management implications are given in Annex O.

B. RECOMMENDATIONS FOR RESEARCH

The Workshop had made a large number of research recommendations and the Committee reiterated the value it attaches to all of those recommendations. However, it recognised the need to assign priorities in the context of IWC interest. It agreed with the Workshop that, in particular, this applies to questions associated with the 'trend and condition of whale stocks' and 'measures for the[ir] conservation' (Article IV of the Convention).

In this regard the Committee confirms the view it has already expressed on several occasions (IWC, 1990b) of the extreme importance of maintaining research effort when investigating trends in both abundance and in biological parameters. The Workshop therefore stresses that high priority should be given to the continuation of both demographic photo-identification studies (SC/50/Rep4, item 9) and surveys designed to improve knowledge of absolute abundance and current trends (see SC/50/Rep4, item 10). Similarly, high priority should be given to the processing and analysis of such data. This is particularly important for the western North Atlantic where there are serious concerns over the status of the stock (see SC/50/Rep4, item 11).

In the same regard the Committee notes the need to initiate and improve such studies in areas of identified concentrations where they are either absent or in their infancy. High priority should be given to those areas where it is believed there is most chance of success.

In order to interpret data on trends and abundance it is important to determine appropriate management units. In this context, high priority should be given to stock identification studies that will answer questions believed to be hindering the Committee's ability to address important conservation questions (see SC/50/Rep4, item 7). Genetic sampling programmes should be initiated where needed, and maintained in areas where increased sample sizes are needed for statistical validity.

The Workshop agreed that high priority should be given to research that will lead directly to improved methods of reducing anthropogenic mortality (e.g. reducing ship strikes and fishing gear entanglements) for stocks for which there is

concern over their survival, and to research examining environmental factors that affect the fecundity and mortality rates of right whale populations (e.g. food limitation, pollution; see SC/50/Rep4, item 12). Such research should ultimately lead to improved recommendations for appropriate and effective management action. Comparative studies between stocks that are recovering and stocks that do not appear to be (see SC/50/Rep4, item 10) may be particularly valuable in this context. Studies that improve information on feeding grounds in the Southern Hemisphere will facilitate such comparisons.

From the genetic standpoint, two questions are of high priority:

(1) what are the implications of the low haplotype diversity detected in certain populations; and
(2) is the effective population size of right whales significantly lower than the abundance estimates?

Given these priorities, the Committee **recommends** that the Commission urges member governments to provide the necessary support, including funding, for the particular research items below.

(1) Continuation of existing programmes of photo-identification, surveys, etc. for assessing and monitoring population status and the establishment of new programmes; use of computerised techniques for matching photographs (Item 9.9.3) should be considered as appropriate.
(2) Processing and analysis of data collected under (1).
(3) Development of methodology and application of existing methodology for analysing survivorship and other biological parameters in northwest Atlantic right whales.
(4) Increased efforts to determine the recent population trajectory of the northwest Atlantic population, including, as a matter of urgency, use of more complex, including stochastic, models.
(5) Research to determine the current status of right whales in areas of the Southern Hemisphere which were historically important but for which there is no recent information.
(6) Investigation of two additional Antarctic data sets for trend analysis - JSV sightings data 1965/66-1981/82, and JARPA, 1987/88-present.
(7) Expansion of research efforts to improve understanding of the status of the North Pacific and eastern North Atlantic populations and any human-related problems they may have, including a further dedicated sightings survey in the Okhotsk Sea that follows the Committee's guidelines for surveys (IWC, 1997e).
(8) Comparative studies to try to determine factors to explain the difference between northern and southern hemisphere population reproductive parameters.
(9) Investigation of problems of stock structure, by ocean basin, i.e. for

Western North Atlantic: directed genetic sampling of females on the calving ground, any unsampled animals in Massachusetts Bay and the Great South Channel, and of 'Fundy-none' females; further examination of available information on mitochondrial DNA haplotypes of individual whales to test for heterogeneity in regional resighting probabilities, scarring patterns and reproductive success; acquisition of further historical samples for the central and eastern North Atlantic preferably prior to the nineteenth century;

North Pacific: further biopsy sampling in all regions; additional analysis of historical samples available in Japan;

Southern Hemisphere: additional genetic sampling to characterise regional relationships, particularly the calving grounds; sampling from feeding grounds for more reliable allocation of catches to calving stocks; collection of biopsy samples from vessels in programmes such as CCAMLR, SO-GLOBEC and BAS krill surveys; timely analysis of both extant and future biopsy samples including the large sample from South Africa; where possible, biopsy samples should be collected from a minimum of 20-50 individuals and in calving areas should be repeated in at least each of three consecutive years.

Although the results of the special meeting represented a major advance in understanding the status of right whales worldwide, the Committee noted that there were still a number of outstanding questions regarding the status of the population in the western North Atlantic. Although the population was known to be small (*ca* 300 individuals), and well below its unexploited size, its current dynamics were unclear. At the same time, it was subject to a range of anthropogenic threats, including ship strikes and fishery entanglements, some of which were proving fatal. The Committee therefore **recommends** that the western North Atlantic right whale should be a priority topic for next year's meeting, with the objectives being to establish the current status and dynamics of the population. A three-day intersessional workshop prior to next year's Scientific Committee meeting was proposed. A schedule and a budget that would allow for a number of invited participants to attend was developed by a steering committee established under Clapham (for members see Annex V).

The Committee noted that if it is judged that insufficient progress on required analyses has been made in advance of the special meeting for it to be held, they expected that at least relevant papers on progress to date would be submitted to next year's Scientific Committee meeting.

9.3 Southern Hemisphere humpback whales

9.3.1 Progress in catch and marking data coding

Allison reported that no catch data had been coded since the last meeting, and it appeared that most individual catch data available for southern humpback whales had been coded already. Coding of marking data for the 1930s is continuing.

9.3.2 Establishment of Southern Hemisphere directory and Antarctic catalogue

The Committee **recommends** that the IWC Secretariat continue with arrangements to create the directory of Southern Hemisphere humpback whale identification photographs, as recommended last year (IWC, 1998b).

Last year, the Committee had also recommended that Carlson be nominated and funded to undertake certain tasks related to the establishment of a centralised catalogue of humpback whale identification photographs from the Antarctic. Carlson reported that she had undertaken these tasks and had also approached the College of the Atlantic to determine whether they would be interested in taking on the responsibility for such a catalogue. Their specific proposal is contained in Appendix 4 of Annex E.

The Committee **recommends** that the Commission should proceed with arrangements for a contract to be drawn up with the College of the Atlantic to create an IWC Antarctic

catalogue of humpback whale photographs, provided that such a contract contains written specifications of (a) how the catalogue is to be made available to researchers, under what conditions and in what format, and (b) what protection will be afforded for the proprietary rights of any contributors to the catalogue. The Secretariat will negotiate these specifications in consultation with potential contributors.

9.3.3 Progress towards assessment

9.3.3.1 ABUNDANCE AND TRENDS

SC/50/CAWS8 analysed humpback whale sightings (548 primary sightings; 1,065 individuals) in Area IV during JARPA 1997/98. For the first time, humpback whales were the dominant species throughout the region surveyed by JARPA. Indices of abundance suggested an increasing density of humpback whales from 1989/90 to 1997/98.

The Committee was informed that it was unwise to calculate a rate of increase from the JARPA abundance indices at present because there may have been undersampling of high density areas. This problem has also arisen with minke whale abundance indices from the same surveys, and is the subject of a current IWC contract.

SC/50/CAWS16 presented an analysis of sightings results from Area IV during the 1995/96 summer. Sightings were made from the Australian ice-breaker *Aurora Australis,* which was carrying out a krill acoustic survey. Searching was in passing mode only, and data collection and analysis were in accord with standard double-platform line transect methodology. The estimate for humpback whales was 900, with a CV of 0.46. This estimate was significantly different in the strictly statistical sense from the estimate of 3,309 (CV 0.445) from the second set of circumpolar IDCR cruises (SC/50/CAWS37). A number of factors that might have combined to reduce the estimate of abundance were identified: different survey timing, 'additional variance', possibly lower $g(0)$, use of passing mode (which would have produced a tendency to underestimate group size), and particularly strict criteria in accepting a sighting as identified.

It was reported that future surveys would use 'big-eye' binoculars to improve species identification during passing mode. The utility of these estimates would be greatly improved if they could be incorporated with other data in a Generalised Linear Modelling (GLM) approach to obtain better estimates of population size and particularly trend. 'Additional variance' could be evaluated. The Committee **agrees** that the evaluation and comparison of such sightings data would be greatly facilitated if the distributions of both angles and radial distances to sightings were given. The Committee referred the issue of using such surveys to obtain estimates of trend to the workshop on Planning Joint GLOBEC/SOWER/CCAMLR Surveys (see Item 12.3.1).

During the 1997/98 summer, sightings surveys were carried out in the Antarctic Peninsula area from the Brazilian Antarctic supply ship *Ary Rongel,* using line transect methodology (SC/50/CAWS36). Densities of humpback whales were obtained and 54 individuals photo-identified (including one match between 27 January and 7 March, suggesting that some individuals might be resident for substantial periods during the summer).

An analysis of the sightings of humpback whales made on two and an incomplete third circumpolar IDCR/SOWER survey, covering the period 1978/79 to 1995/96 was considered (SC/50/CAWS37 and Appendix 5 of Annex E). Analytical details are considered in Annex E. The results indicated an increase from 7,500 humpback whales in the first set of surveys to 11,800 in the second set and 15,700 whales in the third (as yet incomplete) set of surveys.

The Committee noted that conclusions on possible rates of increase should not be based on comparisons by Area, as these estimates had large CVs and were subject to possible additional variance due to inter-survey shifts in distribution. Estimates based on sets of circumpolar surveys were more reliable, but CVs for the estimates in Appendix 5 of Annex E had not yet been calculated, and it was not considered appropriate to use them for estimating rates of increase as yet. Additional variance, such as the effects of high-ice/low-ice years, could be taken into account, possibly using a GLM approach, and this might bring the associated CVs down.

It was noted that future analyses of the IDCR/SOWER data for humpback whales should take into account the new feeding ground on the borders of Areas II and III.

SC/50/CAWS25 was prepared in response to a recommendation last year. Catches of humpback whales by modern whaling in the Southern Hemisphere were reviewed, along with the number of catcher vessels operating in each of a number of whaling grounds. Data were obtained from both published and unpublished sources, but did not include the undeclared catches of humpback whales by either the Soviet fleets or the *Olympic Challenger.* Crude catch per unit effort (CPUE) indices were calculated as annual catch per catcher vessel for each ground. Most grounds showed marked declines in the initial 10 years of whaling followed by either (1) closure of the ground, with some subsequent recovery of the stock, or (2) low catches until the cessation of humpback whaling in October 1963. Estimates of abundance and population trends from after 1963 show Southern Hemisphere populations to be undergoing some recovery in all areas where surveys have been undertaken.

Last year the Committee agreed on a number of options for dividing feeding ground catches into putative breeding 'stocks' (IWC, 1998c, fig.1) and for allocating high latitude catches to them; no changes to the stock division were proposed. The Committee accepted the following plan of action for a preliminary assessment next year.

Modelling of the pre-exploitation size of stocks will be carried out as recently done for southern right whales (SC/50/Rep4). The population model used in the *Catch Limit Algorithm* of the RMP (IWC, 1993b) will be run for stocks where some recent population estimates have been determined (stocks C, D and the east Australian component of stock E). Low latitude catches of humpback whales reported in SC/50/CAWS25 can be assigned to these stocks except for those from the Kerguelen Islands. For the purposes of these analyses the undeclared Soviet catches for which no catch position data are available will be assigned on a pro rata basis. Catches from Kerguelen will be equally divided between C and D. Initial declines from the model can be compared with the CPUE indices in SC/50/CAWS25. These analyses are intended as preliminary; both the population model used and options for allocating catches can be refined in the light of initial results obtained. An intersessional working group under Best (see Annex V) was established to progress the work before the next meeting.

9.3.3.2 STOCK STRUCTURE

Two genetic papers were considered. In Baker and Medrano-Gonzalez (1998) the distribution and worldwide diversity of humpback whale mtDNA lineages was described. Differentiation of mtDNA lineages was weakest

(although statistically significant) among the four wintering grounds of the Southern Hemisphere. A phylogenetic reconstruction of the control region sequences suggested that each ocean is dominated by one clade. In the North Pacific and North Atlantic, a secondary clade seems to be the result of gene flow from the Southern Hemisphere. Only the Southern Hemisphere includes lineages from all three clades.

SC/50/CAWS35 presented a preliminary analysis of mtDNA variation and geographic structure of humpback whales from several wintering grounds. A hierarchical analysis of molecular variance (AMOVA) also showed significant differences among four historical stocks or whaling management areas. However, an analysis of haplotype frequencies was not significant for stocks ($p = 0.059$), but showed more differences between pair-wise comparisons of wintering regions. Most pair-wise comparisons between wintering grounds were consistent with geographic distance or stock divisions in the haplotype analysis. Notable exceptions were the absence of difference between Madagascar and Western Australia, and the absence of difference between both these regions and New Caledonia. Further analysis of a larger dataset is planned.

Some of the apparent inconsistencies in the results can probably be explained by inadequate sample size. The high degree of variation suggests that large sample sizes are needed to obtain adequate resolution. A larger segment of the control region may need to be analysed, and the possibility of inadvertent resampling of individuals on breeding grounds should be investigated. The need to use a number of statistical techniques to analyse such data was stressed, because reliance on only one model might produce misleading results.

More genetic samples from both sides of the South Atlantic and from feeding areas are required. A total of 88 samples from humpback whales in the Antarctic are now available from JARPA, most of which have been analysed (SC/50/O3), and an additional 10 biopsies had been collected from 10 humpback whales during the 1997/98 SOWER cruise (SC/50/Rep1).

In November 1997, 43 sightings of 72 humpback whales had been made in 22 days during a seismic survey offshore from Oman (SC/50/CAWS21). Available data support the hypothesis that these whales are resident year-round in the northwest Indian Ocean, although their abundance off the coast of Oman appears to decline in summer. The recent status of the species in the area, following the Soviet catch in 1966, was in doubt.

The Committee **recommends** that dedicated surveys should be carried out to establish the status of humpback whales in the northwest Indian Ocean, and that these should include the collection of biopsy material from which the genetic relationships of this interesting stock could be investigated.

9.3.3.3 FURTHER INFORMATION ON CATCHES

SC/50/O18 detailed several previously unreported mark recoveries from the Soviet factory ship *Slava* in the Southern Hemisphere. From 1955-66, 51 recoveries (25 humpbacks) had been found: only six of the humpback records had been reported previously. These are probably only a small fraction of the number of recoveries actually made. The need to obtain further information on mark recoveries and marks fired under the Soviet scheme (of which Mikhalev had access to about 1,000) was stressed. The Committee thanked Mikhalev for his efforts, and **urged** him and his colleagues to continue their invaluable work in retrieving catch and marking data from previous Soviet whaling operations.

Borodin requested that the following statement appear in the report. 'For the last few years (IWC, 1997b, p.82; IWC, 1997c, pp.137-8; IWC, 1998b, p.77) 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.'

SC/50/CAWS30 was a response to a request last year for information on Brazilian whaling. Whaling had started in 1602 and continued up to the end of the 19th and into the beginning of the 20th century. Species were usually not reported, but descriptions and circumstantial evidence suggest that the catch was mainly right whales. No complete catch series exists but Ellis (1969) estimated that at least 2,664 whales were taken between 1761 and 1819. This contrasts markedly with Richards' (1993) estimate of 14,904 right whales killed by shore stations from 1772 to 1814. This is probably due to an under-representation of shore stations in Ellis (1969). Only three humpback whales are known to have been taken, in 1801. Modern whaling in Brazil started in 1910 and continued (intermittently) until 1974. Although catch statistics are not always complete, and sometimes contradictory, at least 1,334 humpback whales were taken between 1910 and 1963. SC/50/CAWS30 does not include catches from a Brazilian open-boat fishery taking humpback whales because no records were found in the archives of government departments in Brazil. The original source of the information (mentioned in Tonnessen and Johnsen, 1982) should be consulted.

9.3.4 Future special meeting

The Committee noted progress in a number of areas in the assessment of Southern Hemisphere humpback whale stocks, as reported above. While work is still required to complete many of those tasks, it noted that little or no action has yet been possible, given the short interval between the annual meetings and for other reasons, on a number of other tasks recommended last year.

(i) *Acquisition and entry of revised Soviet catch data* (Item 9.3.1) - Secretariat - no new data have been acquired.
(ii) *Investigation of the availability of original Soviet scheme marking data* (Item 9.3.3.3) - Secretariat - ongoing.
(iii) *Creation and maintenance of a centralised directory of Southern Hemisphere humpback whale photo-identification catalogues* (Item 9.3.2) - Secretariat - action required.
(iv) *Collection of biopsy samples from three main strata: breeding ground, feeding ground, migratory corridor* (Item 9.3.3.2) - national groups - some action.
(v) *Monitoring of abundance to continue or be initiated where no survey programme exists* (Item 9.3.3.1) - national groups - new survey data have been reported this year.
(vi) *Inclusion of humpback whales as targets for biopsy and photo-identification in future Antarctic survey expeditions in the South Georgia region* (Item 9.3.3) - national groups - no action reported.

(vii) *Researchers in photo-identification programmes to evaluate the likelihood of obtaining estimates of biological parameters* (Item 9.3.3) - national groups/individual scientists - no results reported.
(viii) *Comparison of currently observed increase rates to be considered in conjunction with a review of demographic parameters for Southern Hemisphere humpbacks and a comparison with information on increase rates and demographic parameters for North Atlantic and (North Pacific) populations* (Item 9.3.3) – Scientific Committee - no action.
(ix) *Progress report on retrieval of detailed Soviet catch data* (Item 9.3.3.3) - relevant scientists - no action reported.

The Committee established an intersessional working group under Clapham to consider (viii) (see Annex V).

As regards (vii), the Committee felt that the most appropriate approach would be to encourage individual members to consult with researchers concerned with photo-identification on humpback whales in their region for this information.

In light of these outstanding matters requiring action the Committee **agrees** that it would be in a better position at next year's meeting to decide when a Comprehensive Assessment might occur. Experience gained during the preliminary assessment to be considered at that meeting should also assist in identifying important issues to be settled before the Comprehensive Assessment could take place.

9.4 North Atlantic humpback whales

The Committee received an update on the status of information on the North Atlantic humpback whale (Annex E, Appendix 6). Considerable progress had been made, including papers published, in press or in preparation on abundance, trends, population structure, migration and breeding grounds, and catch data. The most important papers from the YONAH project are expected to be available by the end of 1998. Many other analyses are substantially developed, but the likely time frame of their availability is unclear; these include some critical areas such as analyses of trends in abundance and clarification of population structure, especially as it refers to specific breeding grounds. It was stressed that while every effort would be made to construct as comprehensive a catch history for the North Atlantic as possible, it was likely that the total catch will never be known completely, and this would constrain what could or could not be done in the comprehensive assessment.

Apart from an incomplete catch history, two main gaps for an assessment were identified: (1) lack of information on the distribution and abundance of humpback whales in the southeast Caribbean (Windward Islands) and off the Cape Verde Islands, and (2) their relationship to humpback whales in the rest of the North Atlantic. In regards to the former, SC/50/CAWS28 summarised individual identification photographs available for nine humpback whales from the eastern Caribbean. These photographs were compared to the approximately 5,000 animals in the North Atlantic humpback whale catalogue and the approximately 3,000 individuals in the YONAH catalogue. Two of the nine had been matched, one with Puerto Rico and the other with Newfoundland, while there was a third possible resighting in Greenland. The sample was too small and spatially and temporally diffuse to draw any meaningful conclusions; further photographs, biopsy samples and song recordings were required to address these questions.

SC/50/CAWS11 summarised information on the status and stock origin of humpback whales in the Windward Islands (the area in which subsistence hunting occurs, see Item 11.5). Densities appear low, although it was a principal whaling ground in the 19th century. The apparent failure to recover in this region raises the questions about the location of the feeding grounds for these whales and their relationship with whales that use the breeding range to the north. The author proposed a number of research items to examine the question (Annex E, Item 7.1).

The Committee believed that such a research programme would have a greater chance of success if it was carried out in cooperation with regional governments.

Acoustic data from the SOSUS fixed hydrophone arrays collected since 1993 revealed that detection rates for singing humpback whales in the southeast Caribbean in winter were about one-third to one-half of those in the high density areas. Recent Hawaiian fieldwork combining visual and acoustic methods showed that it was possible to locate individual singers acoustically out to 5-6 n.miles, and then to direct a boat with a GPS to the whale so that it could be photographed and biopsied on surfacing. This technique might be especially useful in low density areas such as the southeast Caribbean.

In regard to the situation of the Cape Verde wintering ground, or the eastern North Atlantic stock, SOSUS data collected since 1996 suggested the presence of an eastern component. Singing humpback whales could be heard in the Norwegian Sea in winter, while others proceeded south past Ireland towards Spain. The number of animals involved was small, in the tens per day. The Committee noted that this remnant population remained uncharacterised by photo-identification or genetic information. The possibility of further research was being considered, including a logbook survey in the Cape Verde Islands and an integration of all published information on humpback whales in the eastern North Atlantic as a whole.

The Committee encouraged these initiatives. It **recommends** that the possibility of collaborative research on humpback whales in the southeast Caribbean be explored with national authorities in the area, and the use of combined acoustic and visual methods be investigated to facilitate the collection of abundance and individual identification data.

Given the progress noted above, and the likely time frame for the availability of other analyses, the Committee **recommends** that a Comprehensive Assessment of North Atlantic humpback whales be carried out in 2000. Since this population is subject to a small aboriginal take at Bequia in the West Indies and has in the recent past been subject to an aboriginal hunt in Greenland, there is justification in giving the Comprehensive Assessment of this stock priority over other humpback whale stocks.

9.5 North Pacific humpback whales

SC/50/CAWS31 provided a summary of the status of the North Pacific Humpback Whale Fluke Catalogue maintained by the National Marine Mammal Laboratory, Seattle. It contains over 24,000 photographs and 1,010 resights of individual whales from at least a 5-year period have been found, with resights spanning 20 years. The catalogue is being used to examine calf mortality and average reproductive interval.

Calambokidis *et al.* (1997, cited in Annex E, Item 8) provide mark-recapture for North Pacific humpback whales from the years 1991-1993. The paper itself was not available to the Committee. Although the results are accompanied by caveats, the authors present an estimate for the whole North

Pacific between 1991 and 1993 of approximately 6,000, considerably higher than those previously received by the Committee.

The Committee **encourages** the submission of papers or reports on the above work when it next considers this population.

9.6 Sperm whales

9.6.1 Report of the intersessional group

The Committee received the report of the intersessional sperm whale group set up at last year's meeting to review plans for a Comprehensive Assessment of sperm whales (Annex E, Appendix 7). The group recommended starting with a focus on North Pacific sperm whales. The following studies were proposed:

(a) a review of mark-recapture data and joint US-Japanese genetic studies;
(b) a preliminary abundance estimate for the western North Pacific, based on sightings;
(c) a review of past abundance estimates and models;
(d) a review of historical catch data;
(e) a review of sperm whale regulation in the North Pacific;
(f) life history, social behaviour, ecosystem considerations and current anthropogenic mortality.

9.6.2 Action arising

A number of papers relevant to the studies recommended in the report of the intersessional group were presented.

SC/50/CAWS9 gave estimates of current abundance and distribution of large male sperm whales in Antarctic Areas IV and V using sightings data from JARPA surveys, 1989/90 to 1995/96. These covered the area from 60°S to the ice edge and from 70°E to 170°W. Sperm whales were widely distributed each year, with a high density area from 70°E to 100°E, and they were rarely found within Prydz Bay and the Ross Sea. Abundance estimates for sperm whales in Area IV ranged from 2,946 to 4,289 and for Area V from 2,207 to 3,146 animals. These results are consistent with those from the second and third IDCR/SOWER Antarctic circumpolar surveys. Estimates of abundance were roughly tripled by correcting for animals missed on the trackline using a $g(0)$ value of 0.32 from simulation studies by Kasamatsu and Joyce (1995).

