Report of the Scientific Committee

The meeting was held at the Grande Beach Resort, Grenada, West Indies, from 3-15 May 1999, 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 deaths of three scientists, all connected in various ways with the work of the Committee. Professor David Gaskin, a friend and colleague of a number of members, had contributed particularly to the work of the sub-committee on Small Cetaceans in past years. Professor Ken Norris, friend, colleague and mentor to many members, had influenced cetacean science, including the Committee's work, over many years. John Prescott was well remembered as the host of the Special Meeting on Right Whales in Boston, 1983. The meeting observed a period of silence in their memory.

2. MEETING ARRANGEMENTS

2.1 Appointment of rapporteurs

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

2.2 Meeting procedures and time schedule

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

2.3 Establishment of sub-committees

A number of sub-committees were established in addition to the two Standing Working Groups and the Standing sub-committee on small cetaceans. Reports are given as:

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

Annex E – Standing Working Group on the development of the Aboriginal Whaling Management Procedure (AWMP)

Annex F – sub-committee on aboriginal subsistence whaling (AS)

Annex G – sub-committee on the Comprehensive Assessment of other whale stocks (CAWS)

Annex H – Standing Working Group on environmental concerns (E)

Annex I – standing sub-committee on small cetaceans (SM)

Annex J – sub-committee on whalewatching (WW).

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

2.4 Computing arrangements

Allison outlined the computing facilities available which included several personal computers. In addition, printing facilities were available for delegate use.

3. ADOPTION OF AGENDA

The draft Agenda prepared by the Chairman took account of the seven priority areas agreed last year (IWC, 1999d, pp.5-6). It also included the Commission's acceptance of the Committee's work plan and initial agenda for 1999 (IWC, 1999a) and concentrated particularly on those items accepted by the Commission. An updated list cross-referencing Committee Agenda items to those of the Commission is given as Annex B2. The adopted Agenda is given as Annex B1. Statements on the Agenda are given in Annex T.

4. REVIEW OF AVAILABLE DATA, DOCUMENTS AND REPORTS

4.1 Documents submitted

The list of documents is given as Annex C.

4.2 National progress reports on research

The Committee reaffirmed its view of the importance of national progress reports and **recommends** that the Commission continues to urge member nations to submit them following the approved guidelines (IWC, 1998g). A summary of the information included in the reports is given as Annex K.

4.3 Data collection, storage and manipulation

4.3.1 Catches and other statistical material

Table 1 lists data received by the Secretariat since the 1998 meeting.

4.3.2 Progress of data coding projects

Allison reported good progress on data coding projects. Coding and validation of data from the International Marking Scheme in the Southern Hemisphere is now

Table 1
List of data and programs received by the IWC Secretariat since the 1998 meeting.

Date	From	IWC ref.	Comments
Catch data			
28 Apr. 1999	Norway: N. Øien	E24	Individual catch records from the Norwegian 1998 commercial catch.
3 May 1999	Japan:		Individual catch records from the Japanese 1997/98 Antarctic Special Permit catch.
7 May 1999	Japan:		Individual catch records from the Japanese 1998 North Pacific Special Permit catch.
Sightings data			
11 Nov. 1998	Iceland: Ministry of Fisheries	E21	Permission for Icelandic shipboard sightings data in CM area from NASS-87 and NASS-95 surveys to be available to accredited Scientific Committee members for stock assessment purposes.
10 Apr. 1999	P. Ensor	E22	1998/99 SOWER cruise data (sightings, effort, weather, ice-edge and cruise tracks).
3 May 1999	Japan: T. Miyashita	D165-9	North Pacific JSV data (1965-89).
Programs			
26 Mar. 1999	Norway: M. Aldrin	E23	Revised program for *CLA* implementation.

virtually complete. In addition, coding of Southern Hemisphere catch data from the Natural History Museum, London is almost complete and is being validated.

4.3.3 Progress on program verification projects

Allison reported on progress with the computing work identified last year (IWC, 1999d, p.49).

(1) AWMP.
The Common Control Program to implement multi-stock aboriginal subsistence whaling trials has been completed. Work has begun on implementing a stochastic model in the Fishery Type 2 trials, but has not been completed. These items are discussed under Item 8.

(2) RMP *Catch Limit Algorithm*.
During the intersessional period, the Norwegian Computing Centre (NCC) was contracted to complete a recoding of the *CLA* program (IWC, 1999d, p.6; IWC, 1999e, p.80). Shortly before the meeting, the NCC submitted to the Secretariat a program implementing the *CLA*, together with technical and internal documentation. Smith had successfully compiled and run the program, but there had not been time to do any further testing. This item is discussed under Item 6.1.

(3) RMP implementation.
The program for conditioning and running the North Pacific minke whale trials specified in IWC, 1999e, p.86-99 has been implemented. Results for the base-case trials were circulated to the intersessional steering group, and following their advice a complete set of trials was run. This is discussed under Item 7.1.

(4) SOWER data.
Validation of the 1997/98 SOWER sightings cruise data is progressing. The sightings database contract (IWC-DESS) is discussed further under Item 6.3.2.

4.3.4 Whale marking, including artificial and natural marks

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

New information on Soviet recoveries was presented in SC/51/CAWS42.

5. COOPERATION WITH OTHER ORGANISATIONS

5.1 CMS-Scientific Council

The report of the IWC observer at the Eighth Meeting of the CMS Scientific Council, Wageningen, The Netherlands, is given as IWC/51/10A.

Agenda items of relevance to cetaceans considered draft proposals to include the Southeast Asian populations of three dolphin species (*Stenella longirostris*, *S. attenuata* and *Lagenodelphis hosei*) taken incidentally in fisheries; these proposals will be formally submitted by the Philippines to the next Conference of the Parties in November 1999.

The IUCN Conservation Monitoring Centre reviewed Appendix II species and recommended: (1) the inclusion of Platanista gangetica in Appendix I; (2) that *Balaenoptera borealis* and *B. physalus* (currently not in the Appendices) be considered for addition to Appendix I; and (3) that *Pontoporia blainvillei* be considered for removal from Appendix I.

A report entitled 'Review of the conservation status of small cetaceans in southern South America' was submitted and copies are available from the Secretariat.

The CMS-sponsored Workshop considering the conservation of the franciscana dolphin in the southwestern Atlantic had made progress toward the development of a Memorandum of Understanding for conservation and management. The Proceedings of the Workshop will be published in the CMS Technical Series.

Several preliminary proposals on small cetaceans were approved for funding: (1) survey of shared dolphin populations in the Timor and Arafura Seas; (2) survey of small cetaceans in the Gulf of Tonkin; (3) a training workshop on the conservation and management of small cetaceans of West Africa; and (4) investigation of conservation status of small cetaceans in Senegal and the Gambia.

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

It was noted that consideration as to whether to list sei and fin whales on Appendix I will proceed on a stock-by-stock basis. The Committee endorsed this approach and agreed that the Secretariat would supply relevant available information if requested to do so.

5.1.1 ASCOBANS

The report of the IWC observer at the 1999 ASCOBANS Advisory Committee meeting, Aberdeen, UK is given as IWC/51/10H. A number of issues relevant to the Scientific Committee were raised. These included: consideration of the joint IWC/ASCOBANS workshop on harbour porpoises; issues related to the bycatch of harbour porpoises, including a proposed workshop on mitigation measures; general research matters including assessment of the status of harbour porpoises; whalewatching; the effects of seismic surveys on cetaceans; the effects of high speed ferries on cetaceans; a post-mortem research and stranding scheme;

and the IWC pollution research proposal. The success of the joint IWC/ASCOBANS working group was recognised and ASCOBANS looked forward to continued cooperation with the IWC on matters of mutual scientific interest. In this regard, the IWC observer had agreed to participate in a number of intersessional correspondence groups on such matters.

Several of the issues raised by this observer report were considered by the relevant sub-committees (see Annexes H, I and J).

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

5.2 ICES

The report of the IWC observer at the 1998 ICES Annual Science Conference (the 86th Statutory Meeting of ICES), Cascais, Portugal is given as IWC/51/10C.

Following the restructuring noted last year (IWC, 1999d, p.3), the two newly established Working Groups met in 1998. The Working Group on Marine Mammal Population Dynamics and Trophic Interactions (WGMMPD) addressed questions concerning marine mammal bycatches and cetacean trophic ecology, and reviewed methods for monitoring bycatch on vessels too small to carry observers. Focal species that may support collaborative ICES/IWC efforts included harbour porpoise, bottlenose dolphin and white whale.

The Working Group on Marine Mammal Habitats (WGMMHA) discussed effects of contaminants and acoustic disturbance on marine mammal populations. The former drew heavily on the report of the IWC Bergen Workshop and the subsequent research proposal (Aguilar *et al.*, 1999). The latter was endorsed by the Working Group. WGMMPD and WGMMHA held one joint session where marine mammal aspects of the ICES five-year plan were discussed.

The two groups met again in March 1999. WGMMPD addressed questions related to cetacean diet, marine mammal-fishery interactions and the seasonal/spatial distribution and abundance of several focal species including the harbour porpoise, bottlenose dolphin and white whale. Donovan had been invited to participate in WGMMHA which had reviewed progress in studies of marine mammal habitat requirements and had developed detailed plans for research on cause-effect relationships between contaminants and pinnipeds, using the outline IWC proposal (Aguilar *et al.*, 1999) as a basis for discussion. The possibility of seeking joint funding was raised. This is also considered under Item 11.1 and in Annex H.

The theme of the next Annual Science Conference will be the use of electronic tags.

The Committee thanked Haug for attending the meeting. It was agreed that the Secretariat would consult with Norwegian scientists to determine an appropriate representative at the next Annual Science Conference.

5.3 IATTC

Tillman had acted as IWC observer at the 59th meeting of the Inter-American Tropical Tuna Commission but circumstances prevented him submitting a report to the Committee before the end of the meeting. The Committee reiterated the importance it attached to cooperation with IATTC, particularly in the context of the work of the sub-committee on small cetaceans.

5.4 CCAMLR

The report of the IWC observer to the 17th meeting of the Scientific Committee of CCAMLR is given as IWC/51/10E(i).

Intersessional meetings of its two working groups, the Working Group on Ecosystem Monitoring and Management (WG-EMM) and the Working Group on Fish Stock Assessment (WG-FSA), were held. A workshop was also held in La Jolla, USA to investigate the coherence in environmental and biological indices within and between regions in the Southwest Atlantic.

A major issue at the meeting concerned the illegal, unregulated and unreported fishing of Patagonian toothfish. Measures to combat this were introduced.

A synoptic survey of krill in the South Atlantic (Area 48) is scheduled for January 2000 and the Scientific Committee of CCAMLR welcomed cooperation with the IWC in this regard, noting that the IWC's objective is to study spatial distribution of baleen whales in relation to krill and environmental parameters.

The report of the IWC observer at the CCAMLR Synoptic Survey Meeting, Cambridge, UK is given as IWC/51/10E(ii).

The Committee thanked Ichii and Hedley for attending CCAMLR meetings on its behalf. It agreed that Kock should represent the Committee at the next annual meeting of the CCAMLR Scientific Committee.

Matters relating to CCAMLR are discussed under Item 11.2 and in Annex H.

5.5 NAMMCO

The report of the IWC observer to the 8th Meeting of the NAMMCO Council is given as IWC/51/10B(i). The opening address by the Norwegian Minister for Fisheries underlined the importance of making science-based decisions; he believed the focus should remain on seals and small cetaceans rather than baleen whales. The Council received the report of its Scientific Committee and the IWC observer's report from that meeting is given below. The Council noted the high levels of PCBs and heavy metals in the blubber and meat of pilot whales in the northeastern Atlantic and urged those states responsible to halt production and eliminate the release of these and other contaminants into the environment.

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

The report of the IWC observer to the annual meeting of the NAMMCO Scientific Committee is given as IWC/51/10B(ii). With regards to cetaceans, four items were discussed: (1) the harbour porpoise symposium; (2) population status of white whales and narwhals in the North Atlantic; (3) assessment of the status of fin whales in the North Atlantic; and (4) plans for a NASS (North Atlantic Sightings Survey) in the year 2000.

The international symposium on harbour porpoises in the North Atlantic will be held from 10-14 September 1999. There will be five theme areas: distribution and stock identity; biological parameters; ecology; pollutants; and abundance, removals and sustainability of removals.

A working group with invited participation from Canada and Russia had met in March 1999 to examine the population status of narwhals and white whales throughout the North Atlantic. New information indicated a complex structure for North Atlantic white whales. For narwhals much less information was available but the limited studies indicated a level of philopatry similar to that for white whales. White whales and narwhals are harvested in Canada and Greenland

only. In West Greenland the present harvest level of white whales is a cause for concern since available abundance estimates are small compared to the high and incompletely reported catch levels.

In 1998, the NAMMCO Scientific Committee was asked to undertake an assessment of the status of fin whales in the North Atlantic and established a working group to consider aspects of this. It noted that more information is needed on stock structure but that work so far indicated that there may be a number of stocks in the North Atlantic with a limited gene flow between adjacent stocks. Heterogeneity within the East Greenland/Iceland stock area has also been observed as well as site fidelity. Using the program HITTER, population trajectories incorporating past catch series were conducted to hit abundance estimates and projected with various annual catch levels of up to 200 whales until 2020. With MSYR at 2%, a future annual catch of 200 fin whales was considered unlikely to bring the population to below 70% of its pre-exploitation level under the least optimistic scenarios examined. However, catches should be spread throughout the stock area to avoid local depletion. The Committee agreed that determination of MSY and MSYR levels for fin whales and other whale stocks does not seem possible given present knowledge about the dynamics of whale populations.

Iceland plans to carry out whale sightings surveys in its waters at regular intervals, with the next survey planned to take place in the year 2000. In the past, synoptic surveys have been recommended and the NAMMCO Scientific Committee encouraged all member countries and other neighbouring countries to try to ensure as broad a coverage as possible of the North Atlantic. Although the Committee considered it unlikely that a coverage similar to that of the NASS 95 survey would be possible, the task of coordinating efforts to the extent possible in NASS 2000 was given to the Working Group on Abundance Estimates.

The Committee thanked Øien for attending the meeting on its behalf and agreed that he should represent it at the next meeting of the NAMMCO Scientific Committee. Issues relating to white whales and narwhals are discussed in Annex I. The new NASS survey is considered in conjunction with discussions on the Greenlandic research programme in Annexes F and N, and under Item 9.2.

5.6 Southern Ocean GLOBEC

The SO-GLOBEC observer to the IWC Scientific Committee, Hoffman, had been expected to attend this meeting but had unfortunately been unable to. Reilly had briefly attended a SO-GLOBEC meeting in La Jolla. He had been requested to bring data from the IWC/IDCR and SOWER cruises to the Workshop but the data were too sparse in the area being considered at the Workshop to be of value. Issues concerned with the major IWC collaborative research project with SO-GLOBEC in 2000/2001 are dealt with under Item 11.2 and in Annex H.

5.7 FAO

5.7.1 COFI

The report of the IWC observer at the 23rd meeting of the FAO/COFI Committee on Fisheries and related meetings is given as SC/51/10G.

The meeting adopted International Plans of Action on Management of Fishing Capacity and discussed the issue of predation by cetaceans and other marine mammals. The meeting agreed that greater consideration should be given to the development of more appropriate ecosystem approaches to fisheries management, optimally in collaboration with both FAO and non-FAO bodies.

In addition, at the Annual Meeting of the Indian Ocean Tuna Commission (IOTC), one of the regional management organisations under FAO, it was pointed out that there was a high proportion of predation of swordfish by cetaceans in long-line fisheries. It was strongly recommended that further studies should be advanced concerning the issue of predation by marine mammals including cetaceans.