SC/50/CAWS37 analysed IDCR/SOWER sperm whale sightings between 1978/79 and 1995/96, the first, second and third (incomplete) circumpolar sets of surveys. The estimated effective search half width was different for the first set of surveys, from the latter two, for unknown reasons. Annex E, Appendix 5 updated these estimates to take into account the different area coverage between circumpolar sets and produced corrected values of 7,900 (first circumpolar) 13,000 (second) and 14,300 (third, incomplete) whales respectively. These estimates could be considered negatively biased since they only represented large males and also assumed that $g(0)$ was 1.0. The apparent increasing trend was noted, but caution was expressed over its interpretation.

The Committee agreed that although it was highly unlikely that $g(0)$ for sperm whales was 1.0 given their diving behaviour, it was not appropriate to adopt a lower value until the assumptions behind its calculation had been thoroughly examined. It was also probably not advisable to apply a $g(0)$ estimate from one geographical region to the species as a whole. These papers had illustrated two general problems with sightings surveys of sperm whales: the value of $g(0)$ and segregation by sex and size class of the species. A further difficulty noted was the estimation of mean school size, especially where there was a loose association of individuals/pods.

SC/50/CAWS2 responded to a request of the intersessional group to analyse sightings data obtained from Japanese sighting vessels in the North Pacific between 1982 and 1996 (1,412 sightings of 5,310 sperm whales). If analysis was confined to the area 20°-50°N, 130°E-180°, and if data for 1994 and 1996 were excluded because of low effort, a significant rate of increase (11% a year) was obtained. A line transect estimate for the western North Pacific, uncorrected for $g(0)$ or loose associations of single animals, was 25,816 (CV 0.11). A correction for association increased the estimate to 32,676. This is still negatively biased without a correction for $g(0)$.

SC/50/CAWS20 described a combined visual and acoustic survey for sperm whales conducted in the eastern temperate North Pacific between March and June 1997. A total of 60 acoustic detections was made using a towed hydrophone array during 14,500km of searching. Visual survey was carried out for 8,080km, resulting in eight sightings (excluding those originally detected acoustically). The estimate of $f(0)$ used in the visually-based estimate of abundance was based on sightings from previous surveys in the area. The small number of sightings precluded integration of the visual and acoustic data. The acoustically-based estimate of 39,200 (CV 0.60) sperm whales was not significantly different from the visual estimate (assuming $g(0) = 0.87$) of 24,000 (CV 0.46) whales. Acoustic techniques increased the number of sperm whales detected by increasing the range of detection and allowing night survey, but could not replace visual methods for estimating group size.

In discussion, acoustic estimation of school size was considered. Gillespie (1997) described a computer programme for separating vocalisations from individual sperm whales, allowing the number of vocalising whales to be counted. Alternative methods using estimated click rates per individual also exist. Despite identified possible difficulties, the Committee recognised the potential value of acoustic techniques in estimating sperm whale abundance and **recommends** that researchers cooperate and integrate their results to the greatest extent possible; it **encourages** the submission of further papers on the topic to future meetings.

SC/50/CAWS39, Childerhouse and Dawson (1996) and Childerhouse *et al.* (1995) described research on sperm whales at Kaikoura, New Zealand. Mark-recapture (photo-identification) and acoustic surveys were used to study distribution and abundance. Almost all sperm whales encountered are single males, and all can be photographically identified. Of 135 identified individuals, about half are seen repeatedly; the other half apparently transited through the area and have only been seen in one season. Mark-recapture models will be developed to take account of this population structure.

Acoustic surveys off Kaikoura have used directional and omnidirectional hydrophones. This work can be used to complement, or as an alternative to, the towed hydrophone array methods described in SC/50/CAWS20. Directional hydrophones are used from small vessels, thereby allowing small-scale work on distribution, abundance and movements and the tracking of individuals to study diving and acoustic behaviour. A computer program has been developed to count the number of clicks in a sperm whale recording. Work is continuing to calibrate and ground-truth acoustic surveys by

recording individual whales for complete dive cycles, estimating the click rate per individual, and estimating the range of the hydrophones.

On the subject of photo-identification, the Committee stressed the importance of evaluating photographs separately and quantitatively for quality and distinctiveness. It was suggested that a compilation of photo-identification efforts on sperm whales should be considered, and this was referred to the ongoing intersessional group.

It was agreed that a major topic of the Comprehensive Assessment should be a discussion of the best method of assessing sperm whale abundance.

SC/50/CAWS19 provided a progress report on genetic data for North Pacific sperm whales. The mtDNA control region and six microsatellites were being investigated in historical samples from the Japanese whaling industry and in contemporary samples, for example from biopsies and strandings. Analyses at La Jolla, are concentrating on the eastern North Pacific. Preliminary results indicate a clear subdivision between samples taken within about 300km of the coast and those offshore as far east as Hawaii. However caution is required as the offshore samples were collected 20 years earlier than the coastal samples, and nuclear gene frequencies may change quite rapidly given sperm whale social structure and the likely effects of relative male depletion. A number of recommendations for future work were made in the report (see Annex E).

The Committee **recommends** that the use of sperm whale teeth for genetic analysis be examined further, and that the collection of material from mass strandings of sperm whales be strongly encouraged.

SC/50/CAWS40 described Soviet catching of sperm whales in the Arabian Sea and biological information from the catch. Two Soviet expeditions took a total of 954 sperm whales including 750 females over four seasons (1963-66), but only reported a catch of 424 whales including 75 females to the Bureau of International Whaling Statistics (BIWS). Evidence was presented that this population was separated from the rest of the Indian Ocean. Although extensive marking of sperm whales had occurred in the area, there had been no recoveries in the data available to the author. Little biological material remained from these catches.

Yagi referred to his earlier comment on the accuracy of such data (see Item 4.3.2).

SC/50/CAWS27 summarised information on USSR pelagic catches of sperm whales in the North Pacific between 1949 and 1979. Yearly fleet summaries for some seasons were provided by the late Dr A.A. Berzin to the authors, relating to the period 1963-79. A comparison with official catch statistics submitted to BIWS by the Soviet authorities revealed serious inconsistencies. The total USSR catches for six years (1966, 1967, 1970, 1971, 1972 and 1973), for instance, were officially declared as 37,275 whales, whereas the Berzin data indicated 66,950 sperm whales, with the female catch for the first four years 9.6 times greater than the official records. The authors believed that similar under-reporting of sperm whale catches occurred on other Soviet whaling expeditions in the North Pacific, at least until 1972, when the International Observer Scheme (IOS) came into effect. They estimated that about 180,000 sperm whales may have been taken by Soviet whaling expeditions between 1949 and 1979, or about 60% higher than the officially reported catch.

In discussion, it was noted that some under-reporting may have continued even after the IOS was introduced. There was no information on the locations of the undeclared catches or on the availability of biological data.

SC/50/CAWS12 reviewed the history of Japanese regulatory measures for sperm whaling in the North Pacific. Regulatory measures were introduced as early as 1909, and included, in turn, limitations on effort, catch (by whaling classification), minimum (and later maximum) size, catch of lactating females, season, and whaling ground. The Committee welcomed this paper, and **recommends** to the Commission that member nations be urged to supply similar compilations of their regulations and restrictions (including enforcement) governing the taking of sperm whales, especially as they concern the period prior to the adoption of international regulations on sperm whaling.

SC/50/CAWS10 reported that there was evidence of statistical manipulation in the Japanese coastal sperm whale fishery. Official length composition data frequently featured an unrealistically large number of individuals at or just above the minimum length, and the sex-ratio in samples of whales examined by biologists differed greatly from that in the official statistics, with females being markedly under-represented in the latter in ten seasons between 1959 and 1985. Two catcher-boat logs examined differed from official figures for the numbers of whales killed by the company concerned. The author concluded that the extent of such discrepancies was probably sufficient to render the catch statistics from coastal sperm whaling unreliable for the purposes of the comprehensive assessment. He stressed the need for further effort to discover independent sources of statistical information.

In discussion, some members recalled that other papers had suggested that there were suspicions about the validity of some aspects of Japanese land station data for sperm whales (see Balcomb and Goebel, 1977; Allen, 1980; Cooke *et al.*, 1983; Kasuya and Miyashita, 1988; Kasuya, 1995; and Brownell and Balcomb, 1998).

Some members of the Committee were not convinced that the information provided in SC/50/CAWS10 was any more reliable than the official statistics or that it represented the whole time series of catches. At this stage they considered that it was essential that these allegations should be thoroughly investigated before any conclusions were drawn. Nevertheless, other members welcomed this report. Ohsumi pointed out that some features of the official statistics were similar to those seen in statistics of other nations taking sperm whales, and that for the purposes of the Comprehensive Assessment it was necessary to recognise when such data were inaccurate and to make appropriate adjustments. A number of speakers agreed that if there was to be progress with the Comprehensive Assessment of this stock, then efforts should be directed at attempting to compile as accurate a catch series as possible. If exact figures could not be found, then realistic upper bounds should be sought to express the range of uncertainty. It had been intended that an intersessional correspondence group should be established to work towards developing a suitable catch series. The members of the group (Ohsumi, Brownell, Kasuya) were unable to reach consensus on items 1-3 of the 6 terms of reference proposed by the Chairman of the Group (Ohsumi; see Annex O). The Committee therefore agreed not to re-establish a group at this time.

There was considerable discussion on the issue of the reliability of whaling statistics. Best (1989) had commented on a number of potential problems in BIWS records from his experience with the whaling industry from 1957/58 to 1978/79. Two types of problem were identified: those that were evident from close inspection of the data (e.g. stretching of whale lengths, rounding errors in foetal lengths, unreliable stomach contents) and those that were not (e.g.

under-reporting of catches, incorrect species identification). Best (1989) also referred to two cases of under-reporting where the USSR had not reported catches of humpback and right whales (Chittleborough, 1965; Best, 1988). At that time, the Committee had stated (IWC, 1989) that

> Users of the data base should be made aware of such problems, and it was suggested that others familiar with the data collection process for their national industry (or that of another region) should be encouraged to provide specific information as had been done in SC/40/O 20 [i.e. Best, 1989].

The database referred to is the IWC catch database held by the Secretariat.

Subsequently, evidence of a major falsification of Soviet catch records has emerged (Yablokov, 1994; Zemsky *et al.*, 1995b;) and a review of the true USSR Southern Hemisphere pelagic records was presented to the Committee in 1994 (Zemsky *et al.*, 1995a; b). At that time the Committee (IWC, 1995b, pp.62-3)

> expressed its appreciation for the efforts of Zemsky and his colleagues in locating and securing these extremely important records that go back for many decades

and

> encouraged the Russian scientists to provide the Commission with a report that provides the general background to the Soviet whaling operations and the revised catch statistics.

At this year's meeting a number of papers presenting new information on falsified sperm whale catch records were discussed (SC/50/CAWS27, 40, 10 – see above). Under Item 4.2 the Committee agreed that the official Soviet Southern Hemisphere catches should be removed from the IWC database.

After considerable discussion, two views on how to address this issue emerged.

(1) Some members believed that the Committee should repeat its suggestion of 1988 (given above) with respect to the provision of information similar to that given in Best (1989). They added that although such information should, where possible, be quantitative and if possible identify sources, even data in a less specific form could be useful for evaluating catch series. They noted that there were circumstances in which it would be unreasonable for the names and primary sources to be made openly available because of possible negative consequences for the individuals providing the information.
(2) Other members strongly opposed such an approach, stating that it was inappropriate for the Committee to encourage individuals from a member nation to report alleged infractions by that nation to the Commission. They stated that such allegations should, along with the primary data, first be submitted to the member government concerned, so that an independent and official investigation of the allegations could be undertaken.

Despite this disagreement, the whole Committee **agrees** to request the Commission again, as they had in IWC Resolution/ 1994-6 (IWC, 1995a), to invite member governments to examine data on their past whaling operations for inaccuracies or falsification, and provide any revised data to the Commission.

The Committee **agrees** that work should continue on resolving questions regarding the catch history since catch data that were as accurate as possible would be needed for the eventual assessment.

Considering the many difficult tasks that must be completed before a Comprehensive Assessment of the North Pacific sperm whale stock will be possible, the Committee agreed to consider sperm whales next in 2000 (abundance estimation methods) and 2001 (stock structure).

9.7 Southern Hemisphere minke whales

Appendix 8 of Annex E describes progress on work to address outstanding issues regarding JARPA that had been raised at last year's meeting. This included developing methods to correct bias in abundance estimates, stock definition, statistical analysis of mtDNA, a pilot study on nuclear DNA, availability of low-latitude genetic material, analysis of morphometrics, examination of stock boundaries between Areas IV and V, a segregation study, recalculations of biological parameters by biological stock, a mesoscale survey plan for ecosystem and environmental change. In addition, the Committee had discussed the availability of samples from past commercial whaling for stock identification analysis and the problem of representativeness of samples. Although the interval since the last meeting had been unusually short, the Committee found it helpful to receive the progress report, and looked forward to more detailed responses at its next meeting.

The Committee received SC/50/Rep1, the Cruise Report of the 1997/98 SOWER Antarctic Cruise in Area IIW (60-30°W, S of 60°S). Japan had supplied two research vessels and for the first time four researchers were carried on each. A total of 200 primary sightings of 422 minke whales was made in about 3,000 n.miles searched. Survey coverage was affected by the ice edge. A large (approximately 100,000 n.mile^2) area of open water in the southern Weddell Sea which the survey vessels could not enter because of an ice barrier might explain the fewer than expected number of minke whales seen.

The Committee expressed its thanks to the Japanese Government for the generous provision of these vessels for both this cruise and the SOWER blue whale cruise, and to the participating researchers for their efforts.

SC/50/CAWS8 reported on the 1997/98 JARPA survey which had been conducted in Area IV and the eastern part of Area III. One dedicated sighting vessel and three sighting/sampling vessels were engaged in a closing mode sightings survey. The sighting vessel covered 5,136 n.miles and made 127 primary sightings of 243 minke whales, while the three sighting/sampling vessels searched a total of 16,462 n.miles and made 545 primary sightings of 1,130 minke whales; 438 whales were sampled. The proportion of sexually mature animals was very low amongst the females (22.7%) in Area IV, and immature females dominated in the southern stratum. It was suspected that most of the mature females had moved into ice-free waters inside the pack ice edge where the research vessel could not enter. It was suggested that one of the probable reasons for the character of the present survey results was the different shape of the ice edge.

In discussion, the question of the implications of the apparent environmental effect on the observed maturity rate in females was raised, particularly as it related to the success of the JARPA programme in obtaining representative samples. Nishiwaki replied that it was not known whether the trend would continue, and further study was needed to compare the data with previous results.

Field characters for distinguishing between the two forms of southern minke whale were described and illustrated in SC/50/CAWS15. This was important if abundance estimates from sightings surveys were to be correctly allocated.

The results of RFLP analysis of the mitochondrial DNA in minke whales from Areas V and VI sampled during the 1996/97 JARPA survey were presented in SC/50/CAWS4. Samples were divided into three longitudinal sectors and two time periods. A total of 361 whales was examined (VW late $n=98$; VE early $n=67$; VE late $n=105$; VIW early $n=91$). For comparison the group VIW early of the 1985/86 commercial season was used ($n=134$). Quantification of the mtDNA differentiation among area/time groups was carried out using the Analysis of Molecular Variance (AMOVA). No significant differences were found among the area/time groups of the 1996/97 survey. The combined sample of the 1996/97 survey showed significant differences from a standard sample of the 'western stock' but not from a sample of the 'core stock'. The same results were found when each of the area/time groups of the 1996/97 survey and the group VIW early 1985/86 were compared with the standard samples. A comparison between survey seasons for different area/time groups suggested that yearly variation seems to occur in Area IIIE and Area IVW.

The Committee noted that this study confirmed that the 'western' stock was different from the others studied, which were all similar.

A preliminary examination of mitochondrial DNA heterogeneity in Antarctic minke whales considering temporal, longitudinal and latitudinal (distance from the ice-edge) factors was presented in SC/50/CAWS7. A total of 563 samples from Area IV taken during the 1989/90 and 1991/92 JARPA surveys was used in the exercise. AMOVA was used to test for (a) the latitudinal factor in total Area IV (dividing offshore and ice-edge samples by a line at 60 miles from the ice-edge), (b) the longitudinal (Area IV western and eastern) and latitudinal factors, and (c) for latitudinal, longitudinal and temporal (early and late period in the survey season) factors. The only source of mtDNA heterogeneity was attributed to minke whales from the western part of Area IV taken in offshore areas in the early period of the survey season.

The Committee noted that this study concluded that the differences in the 'western' stock were attributable to an early, offshore component, and that because the commercial catch had been mainly near the ice edge, the analysis of past commercial catches would not be particularly useful for stock identification.

SC/50/CAWS32 examined VPA analyses of Southern Hemisphere minke whales in Areas IV and V by Butterworth *et al.* (1999). The authors had concluded that there was an increasing trend in recruitment in this stock prior to the period of exploitation. SC/50/CAWS32 investigated the effect of changing two key assumptions in the VPA formulation of Butterworth *et al.* (1999), those concerning selectivity and separability among the older age classes during the period of the commercial catches. The investigation was carried out by replacing these assumptions with the assumption that there was no temporal trend in recruitment prior to exploitation, and by examining whether the data on current abundance could be fitted under this assumption and whether the resulting apparent selectivities for the commercial catches were plausible. If the assumption of no temporal trend proved to be inconsistent with current abundance data or if it led to implausible selectivity curves, this would support the conclusions of Butterworth *et al.* (1999).

SC/50/CAWS32 concluded that constant pre-exploitation recruitment was consistent with the basic input data and population dynamics model of Butterworth *et al.* (1999). A lack of pre-exploitation recruitment trend implied a dome-shaped selectivity curve for the commercial catches with a decrease after age 17-26. The results of Butterworth *et al.* (1999) also implied a dome shape and a decrease in catch at older ages. However, the peak in the selectivity curves occurred at somewhat older ages (23-29). SC/50/CAWS32 discussed factors affecting realized selectivities that could have led to the estimated selectivity curves. These included the possibility that older animals found refuge in portions of Areas IV and V where there was little whaling effort or in the pack ice where whalers could not follow.

SC/50/CAWS32 also concluded that the VPA modelling framework, by itself and given the available data, appeared unable to resolve the issue of the pre-exploitation trends in recruitment. The estimates were critically dependent upon assumptions either about trends in past recruitment or selectivities and separability in the commercial catch. Within the VPA context, a resolution would require convincing external evidence favouring a specific selectivity pattern. Polacheck suggested that a way forward would be a more detailed examination of the spatial/temporal pattern of the age composition data from the catches than had yet been carried out and more complete tests of sensitivity to assumptions than were reported in Butterworth *et al.* (1999).

Butterworth responded that the selectivity assumptions in Butterworth *et al.* (1999) had been motivated on two independent grounds, biological and statistical. On the biological front, increasing selectivity with age was suggested by the whalers' desire to take larger, hence older, animals and the fact that whaling took place close to the ice edge where older animals tended to predominate. He drew attention to table 4 of Butterworth *et al.* (1999), which showed an increasing trend in the age of animals caught in Area IV by degree latitude from 61º to 66ºS. He noted, in response to suggestions in SC/50/CAWS32, that differential male/female availability might be confounding the results, and that Butterworth *et al.* (1999) had shown that key results were essentially unchanged when analyses were conducted on a sex-disaggregated basis. He considered that the possibilities suggested by Polacheck to explain the age-selectivity curves resulting from the assumption of no trend in recruitment prior to exploitation were inadequate to explain the large fraction of otherwise takeable whales implied to be unavailable by these curves.

On the statistical front, Butterworth noted that the conclusions of Butterworth *et al.* (1999) regarding the historic increase in recruitment were unchanged when the slope of the commercial selectivity at age from ages 22 to 30 was treated as an estimable parameter. He agreed with Polacheck that this analysis was conditional on the assumption that the maximum in commercial selectivity with age would occur beyond age 21. He believed that other runs of the model, not reported in the analysis, had led to rejection of alternative assumptions regarding that maximum age on the basis of likelihood ratio tests. However, the relevant outputs would have to be checked, and that was not possible in the time available at this meeting. Furthermore, the analyses of SC/50/CAWS32 made no allowance for any pattern in selectivity in the commercial catch as is conventional in the application of VPA to fisheries, and hence ignored the information content of these data with respect to the historic recruitment trend.

Hatanaka noted that the low selectivity for older ages in SC/50/CAWS32 is inconsistent with the actual situation. He anticipated that these analyses using age data can elucidate the real trend of recruitment, and emphasised that such valuable data are obtained only by lethal sampling.

Ohsumi noted that the assumption of SC/50/CAWS32 that there was no temporal trend in recruitment prior to exploitation was contradicted not only by the analyses of Butterworth *et al.* (1999) but also by analyses of Kato (1987), Kato and Sakuramoto (1991), Thomson *et al.* (1997) and Butterworth *et al.* (1997), that showed a decline in age at sexual maturity, and by anecdotal reports from whalers. Polacheck reiterated that his results do not indicate that there was no trend but rather that the VPA modelling framework without selectivity assumptions similar to those in Butterworth *et al.* (1999) is unable to resolve the question. He noted that if data on encounter rates over time were available, an analysis incorporating these data into the VPA framework might provide evidence for a trend. Polacheck also noted that the same data used in Butterworth *et al.* (1999) to indicate a latitudinal trend in age near the ice edge also showed as high a mean age between 59° and 61°S as at the ice edge. Polacheck further noted that the role of and dependence on the selectivity assumptions in Butterworth *et al.* (1999) were substantially different from those in most conventional fisheries applications. This is because of the low cumulative fishing mortality rates and the small amount of external information available for fitting the VPA model in this case.

Smith noted that new information presented under Item 10.1 of Annex E supported the possibility of animals being south of the pack ice edge. Large areas of open water existed during the periods of the SOWER and JARPA surveys, unavailable for sampling. He also noted that the factory vessels apparently tended to be 5-20 n.miles north of the ice edge. Thus the possibility of age selectivity within 60 n.miles of the ice edge needed to be further explored. This general issue also raises the possibility that JARPA age samples are not representative for older animals, as has previously been shown for younger animals.

The Committee agreed that, although some analyses of age and sex distributions of minke whales as a function of latitude had been conducted, the accumulating JARPA data permitted the examination of age and sex gradients approaching the ice edge on a finer scale (e.g. within 60 n.miles) than had been undertaken so far. Longitudinal effects in these distributions could also be further examined. It was agreed that conducting such analyses should be added to the list of tasks identified for JARPA. The analyses might shed some light on what assumptions regarding selectivity of the commercial catch are most reasonable.

The Committee also agreed that additional sensitivity tests encompassing a wide range of selectivity patterns might help to resolve this issue. Since there was no time to complete and consider them, the Committee was unable to reach agreement on whether or not the selectivity assumptions of Butterworth *et al.* (1999) were supported.

The Committee therefore **recommends** that (a) age and sex distributions as a function of latitude and longitude on a fine scale and (b) sensitivity tests encompassing a range of selectivity patterns should be considered further at its 1999 meeting. Polacheck noted that Committee members would need access to the JARPA data to carry out the recommended analyses. Fujise reminded the Committee of Japan's policy in this regard. Scientists must apply to the Institute of Cetacean Research (ICR), describing the data they need and the purpose for which they will be used. A legitimate request could be rejected if Japanese scientists responsible for the data had not completed their primary analyses. In that case, the responsible Japanese scientist would need to be contacted directly for permission; the IWC Secretariat has the contact list. It was noted that ICR would provide a written summary of these rules and procedures.