Based on deliberations at the 23rd COFI meeting, an FAO Ministerial Meeting on Fisheries was held and the issues of 'management of fishing capacity' and 'FAO long and medium term strategies' were discussed. The meeting resulted in the 'Rome Declaration on the Implementation of the Code of Conduct for Responsible Fisheries'. Major points included:

(1) implementation of the Code of Conduct;
(2) promotion of the implementation of the International Plans of Action and active control of illegal catches;
(3) addressing aspects of trade and environment related to fisheries and aquaculture;
(4) greater consideration towards developing more appropriate ecosystem approaches to fisheries development and management.

The Committee thanked Komatsu for attending the meeting on its behalf. The issue of predation by cetaceans is discussed further under Item 11.5.

5.7.2 Coordinated Working Party on Fisheries Statistics

There were no relevant meetings of the CWP last year. There will be a meeting in July 1999. The Secretariat will either attend or supply documentation.

5.8 ICCAT

The report of the IWC observer at the Annual Meeting held in Spain in November 1998 had not been received by the Secretariat in time to be considered by the Committee.

5.9 Other

The Committee noted that there will be a meeting of the parties to CITES in Nairobi in April where a proposal for the downlisting of minke whales from Appendix I to Appendix II will be discussed. Gambell noted that the last time such a proposal had been made the Chairman of the Commission had attended the meeting. The Committee agreed that IWC representation at the April 2000 meeting was a matter for the Commission.

6. COMPREHENSIVE ASSESSMENT OF WHALE STOCKS REVISED MANAGEMENT PROCEDURE (CA/RMP) – GENERAL ISSUES

6.1 Completion of *CLA* program and tuning – report on progress

Last year, the Committee had recommended that the Norwegian Computing Centre (NCC) be approached about completing the work needed to meet the most important requirements of recoding the *CLA* program (IWC, 1999d, p.6; IWC, 1999e, p.80). During the intersessional period, the NCC was contracted by the IWC (with additional funding from Norway) to accomplish this work. Recently, the Secretariat had received from the NCC: an internally documented Fortran 77 sub-routine, an internally

documented main program calling the sub-routine, technical documentation on these programs and reproduced example calculations.

To fully evaluate the new program implementing the *CLA*, the Committee had agreed last year that the program should be applied to selected combinations of input data. Catch limits calculated for these combinations (given in Annex D, item 5) will be compared with catch limits calculated from the published version of MANAGE. For cases where the catch limits appear inconsistent, the double precision version of MANAGE will be used to help explain the inconsistencies. Owing to computing time requirements the double precision version can not be used for all comparisons. This evaluation of the new program should be conducted by the Secretariat supported by an Intersessional Steering Group (see Annex U(1) for members).

Once the testing is successfully completed, the Secretariat will use the program to determine a more accurate value for the tuning parameter using the specifications described in IWC (1999e, p.80). Results will be reported to the next meeting of the Committee.

6.2 Additional variance – report on progress

The work recommended last year to estimate additional variance associated with surveys of southern minke whales using IDCR data had not been completed. Further discussion is reported under Item 6.3.2, where it is noted that Cooke will undertake this work during the coming year.

6.3 Abundance estimation

6.3.1 Report of the intersessional Working Group

The objectives of the intersessional Working Group were to: (1) review abundance estimation projects of interest to the IWC; and (2) document and enlarge the project to evaluate abundance estimators that incorporate $g(0)$ and heterogeneities. With regard to (1), two papers on proposed methods to estimate abundance from multi-year surveys were submitted to the Working Group for review. SC/51/RMP10 had been reviewed and comments provided to the author. SC/51/RMP18 had not been submitted in time for comments to be sent to the authors prior to the Committee meeting. With regard to (2), the computer programs that create the simulated datasets had been successfully transferred from CSIRO (Australia) to NMFS (Woods Hole, USA). An additional 75 simulated datasets have been created for 30 scenarios of different types and of combinations of heterogeneities. All simulated datasets are now available on a web site; members of the Committee can contact Palka for the address. The 100 datasets for all scenarios are being analysed by: Borchers using the logistic regression estimator; Cooke using the likelihood-based hazard probability estimator; Palka using the modified duplicate estimator; and Skaug using the integrated hazard probability estimator. These analyses will be completed by September 1999. A paper reporting the findings will be submitted to next year's meeting.

The Committee re-established the intersessional Working Group (see Annex U(2) for members) to continue the work described above, to address other issues arising and to report to next year's meeting (see also Item 6.3.5).

6.3.2 IWC-DESS (Database Estimation Software System)

The Committee established a Working Group under Butterworth to consider the work to be carried out in the six month rolling contract to the Research Unit for Wildlife Population Assessment (RUWPA), St Andrews, for IWC-DESS support and, in addition, to develop a list of analyses of sightings data requested by the Committee. The report of this Working Group is given as Annex L.

Table 2 lists the groups of items which the Committee would like to see achieved during the next year, in priority order. Further details are given in Annex L. The items in Group A will be carried out in the six month rolling contract (which has two months 'credit' carried over from last year). Groups B to F require additional finance as discussed under Item 18.

The Committee welcomed Cooke's offer to undertake Items 8 and 9 from group B.

A Steering Group (see Annex U(3)) was set up to oversee these tasks and to coordinate priorities. Further members can be co-opted as necessary.

Annex L also lists a number of items of future work on DESS for consideration next year.

A number of analytical tasks were identified during sub-committee discussions in addition to those (B8, 9 and F15) shown in Table 2. These are listed below. The Committee agreed that items (1) and (2) were of highest priority. The financial implications are discussed under Item 18. The Committee noted that task 2(b) was required for the proposed review of Southern Hemisphere minke whale abundance estimates.

(1) *Analyses of IDCR-SOWER data* (see Annex G, Appendix 12).

Table 2

DESS maintenance and upgrade tasks to be completed in the next year.

Group	Task description	Individual time estimate	Sub-total time estimate
A	1. Validation software for SOWER-like data	6 months	
	2. Training and support for Secretariat	2 weeks	
	3. Consistency of 'species identified' field over years	1 week	
	4. Upgrade to MapInfo 5.5	2 weeks	
	5. Reflection of all input specifications in output	1 week	
	6. Validation/incorporation support for 1999/2000 joint IWC/CCAMLR data	2 weeks	8 months
B	7. Incorporation of validated 1997/98 SOWER data	1 week	
	8. Extraction of 'additional variance' data	2 weeks	
	9. Analysis of 'additional variance' data	1 week	1 month
C	10. Inclusion of multiple species extraction capability	2 weeks	0.5 month
D	11. Extension of SMALLMAN to deal with special case scenarios	1 week	
	12. Option pre-set capability for multiple year extractions	2 weeks	
	13. Improvement of documentation for pooling table	1 week	1 month
E	14. Batch mode capability development	4 weeks	1 month
F	15. Analysis of 1997/98 SOWER data	5 weeks	1.25 months

(a) Combined analysis of all estimated distance and angle experiments (Recommendation 1).
(b) Analyses of cue visibility data (Recommendation 6).
(c) Encoding of resightings data (from tracking during IO mode) to facilitate analyses thereof (Recommendation 9).
(d) Application of the Palka/Hammond method to minke whale IO data, if existing swimming direction data are found to be adequate (Recommendation 12).
(e) Analyses to determine the necessity of recording glare information.

(2) *Continuation of analyses previously considered for Southern Hemisphere IDCR-SOWER and JSV data* (IWC, 1999e, p.152).
(a) Best estimates of abundance for species other than minke whales from the IDCR-SOWER dataset.
(b) Re-computation of historic minke whale abundance estimates consistent with DESS data and updated agreed analysis methods (available in DESS).
(c) Extrapolation of the above to lower latitudes using JSV data.

This work was initiated by the University of Cape Town in late 1997. However, owing to unforeseen circumstances, the work had become primarily a contribution to assist in the development of important specifications of DESS in cooperation with RUWPA, St Andrews. In light of this, further funds are required to conduct the analyses originally envisaged.

(3) *Abundance estimation from JARPA data* (Annex G, item 4.1.2).

Intersessional work towards final tests of GAM-based estimation for JARPA data to clarify factors leading to bias. Thereafter, to investigate appropriate model selection and variance estimation approaches and finally to apply the resultant method to provide minke whale abundance estimates for each JARPA survey and the IDCR-SOWER cruises in Areas IV and V.

An intersessional Steering Group (see Annex U(4)) was set up to coordinate preparations for the review of Southern Hemisphere minke whale abundance estimates as discussed under Items 10.6.1 and 10.8.

6.3.3 Estimates from multi-year surveys

Three methods to estimate abundance from multi-year surveys were presented (SC/51/RMP10, 18, 24). Discussion of technical issues relating to these papers is given in Annex D, item 7.3.

The Committee recalled the provisions of the RMP which relate to multi-year surveys (IWC, 1999j, p.252, p.256). The main provision is that the combination of multi-year data should be based on appropriate statistical methods and that adequate precautions be taken to avoid substantial double-counting arising from migration or other factors. The Committee agrees that the methods presented in SC/51/RMP10 and SC/51/RMP24 appeared satisfactory in this regard but noted the following further issues for future consideration.

(1) The timespan over which it is legitimate to combine multi-year data for an abundance estimate. The RMP annotation suggests a maximum period of 10 years, i.e. up to five years before and after the year to which the estimate refers.
(2) 'Time stamp'. To which year should an abundance estimate refer? The RMP specifies merely that the time stamp be statistically appropriate. This could be the mean year of the data, or a weighted mean year. In the case of a *Medium Area* or *Combination Area* surveyed over a number of years, the time stamps for each *Small Area* estimate could in principle be assigned separately, based on when the bulk of the data were collected for each *Small Area*.
(3) Phaseout rule. The RMP phaseout provision (IWC, 1999j, p.257) specifies that the phaseout for a *Small Area* begins eight years after the time stamp of the most recent abundance estimate for that *Small Area*. This could have consequences if *Small Areas* are surveyed infrequently, especially if *Small Area* estimates are calculated only at the end of a multi-year survey cycle.
(4) Unsurveyed areas. The RMP specifies that an area for which no abundance estimates (that meet the other provisions) are available must be assigned a zero abundance. However, it is unclear at what spatial scale this provision should be applied: for example, to what extent may the statistical methods presented in SC/51/RMP24 and SC/51/RMP10 be used to fill in 'holes' in the survey coverage?
(5) Updating of estimates. Depending on how they are applied, a feature of the statistical methods described above is that whenever new abundance data are added to the time series, this can affect the past estimates for each area, albeit typically to a small extent. This form of 'automatic' updating of past estimates should be distinguished from revisions to past estimates caused by improvements to analysis methods. The Committee considered that it may be preferable for accepted past estimates not to be changed, except when the methodology is changed.
(6) The RMP is able to accommodate inter-annual covariance between abundance estimates, such as can arise from the use of the above statistical methods. Where such covariances occur, they should be calculated and used.

In principle, the statistical methods such as those presented in SC/51/RMP10 and 24 could be used to derive a complete time series of annual abundance 'estimates' for each *Small Area*, even in cases where not every *Small Area* is surveyed each year. The lack of full coverage will be reflected in high covariances between the annual values. The issue of time-stamping is thereby avoided. However, there are several potential problems associated with such an approach: (i) it is not clear how the phaseout provision should be interpreted with such time series; (ii) the statistical properties of the resulting time series have not been explored; (iii) none of the simulation trials of the RMP have involved abundance data with high inter-annual covariances. In view of these problems, the Committee **agrees** that this approach need not be considered further at this stage.

6.3.4 Other

The Committee received a method for estimating animal abundance based on DNA-fingerprints from a random sample of individuals taken in catches or bycatches (SC/51/O8). Discussion is given in Annex D, item 7.4.

6.3.5 Future work

The Committee agreed that future work on abundance estimation should include the work described in Item 6.3.1 under the oversight of the intersessional Working Group (see Annex U(2)), the main terms of reference of which are to

review proposed methods that estimate abundance from multi-year data, and to continue the evaluation of abundance estimators that might be used to produce estimates used in the RMP when heterogeneities occur and assumptions are violated. In particular, the precision and bias of estimates when heterogeneities are present, when responsive movement is occurring and when there are duplicate identification errors, will be addressed.

6.4 Stock identity

Last year, the Committee established a Working Group on Stock Identification (WGSI) to try to develop 'one or more operational definitions of stock, which are better suited to the types of data currently available to evaluate stock structure and which are based on the management context in which they are to be used' (IWC, 1999e, pp.82-83). Terms of reference for the intersessional activities of the WGSI were developed. These included to:

(1) review published literature on stock concepts for long-lived, highly mobile species;
(2) review the report on long-lived, highly mobile species;
(3) review case studies of management advice for large whales;
(4) prepare a report summarising successful approaches identified in case studies;
(5) assess the results of studies using suitable spatially explicit population simulation models;
(6) endeavour to refine existing stock definitions; and
(7) assess the desirability and means of considering multiple lines of evidence in developing definitions of stocks.

6.4.1 Intersessional activities

The following intersessional activities were completed: (1) a paper (SC/51/O2) on how stock information was used in the *Implementation Simulation Trials*; (2) case studies for the North Pacific minke whale (SC/51/RMP15), Southern Hemisphere minke whale (SC/51/CAWS30) and North Atlantic humpback whale (SC/51/RMP22); and (3) a discussion paper (SC/51/RMP23) summarising these case studies to serve as a starting point for developing one or more operational definitions of stock. The Committee thanked the authors of these papers (Pastene, Goto, Fujise, Clapham, Palsbøll, Punt and Taylor) for their contributions. No progress was made on either completing a general review paper on stock concepts as applied in management of other species or preparing case studies for the gray and bowhead whale.

6.4.2 Issues for future discussion

This year the WGSI was re-established. Its report is given as Annex M. The WGSI reviewed the papers prepared intersessionally (see Item 6.4.1), as well as SC/51/RMP8, 20 and SC/51/O9. The primary focus was to identify those issues that need to be resolved prior to developing a generic approach for defining stocks.

The Committee first considered the question of what 'unit' is to be conserved. Management objectives must be defined before interpreting population structure data. One suggestion was that management should strive to maintain historical range (on both breeding and feeding grounds); such a definition requires the calculation of the level of dispersal between *Small Areas* required to meet this objective. The Committee agreed that it was premature to finalise the process for defining stocks until all aspects of the terms of reference developed last year are completed.

Several points for further discussion next year were identified from the case studies. These have implications beyond those for a single species in a single ocean basin.

(A) North Atlantic humpback whale
  (1) Management should aim to avoid the extirpation of animals from any current or historically recognised areas important for breeding or feeding.
  (2) Genetic information alone is not sufficient for stock identification.
  (3) Extrapolating stock structure for a species of large whale from one ocean basin, where reliable information is available, to another ocean basin, where few or no data exist, while often unavoidable, is of questionable value.
  (4) In the development of new techniques to estimate gene flow between putative stocks, well studied stocks, such as the North Atlantic humpback whale, should be used.
  (5) Conclusions regarding population structure should not be based on either nuclear or mtDNA alone, but should be based on both.
(B) North Pacific minke whale
  (1) Available information indicates that the stock structure of large whale species may be complex over a relatively small spatial scale.
  (2) It is easier to evaluate population structure in an ocean basin with information from both the winter (breeding) and summer (feeding) grounds.
(C) Southern Hemisphere minke whale
  (1) Where the distribution of two or more stocks occurs in the same [feeding] area, the analysis of stock structure must consider temporal, as well as spatial dynamics.
  (2) Information regarding the Hardy-Weinberg equilibrium, although of limited statistical power, may be useful in identifying areas where animals from distinct stocks mix.

6.4.3 Preparations for next year's meeting

The Committee **agreed** that the following items are required to assist in the development of a standard process by which stock identification can be undertaken:

(1) review of stock structure in the bowhead whale;
(2) review of stock structure in the gray whale;
(3) summary of stock concepts used in the management of long-lived, highly mobile species of terrestrial mammals, pinnipeds and birds (Perrin/Taylor);
(4) overview of concepts used to define management units in tunas and billfish (Polacheck);
(5) review of available information for large whales on extirpations (or near extirpations) where recovery has not taken place, and where recovery has taken place (Clapham);
(6) report on the estimation of statistical power using molecular data (Taylor); and
(7) report on the power of different statistics and the relation between effect size and sample size (Taylor).