In SC/50/CAWS34 minke school density was obtained from the first six IWC/IDCR independent observer (IO) surveys from 1985/86 to 1990/91, using methods which model heterogeneity due to covariates such as school size and sea state in addition to perpendicular distance. Incorporating these covariates reduces bias in estimated density by about 15% compared with the case in which the IO data are analysed using only perpendicular distance. However, comparison with standard line transect results indicates that the estimates of density obtained from the analysis of IO data remain substantially negatively-biased even when heterogeneity due to school size and sea state is modelled. The IO analysis methods are vulnerable to bias from heterogeneity in school surfacing patterns if both platforms search the same region of sea simultaneously. Plots of first sighting distances ahead of the vessel by the two independent platforms show that they do search the same region at the same time, and this is believed to be the primary source of bias in the IO analysis. The authors concluded that if unbiased estimates of density are to be obtained from IWC Antarctic surveys in the future without assuming certain detection on the trackline, it is important to separate the regions that the two independent platforms search. In particular, consideration should be given to using the search procedure suggested by Buckland and Turnock (1992).

In discussion, Butterworth drew attention to the fact that the implications of SC/50/CAWS34 were that the design of IO experiments on the SOWER cruises needs to be reconsidered. The Committee **agrees** to refer this issue to the proposed SOWER planning meeting in Tokyo and to consider it further at its 1999 meeting. It was suggested that an immediate and comprehensive change in procedure may be undesirable, in that it could cause problems of comparability with previous estimates. The Buckland-Turnock Method might be used experimentally for some component of the IO mode survey.

The Committee noted that GAM-based abundance estimation from JARPA minke survey data (SC/50/CAWS33) will also be considered at its 1999 meeting.

9.8 Other species and/or stocks

Information on a number of species off Brazil (SC/50/O5) was welcomed but not discussed owing to lack of time.

9.9 Other issues

9.9.1 Future SOWER cruises

9.9.1.1 REPORT OF INTERSESSIONAL GROUP

The report of this group was considered by the small group under Kato (Item 9.9.1.2).

9.9.1.2 PLANNING FOR 1998/99 SEASON

A small group under Kato was formed to consider this item and it provided a report (Annex Q). The Committee **recommends** that the 1998/99 cruise should take place principally in Area IV south of 60°S, with a blue whale component taking place for 12 days in the southeastern part of Area III where relatively high concentrations of blue whales had been confirmed by past IDCR cruises and JARPA surveys. The Committee **recommends** that there should be a specialist planning meeting for this cruise in Tokyo in October. Financial implications are considered

under Item 19. Kato agreed to act as convenor and a Steering Group (Bannister, Best, Brownell, Donovan, Ensor and Kato) was established.

9.9.2 Acoustics – report of intersessional correspondence group

Swartz reported on progress made by this group since the last meeting (SC/50/O14). The Committee endorsed the proposal that a library of whale sounds be compiled, with a view to archiving representative samples and making copies available to interested researchers: the preferred format was digital, for ease of exchange. The working group was encouraged to continue its work during the coming year and to expand the scope of the acoustic methods considered.

9.9.3 Mathematically-based techniques for recognition analysis

The Committee was informed that the computerised right whale matching programme originally developed by Hiby under an IWC contract had now been completed with financial help from IFAW; it had been demonstrated at the right whale workshop. Hiby was now investigating a similar possible system for humpback whale flukes. The Committee was disappointed that no further progress had been made on recognition analysis since the last meeting, although there had been problems in getting the appropriate people to this meeting as invited participants. It recognised that as photographic catalogues increase in size, the need for computerised matching increases. It therefore **recommends** that the Commission's attention again be drawn to the need to include scientists with relevant expertise among those nominated by member governments to attend Scientific Committee meetings. DeMaster agreed to convene an intersessional e-mail group to facilitate communication among researchers interested in this work (Annex V). The group would provide the Chairman with a list of potential participants for discussion on this topic at last year's meeting. The Chairman undertook to inform the relevant Commissioners.

9.9.4 Biopsy sampling – collection of behavioural data – report of intersessional group

Clapham reported on the results of the intersessional working group established last year. A draft data form had been designed which standardised collection of the necessary information. This was submitted to the Committee for comment. In discussion it was stressed that the form was mainly intended for genetic analysts who required associated behavioural information, and that other researchers were free to modify it to suit their species/area of interest. However the form contained the basic information required, and while items could be added, none should be deleted. The Committee **recommends** that the basic form should be adopted (once comments had been incorporated) and that consideration should then be given to making the form available electronically through the Secretariat.

10. ABORIGINAL SUBSISTENCE WHALING MANAGEMENT PROCEDURE (AWMP)

The report of the Standing Working Group (SWG) on the Development of an Aboriginal Subsistence Whaling Management Procedure (AWMP) is given as Annex F. The Committee's deliberations, as reported below, are largely a summary of that Annex. Last year, the Commission had reiterated the importance it attached to the development of the AWMP and endorsed the Committee's workplan. A glossary of terms is given as Annex F, Appendix 2. For ease of reading, unless another reference is given, 'Last year' refers to the report of the SWG from the 1997 meeting (IWC, 1998e).

The Committee recalled the (summarised) objectives given by the Commission:

(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.

It noted that highest priority shall be accorded to the objective of ensuring that the risks of extinction to individual stocks are not seriously increased by subsistence whaling.

10.1 Action arising from 1997 meeting and Commission's considerations

Last year, the Committee had agreed that it was appropriate for the Chairman of the SWG to present its work to the Commission. The Committee appreciated the Commission's answers to its questions (IWC, 1998a, pp.25-27), noting that some would be considered further by the Commission this year. These replies, and other comments by Commissioners, have been taken into account in the discussion below.

10.2 Future work

10.2.1 Common Control Program

The Common Control Program is the computer code used by developers to run the *Initial Exploration Trials* for scenarios that involve a single[2] stock (IWC, 1998b, p.84). Allison completed the changes to the Common Control Program specified last year, but owing to the short intersessional period, it had not been possible to complete it in time for the developers to use in papers for this year's meeting. The Committee **approved** a change to the specifications that reflected that the gestation time for baleen whales is considered to be one year, rather than the two years that had been inherent in last year's specification.

10.2.2 Statistics

In response to comments made in SC/50/AWMP6, the SWG had adopted a new statistic that better captured features of need satisfaction. The statistic, termed N9 – the average need satisfaction, which is a variant of the N1 statistic agreed previously - avoids giving greater weight to satisfying need when need is large. The Committee **agrees** that N9 should become a mandatory statistic and that the current N1 statistic should become optional. It further **agrees** that for future *Initial Exploration Trials*, the catch would be constrained to be no larger than the level of need. The list of performance statistics currently under consideration is given in Table 3.

The question of the trade-off between the satisfaction of current and future need was considered. Neither the N1 or N9 statistics capture this. As they measure need satisfaction over the full 100-year simulation period they thus only marginally represent current need satisfaction. The Committee **agrees** however, that use of statistics based on a 20-year management period should allow an evaluation of how well need is satisfied in the short term (and see Item 10.8.2).

[2] This remains the case until the Secretariat validates the multi-stock code presented by Punt and used in SC/50/AWMP3.

The format in which simulation results should be presented, in order to facilitate comparison and evaluation, was discussed. The Committee **agrees** that developers must at least include the 5% and median values for the D1 and the N9 statistics in documentation and bring encoded versions of all of the mandatory statistics to meetings so that these can be discussed if the SWG or Committee wishes.

None of the present performance statistics directly assess performance in terms of the variation over time in strike limits. Such statistics can be developed after consideration of Commission comments this year (see Item 10.8.3).

10.2.3 Performance plots

Interpretation of the vast quantity of results of simulation trials is greatly facilitated by standardisation of their graphical presentation. The Committee welcomed the offer of Zeh to work with Allison to revise and update the software she developed last year and ensure that the output from the Common Control Program can easily be integrated with plotting software.

10.3 Review of simulation framework

The SWG reviewed a number of modelling issues previously identified to determine progress. Details of these are given in Annex F (Item 2.3). Some of these issues are also discussed below.

(1) DENSITY DEPENDENT SURVIVAL RATE

The Common Control Program assumes that density dependence acts on fecundity and the calf survival rate. In principle, this can lead to oscillatory population trajectories although the results examined to date do not indicate that this is a severe problem. Such problems would be avoided by allowing density dependence to act on the non-calf survival rate. Work on this will be carried out intersessionally.

(2) COMPONENT TO WHICH MSYL APPLIES

The SWG considered this issue in considerable detail at its 1997 meeting (IWC, 1998e). The Committee had agreed that to progress its work in the short term, developers should carry out the *Initial Exploration Trials* using only the 1+ component (the component which, on balance, appears scientifically preferable). Trials using the mature component will be postponed until further in the development process when candidate *SLA*s are more fully specified and comparison with the RMP is more appropriate and rewarding.

(3) DENSITY DEPENDENCE ON THE MATURE RATHER THAN 1+ component

Last year, it was agreed that density dependence would act on the mature female rather than the 1+ component. The features of this decision are being investigated and additional information is expected next year.

(4) BLOCK QUOTAS AND CARRYOVER

Last year, Denmark, Norway and the USA emphasised that block quotas and carryover provisions were extremely important and should be incorporated as design features in any *SLA*. The Committee acknowledges the importance of incorporating this feature into the final *SLA*s. In terms of the present development process, however, the Committee **agreed** that considering strike limits on an annual basis will provide sufficient information.

(5) MULTI-SPECIES ISSUES

Greenland's need request is expressed as tons of whale meat, with need not assigned to species. Last year the Committee asked the Commission for advice on this issue and Denmark was strongly of the view that a multi-species model should be considered and developed as a priority. The Committee reiterated that it **recognises** the importance of this issue. It is discussed further under Item 10.8.1.

(6) SURVEY FREQUENCY

The frequency of future surveys required or used by an AWMP is an important issue, both for AWMP development and testing, and also as part of a broader aboriginal subsistence management scheme which would include certain data requirements. At present, the Committee **agrees** to consider survey frequency on a stock-specific basis (details are given in Annex F, Appendix 3).

10.4 Facilitating AWMP comparison and tuning

Each candidate *SLA* is likely to achieve a different balance among the objectives specified by the Commission for an AWMP. This makes it difficult to compare candidate *SLA*s. Tuning, or rather more specifically *equivalence tuning*, is a

Table 3

Performance statistics for use in the *Initial Exploration Trials*.
(1+ and mature refer to those components of the population to be reported for the Depletion and Recovery statistics).

ID	Mandatory	Optional	Name	Comment
D1	1+, mature		Final Depletion	Agreed in 1996
D2	1+, mature		Lowest Depletion	Agreed in 1996
D6	1+	mature	Trajectories 1 and 2	Agreed in 1996
D7	1+	mature	Pointwise Quantile Trajectories	Agreed in 1996
N1		Yes	Total Need Satisfaction	Demoted to optional (1998)
N2	Yes		Longest Shortfall	Rescale to 0-1; must convert to years for interpretation by Commission - agreed in 1996
N3		Yes	Severe Shortfall Frequency	Demote to optional (1997)
N4		Yes	Shortfall Frequency	Agreed in 1996
N5	Yes		Block Need Satisfaction	Agreed in 1996
N7		Yes	Percent Need Satisfaction Pointwise Quantile Trajectory Plot	Agreed in 1996
N8		Yes	Percent Need Satisfaction Trajectory Plot	Agreed in 1996
N9	Yes		Average Need Satisfaction	See Item 10.2.2
R1	1+, mature		Relative Recovery	To be redefined
R2		1+, mature	Relative Probability of Recovery	Agreed in 1996
R3		1+, mature	Time Frequency in Recovered State after Recovery	Agreed in 1996
R4		1+, mature	Relative Time to Recovery	Agreed in 1996

way to provide *SLA* developers with the opportunity to adjust their *SLA*s to strive towards a pre-specified balance of risk, catch, and recovery.

The SWG spent considerable time discussing the relative merits of *depletion tuning* and *H-tuning*, the details of which are given in Annex F. *Depletion tuning* aims to achieve a pre-specified median final depletion on a trial, whereas *H-tuning* aims to match a pre-specified set of strike limit trajectories for a collection of trials.

The Committee **reiterates** that it found *H-tuning* a promising idea and **agrees** to the revised specifications included in Annex F, Appendix 3. The SWG agrees that at present, results should be presented for both *depletion tuning* and *H-tuning*. It was also agreed that the approach presented in Appendix 4, which does not give additional weight to trials in which the catches under *H* are high should be adopted.

With respect to comparison of the AWMP with the RMP, the Committee reiterated its view of last year that its primary purpose was to develop an AWMP that fulfils the Commissions's objectives. It noted that simulation trials could be developed in the future for purely comparative purposes with the RMP, although these may not reflect real situations for which the AWMP is implemented.

The Committee also noted that some work has already been carried out (e.g. Givens and Thomas, 1997; Givens *et al.*, 1996) to enable comparison of future *SLA*s with a characterisation of the approach given in Para. 13(a) of the Schedule. This will continue although the developer who began this work noted that it will not be his highest priority.

10.5 Description of fishery type 3

Last year, arising out of discussions of multi-species fisheries, it was agreed that it would be valuable to begin consideration of an additional type of fishery. This fishery, called fishery type 3, referred to populations that were small, although the question of how small was left to be discussed.

This year, the Committee **agrees** that for exploratory purposes, it will initially examine the situation where the current population size is ~300 (loosely based on considerations of the size of the West Greenland humpback whale feeding aggregation, the lower confidence interval of the abundance estimate for fin whales in the West Greenland area and possible sizes of some Canadian stocks of bowhead whales) where demographic and environmental variability may have an impact on recovery times. Initial trials for fishery type 3 would need to consider cases in which the population is depleted to a small fraction of its pre-exploitation size and ones where it is close to this size. The SWG's initial attempts to address this problem are detailed in Annex F, Appendix 3.

10.6 Initial Exploration Trials

10.6.1 Fishery type 1

The Committee (IWC, 1997n, p.243) has defined fishery type 1 as a 'case where there is relatively little available information and stock identity problems (e.g. West Greenland minke whales) and where the Committee has had considerable problems in providing advice under Para. 13(a).'

Progress with the existing trial structure and in particular with the first attempts to consider the stock identity problem were reviewed (Annex F). The results in SC/50/AWMP3 revealed relatively poor performance that depended primarily on the value for the *MSY* rate.

The Committee **agrees** with the decision of the SWG to combine the single stock and multi-stock trials for fishery type 1 to be able to distinguish the impact of *MSYR* from that of uncertainty in stock identity. It accepted the revisions to the trial structure shown in Table 4. A further four trials to those agreed last year were specified, such that a 1% and a 7% MSYR trial were carried out for all combinations. These trials are to be carried out with and without information about stock identity. Need is taken to be constant in all these cases and a further three trials consider increasing need.

In order to investigate whether poor performance in cases of low stock size combined with high MSYR can be improved by more frequent surveys, it was **agreed** that two trials (of the combinations low stock size/low MSYR and high stock size/high MSYR) should be carried out with biannual surveys for the first ten years followed by surveys every ten years thereafter. These trials represent the first step at addressing this issue and further robustness trials will be considered in the future. The issue of data availability and the ability to develop a successful *SLA* for fishery type 1 is discussed further below.

Table 4

The set of trials agreed for fishery type 1.

Trial	$MSYR_{1+}$	Initial population	Catch in Area 1	Need	Survey interval	Stock structure
MM1	0.01	High	0	Const.	10yrs	Boundary between Middle and 2
MM1a	0.07	High	0	Const.	10yrs	Boundary between Middle and 2
MM2	0.01	High	0	Const.	10yrs	Boundary between 1 and Middle
MM2a	0.07	High	0	Const.	10yrs	Boundary between 1 and Middle
MM3	0.07	High	0	Const.	10yrs	Mixing in Middle Cell
MM4	0.07	High	Yes*	Const.	10yrs	Mixing in Middle Cell
MM5	0.01	Low	0	Const.	10yrs	Boundary between Middle and 2
MM5a	0.07	Low	0	Const.	10yrs	Boundary between Middle and 2
MM6	0.01	Low	0	Const.	10yrs	Boundary between 1 and Middle
MM6a	0.07	Low	0	Const.	10yrs	Boundary between 1 and Middle
MM7	0.01	Low	0	Const.	10yrs	Mixing in Middle Cell
MM8	0.01	Low	Yes*	Const.	10yrs	Mixing in Middle Cell
MM9	0.01	High	0	Inc.	10yrs	Boundary between Middle and 2
MM10	0.07	High	0	Inc.	10yrs	Mixing in Middle Cell
MM11	0.01	Low	0	Inc.	10yrs	Mixing in Middle Cell
MM12	0.01	High	0	Const.	2-10yrs[2]	Boundary between Middle and 2
MM13	0.07	High	0	Const.	2-10yrs[2]	Boundary between 1 and Middle

* Catches set using RMP. [2] Surveys every 2 years until year 10, and every 10 years thereafter.

10.6.2 Fishery type 2

The Committee has defined (IWC, 1997n, p.243) fishery type 2 as a case where there is a relatively large amount of information and Para. 13(a) has largely been met (e.g. Bering-Chukchi-Beaufort Seas whales).

The Committee reviewed progress with the existing trial structure and in particular problems related to conditioning (see SC/50/AWMP2). Conditioning is the process of selecting specifications/parameter values for case specific trials to ensure that they do not conflict with already existing data. After considerable discussion in the SWG, an agreed revised method for conditioning was developed. The Committee **agrees** with the method described in Annex F, Appendix 3.

The Committee **agrees** that a move to introduce demographic and environmental stochasticity into fishery type 2 trials was desirable. It **agrees** to the specifications for the stochastic model given in Annex F, Appendix 3, noting that the introduction of stochasticity will require some exploratory work. The assumptions in the trials agreed last year (Table 5) remain unchanged; except that, as a result of the new conditioning approach, the initial population ($=P_{1993}$) is no longer fixed.

The Committee also **agrees** that the matter as to whether uncertainty should be expressed using a large number of trials with little within-trial variation or a small number of trials with greater within-trial variation required further consideration.

10.6.3 Fishery type 3

Trials for fishery type 3 (limited information, small stock size of ~300) should be based on stochastic population dynamics models that allow for variation in the birth-death process and possibly depensation. It was **agreed** to focus on the former and to consider three kinds of model (see Annex F, Appendix 3):

(i) simple demographic stochasticity (on survival and birth rate);
(ii) demographic stochasticity plus environmental stochasticity without auto-correlation;
(iii) same as (ii) but with auto-correlation.

Some initial simulations and explorations are needed to determine feasible and reasonable combinations and ranges of parameter values but the focus is on low population size (~300 whales) and either a K value close to the population size or much higher. MSYR values of 1%, 4% and 7% will be considered for each of the three types of stock model. The initial attempts to address this problem are detailed in Annex F, Appendix 3.

10.7 Planning for future selection of *SLA*s - strategies for optimising and merging *SLA*s

At last year's meeting, the SWG encouraged further work on methods for optimising *SLA*s, noting that the ideas in Givens (1997) appeared highly promising. In SC/50/AWMP5, several potential AWMP *SLA*s were reviewed and enhanced, including the likelihood approach referred to under Agenda Item 4.2 and the Punt-Butterworth (1997) *SLA*. The focus was on an optimisation method for improving the performance of existing *SLA*s and for creating enhanced, merged *SLA*s from existing candidates. The Committee welcomed this work and a number of aspects of it are discussed further in Annex F.

One *SLA* examined at this meeting had been tuned so that the strike limit was a polynomial function of its nominal strike limit and the calendar year. Some concerns were raised as to whether this constituted an inappropriate management strategy but given that the primary objective is good simulation performance, regardless of the intricacies of the *SLA*, and that several RMP candidates had successfully used the time variable, it was **agreed** that no restriction regarding its use should be adopted at this stage.

10.8 Dialogue with Commission and hunters

The Committee reiterated the importance it attached to continuing dialogue with the Commission and hunters throughout the development process (IWC, 1997b). It agreed that the procedure adopted last year, i.e:

(1) a presentation by the Chairman of the SWG of its report and a less technical Chairman's discussion paper;
(2) informal discussions with interested Commissioners;

had proved successful. It **recommends** that the procedure be repeated this year.

The Committee **agrees** that the Commission should be specifically requested for comments on the following issues this year.

10.8.1 Multi-species considerations

The SWG noted the importance which some delegations placed on developing a multi-species operating model. It reiterated that it recognised this and is starting to develop such a model. As a first step in this process, trials are being constructed for fishery type 3. In addition, it is examining options involving multi-species *SLA*s superimposed on top of the upper catch limits of underlying single species *SLA*s (SC/50/AWMP7). Such *SLA*s can fulfil larger needs than single species *SLA*s, and can optimise the recovery rates of the multiple species when need is satisfied. A number of

Table 5

Initial Exploration Trials for fishery type 2.

Trial no.	$MSYR_{1+}$	Initial population P_0	Need		Data quality				Comments
			Initial level	Final level	CV_{est}	$\gamma_{12.9}$	$\lambda_{12.9}$	Bias B_A	
B1	0.025	8,200	68	68	0.25	0	1	1	1996
B2	0.025	8,200	68	68	0.125	4	2	1.5	Replace (7a)
B3	0.04	9,400	100	200	0.25	0	1	1	Deleted 1997
B4	0.04	9,400	68	68	0.25	0	1	1	Deleted 1997
B5	0.01	9,400	100	200	0.25	0	1	1	1996
B6	0.01	9,400	68	68	0.25	0	1	1	1996
B7	0.01	7,200	100	200	0.25	0	1	1	1996
B8	0.01	7,200	68	68	0.25	0	1	1	Deleted 1997
B9	0.04	7,200	100	200	0.25	0	1	1	Deleted 1997
B10	0.04	7,200	68	68	0.25	0	1	1	1996

features of this approach will require input from the Commission and hunters, as can be seen in the discussion under Annex F, Item 4.3. In particular, Commission comment is **requested** on various options for suitable principles for the design of such algorithms, for example species ranking, even catch, even exploitation, even recovery, even risk of extinction or relative productivity.

10.8.2 Need satisfaction

At present, need satisfaction is considered over 20, 50 and 100 year periods. Commission comment is requested on whether greater emphasis should be placed on satisfying current rather than projected future need.

10.8.3 Catch variability considerations

At last year's meeting, the SWG requested that the Committee ask the Commission to provide it with a general indication of the importance of variability in catches. For example, would it prefer an AWMP that achieves a slightly higher level of total need satisfaction averaged over a longer time period at the expense of greater variability in strike limits or would it prefer to sacrifice some satisfaction of total need to ensure less variability in catches? The Commission had agreed to give consideration of this during the year. The Committee **agrees** that resolution of this issue was important for its work. It **agrees** that the Chairman of the SWG should request information on catch variability by presenting the Commission with a series of time trajectories of strike limits which reflect the trade-off between need satisfaction and variation in strike limits.

10.9 Workplan (including computing needs and financial implications)

At its 1996 meeting, the Committee had agreed that the *Initial Exploration Trials* should be case-specific rather than generic because there are a limited number of cases for which aboriginal subsistence harvesting is likely (IWC, 1997b). However, it did not reach consensus on whether the AWMP should include a generic *SLA* or case-specific *SLA*s.

At this meeting, the Committee **agrees** that there were three alternatives:

(1) an *SLA* which is completely generic;
(2) a generic core *SLA* with case-specific modifications; and
(3) completely case-specific *SLA*s.

The Committee **agrees** that it in principle it would be preferable to have a single generic *SLA*. However, the primary task of the AWMP is to satisfy the management objectives established by the Commission to the greatest extent possible for the fisheries of concern.

The Committee **agrees** that given the results so far, and the well-documented differences between the fisheries in terms of data availability, stock identity complexity and the nature of the fisheries themselves (e.g. the multi-species nature of the Greenlandic case), it was extremely unlikely that a single *suitable* generic *SLA* could be developed. It is therefore clear that either alternatives (2) or (3) are most likely to enable the Committee to satisfy the Commission's objectives. It **draws this to the attention** of the Commission. It **agrees** that to the extent possible it would be preferable to follow option (2).