The Committee recognise that aspects of (1), (2), (6) and (7) might provide information important to the work of the SWG on the AWMP. It would be useful if the relevant information were made available to participants in the forthcoming AWMP Intersessional Workshop (see Item 8). Butterworth, Moronuki, Okamura and Ohsumi emphasised that it was desirable to list the reasons why the Committee had previously been confidently able to designate the

Bering-Chukchi-Beaufort Seas stock of bowhead and the eastern North Pacific stock of gray whales as single stocks, in contrast to the situation for many other species/regions. Early development of this list would facilitate the AWMP SWG's Intersessional Workshop in its evaluation of whether plausible hypotheses for multi-stock/substock structure need to be considered for trials for these populations, and what the plausible range (in general terms) for such hypotheses might be. It was noted that such lists could be provided as separate, initial and urgent components of (1) and (2) above.

The Committee **agreed** that the WGSI should be re-established next year to review the above, and other reports as appropriate. Following this, proposals should be developed to define or identify: (1) the data needed and the process to be followed for determining the stock structure for a species of large whale within an ocean basin; (2) a process to characterise stock structure where data are missing; and (3) a process for determining whether new data are sufficient to revise the existing definition of stocks based operationally on few or no data (e.g. *Small Areas*).

The Committee established an Intersessional Working Group (see Annex U(5)) to further this work.

6.4.4 Other information

Geographic differences in whale calls could provide useful information for stock differentiation for some mysticete species (e.g. blue and fin whales); this may not be the case for species that show large seasonal or individual variability in calling behaviour (e.g. humpback whales). However, the Committee recognised that call types must be related to other stock differentiation criteria to be useful in stock identification. Combining on-site acoustic recordings with visual observations from survey vessels, photo-identification surveys and tissue collection for the purpose of genetic analysis should provide a foundation to support such a correspondence (cf. the SOWER blue whale programme). If 'acoustic stocks' can be identified, long-term acoustic recordings could be used to monitor the spatial and temporal distribution of specific stocks. Such devices can provide data from remote areas in weather conditions not conducive to visual observations. This might improve understanding of stock structure in large whales, as well as contributing to future visual surveys and tissue sampling programmes.

6.5 Effects of uncertainty in future catches

The Committee received SC/51/RMP13 which described the effects on performance of the RMP of including different future catch scenarios. Brief discussion is recorded in Annex D, item 8. While the results of generic single stock trials are generally informative, the Committee **recommends** that in cases where there is uncertainty about future catches, the effects be investigated through case-specific *Implementation Simulation Trials*, as is the case for North Pacific minke whales (Item 7.1) in the future.

6.6 Work plan

In addition to the work on stock identification given under Item 6.4.3, the Committee **recommends** that the following work should be undertaken on RMP general issues during the intersessional period:

(1) evaluation of the new *CLA* program and recalculation of the tuning parameter (Secretariat under the guidance of an Intersessional Steering Group (Annex U (1) and see Item 6.1);
(2) evaluation and development of abundance estimators (Intersessional Working Group (Annex U(2)) - see Item 6.3.1).

The Committee assigned priority to (1) noting that it would require little Secretariat time. The agenda for next year's meeting will need to include the following items:

(1) review evaluation and retuning of the new *CLA* program;
(2) review results of work on evaluation and development of abundance estimators;
(1) review the component of the population to which density dependence should apply in the RMP (see discussion under Item 7.2.1.4).

7. CA/RMP – PREPARATIONS FOR IMPLEMENTATION

7.1 North Pacific minke whales

7.1.1 Review results of Implementation Simulation Trials

Last year, the Committee revised the *Implementation Simulation Trials* for North Pacific minke whales (IWC, 1999d, p.11). During the intersessional period, a Steering Group chaired by Butterworth made some minor modifications to the specifications for these trials and provided guidance to Allison on which trials to run.

Trials were completed for the management option in which the *Small Areas* were equal to the sub-Areas, and the RMP is applied separately to each *Small Area*. The Committee expressed its appreciation to Allison on completing what turned out to be a much larger task than expected.

Annex D, Appendix 2, provides some summary statistics for the trials. Results are shown for two options regarding the level of Japanese incidental take (options J(i) and J(ii)). The incidental catches for option J(i) were based on information from Japanese Progress Reports while those for option J(ii) were based on analyses in Tobayama *et al.* (1992). The trials are based on two (J/O) or three (J/O/W) stocks in the North Pacific. Incidental catches are assumed to be taken from sub-Areas 1, 2, 6, 7, 10 and 11 (Fig. 1), while the RMP was used to set catch limits for commercial whaling in sub-Areas 7, 8, 9, 11 and 12. The future catches in sub-Areas 11 and 12 were restricted to the months May-September to minimise the possibility of taking animals from the J stock because such animals are known to mix in these sub-Areas in April. The total catch for a sub-Area was taken to be the catch limit set by the RMP or the level of incidental catch, whichever was greater, as specified by the Commission (IWC, 1999a).

The results of all *Implementation Simulation Trials* considered suggest that irrespective of how the RMP would be used to manage commercial whaling, the J stock, which is found predominantly in the Sea of Japan, Yellow Sea and East China Sea, is likely to decline markedly because of the incidental catches in that area. Although the primary focus of the trials is to examine performance relative to the O stock, the Committee expresses its concern at the implications of the result for the status of this stock.

The Committee noted that the data for sub-Areas 5, 6 and 10 used to condition the trials (a CPUE series and some minimum estimates of abundance) are sparse and of uncertain reliability. Kim considered that it was inappropriate to use the Korean CPUE series to condition the trials. The results from the planned abundance surveys in sub-Area 6 (see Item 7.1.2) should enable the Committee to further examine this issue in the future. Kim believed that the

Fig. 1. Whaling grounds and the 13 sub-Areas used for the *Implementation Simulation Trials* for North Pacific minke whales (IWC, 1997c).

trials in which incidental catches by Korea are set at 150 were unrealistic and that only those with actual estimates should be considered.

The Committee noted that catch limits other than zero are set for some of the *Small Areas* in which animals from the J stock are occasionally found, and proposed that a new output statistic be defined to determine the impact of management using the RMP on the J stock (see Annex D, Appendix 5). It was also noted that the trials were not designed to examine the application of the RMP to minke whales in the Sea of Japan and the Yellow Sea. If the Committee intends to examine this issue in detail, additional trials may need to be designed.

The Committee considered which of the trials specified last year could be omitted to obtain a final set, noting that the primary purpose of the trials was to examine the application of the RMP to the O stock. After considerable discussion, the Committee selected the first nine of the ten trials listed in Annex D, table 1. In the process of selecting these trials, the Committee did not consider the relative plausibility of the alternative scenarios underlying each trial but rather whether the final depletion statistics for the O stock were notably different from the corresponding base-case values.

7.1.2 Sightings surveys

The Committee received a report on a sightings survey conducted last year in the Okhotsk Sea (SC/51/RMP3). A summary is given in Annex D, item 9.2. The results from the survey will not be used for abundance estimation because of the low coverage of the area.

The Committee also received SC/51/RMP19, the research plan for a repeat sightings survey in the Okhotsk Sea from August-September 1999. The Committee reiterates its **recommendation** from last years' meeting (IWC, 1999e, p.66) that methods in addition to visual observations (e.g. VHF telemetry) be used to determine dive times, and urged that this work take place as a matter of priority. The Committee **agrees** that Miyashita should undertake the role of Scientific Committee oversight for the 1999 survey, as he had done in 1998.

The Committee was pleased to note that the Russian Federation had granted permission for the 1998 survey to operate in its Exclusive Economic Zone (EEZ). It **recommends** that the Commission requests the relevant authorities of the Russian Federation to grant permission in timely fashion for Japanese vessels to survey its EEZ in 1999.

Kim introduced plans for a joint Korea-Japan sightings survey in sub-Area 6 (Annex D, Appendix 3), stating that this survey is intended as a pilot study for a proposed two-year series of surveys in this area. The objectives of the programme are to collect information on the distribution of cetaceans and to provide abundance information for inclusion in *Implementation Simulation Trials* for North Pacific minke whales.

7.1.3 Uncertainty over incidental catches

SC/51/RMP17 reported calculation errors in the estimates of incidental catch in Japanese waters (93 annually) made in Tobayama *et al.* (1992) and provided a revised estimate of 57 based on the same methods and data. Moronuki noted that although SC/51/RMP17 provided a revised figure according to the methods and data used by Tobayama *et al.* (1992), this did not imply that Japan supported this value as the best estimate of the incidental take. Japan still believed that the official statistics are more reliable.

Kasuya welcomed SC/51/RMP17 but believed that the revised estimate overcorrected for the errors in the original paper. In particular, he noted that small-type trap nets can catch minke whales and that assuming that minke whales are only available to trap nets for half of the year leads to an underestimation of incidental take. Smith noted that the estimate of 57 in SC/51/RMP17 was not accompanied by a measure of uncertainty; the range for the level of incidental catch in the *Implementation Simulation Trials* must account for this.

Cooke noted that the information from market samples purchased in Japan (SC/51/O9, SC/51/O15 and SC/51/RMP20) indicated that 40% of the animals sampled (22 of 55) were J-type animals. He believed that this percentage significantly exceeds that expected if the annual incidental catch was 27 as indicated in SC/51/ProgRep Japan or 57 as estimated in SC/51/RMP17. Several members argued that the use of market data in this way was flawed because of the possibility of sampling duplicates and the non-representative nature of the sampling process. They also noted that the design of the sampling plan was undocumented. Cipriano responded that, to date, few duplicates had been encountered and the sampling strategy had been documented in SC/49/NP17, SC/49/O2 and SC/50/O8. Butterworth recalled additional problems in interpreting data collected from markets as raised at last year's meeting (IWC, 1999e, pp.67-8), e.g. the implications of possible stock-piling.

The Committee was unable to reach an agreement on a best estimate of incidental catches in Japanese waters. The Committee recalled that a working group had been established two years ago with the aim of specifying a time series of total incidental catches, but that this initiative had not yet resulted in agreement. The Committee encouraged further collaborative work with the aim of determining the best estimates of incidental take. Although it is necessary to agree a series of best estimates in order to implement the RMP, *Implementation Simulation Trials* only require levels of incidental catch that span the plausible range (see Item 7.1.4).

The incidental catch in Korean waters (sub-Areas 5 and 6) was reported to be 45 animals during 1998, compared to 129 and 78 in 1996 and 1997, respectively (Annex D, Appendix 4).

Some members noted that no account had been taken of possible additional incidental catches, i.e. in the Japanese driftnet fishery or by the Democratic People's Republic of Korea, the People's Republic of China, China (Taiwan) or the Russian Federation. The possible catches by Japan and the Russian Federation would be predominantly O stock animals whereas those by the Democratic People's Republic of Korea, the People's Republic of China and China (Taiwan) would be J stock animals. Kato responded that minke whales are not taken in the Japanese driftnet fishery. The Committee encouraged the collection and analysis of data for these fisheries/nations (see Item 4.2).

7.1.4 Specification of final trials

The Committee discussed several issues related to new trials. It **agrees** the revised specifications for North Pacific minke whale *Implementation Simulation Trials* (Annex D, Appendix 5) and **recommends** that the Secretariat conduct the trials during the intersessional period and report the results to next year's meeting.

Three years ago, the Committee had established an Intersessional Steering Group to consider and resolve any inconsistencies that remained in the trials, and to make decisions about the choices related to the selection of trials to run. The Committee re-established this Steering Group (see Annex U(6)), with revised terms of reference as given in Annex D, Appendix 6.

The Committee discussed the range to be used for the level of incidental catch, noting that all of the figures presented and discussed under Item 7.1.3 are subject to uncertainty. The discussion focused primarily on the range to assume for the incidental catch in Japanese waters as these catches were more likely to impact the performance statistics for the O stock.

There was considerable discussion regarding the upper bound for this range. Some members commented that the value (93) used in the trials specified last year was based on an analysis now considered to be flawed, while other members believed that the corrected figure in SC/51/RMP17 represented an overcorrection for the errors and ignored uncertainty. Butterworth noted that the trial results (Annex D, Appendix 2) generally change consistently and as expected when the level of incidental catch is changed from option J(i) (27 annually) to J(ii) (93 annually). He argued, therefore, that trial results corresponding to a best estimate of incidental catch to be agreed in the future could be determined by interpolation. He suggested, and several members agreed, that selecting a range of values for trial purposes did not constitute agreement by all members of the Committee that the entire range was necessarily plausible.

Considering all of the information presented and discussed, and in the absence of agreement on a best estimate, the Committee agreed that an appropriate range of annual incidental take of minke whales by Japan for the purposes of *Implementation Simulation Trials* would be 25-75. Prior to making a recommendation on options for implementation of the RMP, the Committee will need to determine the best estimate of incidental take (see Item 7.1.3).

Additional technical details of the trials are reported in Annex D, item 9.4.

7.2 Western North Pacific Bryde's Whales

7.2.1 Implementation Simulation Trials

7.2.1.1 STOCK STRUCTURE

INSHORE/OFFSHORE STOCK STRUCTURE

Last year, the Committee did not have sufficient time to finalise discussion on how to model the structure of inshore and offshore Bryde's whales around major island groups.

SC/51/RMP9 introduced new information about Bryde's whales in inshore waters off Kochi (Pacific) and Kasasa (East China Sea). Of 134 sightings off Kochi, all but one were made within 15 n.miles of the coast, to the west of Tosa Bay. Two animals sighted off Kasasa were morphologically similar to those off Kochi. The authors concluded that this, along with other morphometric, genetic and distribution data implies that the animals off Kochi are not a local stock but rather part of the larger East China Sea stock. The Committee agreed that this paper represented a major contribution on the stock structure of Bryde's whales and encouraged the authors to conduct their proposed photo-identification and genetics studies.

Some members considered that the hypothesis that the waters around major island groups in the western and central Pacific could contain inshore form animals had been based on an analogy with the situation in Kochi. However, as the animals in this area now appear to be part of a much larger East China Sea stock, they believed that it was no longer plausible to assume that major island groups could contain separate local stocks of inshore Bryde's whales. Other

members recalled arguments that had been put forward last year as to the plausibility of whether inshore form Bryde's whales might be found in and around major island groups in the western and central Pacific (IWC, 1999e, pp.74-76). The Committee could not reach consensus on this issue and two positions emerged: (1) inshore form Bryde's whales are not found in and around major island groups in the western and central Pacific; and (2) this possibility cannot be excluded as implausible given the lack of information for many of the island groups concerned.

The Committee considered this issue in the context of the development of *Implementation Simulation Trials*. After some discussion (reported in Annex D, item 10.1.1.1), the Committee agreed to define an area around each island group in which inshore form animals could plausibly be located and to exclude that area when estimating abundance for conditioning the trials. A large proportion of the abundance estimate for western North Pacific Bryde's whales is derived from 5° squares in which major island groups are located (IWC, 1999e, pp.108-115), and therefore, the results of *Implementation Simulation Trials* might be sensitive to the size of the area excluded when conditioning the trials. The Committee agreed to exclude the areas around the island groups listed in Annex D, table 3 when calculating the abundance estimates to be used. All of the sightings should be used to obtain the abundance estimates because these have not occurred in the neritic waters in which inshore form Bryde's whales are likely to be found. It was agreed that encounter rates inside and outside the areas excluded should be examined.

Hatanaka noted that the question of whether inshore form Bryde's whales are, in fact, found in and around island groups could be examined through surveys and biopsy work in the territorial waters of the countries involved in the island groups. He added that Japan is prepared to extend support to countries to facilitate this work. The Committee welcomes this offer and encouraged such research.

WITHIN-(OFFSHORE) STOCK SPATIAL STRUCTURE

Last year (IWC, 1999d), the Committee agreed to two alternative stock-structure hypotheses (see Fig. 2 for definitions of the sub-Areas):

(i) there is only one stock (stock 1) of (offshore form) Bryde's whales in sub-Areas 1 and 2;
(ii) there are two stocks (stocks 1 and 2) of (offshore form) Bryde's whales in sub-Areas 1 and 2. One stock is found in both sub-Areas and the other is found in sub-Area 2 only;

but had failed to agree on whether or not there was evidence for within-stock spatial structure.