Thus, a likely potential scenario is that the Commission might establish an Aboriginal Whaling Scheme that comprises the scientific and logistical (e.g. inspection/observation) aspects of the management of all aboriginal fisheries. Within this, the scientific component might comprise some general aspects common to all fisheries (e.g. Guidelines and requirements for surveys and for data c.f. the RMP) and an overall AWMP within which there will be common components and case-specific components.

An important implication of this is that given the different degrees of difficulty, it will be possible to develop *SLA*s for some stocks before others. The Committee **agrees** that it could best fulfil its role of providing the Commission with advice on stocks subject to aboriginal whaling if it presented available components of the AWMP to the Commission as and when they were ready. It **draws this to the attention** of the Commission. This is considered further below.

The Committee reaffirmed that its aim was to produce an AWMP that satisfactorily meets the Commission's objectives as quickly as possible. The SWG noted that improvements beyond this point would not be justified in terms of time and cost.

10.9.1 Short-term (1 year)

The Committee identified a number of tasks that required work during the coming year, including computing tasks for the Secretariat. These are given in Table 6. The SWG had recommended that the highest priority be accorded to these computing tasks, stressing that the pace of the development process was critically dependent on the appropriate software being available as soon as possible. This is discussed further under Item 18.

The Committee recalled that last year, it had noted that the SWG would probably require an intersessional meeting between the 1998 and 1999 meetings. In order to give developers as much time as possible and to ensure that adequate time is available for the SWG to consider the results of their work, the Committee **recommends** that the work of the SWG commences three days immediately prior to the next Scientific Committee meeting. It also **noted** the SWG request that invited participants be invited on more than a one-off basis.

The Committee noted the importance of continuity to its work. It therefore **recommends** that Donovan act as co-ordinator of its intersessional activities during the coming year.

10.9.2 Medium-term funding

During the development of the *RMP*, the Commission had established a fund to help support the work of some developers. Last year the Committee had requested that the Commission should consider establishing a similar scheme for AWMP development. The Committee **recommends** that such a fund be established. It **agrees** that the fund should initially be established at a level of £5,000 with a maximum of £1,500 available annually to each developer. It is envisaged that the fund should carry over from year to year, such that each year it begins with £5,000. Developers wishing to draw on the fund should apply to the Secretariat. The decision to approve the application should be taken by the Chair of the Standing SWG and the Chair of the Committee.

10.9.3 Long-term

The SWG noted the steps it had previously identified in the development of the AWMP (see e.g. IWC, 1998e):

(1) summarise existing data for stocks harvested by aboriginal whalers (completed);
(2) clarify management and performance objectives of the *AWMP* ([may require] additional input from the Commission and hunters [as work proceeds]);

Table 6

Aboriginal Whaling Management Procedure work to be carried out in the coming year.

Task		Estimated time/by
Secretariat computing		
(1)	Revise the program to implement the multi-stock trials for fishery type 1 as detailed in Annex F, Appendix 3.	1 month
(2)	Implement the stochastic dynamics model (including the 3 methods given in Annex F, Appendix 3) and apply the stochastic backwards method to obtain input parameters for fishery type 2. This may require iteration through the AWMP correspondence group. As a first step, modify the control program to input rather than pre-specify P_0 and apply the deterministic backwards method to obtain input parameters for fishery type 2 that can be used until the task is completed.	2 months
(3)	Modify the common control program to implement and run trials to investigate the effects of three different methods of incorporating stochasticity into fishery type 3 trials.	
(4)	Finalise the plotting program (in collaboration with Zeh).	
Other		
(1)	Software distribution questions (Annex F, Item 1.7).	Secretariat
(2)	Incorporate density dependence on the survival rate for juveniles into the common control program and present trajectories (Annex F, Item 2.3.1).	Punt
(3)	Additional information on density dependence on the mature rather than 1+ component (Annex F, Item 2.3.3).	Punt
(4)	Begin work on gray whales (Annex F, Item 8.3).	DeMaster

(3) specify performance measures (on-going);
(4) specify simulation trials (on-going);
(5) specify candidate *SLA*s (on-going);
(6) subject candidate *SLA*s to stock-specific simulations trials and compute performance measures under a range of scenarios;
(7) if required, modify candidate *SLA*s in light of simulation results and repeat simulation trials;
(8) recommend *SLA*s to the Commission.

In the light of its discussions above, it reiterates that it believes that it is most appropriate to provide the Commission with recommended *SLA*s for different fisheries at different times.

The Committee is not in a position to develop a precise timetable for its work but believes it will be in a stronger position to do so at its next meeting. It therefore confined itself to:

(1) an elaboration of the process above by which it would arrive at recommended *SLA*s;
(2) general comments on a timetable on a fishery by fishery basis.

With respect to (1), it identified that the following types of trials are necessary.

Evaluation Trials. Such trials would be used for formal comparison of candidate *SLA*s. Their number would be limited, compared to the number of *Robustness Trials*. Development of *Evaluation Trials* would commence prior to that of *Robustness Trials*. More than one round of such trials is likely before a favoured *SLA* is identified. Developers would be able to adapt their efforts accordingly.

Robustness Trials. Trials to examine *SLA* performance for a full range of plausible scenarios. These would be applied to the restricted set of *SLA*s found to perform well in *Evaluation Trials*. The number of such trials would be potentially large. Results will be used to fine-tune *SLA*(s) for acceptable performance. Again, more than one round may be necessary.

With respect to (2) the Committee made the following general comments:

GREENLAND FISHERIES

The Committee **agrees** that providing advice on the Greenlandic fisheries was a matter of the highest priority. It concurred that given the present state of knowledge, developing a *Strike Limit Algorithm* for the Greenland Fisheries that would fulfil all the Commission's objectives will be an extremely difficult, if not impossible task.

It **strongly recommends** the proposal with respect to research on Greenland stocks given in Annex P.

The Committee **agrees** that it would be in a stronger position to provide advice on a timetable for providing the Commission with a recommended *SLA* for this multi-species fishery when the results of the research programme begin to become available.

BERING-CHUKCHI-BEAUFORT SEAS STOCK OF BOWHEAD WHALES

The Committee noted that last year the Commission had established catch limits for this stock until the year 2002. It therefore **agrees** that it would be highly desirable if it could be in a position to recommend an *SLA* for this fishery to the Commission by that year. It hoped to be able to give the Commission more advice on whether this was achievable after its next meeting.

EASTERN STOCK OF GRAY WHALES

Although the fishery type 2 *Initial Exploration Trials* have been based on the bowhead whale situation, the SWG **agrees** that the eastern stock of gray whales is essentially a fishery type 2 stock. It believed that it was likely that a single *SLA* (or minor variants) would be applicable to both stocks. The Committee **agrees** that consideration of this fishery should begin in the near future. DeMaster indicated that such work may be undertaken within the USA. The Committee noted that last year the Commission had also established catch limits for this stock until the year 2002. It therefore **agrees** that it would be highly desirable if it could also be in a position to provide a recommendation to the Commission for this fishery by that year. It hoped to be able to give the Commission more advice on whether this was achievable after its next meeting.

ST VINCENT AND THE GRENADINES HUMPBACK WHALES

The SWG has not yet considered this fishery in any detail. The Committee is intending a major review of North Atlantic humpback whales at the 2000 meeting that will be relevant to the development of an *SLA* for this stock.

10.10 Other

The Committee has in the past expressed concern over the status of the Baffin Bay-Davis Strait and Hudson Bay-Foxe Basin stocks and this was re-iterated in Annex G this year. It also noted the kill of one whale in 1996 from the Hudson Bay-Foxe Basin stock that Canada, a non-member nation,

had authorised up to two strikes in 1998 from the Baffin Bay-Davis Strait stock.

DeMaster indicated that he was planning to begin exploratory work on developing a management procedure for these stocks. The Committee **agrees** that, provided it does not interfere with its priority work to develop *SLA*s for those stocks that the Commission is managing directly, it would be prepared to review and comment on work on other stocks.

11. ABORIGINAL SUBSISTENCE WHALING STOCK ASSESSMENTS

11.1 Bowhead whales

11.1.1 Bering-Chukchi-Beaufort Seas Stock

A thorough assessment of this stock of bowhead whales was carried out in 1991 (IWC, 1992b), and in-depth discussions have taken place in the Scientific Committee in subsequent years. This occurred especially in 1994 (IWC, 1995b), following the successful census in 1993, and in 1995 (IWC, 1997b), following the identification of a possible serious theoretical difficulty with the Bayesian synthesis method used for stock assessment since 1993. Extensive sensitivity analyses in subsequent years have not identified a strong effect for the bowhead assessment. However, in 1997 (IWC, 1998b) it was agreed that at least one solution to the theoretical difficulty was to use standard Bayesian analysis, rather than the specific Bayesian synthesis method. Debate has also occurred regarding the merits of two standard Bayesian analysis methods. In one, a prior distribution is specified for K (carrying capacity) and the population model is projected 'forwards' to the current time. In the second, a prior is specified for current abundance, and the model is projected 'backwards' to find the value of K that would be necessary for this value of current abundance. An alternative standard Bayesian solution was also developed, which involves the geometric pooling of multiple prior distributions. The Committee is pleased to note that this approach has resolved the previously identified theoretical difficulties that have been extensively discussed in recent years.

11.1.1.1 ASSESSMENT

SC/50/AS3 reported bowhead whale sightings data collected around Chukotka from 1994-96. Whales winter in leads and polynyas along the southwestern shore of Chukotka, in the Anadyrskiy Gulf, with some remaining throughout the year. In May, some whales migrate north along the southeastern shore of the peninsula. By August or September they are seen along the northern shore. Whales migrate east along the northern side of Chukotka, still feeding, before the ice begins to freeze. The timing and numbers of whales observed along this coast have varied between years, related to the ice conditions in the Chukchi and perhaps Beaufort Seas. The authors also noted that the origin of the whales arriving along the north coast of Chukotka in Autumn is unknown; they speculated that they could be animals migrating out of the Beaufort Sea.

SC/50/AS4 considered the morphology of the bowhead whale eye and the author concluded that the bowhead whale probably has significant eye mobility.

In SC/50/AS10, age was estimated for 42 animals using the aspartic acid racemisation ageing technique. The racemisation rate for aspartic acid was estimated using data from earlier studies of humans and fin whales. Age at sexual maturity and growth rate estimates accord with those from photogrammetry and baleen ageing techniques. Growth slows markedly for both sexes at about 40-50 years but does not cease. Age estimates for four males were considerably greater than 100 years. These results generally confirm those from other ageing methods, which suggest slow growth, great longevity and high survival rates. Six 'traditional' Eskimo harpoon points (four of stone) have been recovered from the Eskimo whale harvest; stone tools appear to have been generally out of use for over 100 years. That the five oldest animals were male may reflect a higher survival rate for males or be a residual effect of the commercial fishery which may have been directed toward large females.

In SC/50/AS11, the possibility that bowheads in the Okhotsk Sea were derived from the Bering-Chukchi-Beaufort Seas population was examined by genetic analysis of tissue samples collected from the Okhotsk Sea ($n=25$) and off Barrow ($n=29$). Small but significant differences between the two groups were found, suggesting that the sampled animals are from separate gene pools.

SC/50/AS14 attempted to (1) quantify genetic variability in the Bering-Chukchi-Beaufort Seas stock using mtDNA control region sequences and (2) determine the likelihood of a potential genetic bottleneck in this stock as a result of commercial whaling. The level of genetic diversity was found to be much higher than for some other marine mammal populations. The results suggest that (1) any reduction in total population size would result in only a negligible loss of diversity and (2) the expected pre- and post-bottleneck levels of diversity are not significantly different from each other.

SC/50/AS9 summarised information on the 1997 Alaskan hunt; 66 whales were struck and 48 were landed, for an efficiency of 73%. Of the landed whales, 29 were female (10 considered mature based on their length) and 19 male. One animal had a 409cm foetus. Preliminary analysis of weather and harvest records at Barrow confirm the hunters' belief that hunting success is greatly influenced by wind direction and wind speed.

SC/50/AS12 provided information on the value of acoustic methods in the bowhead census, especially for quantifying the proportion of whales further than 4km offshore. It also described a relatively new method for collecting recordings of whale sounds with possible application to the bowhead census and to the remote acoustic sampling of blue whales in the Southern Ocean.

An intersessional e-mail group had clarified an agreed reference set of prior distributions, for use in comparing the results of the different proposed assessment methods, and had clarified details of calculations, catch history, and abundance estimates.

SC/50/AWMP1 gave the full technical specifications of the BALEEN II population dynamics model. It was agreed that a revised version should be available as Annex R. The model forms the basis for the assessments reported in SC/50/AS1 and SC/50/AS6 and a variety of methods for parameterising the model are described.

SC/50/AS1 addressed four methodological aspects of the Bayesian approach to this assessment. (1) It suggested that the prior on MSYR be replaced by one on the rate of increase at low population size, as this (rather than MSYR) was the parameter for which basic data were available from other stocks. (2) It developed several approaches to include abundance information in the analysis, particularly the N_4/P_4 time series and its relationship to absolute abundance (including the authors' preferred approach of taking account of correlations in the N_4/P_4 series). (3) It developed a basis to commence the analysis in a more recent year than 1848

when commercial catching started and thus to avoid problems with uncertainty about 19th century catch levels and possible changes in parameters such as the carrying capacity *K*. (4) It expressed preference for the 'backwards' over the 'forwards' approach on the basis of simulation test results.

SC/50/AS6 continued to examine the difference between the forwards and backwards results. It applied the full pooling method, which resolves the difference, to the bowhead assessment. Results were intermediate between those using the forwards and backwards methods. Full pooling creates a joint prior that reflects relationships between parameters determined by the population dynamics model. It thus circumvents the independence assumptions of both methods while simultaneously yielding a unique solution.

SC/50/AS7 implemented the reference set of priors and the likelihoods using a forwards method. The analysis was based on the age- and sex-specific Leslie matrix model with density-dependence in the fecundity term. Two methods were used to sample from prior distributions. The first put a prior distribution on λ_{max}, the maximum growth rate of the population, and the second was the 'reference' case where a prior was put on MSYR. In discussion, it was noted that although the results for the two methods were similar for λ_{max}, this was not true for some other parameters of interest.

SC/50/AS8 investigated the sensitivity of the bowhead assessment to certain assumptions. The particular implementation of the assessment was a forwards projection from *K* in 1848. Two versions were used, one with a prior on λ_{max}, with juvenile survival and MSYR then calculated, and another with a prior on juvenile survival, with λ_{max} and MSYR then calculated. In general, the two versions gave similar results. The assessment was not found to be sensitive to (1) the marginal prior distributions for adult survival and age at sexual maturity or (2) the data on the fraction mature and the fraction calves in the population. However, it was strongly influenced by the rate of increase (ROI) data. An additional analysis fitted a Leslie matrix (with no density-dependence) projected from 1975-1998 to the data; it confirmed that the marginal prior distributions for the life-history parameters could closely agree with the observed data on ROI. Finally, it was found that even if there was substantial bias in the recorded harvests in the 19th century, there was little effect on the estimated catch-related quantities, although estimates of depletion level were, as expected, much lower.

SC/50/AS2 examined the likelihood of the direct and indirect data relevant for the bowhead asessment. The indirect component of the likelihood is constructed from the prior distributions (Schweder and Hjort, 1997). It is argued that several of the prior distributions are only weakly supported by data, and should be disregarded. The likelihood is in each case concentrated on a narrow curved band in the 7-dimensional parameter space of the BALEEN II model. The model fits the data well, which is not surprising since the number of free parameters equals the number of data points or is slightly less. The parameter of interest, the 1998 replacement yield, is a rapidly varying function of the basic parameters of the model. This sensitivity makes it difficult to find confidence intervals for replacement yield. In discussion, the method being developed was noted to be interesting, and further work was encouraged. The interpretation of prior distribution as confidence intervals that might be derived using bootstrap methods, was questioned. Therein followed the usual frequentists *versus* Bayesians thrust and parry, *sans touché*.

The Committee **agreed** on the basic data required for an assessment. The catch data are complete up to 1997 and thought to be generally reliable. However, the suggestion that the commercial fishery preferentially took larger females (see above), raised questions about the sex ratio in the historic catch. This was identified as an issue for future sensitivity investigations. Abundance data included the 1993 Bering-Chukchi-Beaufort Seas abundance estimate (8,200, SE = 564) and a series of estimates termed N_4/P_4. In order to combine these estimates, the time series of absolute abundance estimates N_4/P_4 was treated as a series of relative abundance estimates, and an abundance series with covariances was calculated. Aerial photographic data were used to estimate length distributions for the proportions of calves and matures and the rate of adult survival. The next abundance survey is planned for 1999.

In discussion, concerns were raised over technical difficulties encountered in estimating parameters of interest in some situations for several of the proposed assessment methods. The cause of these difficulties and their implications for the present assessment were discussed. Subsequently, possible ways of minimising or avoiding such difficulties in the future were identified. There was disagreement over whether some of these difficulties were related to the specific parameterisations being used, (especially dependencies among parameters to over-parameterisation given the data) or to inadequacies in the underlying population dynamics model.

There was general agreement that although there may be concerns over the underlying population dynamics model and its parameterisation, these difficulties did not preclude sampling from the posterior distribution in the Bayesian analyses presented. These issues should be addressed in the future.

The Committee compared the three basic methods of fitting the models, termed forward, backward, and full pooling. After considerable discussion (see Annex G) it was **agreed** to reject the forwards method, conduct an assessment using the backwards method and to examine the results from the full pooling method.

The Committee reviewed the previously used prior distributions and **agreed** appropriate values for use in the present assessment, although for some parameters (maximum calving interval, MSYR, adult survival rate, age at transition between adult and juvenile survival rates, carrying capacity), there were no direct data available to help set prior distributions.

Consideration was given to the implications for the assessment of the fact that 10% of the sample of animals considered in SC/50/AS10 was estimated to be older than 100 years and in particular to the way the mortality rates for older animals were handled. After some discussion it was agreed that for this assessment it would be sufficient to explore the issue by considering two alternative calculations, one involving not setting a maximum age and constraining adult survival rate to be less than 0.995, and the other retaining the maximum age but allowing survival to be as high as one. A number of other matters were identified that should be addressed in the future (see Annex G).

Assessments using the methodologies of SC/50/AS1 and SC/50/AS6, making the assumptions agreed, were presented. Both included calculations using the 'backwards' method using the two alternatives above. The results of the full pooling method under these two cases were presented.

The posterior distributions of several statistics summarising the assessments were reported, including the replacement yield and a similar quantity Q_0, that accounts

for the situation when the population might be above MSYL. This quantity is defined as 90% of MSY when a population is above MSYL (IWC, 1998j, pp. 241-42).

11.1.1.3 MANAGEMENT ADVICE

The best estimates of replacement yield (RY) from the above agreed alternative assessments ranged from 184 to 210. The Committee **agreed**, as in the last bowhead assessment, to use the lower 5th percentiles of the posterior distributions of RY and Q_0 to provide management advice. The Committee recognised that this was a conservative approach and that the AWMP currently under development will probably provide a better approach. The relevant 5th percentiles, along with the best estimates (medians) of depletion, are shown in Table 7. Depletion has been expressed in terms of the 1+ population as this is the component of the population that is hunted.

Table 7

Lower bounds (5th percentiles) of replacement yield (RY) and Q_0 for 1998, and the median estimated depletion in terms of 1+ population size for four combinations of assessment method from the two assessments of the status of the Bering-Chukchi-Beaufort bowhead population. The alternate case results are from the backward method from the combinations of assumptions considered that resulted in the lowest values among the alternates considered of RY and Q_0, namely assuming no upper bound on life span and comparing the results to the population size including calves.

	SC/50/AS6 Poole and Raftery (1999) methodology		SC/50/AS1 Punt and Butterworth (1999) methodology	
Quantity	Full Pooling	Backwards	Backwards	Alternate case
RY	108	119	123	113
Q_0	102	114	120	110
Depletion	61%	68%	68%	66%

The results of the backwards method as implemented by the two groups of authors were noted to be similar, as would be expected given that the method is the same. The differences reflect expected levels because Monte Carlo methods are used. The full pooling method gives lower values of the 5th percentile of replacement yield (108) and of the quantity Q_0 (102) than were obtained using the backward methods. The other cases considered resulted in values intermediate between the backwards and the full pooling methods.

The differences of management concern in the estimates of the values are relatively small. It was agreed that the management advice would be the same regardless of the methods used. The population appears to be near MSYL, and will probably increase under catches of up to 108 animals.

In terms of Para. 13(a) of the schedule, appropriate catch levels in these circumstances should not exceed 90% of MSY. The calculations reported therefore indicate that it is very likely that a catch limit of 102 whales or less would be consistent with the requirements of the schedule.

11.1.2 Other stocks

11.1.2.1 BAFFIN BAY/DAVIS STRAIT AND HUDSON BAY STOCKS

A brief description of the distribution, current abundance and status of the two putative stocks of bowheads in eastern Canada - the Davis Strait 'stock', which is known to be shared with Greenland, and the Hudson Bay/Foxe Basin stock - was given in IWC (1992c, pp.138-139). Pertinent new information available since 1991 is summarised in the following paragraphs.

The Committee noted that Canada has agreed to the request by Nunavut Wildlife Management board for Inuit hunters in eastern Baffin Island to strike up to two and catch up to one bowhead whale from the Baffin Bay/Davis Strait stock in the summer of 1998. This planned hunt follows the initiation of legal hunting on the Hudson Bay/Foxe Basin stock in 1996. An estimate of 270 (CI 210-331) for the northern Foxe Basin part of the Hudson Bay/Foxe Basin stock's summer range in August 1994 has been published (Cosens *et al.*, 1997). In addition, Innes referred to an estimate of 59 (CI 20-120) for the northwest Hudson Bay part of this stock's range in August 1995 (Cosens *et al.*, 1998). Both estimates are from systematic aerial survey.

No recent information on absolute abundance or trend is available for the Baffin Bay/Davis Strait stock. The statement in IWC, 1997b (p.90) that both stocks have been conservatively estimated at 450 whales each, citing Zeh *et al.* (1993), is incorrect. Zeh *et al.* (1993) estimated that there were at least 450 whales in the two stocks, combined. Of this total, about 350 were estimated for Baffin Bay/Davis Strait and 100 for Hudson Bay/Foxe Basin.

SC/50/AS15 presents observations of bowheads at Isabella Bay, northeast Baffin Island for 11 autumn seasons between 1983 and 1997. Except in 1983, bowheads were observed on most days. The study indicates that up to 99 bowheads can be present in Isabella Bay at one time during the autumn.

For both of these stocks the Committee expressed appreciation for the recent studies on abundance and distribution, using traditional knowledge, sightings surveys, photography and biopsy samples, and **encourages** additional work along these lines. Given the apparent interest in continuing harvests from these two stocks that were depleted by commercial whaling, additional knowledge of their status is crucially needed.

The Committee **remains concerned** for the viability of the Hudson Bay-Foxe Basin stock because of its small size, especially in light of the aboriginal harvest of one whale in 1996 (IWC, 1998b, p.92). The Committee also **expressed concern** about the approval for up to two strikes of whales in 1998 from the Baffin Bay/Davis Strait stock because of its small size and lack of information on trend.

11.1.2.2 OKHOTSK SEA STOCK

SC/50/AS11, which included information on this stock, was discussed under Item 11.1.1.1. Previously reported estimates for this population are 50-300 whales but they were not based on quantitative surveys. SC/50/AS11 suggested that the population size might be estimated using a genetic mark-recapture study.

11.1.2.3 OTHER STOCKS

The Committee **remains concerned** about the status and apparent low abundance of the Spitzbergen stock, about which little is known (Burns *et al.*, 1993). It **encourages** additional studies on abundance and distribution.

11.2 North Pacific gray whales

11.2.1 Eastern stock

SC/50/AS13 reported on observation studies in Mechigmenskiy Zaliv, Chukotka, and adjacent waters from 1984-96. Most sightings of gray whales in this area occurred between June and November with peak numbers occurring

in August or September in most non-El Niño years. During the years influenced by El Niño, peak numbers occurred in June.

Borodin reported that in 1997, the Russian State Committee on Environment issued an allowance to the Chukotka Autonomous Okrug for the harvest of 140 gray whales, which is within the catch limit set by the IWC. In accordance with the requests it received, the Okrug Administration distributed an allowance of 101 whales between nine settlements. During the 1997 hunting season, 79 whales were harvested: 48 males and 31 females.

The hunting was conducted from whaling boats and sea kayaks under the direct control of fishery inspectors from the Chukotka Regional Fisheries Inspection Agency. In the majority of settlements, rifles were used during the hunt. In 1997, 20 darting guns with bombs, received as humanitarian aid from Alaskan Eskimos, were used for the first time in the gray whale harvest. Using the darting guns, 17 shots resulted in 16 catches (i.e., one animal was shot twice with the darting gun).

In regard to a recommendation from last year, Pérez-Cortés stated that studies in the gray whale breeding lagoons were continued and expanded to most of the wintering range of this stock in Mexican waters (SC/50/ProgRep Mexico). Although no detailed information is available owing to the short period between the end of the field season and this meeting, preliminary information suggests that whales were present in fewer numbers in the southernmost breeding lagoon in Baja California (Magdalena Bay) in this el Niño year, and that they left that location earlier than observed in other years.

The Committee has no changes to the management recommendations made last year (IWC, 1998b).

11.2.1.1 CURRENT STATUS, INCLUDING STOCK MONITORING - REPORT OF THE INTERSESSIONAL GROUP

Brownell reported that no detailed work was conducted by the intersessional group, owing to the short intersessional period. However, the Committee **agrees** to a proposal that the group continue its work over the next two years, its terms of reference being to review the current status of the stock, including a review of past monitoring and recommendations for future monitoring.

11.2.2 Western stock

SC/50/AS5 summarised the location and year of sightings, strandings, and catches of gray whales in Chinese coastal waters. The Committee thanked the authors for their efforts in summarising this information. Given the severely depleted nature of the stock, this information is important in establishing base lines for sighting and stranding studies that may be used to infer trends in abundance in the future.

The Committee **strongly urges** that scientists from other countries with an interest in or within the range of these whales identify and conduct research on this stock, and consider measures required to maximise the chances of this stock recovering.

11.3 Greenland minke whales

There were no papers submitted on the two management stocks of minke whales that occur off Greenland. Born reported that in 1997 a total of 146 minke whales (99 females, 42 males and 5 with sex undetermined) were landed in West Greenland. Additionally, two whales were struck and lost. A total of 65 samples was collected from the catch (see SC/50/ProgRep Denmark).

Born also reported that eleven minke whales (10 females, 1 male) were landed in East Greenland in 1997. Three whales were struck and lost. The question of management advice is discussed under Item 11.6 and in Annex P.

11.4 West Greenland fin whales

At last year's meeting the Committee agreed that population structure and abundance must be more thoroughly understood before the Comprehensive Assessment process begun in 1991 (IWC, 1992a) can continue.

There were no papers submitted on this stock. Born reported that in 1997 eleven fin whales (5 females, 5 males and 1 of undetermined sex) were taken. Four samples for genetic analysis were collected from the catch (see SC/50/ProgRep Denmark). The question of management advice is discussed under Item 11.6 and in Annex P.

11.5 Humpback whales off St Vincent and the Grenadines

Hester reported that on 26 February 1998, two humpback whales were taken and landed at the whaling station on Petit Nevis. The whales were landed after 1700hrs. As the Fishery Officer did not receive word immediately, he did not arrive until the following day, after the smaller whale had been butchered and distributed. It was described to him by the fishermen to have been a male 4-6m in length. He measured, photographed and examined the remaining whale, which was in the process of being cut up. It was a non-lactating female 15.3m in length. Information regarding other data and samples that may have been collected will be released at a later date.

There was some discussion by the Committee about the 4-6m male. Carlson noted that photographs of both animals landed as well as skin and blubber samples collected by locals were available. Clapham and Brownell commented that, based on information from the Southern Hemisphere and North Pacific, animals of 4m are close to the average length at birth for humpback whales; average length at weaning is typically 8-9m. Clapham undertook to provide information at the next meeting on the size distribution of calves of this species, particularly in the North Atlantic.

During the Committee's review of its discussions on this matter, Hester asked that information on the location of the tissue samples be included in the report. He expressed concern that scientific samples were collected but no information could be provided. He therefore enquired how these samples were collected and archived, and what was the intention for their final disposal.

Joseph, Walters, Lawrence, Yagi and Komatsu noted that unauthorised marine scientific research in the eastern Caribbean is creating considerable problems for the governments in the region. They stated that this was underscored by what they felt was questionable reporting with regard to the above two whales by members of the Scientific Committee engaged in cetacean research in the EEZ of eastern Caribbean states. They stated that illegal marine scientific research is a growing problem in the eastern Caribbean and can create much embarrassment to the Scientific Committee if research reports cannot be substantiated. Such illegal activity undermines the sovereignty of these independent states and also the integrity of the Scientific Committee. Committee members desirous of undertaking research in the Caribbean are urged to seek the requisite approval of their research activities by respective states before engaging in any such activities in order to avoid unpleasant controversies.

Brownell, Donaghue, Slooten, Reijnders, Thiele, Berggren, Perrin, Stachowitsch, Tillman, Reilly, Deimer and Kock noted that during the discussion of this item in the full Committee, Carlson had reported that she had photographed the two dead whales at the whaling station whilst on vacation. It was their view that most members of the Committee did not believe that these opportunistic photographs constituted scientific research as noted by Joseph.

Regarding advice to the Commission concerning management, the Committee has no changes to the recommendations it made during last year's meeting. The Committee **draws attention** to its intention to undertake a Comprehensive Assessment of North Atlantic humpback whales at its meeting in 2000. Further, additional information on the status of humpback whales in the North Atlantic can be found in Annex E.

11.6 Long term priorities

The Committee noted the actions by the Commission last year in approving five-year aboriginal catch limits for Bering-Chukchi-Beaufort Seas bowhead whales before a new assessment had been completed, and in approving coincident 5-year aboriginal catch limits for both bowheads and eastern Pacific gray whales, west and east Greenland minke whales and west Greenland fin whales. It noted that the time required to complete a new assessment for a stock precludes undertaking more than one assessment during an annual meeting. The Committee therefore **agrees** that it does not appear necessary, and is not in any event feasible, to match the time between assessments with the time period of catch limits.

Recognising the Commission's request that the Committee keep the stocks under annual review in any event, and that in the development of the AWMP intervals between assessments of up to six years are being considered, the Committee **agrees** it will give attention to the more important of the stocks subject to aboriginal harvest every six years. It also noted that in Item 9.4 it recommends that it undertake a Comprehensive Assessment of North Atlantic humpback whales in the year 2000. Further, the Committee noted its own concerns this year about other stocks of bowhead whales. Finally, it **encourages** pursuit of proposals for future work to improve the Bering-Chukchi-Beaufort bowhead assessment model.

The Committee noted that it has never been able to provide satisfactory scientific advice on either fin or minke whales off Greenland. This is a matter of **great concern**, given that the provision of management advice on stocks subject to whaling is a high priority task assigned to the Committee by the Commission. The Committee **strongly recommends** the proposal to develop a research programme for the Greenland stocks outlined in Annex P.

Based on these developments, the Committee **recommends** that, while keeping all stocks subject to aboriginal whaling under review annually, primary attention be given to continuing work on the aboriginal whaling management procedure and to intensive assessments of stocks at future meetings as given in Table 8.

Table 8

Timetable for stock assessment consideration at future Annual Meetings.

Year	Stock to be considered
1999	Greenlandic research programme; stocks of bowhead whales other than the Bering-Chukchi-Beaufort stock
2000	North Atlantic humpback whales
2001	Fin whales off Greenland
2002	Minke whales off Greenland
2003	Eastern and western Pacific gray whales
2004	Bering-Chukchi-Beaufort Seas bowhead whales

12. ENVIRONMENTAL CONCERNS

The Committee's discussions were structured to reflect last year's discussions and IWC Resolution 1997-7.

12.1 Pollutant and contamination issues

12.1.1 Review of progress on research initiative

Last year, the Commission adopted a resolution (IWC Resolution 1997-7) endorsing the Scientific Committee's recommendation to initiate a research programme to establish pollutant cause-effect relationships in cetaceans (SC/49/Rep6) and to hold and fund a Planning Workshop as the first phase in implementing the proposal. The Committee established a Steering Group to organise the Planning Workshop (Reijnders, Aguilar, Bjørge, Donovan). The Workshop, which will last 3-4 days, will be held in November 1998 in Barcelona, Spain. The Steering Group has identified and will soon contact persons representing institutions or organisations that might be interested and potentially involved in the analyses and/or sample collection and funding. In addition, advisory experts on specific subjects, e.g. toxico-pathology, will be invited.

It was stressed in the original proposal that the programme was intended to address specifically the main recommendation of the IWC Pollution Workshop. Further, researchers were encouraged to address the other recommendations of that Workshop and consider other species and sources of samples. The priorities of the research programme were not meant to imply that other approaches were untenable, including the opportunistic collection of data from stranded animals, although data from such sources were likely to be subject to the concerns identified at last year's Committee meeting (IWC, 1998b).

In this context, it was noted that the Parties to ASCOBANS at their 2nd Meeting in Bonn in November 1997, expressed strong support for the research programme and recommended that the Parties should seek ways to facilitate its execution (SC/50/SM10; Annex L).

The Committee was informed that sufficient funds were available for the Planning Workshop, at which further discussions regarding the financing of the entire research project would take place. It was reiterated that sufficient funding for the overall Programme has not yet been secured and potential funding sources are **encouraged** to consider supporting the project.

The Research Programme is expected to last at least four years. Its products will include an integrated report of all the programme's components, a set of guidelines to assist others who wish to pursue similar research projects, and a summary of the entire programme in terms of the identified parameters that may be indicative of the health of cetacean populations.

12.1.2 Other documents on pollutants and contaminants

The committee reviewed three documents related to pollutants and chemical contamination.

SC/50/E5 presented an analysis of contaminant levels in bowhead whale tissues. Resulting mean levels of metals in bowhead liver and kidney samples were considered low or

normal compared to most mysticete species. Overall, bowhead tissues had relatively low levels of most natural and anthropogenic contaminants of the inorganic, organochlorine, and radionuclide classes when compared to other marine mammal species. From a subsistence perspective, kidney samples represented a significant source of cadmium which requires further investigation.

SC/50/E6 reported an opportunistic study of organochlorine and mercury concentrations in tissues from a sample of cetaceans from the northeastern Atlantic. The available data indicate that levels in small cetaceans in this region are high and suggest that the eastern Irish Sea might be a 'hot spot' of contamination.

SC/50/SM11 reported on the progress of toxicological and pathological investigations of harbour porpoises from the North and Baltic Seas and from waters around Greenland. Contents and patterns of chlorinated contaminants in harbour porpoise blubber samples indicated significant variation between the three areas, suggesting that the contaminant levels might indicate separate populations.

In addition to these three documents, the Committee reviewed briefly, and endorsed the protocol for, skin/blubber biopsy collection for study of chemical pollutants presented in Annex H, Appendix 2. It **recommends** that this be forwarded to the planning meeting for the SOWER cruises (see Annex Q).

12.2 Climate change and habitat

12.2.1 Review of progress on SOWER 2000 planning

REPORT OF E-MAIL GROUP

Reilly reported that the SO-GLOBEC small-scale process study originally planned for 1999/2000 has been delayed until 2000/2001 because of ship scheduling conflicts. Consequently, SO-GLOBEC's small-scale process study will not occur concurrently with CCAMLR's large-area synoptic survey to estimate total krill biomass. Re-iterating the unique opportunity that the research activities planned by SO-GLOBEC and CCAMLR present for the IWC to conduct research on the distribution of whales in relation to their environment and prey, the Committee discussed alternatives regarding IWC participation in these CCAMLR and SO-GLOBEC research activities. The Committee **agrees** to proceed with the existing proposal to work with CCAMLR in 2000 by having IWC observers conduct whale sightings during CCAMLR's synoptic krill survey in Area 48. After discussing the implications of the one year delay in the SO-GLOBEC small-scale process studies, the Committee re-confirmed its decision to work with SO-GLOBEC despite the delay. Thus, the Committee **reiterates** its support for the collaborative research activities with SO-GLOBEC and CCAMLR, which were originally proposed at last year's meeting and subsequently endorsed by the Commission.

12.2.1.1 CCAMLR

SC/50/O11 identified several areas of mutual interest between SC-CAMLR and the IWC Scientific Committee (IWC/SC):

(1) coordination of CCAMLR and IWC research activities;
(2) analysis of historical and recent datasets;
(3) CCAMLR surveys as platforms of opportunity for whale sightings;
(4) consideration of re-establishing minke whales as a monitoring species in the CCAMLR Ecosystem Program (CEMP);
(5) annual exchange of information.

To achieve greater collaboration between CCAMLR and IWC, the formation of a liaison group with IWC/SC and SC-CAMLR was suggested. The Committee noted that the establishment of such a group has been previously endorsed by the Commission. A Working Group was established to facilitate collaboration with CCAMLR, and form the basis for IWC representation in the liaison group. The Committee suggested that the following persons from countries participating in the CCAMLR Area 48 krill survey should communicate with their national CCAMLR representatives regarding these collaborative efforts: Hammond (United Kingdom), Kato (Japan), Reilly (USA), Thiele (Australia), Findlay (South Africa) and Slooten (New Zealand).

Two CCAMLR meetings are scheduled for June 1998 in La Jolla, California: a workshop on retrospective analysis of physical and biological data for CCAMLR Area 48, to provide the scientific context for the 2000 synoptic krill survey; and, a planning meeting for that krill survey. IWC participation was encouraged in both. IWC data have been requested for use in the retrospective analyses. Allison reported that there are two categories of relevant data: IWC catch data, which are available without restriction and have already been transferred to CCAMLR; and data for which restrictions exist. Shimadzu stated that full Japanese catch records will be made available to CCAMLR through the IWC, including biological data (except age and reproductive status); scouting boat data will also be accessible to CCAMLR.

12.2.1.2 SO-GLOBEC

Hammond presented his observer's report of the SO-GLOBEC Planning Group meeting in March 1998 (Annex H, Appendix 3). Three items recommending IWC action were identified:

(1) participation in SO-GLOBEC regional planning meetings;
(2) input on preferred measurements for small-scale process studies to increase overall the comparability of data by defining standard core measurements and methods;
(3) nominations of IWC participants for SO-GLOBEC working groups on data management and modelling.

Hofmann, Chair of Southern Ocean GLOBEC, presented a GLOBEC report (Hofmann, 1998) which outlined the updated implementation plan for the 2000/2001 small-scale process studies. One recent change was a narrowing of the project's focus in terms of target species and location, although an ecosystem approach of studying habitat, predators, prey, and competitors was still intended. The modifications to the existing plan include the following:

(1) selection of Antarctic krill (*Euphausia superba*) as the primary target species, including a focus on habitat, prey, predators, and competitors of this species;
(2) temporal expansion of the plan to a year-round study, with an emphasis on austral winter processes.

Two primary field sites were identified: the Antarctic Peninsula region (the major component) and 70°E and the surrounding area. The former will be studied year-round through a multi-national, multi-ship effort. In addition, associated programmes were identified that support SO-GLOBEC-related research. For example, the Australian Southern Pelagic Monitoring Cetacean Programme includes cetacean sightings throughout the Antarctic 'season' on all voyages, including a multidisciplinary winter polynya voyage (July-September 1998) and a fine-scale krill survey

(1999/2000). It was suggested that the IWC could use the data from the 1999/2000 fine-scale survey as a pilot study to test data collection methodologies in preparation for its participation in the CCAMLR 2000 and SO-GLOBEC 2000/2001 projects. Given this suggestion, the importance of discussing optimal research methodologies at the planned St Andrews Sightings Workshop (see Item 12.3.1) was stressed. The first regional planning meetings for the SO-GLOBEC programme will occur in the next six months and the IWC is encouraged to participate.

A working group was established to facilitate collaboration between the IWC and SO-GLOBEC. Annex H, Appendix 4 lists five SO-GLOBEC planning activities that will require IWC input in preparation for the 2001 field programme. Individuals to represent the Scientific Committee in these activities will be identified in consultation with the Chairman.

12.2.1.3 HABITAT

The Committee reviewed several documents related to habitat. SC/50/E1 investigated minke whale sightings in relation to sea surface temperature in Area II (Weddell Sea) of the Antarctic using data from IWC/IDCR cruises from 1981/82 and 1986/87. In SC/50/E2, interspecific density relationships among whales on Antarctic feeding grounds were examined using sightings data from the Japanese Antarctic Research Program (JARPA) from 1989/90 to 1995/96 and the IWC/IDCR cruises from 1978/79 to 1987/88. SC/50/E3 reported on oceanographic sampling during the IWC/SOWER/Blue whale cruises in 1995/96 and 1996/97.

The Committee noted discussion in Annex H of inter-annual variability in the location and extent of the marignal sea ice zone (SC/50/E7). The work is relevant to questions arising in Annex E about the representativeness of the JARPA samples. The Committee **encourages** additional attention to this topic.

SC/50/CAWS18 addressed critical habitat and abundance of right whales in the southeast Bering Sea based on data collected during a survey in the summer of 1997. In conjunction with retrospective analyses of sightings data since 1985, the results suggest that right whales predictably occupy the middle shelf and near-Inner Front regions of the Bering Sea shelf during summer. The Committee noted a recently published paper regarding the ecological importance of the Southern Boundary of the Antarctic Circumpolar Current (Tynan, 1998). Historical data on cetacean distribution and krill catches were used to show the importance of this boundary to the complex and predictable Southern Ocean food web.

12.3 Other concerns and activities

12.3.1 Future workshop – report of the intersessional group

As agreed at last year's meeting, an intersessional workshop is being planned to develop sighting and analysis methods for cetacean components of multidisciplinary research programmes. It is scheduled for late March 1999 and will be held in St Andrews, Scotland. The Committee noted the importance of having GLOBEC and CCAMLR participants at the workshop, especially in light of the sampling and analytical methodologies that may be common to all three groups. A steering group was established to complete planning. The proposal, draft budget and planning schedule are given in Annex H, Appendix 5. The Committee **strongly recommends** funding for this workshop (see Item 19), which it views as essential preparation for the SOWER 2000/1 field programs on baleen whale habitat and prey. The results will also be of more general value to future efforts to study cetaceans in a multidisciplinary context.

12.3.2 SOWER cruise activities

These are discussed in Item 9.9.1 and Annex Q.

12.3.3 Noise

SC/50/E8 and E9 provided overviews of the complex topic of noise in the oceans and its potential significance for marine mammals. Both papers considered established sources of marine noise as well as new and potentially important sources, including seismic surveys, sonar systems such as the US Navy's SURTASS-LFA system, and other sources such as the Acoustic Thermography of Ocean Climate (ATOC) experiment. During its discussion of these papers and additional information presented by Clark (Annex H, Appendix 6), the Committee noted the difficulty of assessing the potential impact of various sources of anthropogenic noise on marine mammal populations. Two important considerations were identified when designing studies to try to measure the impact of noise on marine mammals: (1) the need to identify appropriate measurable variables and apply statistically sound analytical techniques and (2) the need to identify ways to determine the biological significance of any response. The latter requires a more comprehensive evaluation of the relevant sources of noise and their frequency ranges. Given the potential of noise pollution to affect right whales, the Right Whale Workshop (SC/50/Rep4) had recognised the importance of understanding the anatomy and physiology of right whale hearing. It noted that such studies are being undertaken by D. Ketten (Woods Hole, USA). It had recommended that, where possible, suitable samples (frozen or fixed middle and inner ears) be collected for Southern Hemisphere animals, following the protocol given in Blaylock *et al.* (1995).

This led to a general discussion of how to measure short- and long-term behavioural responses of cetaceans, a question which also arose in consideration of whalewatching (see Item 15 and Annex J) and at the Right Whale Workshop (SC/50/Rep4). The Committee noted the broad scope of any attempt to assess the impact of noise (both anthropogenic and non-anthropogenic) on marine mammals. While recognising that this issue is relevant and important, it **agrees** that attempting a major initiative on the impact of noise on cetaceans was not advisable at this time.

12.3.4 Ozone depletion

SC/50/E4 summarised the mechanisms by which ozone is destroyed, the recent trends in ozone depletion in polar regions, and the sources of ozone and UV/B measurement in the Arctic. The 1997 polar-averaged, column-integrated ozone depletion was approximately 21% of historic levels, and comparable to depletions observed during the previous four winters. Potential ecological consequences of ozone depletion include altered trophic interactions, reduced biomass production, changes in species composition and diversity, and alterations of biochemical processes.

12.3.5 Physical and biological habitat degradation

The Workshop on the Comprehensive Assessment of Right Whales (see SC/50/Rep4) made the following statement with respect to habitats:

> The Workshop recognised the importance of quantitative studies of right whale habitats. It noted the increasing importance that the Scientific Committee has placed on environmental change and habitat studies (e.g. IWC, 1998k). In this context it **recommends** that

the Committee considers convening a workshop to develop approaches to quantify key features of whale habitats, including trophic structure; right whales should be considered as a potential key species. Such a workshop would involve a variety of disciplines.

With respect to right whales, particular attention should be paid to comparative studies between the Northern and Southern Hemisphere populations. Such studies should: (1) identify the most important parameters characterising right whale habitats and standardise methods to measure them; (2) assess 'threshold' levels of disturbance (including noise, temperature, food availability); and (3) identify potential sources of disturbance.

The above recommendation was endorsed by the Committee (Item 9.2.2).

The Standing Working Group on Environmental Concerns (SWGEC) received a proposal for an intersessional workshop on habitat degradation and its possible effects on cetacean populations. There was considerable discussion of this proposal, after which it was **agreed** that a preferable course of action would be to develop a revised proposal that incorporated the recommendation from SC/50/Rep4. Initial informal discussions led to a slightly revised proposal (Annex H, Appendix 7) being presented for information. The Standing Working Group had believed that this required further work and it was **agreed** that interested scientists should continue informal discussions with a view to presenting an agreed revised proposal to the Committee during the meeting for consideration. In the event, no agreed proposal was submitted. The Committee **agreed** that this should be considered further next year.

12.3.6 Effects of fisheries

Kemper and Gibbs (1998) reported on marine mammal entanglements in tuna farms in South Australia. The Committee noted that there are proposals to build similar fish farms in other countries; such facilities provide another potential source of marine mammal mortality and should be monitored.

12.3.7 Disease and mortality events

O'Hara *et al.* (1998) presented results of a viral serologic survey of bowhead whales in Alaska. The Committee **agrees** that such studies are important to provide a scientific basis for understanding effects on cetaceans of complex environmental problems, and **encourages** similar studies. SC/50/E7 reported on potential new opportunities for collaboration arising from recent international developments, particularly those relating to the 'Year of the Ocean', and identified some major perturbations in the marine environment that have occurred since the last meeting. Simmonds (1997) suggested a framework for considering cetacean strandings. The Committee noted that such attempts to improve understanding of the meaning of cetacean strandings were important, albeit ambitious. Nevertheless, it was recognised that information gathered from strandings, when viewed from a larger context and considering possible environmental effects, could help build a basis for understanding these events.

12.4 Arctic issues

The subject of environmental concerns in the Arctic was discussed primarily under Item 12.5. The Committee **agrees** to establish an e-mail group to address this subject, and members interested in participating were instructed to contact DeMaster or O'Hara (see Annex V).

12.5 Longer-term priorities and directions

In discussion of Arctic environmental issues, it was agreed that a research initiative focussing on Arctic cetaceans may be appropriate at some time in the future. Some members noted that focus on white whales and narwhals in 1999 might provide an impetus for the Committee to also focus on environmental concerns for those species. The Committee **agrees** that Arctic issues and the habitat definition/degradation initiative would be of lower priority in the coming year than the two ongoing research initiatives.