SC/51/RMP6 summarised operations of the Japanese whaling fleets in the North Pacific for the years 1974-79. Operational features combined with the lack of trend in catch per 'catcher searching worked' (CSW; Ohsumi, 1981) day at a 5° square led the authors to conclude that there is no evidence for within-stock structure for the western North Pacific Bryde's whale. SC/51/RMP14 compared Japanese Bryde's whale catches and fishing effort data with the corresponding sightings information. The author argued that the migratory patterns and geographic distribution of historical catches should be accounted for in defining areas in *Implementation Simulation Trials*. Details of both these papers and subsequent discussion are given in Annex D, item 10.1.1.2.

After considerable discussion, the Committee **agreed** that the available data did not provide evidence of sub-stock structure in offshore form Bryde's whales in the western

Fig. 2. Agreed boundaries for sub-Areas to be used in the Bryde's whale trials.

North Pacific. However, it discussed whether it would be necessary to enforce widespread distribution of future catches within sub-Area 1, noting some members' concerns that this sub-Area is very large and that there is limited information for some parts of it. Within the RMP framework, such enforcement can be implemented by dividing sub-Area 1 into a number of *Small Areas*, perhaps in combination with the *catch cascading* option. *Catch cascading* involves calculating the catch limit for a given area (referred to as a *Combination Area*), and then dividing this catch limit into catch limits for each of the *Small Areas* that constitute the *Combination Area* in proportion to the estimates of abundance for those *Small Areas*. Implementing *catch cascading* spreads the catch across the *Combination Area*, which leads to a more uniform spatial distribution of fishing mortality, and hence to a lower probability of depletion of a local aggregation.

The Committee **agreed** to develop a set of *Implementation Simulation Trials* to assess whether some form of *catch cascading* is necessary to prevent possible local depletion. If this proved to be the case, further trials/discussion may be needed to select the number of *Small Areas* within sub-Area 1.

The Committee discussed how sub-Areas 1 and 2 could be further divided into smaller sub-Areas, how many sub-stocks should be included in the trials, and where the boundaries between the stocks/sub-stocks should lie. It agreed that the three alternative hypotheses for the dynamics of the area east of 180° (sub-Area 2) would be as follows:

(i) only stock 1 is found in sub-Area 2;
(ii) there is a separate stock (stock 2), and only that stock, in sub-Area 2;
(iii) there is stochastic mixing of stocks 1 and 2 in sub-Area 2 (a 50:50 split between the two stocks in the pristine state).

The Committee **agreed** to divide sub-Area 1 into eastern and western sub-Areas (Fig. 2) and to assume that when sub-Area 1 is treated as a *Small Area*, all of the catches are taken from the (more depleted) western sub-stock. This is an extreme scenario. Trials can consider extreme scenarios, because if the RMP is robust to them it should also be robust to less extreme scenarios.

The Committee then discussed whether it was appropriate to divide sub-Area 1 west further (into northern and southern sub-Areas). Some members noted that the 5° squares closest to northern Japan had yielded large catches during the 1970s, but low catches during the 1980s, while the abundance estimates for these squares are very low for the complete period. Hatanaka and Ohsumi explained that the reduction in the catch off Japan was a consequence of the closure of the land stations in this area due primarily to the zero quotas for fin and sei whales, and that densities of Bryde's whales close to Japan had never been high. They explained further that the high catches at the Ogasawara Islands during the 1980s were a consequence of the establishment of a land station there in 1980. The Committee agreed that the probability that the coastal waters of northern Japan contained a local sub-stock was low because the abundance in this area had never been high, and that the evidence did not support the need to consider trials in which sub-Area 1 west was further sub-divided into northern and southern sub-Areas to reflect possible separate localised aggregations.

The Committee discussed whether it was necessary to divide sub-Area 1 by lines of longitude into more than two (i.e. east and west). It was noted that the trial structure could incorporate more sub-Areas but that this would necessitate making assumptions regarding exchange rates between the sub-stocks because the data would allow only a very limited number of such rates to be estimated from the mark-recapture data. However, it was noted that for such trials, the most difficult scenario would probably involve all future catches being taken from sub-Area 1 west as the sub-stock in that sub-Area would be the most depleted at the time the RMP is first applied. It was therefore agreed not to sub-divide Sub-Area 1 further at this stage.

The Committee also discussed whether the trials should allow for the possibility that the boundary between stocks 1 and 2 differs from 180°. Butterworth argued that the trials in which stocks 1 and 2 mix in sub-Area 2 effectively examine the implications of an erroneous choice for the stock boundary.

7.2.1.2 ABUNDANCE ESTIMATES

The Committee focussed first on data sources and desirable characteristics of abundance estimates for the purpose of conditioning the *Implementation Simulation Trials* for western North Pacific Bryde's whales. Due to the seasonal pattern of the historical catches, it would be most useful to have single estimates corresponding to the months of largest catches for each sub-Area considered. This is preferable to a series of estimates over season, for example, which makes the conditioning more complex. If this were not possible, the next most desirable estimates would correspond to the months in which future surveys will take place, which need to be specified.

The Committee noted that rough abundance estimates would be sufficient for conditioning, as opposed to the actual abundance estimates to be used for calculating catch limits. For sub-Area 1 west, the middle of the catch period was roughly June-July, although some shifts in months across years had occurred.

Two potentially useful sets of sightings data were identified:

(1) Japanese Scouting Vessel (JSV) 1972-1981, May to September;
(2) Dedicated, 1982-1998, May to September.

The JSV data have potential biases because the positions were allocated to noon positions and primary and secondary sightings were not distinguished. The procedures followed were described by Ohsumi and Yamamura (1982) and Miyashita *et al.* (1994). Ohsumi (1981) used JSV data collected from 1974 to 1979 to estimate Bryde's whale abundance in the western North Pacific, with data on sightings distances and angles collected in 1977-1979. Miyashita *et al.* (1995) used these data to compute sightings per track mile indices of abundance by 5° square and month.

The dedicated surveys were conducted under standard line transect assumptions. They are more complete in August and September, and estimates for these months are given in SC/51/RMP18. However, data were collected in June and July, especially from 1982-1986, and some data were collected in May 1986.

The Committee judged that it should be possible to obtain the rough abundance estimates required as input to the trials for the June-July period from the dedicated survey data, and to form the sighting mixing matrices using the JSV data for a broader range of months. An Intersessional Steering Group (see Item 7.2.1.5 and Annex U(7)) was requested to supervise the process of analysing these data and incorporating the results into the trial specifications.

7.2.1.3 CATCHES

SC/51/RMP2 compared official Soviet catch statistics with estimates of catches reported recently by Russian and US scientists. The authors argued that some of the catch rates implied by the scientists' figures were unrealistic and concluded that the catches by the Soviet Union in the North Pacific were reported correctly. They proposed that the catches used during the Comprehensive Assessment be included in any base-case trials.

SC/51/RMP25 described the operations of some Soviet fleets. For reasons discussed in the paper, the author believed it highly likely that these fleets took, but did not report, Bryde's whales in the North Pacific.

Vladimirov stated that the Russian Federation does not accept that the USSR submitted incorrect catch statistics to the Bureau of International Whaling Statistics. All alleged reports from the whaling fleets and other raw data available, that form the basis for such accusations, should be re-evaluated and compared with the official statistics by an independent group of experts. Only after this has been completed is the Russian Federation prepared to discuss the correctness of the official reports. These comments also apply to Item 10.2.3.

Hatanaka argued that none of the papers presented to the meeting provided any evidence for mis-reporting by the Soviet fleets in the North Pacific. He noted that the Soviet fleets started their operation in the Bering Sea and the Aleutian Islands targeting blue, fin and male sperm whales, and had gradually expanded south when the targets of the fishery changed to Bryde's whales and female sperm whales. This, he concluded, argued against the possibility of unreported catches of Bryde's whales by the Soviet fleets.