The Committee was informed by Slooten, Simmonds and von Bismarck of the formation of an informal information review group that would collect and review intersessional developments in the marine environment likely to impact cetaceans. That group intended to submit to the Committee an 'Annual State of the Cetacean Environment Report'. The Committee was also informed that that group might collaborate with the Emergency Task Force of UNEP's Marine Mammal Action Plan (Item 5.6; IWC, 1998b, item 5.8).

After considerable discussion, the Committee **agrees** that its priorities for the near-term and mid-term can be summarised as follows.

(1) The two ongoing research initiatives should be accorded the highest priority:
   (a) significance of pollutants and chemical contaminants on cetaceans;
   (b) baleen whale habitat and prey studies in the Southern Ocean, related to climate change (with CCAMLR and SO-GLOBEC).
(2) The following two projects were considered lower in priority:
   (a) developing a mechanism for identifying and evaluating the parameters defining cetacean habitats, and the use of those to evaluate the effects of physical and biological habitat degradation on cetaceans;
   (b) investigating effects of environmental change on populations of Arctic cetaceans.
(3) The Committee identified a number of other issues it considered important, but that were not identified as priority items for the forthcoming year. They include:
   (a) investigating the impact of environmental factors found in individual cetaceans for consequences on population level;
   (b) investigating the possible impact of oil pollution on cetacean health.

12.6 Intersessional Work Plan

The following intersessional activities are planned, with estimated costs given in brackets.

Pollutants and Contaminants

(a) Prepare and hold the Planning Workshop (Barcelona, November 1998[3]) related to the pollutant and contaminants research initiative (no new funds required).

Climate Change and Habitat

(a) Complete planning and conduct the Sightings Workshop (St. Andrews, March 1999) (£25,000).
(b) Continue planning activities in conjunction with CCAMLR and SO-GLOBEC for the SOWER 2000/2001 programme (£7,000).

[3] *Editor's note*: for logistical reasons, the 'POLLUTION 2000+' Workshop was held in March 1999.

Other Concerns

(a) Develop an agreed proposal for a workshop on habitat definition/degradation.

Arctic

(a) Identify potential issues and activities related to assessing environmental effects on Arctic cetaceans, through the established e-mail group (Annex V).

13. SMALL CETACEANS

13.1 Action arising from the 1997 meeting

The Committee has on several occasions expressed great concern about the perilous status of the vaquita, which is endemic to the upper Gulf of California. Last year it welcomed information that the Mexican Government had convened an International Committee for the Recovery of the Vaquita (ICRV). It looked forward to receiving a report on further developments at this meeting.

The Committee was informed that the ICRV had not met in early 1998, as had been expected, but that it would do so in October 1998. At that time it will consider the following topics: a temporal assessment of the unusual age structure of samples from bycatches; a spatial analysis of bycatches, incorporating age, sex, date and the geographical boundaries of regulatory areas; a description of fishing grounds and perhaps fishing effort; a review of the most recent estimates of abundance; initial formulation of a recovery plan, incorporating socio-economic factors. The Committee once again offered to assist the ICRV in its work in any way possible.

13.2 Review of small cetaceans in the Indian Ocean and Red Sea, with special reference to the Middle East

Reflecting the information available to it in presented papers, the Committee limited its discussion to the northwestern part of the Indian Ocean, and in particular waters bordering the Arabian Peninsula. Three geographical zones were arbitrarily defined within this region and considered in turn:

(1) the shallow, semi-enclosed Arabian (Persian) Gulf;
(2) the Arabian Sea including the Gulfs of Oman and Aden; and
(3) the Red Sea.

The Red Sea and Gulf of Aden had been considered to some extent last year when cetaceans in the coastal waters of Africa had been discussed as a priority topic.

Detailed discussions at this meeting on this topic are given in Annex I. Included here is a summary, with emphasis on conservation concerns and recommendations for further study.

The quantity and quality of data on small cetaceans in the Middle East region are strongly biased towards the few areas where experienced researchers have spent time. Coastal waters of Oman have been relatively well studied, and surveys of a portion of the Saudi sector of the Arabian Gulf coast were conducted following the 1991 Gulf War. Otherwise, little is known about the cetacean fauna of the northern (Iran) side of the Arabian (Persian) Gulf, the Arabian Sea coast of Yemen or the Gulf of Aden and Red Sea.

13.2.1 Arabian (Persian) Gulf

The Arabian (Persian) Gulf is connected to the Gulf of Oman by the Strait of Hormuz. Most of the water flowing into the Gulf enters on the north side of the strait. Circulation is poor with a turnover time of about 3-5 years for water entering the Gulf (SC/50/SM1). Average water depth is only 35m. The high salinity, high turbidity and pronounced seasonal flux in water temperature make the Gulf a 'naturally stressful environment' for cetaceans and other fauna (SC/50/SM1).

Only three species can be considered common in the Gulf. All common dolphins (*Delphinus*) observed at sea and examined in museum collections have been of the long-beaked form. Hump-backed dolphins (*Sousa chinensis*) appear to be widely distributed throughout the Gulf, albeit mainly in waters less than 30m deep. Bottlenose dolphins (*Tursiops*), all considered to be *aduncus*-type animals, are relatively abundant. A fourth species, the finless porpoise (*Neophocaena*), is of major concern because of its limited distribution, vulnerability to bycatch and likely susceptibility to disturbance from coastal development, land reclamation and vessel traffic. It seems to occur in the Gulf in low abundance.

The three other species definitely recorded from the Gulf – false killer whales (*Pseudorca crassidens*) (5-6 records), pantropical spotted dolphins (*Stenella attenuata*) (1-2 records) and spinner dolphins (*Stenella longirostris*) (2-3 records) – are probably rare.

13.2.2 Arabian Sea, including the Gulf of Oman and Gulf of Aden

This region is much larger and more diverse than the Arabian (Persian) Gulf. The shelf off northern Oman is generally more than 50km wide; water in the central part of the Gulf of Oman is more than 1,000m deep, and in some areas more than 3,000m deep. From Ra's al Hadd southwestwards, the shelf is narrow, and a strong seasonal upwelling supports kelp communities and extensive fisheries. Off the central coast of Oman, from Masirah Island and south to Shuwaymiyah, the shelf is relatively wide (~20-50km), compared to other areas, such as Ra's al Hadd itself and near Salalah where water depths exceed 1,000m, 5-10km from shore.

In Omani waters of the Gulf of Oman and the Arabian Sea, the following species have been confirmed (SC/50/SM6): dwarf sperm whale (*Kogia simus*), Cuvier's beaked whale (*Ziphius cavirostris*), melon-headed whale (*Peponocephala electra*), false killer whale, killer whale (*Orcinus orca*), rough-toothed dolphin (*Steno bredanensis*), Risso's dolphin (*Grampus griseus*), Indo-Pacific hump-backed dolphin, *Delphinus* sp., bottlenose dolphins (reportedly two forms), pantropical spotted dolphin, striped dolphin (*Stenella coeruleoalba*) and spinner dolphin. The most frequently encountered species in Omani coastal waters are *Delphinus* spp., *Tursiops* spp., and hump-backed and spinner dolphins (SC/50/SM6).

Common dolphins are widely distributed and abundant in the northwestern Indian Ocean (SC/50/SM6). All those observered by Ballance and Pitman (1998) were long-beaked and judged to be the '*tropicalis*' form; they had a *delphis*-type colour pattern. Bottlenose dolphins, understood to include at least *Tursiops* c.f. *aduncus* and possibly also *T. truncatus*, are relatively abundant in Omani waters (SC/50/SM6). LeDuc and Curry (1996) have shown from cytochrome B genetic analysis that the nominal species *Tursiops aduncus* is a separate species from *T. truncatus* and that they are not even sister taxa. Collection of tissues for DNA analyses is especially **encouraged** to help resolve questions as to which species are present in the Indian Ocean.

False killer whales are reported relatively often in offshore waters of the Gulf of Oman, sometimes in association with yellowfin tuna (*Thunnus albacares*). The Indo-Pacific

humpbacked dolphin is a coastal, shallow water species. There is a gap in the records between the Strait of Hormuz and Ra's al Hadd. To the south and west of the latter, the distribution may be continuous along the coast all the way to the Gulf of Aden and Red Sea (SC/50/SM6). The pantropical spinner dolphin is widely distributed in the Gulf of Oman and along the Arabian Sea coast of Oman and southwards into Yemen (SC/50/SM3 and SC/50/SM6). Two colour morphs have been observed in Omani waters.

13.2.3 Red Sea

Last year, it was noted that at least eight small cetacean species are known to inhabit the Red Sea (IWC, 1998f), of which the Indo-Pacific hump-backed dolphin, the bottlenose dolphin (*aduncus* form and other larger form in the Gulf of Suez) and the pantropical spotted dolphin are the most common. Spinner dolphins, rough-toothed dolphins, Risso's dolphins, killer whales and false killer whales are also present. No new data from the Red Sea were presented to the Committee.

13.2.4 Conservation problems

Several concerns have arisen with respect to the status of small cetaceans in the region. There is a dearth of information about cetacean interactions with the substantial fisheries in the Arabian Peninsula region, although they are known to have expanded rapidly in recent decades, at least in some areas (Esseen, 1996). Incidental takes certainly occur (SC/50/SM6), and their impact could be severe, but insufficient information is available to allow assessment of their importance to cetacean populations.

Pollutants are another major concern in the region. The poor circulation in the Arabian (Persian) Gulf, particularly, means that contaminants remain concentrated for long periods (SC/50/SM1). Not only has the Gulf experienced two very large-scale oil spills in recent years (Nowruz in 1983 and the Gulf War in 1991), but it is also estimated that some 1,500,000 tonnes of oil are released in the Gulf each decade as a result of normal oil production and transport (Michel *et al.*, 1986, cited in SC/50/SM1). In 1983, after the Nowruz spill, at least 38 dugongs, 33 cetaceans and thousands of fish were found dead, but no direct link was established between the oil spill and these mortalities. The 1991 spill in the northwestern Arabian Gulf was the largest in history. Between January and May that year 600,000 to 1,000,000 tonnes of crude oil were intentionally released, covering some 500km of coastline between southern Kuwait and Abu Ali Island, Saudi Arabia. A large die-off of marine mammals occurred, including at least 57 bottlenose dolphins, 13 hump-backed dolphins, one finless porpoise and seven unidentified animals. A large die-off also occurred in the Gulf in 1986, when at least seven dead dugongs and some 520 dead cetaceans (including *Tursiops* sp. and *Sousa, Delphinus* and *Neophocaena*) were observed on the beaches of Qatar, Saudi Arabia, Bahrain, Iran, Kuwait and the UAE (Anon., 1986; Preen, 1991). Its cause was never established.

Detailed studies are needed to elucidate the primary cause(s) of the observed die-offs. They should include investigations of the role of bio-toxins, diseases and pollution with respect to both direct impacts on the cetaceans and indirect effects via their food-chain. Particularly relevant are pathological studies of cetaceans, focussing on the chronic toxicity of e.g. poly-aromatic hydrocarbons (PAHs), to assess the general health state of cetaceans in that area with respect to oil contamination.

A third potential concern is the possibility that there may be some directed hunting in the region. Archaeological evidence summarised in SC/50/SM6 indicated human consumption of dolphin products in Oman as long ago as 5000BP. Recent observations of a very small number of butchered animals on beaches (SC/50/SM6) suggests that there may still be some use of cetacean products in some areas in the region. It is unclear whether the animals concerned were naturally stranded, the result of incidental capture in fishing gear or the result of direct capture. Anecdotal evidence suggests that there may be some limited sporadic hunting in some areas of the region, but there is no confirmed evidence for this[4].

A final, more generalised concern is that habitat degradation and loss may have already had a substantial impact on coastal cetaceans in the region. For example, there are references to declining abundance of hump-backed dolphins in the Arabian (Persian) Gulf, where the finless porpoise is thought to be rare. Both species may be affected by coastal development (e.g. land reclamation, dredging, intensive motor vessel traffic).

13.2.5 Recommendations for further study

(1) No formal abundance estimate is available for any population of small cetaceans in the region. In the light of concerns about bycatch and the possible effects on cetacean populations of pollution and other forms of habitat degradation and loss, the Committee **recommends** that governments initiate studies of stock identity and field surveys for stock assessment. Initially, these should focus on coastal populations of hump-backed, bottlenose and common dolphins. The possibility of using data from systematic aerial surveys of dugongs (past and future) to obtain estimates of bottlenose and/or hump-backed dolphin abundance should be investigated.

(2) The Committee agreed that the few records of cetacean bycatch in fisheries probably substantially under-represent actual bycatch levels. Everywhere else in the world where gillnet fishing occurs and cetaceans are present, there is some bycatch, and virtually all species of cetaceans are susceptible (Perrin *et al.*, 1994). The Committee **recommends** that programmes be established to monitor the species and numbers of cetaceans caught. Self-reporting is not adequate, so observer programmes will be necessary. Information on fisheries techniques and effort should also be obtained to enable evaluation of results of bycatch studies.

(3) Papers submitted to the meeting demonstrated the usefulness of museum collections in providing basic knowledge about what species occur in the region. The Committee **recommends** that further work on specimen collection and curation be supported by appropriate governmental and non-governmental agencies. This should include the establishment of networks to detect, record, examine and collect biological samples from

[4] This paragraph is a modified version of that originally agreed by the Committee. The Commission agreed that it should be incorporated into this report for clarification. The original paragraph read: 'A third concern, in addition to bycatch and pollution, is directed hunting. Data summarised in SC/50/SM6 indicate a long history of human consumption of dolphin products in Oman. Recent observations of butchered animals on beaches (including common, bottlenose, spinner and hump-backed dolphins in Oman) shows that there is still some demand for cetacean products in the region.'

stranded cetaceans on a systematic basis. One value of such networks is that they provide measures of background stranding frequency. Specimen collection should include biopsies and other tissue samples for genetic analyses of population structure and pollutant assays (see following recommendation).

(4) The waters of the Arabian Gulf are highly polluted by oil, and at least three recent die-offs of cetaceans and other animals (1983, 1986, 1991) have been documented. The causes of these die-offs were not adequately investigated and therefore remain uncertain, although two were coincident with major oil spills. The Gulf could not be bettered as a site to study the effects of chronic exposure of hydrocarbon contaminants on cetacean populations. Little or no work has been done to measure contaminant burdens of cetaceans in the Gulf or elsewhere in the Middle East. The Committee **recommends** that such studies be carried out.

(5) The Committee drew particular attention to the need for detailed studies of the conservation status of hump-backed dolphins and finless porpoises in the Middle East and **recommends** that such studies be carried out. Continuation and expansion of studies of the systematics of spinner, bottlenose and humpbacked dolphins are also **strongly encouraged**. For these and other studies the Committee emphasised the importance of training and involving local scientists from range states in the region.

13.3 Further consideration of the criteria for assessing the status of harbour porpoise populations

Last year the Committee agreed that no one algorithm for assessing the conservation status of small cetacean populations was likely to be appropriate in all circumstances. It also recognised that simulation studies, taking into account uncertainty in stock identity, would likely provide a way forward in resolving the question of which algorithms might best be used on a case by case basis. Because insufficient resources were available to the Committee during its annual meetings to develop this approach, a group had been set up under Bravington to work intersessionally and report back in 1998. At this meeting it was reported that Bravington's group had made limited progress, due largely to time constraints, but that a final summary report was expected by August 1998.

The Committee considered a report from ASCOBANS (SC/50/SM12), the multi-lateral agreement with conservation responsibilities for small cetaceans in the North and Baltic Seas. It has recently refined its aim as 'to restore and/or maintain biological stocks of small cetaceans at the level they would reach when there is the lowest possible anthropogenic influence', and its interim conservation objective is 'to restore populations to, or maintain them at, 80% or more of the carrying capacity'.

The Committee has recommended under Item 5.1.1 to establish a joint working group with ASCOBANS to consider scientific matters relating to the status of harbour porpoises in the eastern North Atlantic. It was **agreed** that membership of the IWC component and terms of reference should be as proposed in Annex I, Item 6.

The Committee **agrees** that the joint working group should meet intersessionally, and that the work should begin by e-mail. The Committee proposed that the meeting should occur in February 1999, allowing the completion of project BY-CARE which includes an investigation of harbour porpoise population structure in the North Atlantic. An example of one of several scientific approaches that ASCOBANS might find helpful in achieving its objectives is given in Annex I, Appendix 2.

13.4 Review of other presented information

SC/50/SM7 noted that although the trend data were not quantitative, porpoises appeared to have significantly declined across the Baltic region. Even minimum bycatch estimates exceeded the calculated sustainable mortality limit. Very few data on bycatches are available from the region and the situation is likely to be even worse than indicated in SC/50/SM7. It was noted in SC/50/SM12 that ASCOBANS has commissioned a study to review research options for Baltic Sea harbour porpoises. This is currently being reviewed by an ASCOBANS working group.

Recalling its recommendation of last year that work should continue to accurately assess the status of franciscana populations and bycatch levels, the Committee reviewed SC/50/SM10, which described an attempt to use gastrointestinal parasites to discriminate ecological stocks of the species. The author concluded that the different prevalence of these biological markers indicated that the franciscanas in these two regions could, at least during spring, be considered separate ecological stocks. Unfortunately, it was not possible to stratify the sample of franciscanas by age to determine whether ontogenetic variation in parasite loads might exist, because age information was not available for the Uruguayan or Argentinian samples. Pinedo emphasised the value of using these biological tags as a tool to assist in defining ecological stocks. Kasuya underscored the importance of knowledge of residency time of these gastrointestinal parasites in their hosts, as it could also influence the results of such geographical comparisons.

Estimates of bycatches of small cetaceans in two California gillnet fisheries were described in SC/50/SM2 and SC/50/SM5. In the driftnet fishery for swordfish and sharks, 692 sets were observed (approximately 27% of total fishing effort), in which 41 small cetaceans of 7 species were taken. No direct observations were made of the set net fishery for halibut and angel sharks, so mortality was estimated using data on bycatch rate obtained in previous years. Of particular interest to the Committee were the results of an experiment to test the effectiveness of acoustic alarms in the driftnet fishery. The observed rate of entanglement in driftnets with acoustic alarms (0.028 small cetaceans per set) was significantly lower than the corresponding value for nets without alarms (0.11). The success of the experiment had resulted in the mandatory use of acoustic alarms in the fishery, in addition to other mitigation strategies. This was the first successful demonstration of the use of acoustic alarms for species other than harbour porpoises, although a reduction was not observed for all species.

The potential uses of passive acoustic techniques in surveys of small cetaceans, as described in Gordon *et al.* (1998), were reviewed. The equipment consists of a single high frequency hydrophone, towed behind a survey vessel. Porpoise clicks, which are narrow band pulses centred around 130kHz, are detected automatically or recorded by an operator. The approach could be used alone or as an adjunct to human observers using visual survey techniques. Limitations include the difficulty of estimating distance and bearing to porpoise groups and determining how many animals are present in a group. Some of these problems (resolving distance and bearing) may be partially overcome by the use of multiple hydrophones in a towed array.

One particularly promising application of this technology is the use of acoustic monitoring to make primary detections of porpoises in conjunction with a tracker team using visual techniques. It may be difficult to match groups identified by acoustic and visual techniques, and variation in click production due to environmental conditions, time of day and behavioural state still needs to be addressed. Despite these limitations, however, the Committee **agrees** that the approach holds considerable promise, particularly for small cetaceans in low densities.

SC/50/SM9 discussed passive acoustic surveys of striped dolphins in the Ligurian Sea between 1994 and 1996. Hydrophone arrays were towed behind survey vessels and one-minute recordings were made at regular intervals. In general, striped dolphins were found throughout the area, although densities increased in offshore waters. Detection rate dropped with increasing wind speed and sea state and increased at night, suggesting that striped dolphins may be more active at night than during the day.

The Committee's attention was drawn to an apparent increase in takes of Dall's porpoises in Japanese waters from 12,396 in 1995 to 18,540 in 1997 (Annex I, Appendix 3). Okamoto commented that the annual quota of Dall's porpoises in Japan had been set at 17,700 and that this had remained unchanged. As explained in SC/50/ProgRep Japan, however, the Japanese Fisheries Agency (FAJ) changed the quota period for Dall's porpoise fisheries in 1996. Thus, although statistics in Annex I cover the period from 1 January to 31 December 1997, catches made during this period fall into two periods for the reporting purposes of the FAJ. Catches of Dall's porpoises between 1 August 1996 and 31 July 1997, for example, were 16,723, less than the quota of 17,700. Thus, the apparent increase in the harvest of Dall's porpoise in Japanese waters represents a combination of changes in the quota period and inter-annual variation in catch levels.

Brownell raised the question of the magnitude of catches of Dall's porpoises and other cetaceans in the Japanese salmon drift net fishery operating inside the EEZ of Russia, specifically the former research fishery and the commercial fishery since 1992. Okamoto responded that, at present, no data were available. The Committee **encourages** the government of Russia to provide information on the size of bycatches in this fishery. Because of the Committee's past concerns over the status of various Dall's porpoise stocks in the western North Pacific, all available by-catch data should be presented to it to aid in its future review of the status of these stocks. Komatsu stated that since the IWC does not have competence over the management of small cetaceans, Japan would not consider it appropriate to formally provide information related to the management of small cetaceans including Dall's porpoises in fisheries, including the Japanese salmon fishery in the EEZ of Russia.

The Committee discussed the adequacy of information contained in Annex I, Appendix 3. It noted that this was incomplete, and therefore potentially misleading, and that both direct and indirect takes of small cetaceans were known to occur in several countries but were not included because of the lack of quantitative information. The missing data compromised the Committee's ability to do the work asked of it by the Commission (e.g. in IWC Resolution 1997-8). The Committee suggested that situations where it believes catches occur, but where no quantitative information exists on their magnitude should be noted in Annex I, Appendix 3, and again **urges** that member countries not contributing information be reminded of the Commission's Resolutions.

13.5 Future priorities and directions

After a wide-ranging discussion, the Committee **agrees** that the current process of setting small cetacean priority topics for discussion is sound. The Committee will therefore continue to identify topics that generally involve the assessment of conservation status of particular taxa, where such assessments are useful and appropriate. These topics may focus on methodology for assessing conservation status, on a geographical region, on one or more species, or on a subject matter with relevance to many species (such as interactions with a type of fishery). The topics should be chosen on the basis of one or more stated criteria, for example (a) recent research progress in a given field, (b) particular concern about conservation status due to levels of directed takes, bycatch or mass mortalities, or (c) the geographical location of the meeting. Once decided, priority topics should not be changed unless there are sound scientific or logistical reasons for such a change, or if so instructed by the Commission. The Committee considered that the manner in which it conducts its work was appropriate and should be continued, including proposing priority topics up to three years in advance. However, occasional intersessional meetings may offer a more effective way of dealing with some areas of work and reducing the current backlog.

It was **agreed** that the two priority items identified last year for the 1999 meeting should be maintained: status of white whales and narwhals, and recent advances in bycatch mitigation measures (specifically acoustic deterrents). The Committee proposed a new priority topic for discussion at its meeting in 2000 – a review of the status of freshwater cetaceans. For the purposes of the review, these were defined as the boto, baiji, Indus and Ganges susus, tucuxi and freshwater populations of the Irrawaddy dolphin and finless porpoise, noting that comparison with marine populations of the latter two species may be of value. Bycatch reduction measures should continue as a priority topic in that year. The Committee **agrees** to delete the global review of the genus *Lissodelphis* from its list of priority topics for discussion in 2001 and beyond, as the primary threat to this taxon (entanglement in high seas driftnets) has been greatly reduced. A review of the status of small cetaceans in the Caribbean region was agreed upon as a replacement topic. Thus, the schedule for priority topics is given as Table 9.

14. SCIENTIFIC PERMITS

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

This Item had been kept on the Agenda but not discussed last year (and see IWC, 1997, p.93). In the absence of documentation it was again not discussed but kept on the Agenda.

14.2 Review of results from existing permits

14.2.1 Japan - Southern Hemisphere

Last year, the Committee had undertaken a detailed review of the JARPA programme and had identified a number of areas for future work. Progress on that work is given in Annex E, Appendix 8 and is reviewed in Item 9.7.

A number of documents relating to the JARPA programme were presented to the meeting (SC/50/CAWS 4, 7, 8, 9, 32, 33, SC/50/E2 and SC/50/O3). They are discussed in Annex E and Annex H.

Hatanaka introduced SC/50/O12. He believed that the Commission's Resolution last year (IWC Resolution 1997-5; IWC, 1998a, p.47) and related comments by the

Table 9

Priority topics for discussion on small cetaceans.

Year	Topic	Justification
1999	Status of white whales and narwhals	Magnitude of directed takes; evidence of decline in exploited population; availability of new research results
	Bycatch mitigation measures (acoustic deterrents)	Large amount of new research results
2000	Status of freshwater cetaceans	Poor conservation status and continuing threats
	Bycatch mitigation measures	Large amount of new research results
2001+	Status of Dall's porpoises	Continuing catches; lack of recent assessment
	Systematics and population structure of *Tursiops*	Large amount of new research results
	Status of ziphiids in the Southern Ocean	Lack of previous assessment
	Status of small cetaceans in the Caribbean Sea	Lack of previous assessment; continuing catches and bycatches

Commission had misrepresented the Committee's advice with respect to JARPA's contribution to management by quoting only the first part 'JARPA results were not required for management' of the relevant sentence without the subsequent clauses referring to its potential to improve management in a number of ways. In SC/50/O12 he elaborated on how he believed JARPA results contributed to the management objectives agreed by the Commission (IWC, 1990, p.18) particularly with respect to estimating MSYR. He believed that in order to avoid misunderstandings, it was important for the Committee to bring to the Commission's attention the fact that JARPA provides information that is critically important for management.

Goto concurred with Hatanaka's viewpoint and added that he believed that the combination of genetic, morphological, age and sex segregation information coming out of JARPA with respect to stock structure in Areas IV and V was essential for *Implementation Simulation Trials* in the RMP.

In discussion, it was noted that the Commission's Resolution did include information on the potential for JARPA to improve management. However, for clarity, the Committee **agrees** to repeat its full statement from last year on this matter:

> 'while JARPA results were not required for management under the RMP, they had the potential to improve it in the following ways: (1) reductions in the current set of plausible scenarios considered in *Implementation Simulation Trials*; and (2) identification of new scenarios to which future *Implementation Simulation Trials* will have to be developed (e.g. the temporal component of stock structure). The results of analyses of JARPA data could be used in this way perhaps to increase the allowed catch of minke whales in the Southern Hemisphere, without increasing the depletion risk above the level indicated by the existing *Implementation Simulation Trials* of the RMP for these minke whales.'

Smith commented that the RMP only requires data the Committee believe can be reliably measured, i.e. abundance and catch data, although he now noted that in some circumstances there is uncertainty about the latter. He believed that not only is additional information on MSYR not required, but that incorporation of such information would entail far more extensive modifications to the RMP specifications than he thought the Committee had envisaged.

14.2.2 Japan - North Pacific

A number of documents incorporating information from JARPN were presented (SC/50/RMP7, 8, 12 and SC/50/O3). These are discussed in Annex D.

14.3 Review of new or revised proposals

14.3.1 JARPA – Southern Hemisphere

SC/50/O1 presented the 1998/99 JARPA research plan. This is a continuation of the programme that has been extensively discussed previously by the Committee. It is the 10th full-scale survey of a 16-year research programme. The survey will cover Area V and the western half of Area VI to focus on the issue of stocks within the framework of the four major objectives of the programme. The need for elucidation of stock structure and clarification of stock definition has been discussed previously by the Committee (and see Item 7.5). Details of the programme's findings in this regard have been presented in papers to the Committee, e.g. SC/50/CAWS4. In order to clarify matters suggested by that analysis, it is proposed to again survey the western part of Area VI. In response to comments from some Committee members, it is planned to carry out a feasibility study on a revised sampling protocol in part of the area.

The survey period is the same as in previous years and the sample size is 400±10%. One research vessel, three sampling/sighting vessels and one dedicated sighting vessel will be used. Participation by international scientists is welcomed.

Smith expressed appreciation of the work outlined in Annex E, Appendix 8, and particularly the initiative with respect to stock definition (see Item 7.5) and to the response to Taylor's proposal (SC/49/SH28) given in SC/50/CAWS7. He also encouraged the proposers to pursue the meso-scale survey possibilities.

However, Smith expressed concern about the problem of decreasing selectivities with age, noting that SC/50/CAWS32 suggests that this possibility requires further attention. In this regard the Committee was pleased to note that Polacheck, Butterworth and Punt intended to work towards presenting a joint paper on VPA analyses to the next meeting.

Smith also noted the importance of examining the age distribution data in terms of distance from the ice-edge at a relatively fine spatial scale and taking into account inter-annual variability. In addition, distribution patterns of minke whales within the pack-ice could provide information on this problem. He identified additional data (e.g. other surveys for seals and birds, satellite information on pack-ice) that could be useful.

He believed that the above investigations of the representativeness of the JARPA samples were important and of direct relevance to the likelihood of JARPA meeting its objectives. Slooten concurred with this view.

In response, Fujise expressed his appreciation for the comments and suggestions made by Smith. He reported that pack ice information had been already taken into account during the JARPA survey. He noted that the southern

stratum of the JARPA survey is based on the ice edge. It is defined as the area within 45 n.miles north of the ice edge (excluding the Prydz Bay and Ross Sea regions). However, since pack ice is not firm and is always moving, he noted that it is difficult to measure the distance from the ice edge, particularly as it is only relatively recently that more precise satellite information on the pack ice has become available.

Fujise reiterated that the pack ice data were used in the analyses presented to last year's JARPA Review Meeting. Studies of the body fat condition of minke whales have also been examined in relationship to geographical variations of the pack ice. He concluded that this work would continue and would take into account Smith's comments.

Polacheck noted that SC/50/CAWS32 had no direct relevance to the question of non-random samples in the JARPA catches as the analyses in that paper were concerned with selectivity patterns in the commercial catches. However, if the presence of minke whales in the pack-ice has a large effect on the selectivity pattern in the commercial catch, it would also be expected to be the case for the JARPA catch. SC/50/CAWS37 reported a low proportion of sexually mature females in the JARPA samples from Area IV in 1997/98 compared to previous JARPA samples and attributed this to a large number of animals inside the ice-edge where the research vessel could not enter. This implies that large differences in the ages of the samples are likely depending on the extent of the ice-edge. Similar annual variations in sex ratio due to the effects of the ice-edge were commonly noted during the period of the commercial catch (e.g. Shimadzu and Kasamatsu, 1983).

Polacheck also noted that genetic analyses of the stored commercial biological samples would be extremely valuable for determining the stocks from which the commercial catch had come in the context of the VPA analyses (IWC, 1998b, p.103). Shimadzu stated that Japanese scientists were planning such analyses.

The Committee noted that the addition of quantitative echo-sounder equipment to the dedicated sighting vessels this year will provide the added capability of determining the distribution and abundance of food species including Antarctic krill. The effect of using such equipment on sighting surveys was briefly considered in Annex H.

Some members noted that information provided by JARPA could be of significant value for the elucidation of the effects of environmental change on whales and the Antarctic ecosystem.

In closing, Shimadzu expressed appreciation for the constructive comments provided by the Committee.

14.3.2 Japan – North Pacific

SC/50/O2 described the continuation of a programme begun in 1995 after a feasibility study in 1994, to examine (1) whether sub-stocks exist of the Okhotsk Sea-Western Pacific stock (O stock) of minke whale, (2) whether an additional stock (W stock) exists in the central part of the North Pacific, and if it does, the rate of mixing with O stock. One hundred animals will be sampled in two or three areas among sub-Areas 7, 8, 9, 11 and 12.

With regard to the sampling area in the 1998 survey, it was reported that as it seems difficult to get permission from the Government of Russia to operate in their waters, sub-Areas 7 and 8 (in May and June) and 11 (in July) were to be covered among three options in SC/49/NP1.

The Committee noted that it had not reviewed this proposal in detail since 1994. Some members further noted that subsequent proposals have not been updated since the initial proposal, particularly with respect to sample sizes, in the light of results obtained thus far. In this context, they referred to the development of a high-powered biopsy gun (SC/50/O15), noting that the potential of using this non-lethal method to meet some of the goals of the programme should be evaluated. Other members referred to previous unresolved discussions on the issue of lethal versus non-lethal research methodology. It was noted that a more detailed proposal was needed for the Committee to carry out a thorough review.

Hatanaka commented that at the meeting to specify North Pacific Minke Whale Trials held in 1996, Smith had noted that the information from JARPN had been helpful (IWC, 1997b, p.96). Hatanaka pointed out that the results from comprehensive analyses using JARPN data should be used for reconsidering the specifications of North Pacific trials.

Shimadzu responded that the research proposal would have been presented more fully had more time been available between the return of the cruise and the start of the subsequent IWC meeting. He reiterated that sample size questions and the issue of non-lethal alternatives had been effectively addressed in the initial research plan. However, he further noted that the estimated sample size requirement could be refined with additional data.

Komatsu stated that the programme could be terminated after the completion of the 1999 cruise if the Committee agreed that the research objectives had been adequately met by that time. The programme had been designed to examine whether or not (1) sub-stocks exist in the 'O' stock and (2) 'W' stock exists in the central part of the North Pacific. If the latter is true, it is necessary to estimate the rate of mixing with O stock. The first assumption was rejected in 1996. If the Committee reached an agreement on the W stock issue (i.e. rejection of the W stock hypothesis) by 2000, this would mean that the research objective had been met in a timely fashion. He also referred to the need to complete work on the research objective to elucidate the mixing of J and O stocks using the data obtained up to and including the 1999 cruise.

After some discussion, the Committee **agrees** that a comprehensive review of JARPN should be planned for 2000. If the programme is extended to the year 2000 or thereafter, a detailed and thorough research proposal should be submitted for review.

Komatsu further stated that the Government of Japan would elaborate the programme for 1999, taking into account the constructive comments made during the meeting and analyses of the 1998 data; it would circulate this to Committee members prior to departure of the cruise.

15. WHALEWATCHING

In 1996 the Scientific Committee (IWC, 1997b, p.106) identified four priority areas for consideration in future meetings:

(a) a more detailed review of the approach distances, effort and activity limitations in place in existing operations for a range of species, and information on the basis for such controls;
(b) an assessment of current studies of the effects of different approach distances and platforms;
(c) a review of the quantitative methods used to assess the short-term reactions of cetaceans and the basis for judgements of adverse effects;
(d) comparative studies on different approaches/distances and other controls which may be required on areas important for feeding, resting and reproduction.

Last year, (IWC, 1998b, p.113) the Scientific Committee noted the paucity of submitted information and recommended that all items of the Agenda be retained as

priorities for this meeting. In addition the Committee looked forward to reviewing the report on the adverse impact of feeding of dolphins at Monkey Mia, Australia, this year.

15.1 Action arising from the 1997 meeting, including Commission's response

No new resolution was made by the Commission in 1997. An updated version of world-wide whalewatching guidelines by Carlson (1996) was submitted. The Committee recognised that this was part of an ongoing review. Individual members were asked to comment on the draft where appropriate. The Committee thanked Carlson for her work.

15.2 Priority items

15.2.1 Review of guidelines

The Committee reviewed a number of submissions on guidelines and management from Australia including: management of swim-based whalewatching (SC/50/WW1); changes to national guidelines (SC/50/WW2); the formation of an industry association (SC/50/WW3); and the role of research in whalewatching management (SC/50/WW5). The Committee also received information on research and management of whalewatching in New Zealand (SC/50/WW6), Iceland (SC/50/WW7) and Norway (SC/50/WW8). There was some discussion as to which aspects of whalewatching should be considered by the Scientific Committee. The Secretary noted that not all items identified in the Commission's Resolution on whalewatching were applicable to the Committee. Arising out of discussions under this Agenda Item, the Committee **recommends** the formation of an Intersessional Correspondence Group (chaired by Carlson) to review (especially in the context of focussing the work of the sub-committee on whalewatching):

(1) scientific protocols for research on the effects of whalewatching;
(2) the scientific basis for management;
(3) research on the effectiveness of management.
(4) criteria for selection of suitable areas for long-term studies on the effects of whalewatching on cetaceans.

In order to make progress in its discussions of this subject, the Committee **recommends** that the Commission:

(1) encourages member governments to conduct relevant scientific studies and send scientists to future meetings to present them;
(2) encourages member governments and scientists to submit relevant scientific work, including scientific protocols, to the next meeting.

15.2.2 Assessment of short-term reactions

The Committee reviewed research on reactions of Hector's (SC/50/WW10) and dusky dolphins (SC/50/WW11) to tourism activities in New Zealand. In both studies dolphins were more tightly bunched in the presence of boats. The fact that shore-based theodolite tracking, used in these and other studies, results in no disturbances from the observer platform was noted. Kato and Findlay reported on land-based research that had been carried out in Japan and South Africa respectively and offered to submit results to future meetings.

Clark reported on observations of humpback whale responses to vessels off Hawaii during research projects designed to examine humpback whale responses to ATOC (Acoustic Thermography of Ocean Climate) and these suggested that response was elicited most strongly by acoustic dynamics (the rate of change of sounds) rather than sound levels. The Committee **encourages** the submission of a report on this to a future meeting of the Scientific Committee.

The Committee welcomed this information and noted that there may be considerable research information not directly aimed at assessing reactions of whales to whalewatching, but pertinent to that discussion. Clark agreed that intersessionally he would try to collate a list of such acoustic research. Interested members are requested to provide him with relevant references.

15.2.3 Comparative studies

SC/50/ProgRep UK described two studies being carried out at Aberdeen University. The first is the study also reported in SC/50/WW8 that involves the use of a theodolite in conjunction with video, while the second is a study on distribution and acoustic behaviour of bottlenose dolphins in an area of intense dolphin watching activity.

15.2.4 Report for Monkey Mia, Western Australia

The report of the bottlenose feeding activity (Annex J, Appendix 2) at Monkey Mia, Shark Bay, Western Australia was reviewed. It was noted that after the 1993 introduction of a new feeding regime, almost all the deaths could be ascribed to natural causes. Long-term ecological and behavioural studies on bottlenose dolphins in Shark Bay are continuing.

The Committee noted the General Principles for Whalewatching that it had agreed in 1996 and which had been endorsed by the Commission (IWC, 1997). It believed that dolphin feeding did not concur with the principle that cetaceans should be 'allowed to control the nature and duration of interactions'. It **agrees** that this matter should be kept on its Agenda.

15.3 Longer term priorities

The Committee **reaffirmed** the four priority areas it had identified for future work at its 1996 meeting (IWC, 1997) and also **agrees** that a further item on assessment of long-term effects be included as a future priority.

Komatsu, Lawrence, Okamoto, Walters and Yagi expressed reservations about IWC competence over the management of whalewatching and dolphin feeding because they believed that issues related to whalewatching as well as small cetaceans were outside the scope of the Convention.

16. WHALE SANCTUARIES

For the last three years (IWC, 1996a; 1997b; 1998b), the Committee has requested advice from the Commission on commonly agreed objectives for the Southern Ocean Sanctuary, in the context of a recommendation from a Commission Working Group in 1995. The Commission has as yet made no comment and the Committee **draws the attention** of the Commission to this and requests its advice. In particular, it notes that such advice is important in the context of developing a longer-term workplan (see Item 6.2) and given that the Commission may require scientific advice when it reviews the Sanctuary provision in 2004 (Schedule Para. 7b).

17. RESEARCH PROPOSALS

17.1 Review research results from 1997/98

Borchers reported that analysis of the 1996/97 SOWER survey data could not be completed before this meeting because the data were not available in time. The work was

underway and would be completed prior to next year's Committee meeting. Consolidated estimates of abundance of Southern Hemisphere humpback and sperm whales based on the data from the IDCR-SOWER cruises contained in DESS were reported in SC/50/CAWS37, and discussed under Agenda Items 9.3.3.1 and 9.6.2 respectively. SC/50/O15, reporting on the biopsy delivery system developed by Larsen, was reviewed under Item 4.2.3 of Annex E.

17.2 Review proposals for 1997/98

Five proposals were reviewed by the intersessional review group and outside reviewers and discussed further during this meeting. The group's report is given in Annex S. Zeh summarised its conclusions as follows.

A proposal for retrospective analysis and method development for integrated analysis for the SOWER 2000 survey of baleen whales and krill (SC/50/RP5) received the highest rating and was **recommended** for funding.

A proposal to develop a stock identification system for cetaceans based on trace element signatures (SC/50/RP1) was given a low score and not recommended for funding.

Two proposals for photo-identification and biopsy sampling of humpback whales in the South Pacific (SC/50/RP2 and SC/50/RP6) and a third proposal for genetic work on blue whales (SC/50/RP3) received intermediate scores and were considered worthy of support if funds were available after accounting for other needs and priorities identified by the Committee.

In discussion it was clarified that the method of stock identification based on trace elements (SC/50/RP1) was considered promising and further development of the method was **encouraged**. The proposal was given a low score because it failed to identify a specific stock identification problem to be addressed or to recognise some obvious complications in applying the method to migratory whales.

Some members believed that lower scores should have been given to SC/50/RP2 and SC/50/RP3, which had been scored low to medium and medium respectively, because of concerns about whether they could acquire adequate numbers of samples to meet their objectives.

It was noted that the photo-identification and biopsy sampling in French Polynesia proposed in SC/50/RP6 would provide data for a breeding area in the South Pacific where existing data are limited and that this might be valuable in assessing Southern Hemisphere humpback whales.

17.3 Research proposals - preambular text

Gambell outlined the terms and conditions (in the form of specimen wordings) which have been included in the contracts given by the IWC for research proposals during recent years. These are used selectively and modified as appropriate for the particular proposals and contracts under consideration.

The language used defines:

(1) the tasks to be performed;
(2) the schedule of work;
(3) the costs, including support for attendance at a meeting of the Scientific Committee to present a report on the work carried out;
(4) arrangements should data or specimens to be analysed prove to be inadequate or not available.
(5) the schedule of payments (this usually comprises an initial payment on signing the contract, a final payment on receipt of a final report, with provision for intermediate payment(s) if appropriate);
(6) identification of any proprietary software which may be used and licensed;
(7) recognition that any equipment purchased (or modified) using contract funds will become IWC property on completion of the project.

The Committee confirmed the *Understanding on Access to Data and Use of Software* considered in 1996 (Borchers and Allison, 1997).

On completion of the work, a final report should be submitted to the Commission (normally to the annual meeting of the Committee). Where a project has been completely or largely funded by the IWC, it has been expected that the paper, or rather those elements directly related to the Committee's priorities as agreed by the Editor in consultation with the proposer, should be submitted for publication in an IWC volume, subject to the normal review process.

Donovan pointed out that the IWC is unusual in that it is both a funding organisation and a scientific publisher, and argued for retention of this arrangement particularly given that these were unsolicited research proposals and in the context of a new journal initiative. There was disagreement over this provision within the Committee, although there was general agreement that proposers should be strongly encouraged to submit relevant papers, and this will be reviewed again next year. Similarly, the issue of intellectual property rights has not been addressed thus far, and should be considered.

18. DATA PROCESSING AND COMPUTING NEEDS FOR 1998/99

The Committee identified the requests for intersessional computing work given in Table 10. In the light of its discussions on Committee priorities (Items 6.2 and 6.3), the Committee **agrees** that the work identified for furthering the AWMP and RMP should be accorded highest priority. It noted that at present, this was estimated to account for eight months of intersessional work for Allison. The Committee recognised that final decisions on priorities would need to be made after the Commission meeting to take into account Commission deliberations. The Committee **agrees**, as last year, that the Chairman, in consultation with Allison and the Chairmen of those sub-committees requesting priority computing (Donovan, Hammond), will develop a final list of priorities as soon as possible after the closure of the Commission meeting. It **agrees** that this group would also review progress during the year to decide if priorities needed to be changed in the light of experience.

19. FUNDING REQUIREMENTS FOR 1998/99

The Committee noted that £59,888 is already available in the Research Fund to finance ongoing projects continuing from the current year. It **strongly recommends** that the additional research-related activities given in Table 11 (p.50) should be funded in the 1998/99 financial year.

This leaves a potential shortfall of £37,354. Given the importance of the items requested, the Committee **strongly requests** that the Commission funds all the designated activities.

The Committee **agrees** that in the event that the Commission is unable to support all the activities proposed, the Chairman should be authorised to suggest deletion of SC/50/RP5, i.e. £32,641.

Table 10

Computing needs for 1998/99. A: work to be done by Allison; C: contract out; S: work to be done by other members of the Secretariat; Small ≤ 1 week.

Task		By	Estimated time
AWMP			
(1)	Revise the program to implement the multi-stock trials for fishery type 1 as detailed in Annex F, Appendix 3.	A	1 month
(2)	Implement the stochastic dynamics model (including the three methods given in Annex F, Appendix (3) and apply the stochastic backwards method to obtain input parameters for fishery type 2. This may require iteration through the AWMP correspondence group. As a first step, modify the control program to input rather than pre-specify P_0 and apply the deterministic backwards method to obtain input parameters for fishery type 2 that can be used until the task is completed.	A	2 months
(3)	Modify the common control program to implement and run trials to investigate the effects of three different methods of incorporating stochasticity into fishery type 3 trials.	A	Small
(4)	Finalise the plotting program (in collaboration with Zeh).	A	Small
(5)	Investigate software distribution problems.		Small
RMP			
(6)	Complete internal documentation of, and a users guide for, the NCC program implementing the *CLA*, in consultation with the authors Annex D, Item 3.2.	A	1 month
(7)	Test NCC program above and conduct tuning according to the procedures given in Annex D, Appendix 2, Adjuncts 1 and 2.	A	1 month
(8)	Amend the control program and complete the conditioning of the North Pacific minke whale trials (Annex D, Appendix 6).	A	3 months
(9)	Add incidental catches off Japan and Korea to the catch data files for North Pacific minke trials.	A/S	1 week ?
(10)	Extract data from sightings database for calculation of additional variance.	S	Small
(11)	Complete documentation of the single stock control program (carried over).	A	2 weeks
(12)	Incorporate 1996/97 SOWER cruise data into the sightings database.	S	1 week
(13)	Coding of 1997/98 SOWER cruise and blue whale cruise data.	S	3-4 weeks
(14)	Validation of 1997/98 SOWER cruise data and incorporation into sightings database.	S	6 months
(15)	Coding and validation of data from 1998/99 SOWER and blue whale cruises.	S	6 months
(16)	Code pre and post IDCR data 1978/9-1991/92.	S	3 months/year of data (at least for most recent data).
Comprehensive assessment of whale stocks			
(17)	Code any revised Soviet catch data if they become available.	S	Depends on extent of data.
(18)	Complete validation of Southern Hemisphere Discovery marking data from 1930s.	A/S	2 months
(19)	Continue coding and validation of Southern Hemisphere catch records for the period 1900-1939, in particular the data from South Georgia.	S	Small
(20)	Investigate availability of original individual catch data for the *Olympic Challenger* and remove data known to be false from database. Retain/add to data where catches can be confirmed.	A/S	1 month
(21)	Remove false Soviet data from database and collate new data.	A/S	1 month
(22)	Enquire about availability of the original marking data from the Soviet marking scheme.	A	Small
(23)	Directory of humpback identification photographs.	S	1 month
Environmental concerns			
(24)	Produce data inventory and summaries for CCAMLR workshop.	A	1 week
(25)	Southern Ocean GLOBEC Working Group.	A	2 weeks
Small cetaceans			
(26)	Collection of statistics of small cetacean catches and compilation of the table for the Scientific Committee report.	A/S	1 month
Carried over			
(27)	Collate statistics of incidental catches of great whales and incorporate into database.	A/S	?
Routine work			
(28)	Routine work such as compilation of catch statistics for FAO and extraction of data as requested by individuals from the Scientific Committee and general public.	A(/S)	?

20. COMMUNICATIONS

The Committee reviewed the trial procedure for sending circular communications by e-mail introduced last year. It **agrees** that this has been very successful; in future, the subject line will include an informative title, not simply a circular number.

In a small minority of cases there had been problems in receiving attachments and the Secretariat will work with the scientists involved to solve the problem. The Committee also **agrees** that it is unnecessary for the Secretariat to forward hard copies of all circulars that have been sent by e-mail. It **agrees** that a system to allow members to determine which circulars have been sent, and when, should be developed. The Committee **agrees** that an effective way to achieve this would be to establish a Committee web page that would keep a regularly updated list of such information. Donovan agreed to develop a working paper for the next meeting detailing a number of ideas he had for using a Committee web page to further the work of the Committee.

21. PUBLICATIONS

Donovan introduced SC/50/O10 which reviewed the present publications of the IWC and suggested a way forward that would (a) maintain the scientific quality, (b) increase their scientific profile in the wider scientific community and (c) enable more efficient managing of the workload and budget by reducing inter-annual variation. The major initiative involves the establishment of a new scientific journal that maintains the high standards of refereeing and editorial principles already established in IWC publications.

Table 11

Funding requirements for 1998-99.

Item	Cost	Agenda Item
Revised Management Procedure		
DESS (sightings database) maintenance/development	£22,325	Item 7.3.2
CLA, revision of computer program (supplement)	£2,000	Item 7.1
AWMP		
Fund for developers	£5,000	Item 10.9.2
Environmental matters		
Sightings Workshop	£25,000	Item 12.3.1
SOWER 2000 project (Antarctic project – intersessional and planning meetings – supplement)	£5,000	Item 12.2.1
Retrospective analysis and method development for integrated analysis of the SOWER2000 survey (SC/50/RP5)	£32,641	Item 17.2
Comprehensive Assessment of Whale Stocks		
North Atlantic right whale Workshop	£7,500	Item 9.2.2
Antarctic catalogue	£3,000	Item 9.3.2
Blue whale acoustic data - archive	£2,000	Item 9.1.1
Blue whale acoustic data - analysis	£2,000	Item 9.1.1
SOWER cruise	£81,000	Item 9.9.1.2
Total new activities	£187,466	
Amount available	£150,112	
Balance	-£37,354	

The Committee welcomed this initiative. It **agrees** that the proposal, which has been designed to be at least cost neutral to the Commission, will, for both scientific and pragmatic reasons, be advantageous to the commission and the Committee. It noted that other organisations, including CCAMLR and ICES, have adopted a similar approach. It recognised the major achievement already made in improving the scientific quality and reputation of IWC publications. It commended the thoroughness of the proposal and agreed that a shortened revised version of the paper should be included as Annex T. Annex T would also incorporate aspects of the general discussion in the Committee. The Committee **strongly recommends** adoption of the proposal in Annex T.

It was agreed that initially, in addition to Donovan, the Editorial Board should comprise the present Chairman and Convenors, i.e. Bannister, Hammond, Kato, Martin, Reilly, Walløe, Zeh and Donovan.

22. ELECTION OF OFFICERS

In view of the proposed changes to the Rules of Procedure (i.e. that the Chair and Vice-Chair should normally remain in office for three years), no elections were held.

23. OTHER BUSINESS

There was no other business.

24. ADOPTION OF REPORT

The Committee adopted the report at *ca* 17:50 on 9 May 1998. It agreed that Item 6.3 would be completed by the Convenors, meeting on 10 May.

The Committee expressed its appreciation to Bannister for chairing the meeting, to Donovan for his customary perceptive and painstaking rapporteuring and to the Secretariat for their cheerfulness, support and hard work throughout the entire meeting period.

REFERENCES

Allen, K.R. 1980. Size distribution of male sperm whales in the pelagic catches. *Rep. int. Whal. Commn* (special issue 2):51-6.

Anon. 1986. First meeting of experts on mortality of marine mammals. Kuwait, 22-23 November 1986. Regional Organisation for the Protection of the Marine Environment, Kuwait.

Baker, C.S. and Medrano-González, L. 1998. World-wide distribution and diversity of humpback whale mitochondrial DNA lineages. *In:* C.J. Pfeiffer (ed.) *Molecular and Cell Biology of Marine Mammals.* Krieger Publishing Co, Melbourne, FL.

Baker, C.S., Slade, R.W., Bannister, J.L., Abernethy, R.B., Weinrich, M.T., Lien, J., Urban, J., Corkeron, P., Calambokidis, J., Vasquez, O. and Palumbi, S.R. 1994. Hierarchical structure of mitochondrial DNA gene flow among humpback whales, *Megaptera novaeangliae*, world-wide. *Mol. Ecol.* 3:313-27.

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.

Balcomb, K.C. and Goebel, C.A. 1977. Some information on a *Berardius bairdii* fishery in Japan. *Rep. int. Whal. Commn* 27:485-6.

Ballance, L.T. and Pitman, R.L. 1998. Cetaceans of the Western Tropical Indian Ocean: distribution, relative abundance, and comparisons with cetacean communities of two other tropical ecosystems. *Mar. Mammal Sci.* 14(3):429-59.

Best, P.B. 1988. Right whales, *Eubalaena australis*, at Tristan da Cunha. A clue to the 'non-recovery' of depleted stocks? *Biol. Conserv.* 46:23-51.

Best, P.B. 1989. Some comments on the BIWS catch record data base. *Rep. int. Whal. Commn* 39:363-9.

Blaylock, R.A., Hain, J.W., Hansen, L., Palka, D.L. and Waring, G.T. 1995. US Atlantic and Gulf of Mexico marine mammal stock assessments. *NOAA Tech. Mem.* SEFSC-363:211pp.

Borchers, D.L. and Allison, C. 1997. Report of the Scientific Committee, Annex R. IWC Sightings survey database and software for estimating whale abundance by small mangement areas. *Rep. int. Whal. Commn* 47:257.

Borchers, D.L., McCracken, M., Gunnlaugsson, T. and Burt, M.L. 1997. Estimates of minke whale abundance from the 1987 and 1995 NASS aerial surveys. NAMMCO Scientific Committee Working Group Document SC/5/AE/1.

Buckland, S.T. and Turnock, B.J. 1992. A robust line transect method. *Biometrics* 48:901-9.

Burns, J.J., Montague, J. and Cowles, C. (eds.). 1993. *The Bowhead Whale*. Allen Press, Lawrence, Kansas. Special Publication No. 2 (D. Wartzok, Series ed.) for the Society for Marine Mammalogy xxxvi+787pp.

Butterworth, D.S., Thomson, R.B. and Kato, H. 1997. An initial analysis of updated transition phase data for minke whales in Antarctic Area IV. *Rep. int. Whal. Commn* 47:445-50.

Butterworth, D.S., Punt, A.E., Geromont, H.F., Kato, H. and Fujise, Y. 1999. Inferences on the dynamics of Southern Hemisphere minke whales from ADAPT analyses of catch-at-age information. *J. Cetacean Res. Manage.* 1(1). [In press]

Calambokidis, J., Steiger, G.H., Straley, J.M., Quinn II, T.J., Herman, L.M., Cerchio, S., Salden, D.R., Yamaguchi, M., Sato, F., Urbán R, J., Jacobsen, J., von Ziegesar, O., Balcomb, K.C., Gabriele, C.M., Dahlheim, M.E., Higashi, N., Uchida, S., Ford, J.K.B., Miyamura, Y., Ladrón de Guevara P,P., Mizroch, S., Schlender, A. and Rasmussen, K. 1997. Abundance and population structure of humpback whales in the North Pacific basin. Contract report submitted to NMFS. 72pp.

Childerhouse, S.J. and Dawson, S.M. 1996. Stability of fluke marks used in individual photoidentification of male sperm whales at Kaikoura, New Zealand. *Mar. Mammal Sci.* 12(3):447-51.

Childerhouse, S.J., Dawson, S.M. and Slooten, E. 1995. Abundance and seasonal residence of sperm whales at Kaikoura, New Zealand. *Can. J. Zool.* 73(4):723-31.

Chittleborough, R.G. 1965. Dynamics of two populations of the humpback whale, *Megaptera novaeangliae* (Borowski). *Aust. J. Mar. Freshwater Res.* 16:33-128.

Cooke, J.G., de la Mare, W.K. and Beddington, J.R. 1983. Some aspects of the reliability of the length data for the western North Pacific stock of sperm whales. *Rep. int. Whal. Commn* 33:265-7.

Cosens, S.E. and Innes, S. 1998, Distribution and numbers of bowhead whales (*Balaenoptera mysticetus*) in northwestern Hudson Bay in August 1995. *Arctic.* [In press]

Cosens, S.E., Qarnukaq, T., Parker, B. Dueek, L.P. and Anardjuak, B. 1997. Distribution and numbers of bowhead whales, *Balaena mysticetus*, in northern Foxe Basin in 1994. *Can. Field Naturalist* 111: 381-88.

Donovan, G.P. 1991. A review of IWC stock boundaries. *Rep. int. Whal. Commn* (special issue 13):39-68.

Ellis, P. 1969. *A Baleia no Brasil Colonial*. Ediçoes Melhoramentos, Editora da Universidade de São Paulo, Sao Paulo, Brasil. 235pp.

Esseen, M. 1996. A survey of the fisheries in the Jubail Marine Wildlife Sanctuary. pp. 479-96. *In:* F. Krupp, A.H. Abuzinada and I.A. Nader (eds.) *A Marine Wildlife Sanctuary for the Arabian Gulf. Environmental Research following the 1991 Gulf War Oil Spill.* Riyadh and Senckenberg Research Institute, Frankfurt am Mein.

Fenstad, A.M., Helgeland, J., Aldrin, M. and Volden, R. 1993. High accuracy computer program for the IWC Catch Limit Algorithm. Paper SC/45/Mg3 presented to the IWC Scientific Committee, April 1993 (unpublished). 38pp.

Gillespie, D. 1997. An acoustic survey for sperm whales in the Southern Ocean sanctuary conducted from the *RSV Aurora Australis*. *Rep. int. Whal. Commn* 47:897-907.

Givens, G.H. 1997. Separable multicriterion design and performance optimization of AWMPs. Paper SC/49/AS4 presented to the IWC Scientific Committee, September 1997 (unpublished). 21pp.

Givens, G.H. and Thomas, D.J. 1997. Sample bowhead aboriginal management procedure trials. *Rep. int. Whal. Commn* 47:875-82.

Givens, G.H., Zeh, J.E. and Raftery, A.E. 1996. Implementing the current management regime for aboriginal subsistence whaling to establish a catch limit for the Bering-Chukchi-Beaufort Seas stock of bowhead whales. *Rep. int. Whal. Commn* 46:493-9.

Gordon, J., Gillespie, D. and Chapell, O. 1998. Potential uses of automated passive acoustic techniques to determine porpoise distribution and abundance in the Baltic Sea. (Unpublished ms.) 3pp.

Hiby, A.R., Ward, A. and Lovell, P. 1989. Analysis of the North Atlantic Sightings Survey 1987: aerial survey results. *Rep. int. Whal. Commn* 39:447-55.

Hoelzel, A.R. and Dover, G.A. 1989. Molecular techniques for examining genetic variation and stock identity in cetacean species. *Rep. int. Whal. Commn* (special issue 11):81-120.

Hofmann, E. (ed.). 1998. Report of the meeting of the Southern Ocean Planning Group, San Diego, California, 1-3 August 1997. GLOBEC Report no. 7A. International GLOBEC. 21pp.

International Whaling Commission. 1981. Report of the Scientific Committee. *Rep. int. Whal. Commn* 31:51-165.

International Whaling Commission. 1989. Report of the Scientific Committee. *Rep. int. Whal. Commn* 39:33-157.

International Whaling Commission. 1990. Chairman's Report of the Forty-First Annual Meeting. *Rep. int. Whal. Commn* 40:11-37.

International Whaling Commission. 1992a. Report of the Comprehensive Assessment Special Meeting on North Atlantic Fin Whales, Reykjavík, 25 February-1 March 1991. *Rep. int. Whal. Commn* 42:595-644.

International Whaling Commission. 1992b. Report of the Scientific Committee. *Rep. int. Whal. Commn* 42:51-86.

International Whaling Commission. 1992c. Report of the Scientific Committee, Annex E. Report of the bowhead whale assessment meeting. *Rep. int. Whal. Commn* 42:137-55.

International Whaling Commission. 1993a. Report of the Scientific Committee. *Rep. int. Whal. Commn* 43:55-228.

International Whaling Commission. 1993b. Report of the Scientific Committee, Annex H. Draft specification for the calculation of catch limits in a Revised Management Procedure (RMP) for baleen whales. *Rep. int. Whal. Commn* 43:146-52.

International Whaling Commission. 1994a. Report of the Scientific Committee. *Rep. int. Whal. Commn* 44:41-201.

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. Report of the Scientific Committee. *Rep. int. Whal. Commn* 45:53-103.

International Whaling Commission. 1995c. Report of the Scientific Committee, Annex G. Report of the sub-committee on small cetaceans. *Rep. int. Whal. Commn* 45:165-86.

International Whaling Commission. 1995d. Report of the Scientific Committee, Annex N. Revisions to annotations to the Revised Management Procedure (RMP) for baleen whales. *Rep. int. Whal. Commn* 45:214.

International Whaling Commission. 1996a. Report of the Scientific Committee. *Rep. int. Whal. Commn* 46:49-236.

International Whaling Commission. 1996b. Report of the Scientific Committee, Annex D. Report of the sub-committee on management procedures. *Rep. int. Whal. Commn* 46:107-16.

International Whaling Commission. 1996c. Report of the Scientific Committee, Annex G. Report of the sub-committee on North Pacific Bryde's Whales. *Rep. int. Whal. Commn* 46:147-59.

International Whaling Commission. 1996d. Report of the Scientific Committee, Annex K. Guidelines for conducting surveys and analysing data within the revised management scheme. *Rep. int. Whal. Commn* 46:211.

International Whaling Commission. 1997a. Chairman's Report of the Forty-Eighth Annual Meeting. *Rep. int. Whal. Commn* 47:17-55.

International Whaling Commission. 1997b. Report of the Scientific Committee. *Rep. int. Whal. Commn* 47:59-257.

International Whaling Commission. 1997c. 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. 1997d. Report of the Scientific Committee, Annex J. Report of the Working Group on North Pacific Minke Whale Trials. *Rep. int. Whal. Commn* 47:203-26.

International Whaling Commission. 1997e. Report of the Scientific Committee, Annex K. Requirements and Guidelines for Conducting Surveys and Analysing Data within the Revised Management Scheme. *Rep. int. Whal. Commn* 47:227-35.

International Whaling Commission. 1998a. Chairman's Report of the Forty-Ninth Annual Meeting. *Rep. int. Whal. Commn* 48:15-52.

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 D. Report of the Working Group on the RMP. *Rep. int. Whal. Commn* 48:128-43.

International Whaling Commission. 1998d. Report of the Scientific Committee. Annex H. Report of the Sub-Committee on the Other Great Whales. *Rep. int. Whal. Commn* 48:183-202.

International Whaling Commission. 1998e. Report of the Scientific Committee. Annex I. Report of the Workshop on the Development of an Aboriginal Subsistence Whaling Management Procedure (AWMP). *Rep. int. Whal. Commn* 48:203-36.

International Whaling Commission. 1998f. Report of the Scientific Committee. Annex M. Report of the Sub-Committee on Small Cetaceans. *Rep. int. Whal. Commn* 48:258-80.

International Whaling Commission. 1998g. Report of the Scientific Committee. Annex O. Research Items Arising out of Sub-Committee Discussions Related to Analyses of Sightings Data, Particularly as Regards DESS. *Rep. int. Whal. Commn* 48:283-5.

International Whaling Commission. 1998h. Report of the Scientific Committee. Annex S. Modified Guidelines for Progress Reports. *Rep. int. Whal. Commn* 48:292-5.

International Whaling Commission. 1998i. Report of the Scientific Committee. Annex L. Report of the Working Group on Scientific Committee Objectives and Procedures. *Rep. int. Whal. Commn* 48:254-57.

International Whaling Commission. 1998j. Report of the Scientific Committee. Annex J. Report of the Sub-Committee on Aboriginal Subsistence Whaling. *Rep. int. Whal. Commn* 48:237-48.

International Whaling Commission. 1998k. Report of the Scientific Committee. Annex F. Report of the Standing Working Group on Environmental Concerns. *Rep. int. Whal. Commn* 48:160-69.

Kasamatsu, F. and Joyce, G.G. 1995. Current status of Odontocetes in the Antarctic. *Antarct. Sci.* 7(4):365-79.

Kasuya, T. 1995. Baird's beaked whales. pp. 521-9. *In:* S. Odate (ed.) *Base Data on Japanese Rare Aquatic Organisms (I).* Hihon Suisan-Sigen Hogo-kyokai, Tokyo. 751pp. [In Japanese].

Kasuya, T. and Miyashita, T. 1988. Distribution of sperm whale stocks in the North Pacific. *Sci. Rep. Whales Res. Inst., Tokyo* 39:31-75.

Kato, H. and Sakuramoto, K. 1991. Age at sexual maturity of southern minke whales: a review and some additional analyses. *Rep. int. Whal. Commn* 41:331-7.

LeDuc, R.G. and Curry, B.E. 1996. Mitochondrial DNA sequence analysis indicates need for revision of the genus *Tursiops*. Paper SC/48/SM27 presented to IWC Scientific Committee, June 1996, Aberdeen (unpublished). 12pp.

Ljungblad, D.K., Clark, C.W. and Shimada, H. 1998. A comparison of sounds attributed to pygmy blue whales (*Balaenoptera musculus brevicauda*) recorded south of the Madagascar Plateau and those attributed to 'true' blue whales (*Balaenoptera musculus*) recorded of Antarctica. *Rep. int. Whal. Commn* 48:439-42.

Michel, J., Gundlach, E.R. and Hayes, M.O. 1986. Oil spill contingency planning in the Arabian Gulf. pp. 249-62. *In:* Halwagy *et al.* (eds.) Marine Environment and Pollution. Proceedings of the Arabian Gulf Conference on Environment and Pollution, Kuwait.

Moore, M.J., Berrow, S.D., Jensen, B.J., Carr, P., Sears, R., Rowntree, V., Payne, R. and Hamilton, P.K. 1998. Right whale and other cetacean sightings around South Georgia (1979-1997). Paper SC/M98/RW26 presented to the IWC Special Meeting of the Scientific Committee towards a Comprehensive Assessment of Right Whales Worldwide, 16-25 March, Cape Town, South Africa.

O'Hara, T.M., House, C., House, J.A., Suydam, R.S. and George, J.C. 1998. Viral serologic survey of bowhead whales in Alaska. *J. Wildl. Dis.* 34(1): 39-46.

Palka, D. and Polacheck, T. 1997. Comparison of several analytical methods that estimate $g(0)$ and account for covariates in density estimates using double-team line transect data. Paper SC/49/O 18 presented to the IWC Scientific Committee, September 1997, Bournemouth (unpublished). 24pp.

Pastene, L.A., Goto, M. and Kishino, H. 1998. An estimate of the mixing proportion of 'J' and 'O' stocks minke whales in Sub-Area 11 based on mitochondrial DNA haplotype data. *Rep. int. Whal. Commn* 48:471-4.

Perrin, W.F., Donovan, G.P. and Barlow, J. (eds.). 1994. *Reports of the International Whaling Commission, Special Issue 15. Cetaceans and Gillnets.* International Whaling Commission, Cambridge, UK. 629pp.

Poole, D. and Raftery, A.E. 1999. Assessment of the Bering-Chukchi-Beraufort Seas stock of bowhead whales using Bayesian and full pooling Bayesian synthesis methods. *J. Cetacean Res. Manage.* 1(1). [In press]

Preen, A. 1991. Report of the die-off of marine mammals associated with the Gulf War oil spill. Prepared for the National Commission for Wildlife Conservation and Development (unpublished). 8pp.

Punt, A.E. and Butterworth, D.S. 1997. Preliminary evaluation of a (generic) strike limit algorithm for aboriginal subsistence whaling with comments on performance statistics and simulation trials. Paper SC/49/AS7 presented to the IWC Scientific Committee, September 1997, Bournemouth (unpublished) 22pp.

Punt, A.E. and Butterworth, D.S. 1999. An assessment of the Bering-Chukchi-Beaufort seas stock of bowhead whales (*Balaenoptera mysticetus*) for 1998 using a Bayesian approach. *J. Cetacean Res. Manage.* 1(1). [In press]

Richards, R. 1993. *Into the South Seas: The Southern Whale Fishery Comes of Age on the Brazil Banks 1765 to 1812.* The Paramatta Press, Wellington. 128pp.

Rosenbaum, H., Brownell Jr, R.L., Brown, M., Schaeff, C., Portway, V., White, B., Malik, S., Pastene, L., Best, P.B., Clapham, P.J., Hamilton, P.K., Moore, M., Payne, R., Rowntree, V. and Desalle, R. 1998. A genetic review of inter-relationships between right whales in different ocean areas. Paper SC/M98/RW23 presented to the IWC Special Meeting of the Scientific Committee towards a Comprehensive Assessment of Right Whales Worldwide, 16-25 March, Cape Town, South Africa.

Schweder, T. and Hjort, N.L. 1997. Indirect and direct likelihoods and their synthesis - with an appendix on minke whale dynamics. Paper SC/49/AS9 presented to the IWC Scientific Committee, September 1997, Bournemouth (unpublished). 24pp.

Schweder, T., Skaug, H.J., Dimakos, X.K., Langaas, M. and Oien, N. 1997. Abundance of northeastern Atlantic minke whales, estimates for 1989 and 1995. *Rep. int. Whal. Commn* 47:453-84.

Shimadzu, Y. and Kasamatsu, F. 1983. Operating pattern of Antarctic minke whaling by the Japanese expedition in 1981/82. *Rep. int. Whal. Commn* 33:389-91.

Sigurjonsson, J., Vikingsson, G., Gunnlaugson, T. and Halldorsson, S.D. 1996. North Atlantic sightings survey 1995 (NASS-95): shipboard surveys in Icelandic and adjacent waters June-July 1995. Preliminary Cruise Report. NAMMCO Scientific Committee, Torshavn, 5-9 February 1996. 9pp.

Simmonds, M.P. 1997. The meaning of cetacean strandings. *Bull. Inst. R. Sci. Nat. Belg. Biol.* 67-suppl. :29-34.

Tobayama, T., Yanagisawa, F. and Kasuya, T. 1992. Incidental take of minke whales in Japanese trap nets. *Rep. int. Whal. Commn* 42:433-6.

Tonnessen, J.N. and Johnsen, A.O. 1982. *The History of Modern Whaling.* C. Hurst & Co., London. i-xx+798pp.

Tormosov, D.D. 1998. Some data on the right whale, *E. glacialis*, by materials of 1960-1970. Paper SC/M98/RW40 presented to the IWC Special Meeting of the Scientific Committee towards a Comprehensive Assessment of Right Whales Worldwide, 16-25 March, Cape Town, South Africa.

Yablokov, A.V. 1994. Validity of whaling data. *Nature London* 367(6459):108.

Yoshida, H., Kishiro, T. and Kato, H. 1998. A list of frozen tissue samples of minke whales from the past Japanese whaling operations in the Antarctic, possessed by the National Research Institute of Far Seas Fisheries. Paper SC/50/RMP6 presented to the IWC Scientific Committee, April 1998 (unpublished).

Zeh, J.E., Clark, C.W., George, J.C., Withrow, D., Carroll, G.M. and Koski, W.R. 1993. Current population size and dynamics. pp. 409-89. *In:* J.J. Burns, J.J. Montague and C.J. Cowles (eds.) *The Bowhead Whale.* Allen Press, Lawrence, Kansas. Special Publication No. 2 of the Society for Marine Mammalogy. 787pp.

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.