Last year Brownell had stated that various papers have highlighted the coastal Japanese sperm whale catch data as unreliable as noted by the *ad hoc* intersessional sperm whale group (IWC, 1999f, p.147) and that this implies that it is likely that some Japanese Bryde's whale catches are also unreliable. Few original data are available for the China (Taiwan) pelagic catches of Bryde's whales in the late 1970s and early 1980s, although the actual catches by China (Taiwan) were higher than those used in previous assessments. Brownell recalled that Perrin had stated that catch data for the Philippines were known to be unreliable, while Kato had reported previously that the People's Republic of China took some Bryde's whales in the East China Sea but that no catch figures are available (IWC, 1996b, p.147).

SC/51/O7 compared official and informal catch statistics for some companies involved in the coastal fishery off Japan. This comparison indicated that sperm whales were under-reported. Kasuya reported that his discussions with whalers indicated that they were not always able to distinguish between sei and Bryde's whales so the catch figures for coastal Japan are consequently uncertain. Ohsumi argued that whalers in the Japanese coastal fishery had been distinguishing sei and Bryde's whales accurately since 1955 and that Bryde's whales were rare in the Hokkaido area. The Committee could not reach agreement on whether Bryde's whales may have been reported as sei whales.

Perrin noted that catches of Bryde's whales and sei whales in the Japanese pelagic operation changed markedly from 1973 to 1974 in a reciprocal fashion (SC/51/RMP6). An examination of catch positions by 5° square revealed that the fishery did operate in 1972 and 1973 in an area where Bryde's whales are found. However, it was not possible to determine whether or not some catches recorded as sei whales in these two years could have been Bryde's whales. The Committee **recommends** further investigation of this matter intersessionally, and looks forward to receiving a report at next year's meeting.

7.2.1.4 BIOLOGICAL PARAMETERS

The Committee considered values for the biological and operational parameters of the operating model (given in Annex D, Appendix 7). There were two points of discussion.

The historical selectivity patterns for sub-Area 1 west and east were chosen to be consistent with the existing minimum legal size restrictions in the Schedule. Due to uncertainty about future catch operations, it was not clear whether past selectivity patterns should be assumed in the future and it was suggested that uniform selectivity from age 1 should be an option. It was noted, however, that making uniform selection from age 1 would in effect make the trials somewhat less demanding. The Committee noted a comment from Hatanaka that future whaling in sub-Area 1 west would be based predominantly on pelagic operations, and agreed that for trial purposes, future selectivity for all sub-Areas would be that for the pelagic fishery.

The Committee noted that previous *Implementation Simulation Trials* assumed that density-dependence acted on the mature female component of the population and the assumption $MSYL = 0.6K$ referred to this component of the population. Butterworth commented that the Standing Working Group on the AWMP had previously agreed that *MSYL* and density-dependence should relate to the 1+ component of the population (IWC, 1998e, p.206) and advocated that the same selections be made for the trials for western North Pacific Bryde's whales. Punt and Cooke noted that changing these specifications implied both a slight change to the productivity of the resource (even given no change to the range for $MSYR_{mat}$ considered in the trials) and a changed meaning to the relative recovery statistic. This is because $MSYL_{mat}$ is less than $MSYL_{1+}$ so that the specification $MSYL_{1+} = 0.6K_{1+}$ implies that $MSYL_{mat} < 0.6K_{mat}$.

The Committee briefly discussed which component of the population density-dependence should apply in the RMP. Points raised included: whether or not this should be consistent between the RMP and the AWMP; the biology of the species concerned (noting that West Greenland minke whales are relevant to both management procedures); and any effect changing this in the RMP has in the context of the tuning of the RMP. The Committee agreed to consider this issue next year taking due note of previous extensive discussions in the Standing Working Group on the AWMP (IWC, 1998e).

7.2.1.5 SPECIFICATION OF TRIALS

The Committee **agreed** the specifications for *Implementation Simulation Trials* in Annex D, Appendix 7 and **recommends** that the Secretariat conduct the trials during the intersessional period and report the results to next year's meeting. The Committee established an Intersessional Steering Group (see Annex U(7)) to consider and resolve any inconsistencies that remained in the trials, to supervise the estimation of abundance and to make decisions about the choices related to the selection of trials to run. A number of technical details are given in Annex D, item 10.1.5.

The Committee discussed how catches for the trials should be specified, particularly in the context of the extent to which known mis-reporting in other areas and on other species could be extrapolated, and the uncertainty regarding catches by China (Taiwan) and the Philippines. The single

stock trials for the RMP had shown that it was robust to underestimation of historical catches by 50% (IWC, 1992a, p.88). The Committee agreed that any under-reporting of historical catches for western North Pacific Bryde's whales lay within the range considered during the development of the *CLA*. Trials in which the catches for conditioning are different from the BIWS are only needed if there is an interaction between uncertainty in catches and stock structure. It was noted that the main purpose of *Implementation Simulation Trials* was to examine the relative performance of different management options and that this was likely to be insensitive to the level of historical catch. The Committee therefore **agreed** that these initial trials would be based on the base-case catch series in the 1996 assessment (IWC, 1997d, p.168).

7.2.2 Sightings surveys

SC/51/RMP4 provided a report on a sightings survey for Bryde's whales conducted in August and September 1998 in the area bounded by 10°-43°N and 145°-165°E. SC/51/RMP5 described Japan's research plans for a 1999 Bryde's whale abundance survey for future implementation of the RMP. Details of both these papers are given in Annex D, item 10.2. The Committee **agrees** that Shimada is an appropriate scientist to undertake the Scientific Committee's responsibilities for oversight of the 1999 survey.

The Committee **agrees** that it would be useful to obtain estimates of the probability of detection on the transect line $g(0)$. The results of an unsuccessful experiment and a discussion of ways to address this further are given in Annex D, item 10.2.

7.3 North Atlantic minke whales

7.3.1 Abundance

Øien presented a revised 1987 estimate of minke whale abundance in the CM *Small Area* of the Central *Medium Area* (Annex D, Appendix 8) which addressed three questions raised at last year's meeting (IWC, 1999d, p.12). The resulting estimate for the CM *Small Area* is 5,609, with a CV of 0.262.

Walløe reported that Icelandic sightings survey data from NASS-87 and NASS-95 for the CM *Small Area* are now permanently on file with the IWC Secretariat. The Committee expresses its appreciation to Walløe for his efforts in this regard and to the Icelandic authorities.

The Committee **agrees** that this further analysis and the arrangements for permanent access to the sightings survey data addresses all of its concerns about this estimate, and accepts it for use in the RMP.

7.3.2 Stock identity and area boundaries

The Committee received SC/51/RMP11 which attempted to help to clarify the genetic structure of northeastern Atlantic minke whales through an analysis involving random amplification of polymorphic DNA (RAPD). Details of the study are given in Annex D, item 11.2. SC/51/RMP11 identified three possibilities concerning stock structure:

(1) there is only one breeding stock in these *Small Areas* – the fact that the low level of genetic variability explained was significant may be attributable to the very uneven, and sometimes extremely low, sample size;
(2) there are separate breeding stocks that segregate in the *Small Areas*, but the analysis method was not able to discriminate between them; or
(3) there are two breeding stocks, not necessarily the two groups described above, that share several of the *Small Areas* as feeding grounds and/or cross several of the *Small Areas* before reaching their final destination (in the authors' opinion the most likely).

The authors noted that more detailed analysis of the data at the individual level, including sex, size, precise location and date of capture, is required to elucidate the genetic structure of minke whales in these waters. On behalf of her co-authors, Martinez sought suggestions from Committee members for further analyses; the authors are considering pursuing joint work with pertinent members of the Committee.

The Committee expressed its appreciation for this initial analysis of samples collected from commercial whaling operations. It noted that results from analyses of such data may help to reduce uncertainties in the *Implementation Simulation Trials* conducted previously for northeast Atlantic minke whales (IWC, 1993b, pp.153-96). As such, this and other accumulating information could provide a basis for an *Implementation Review* in the next few years. Butterworth noted that those *Implementation Simulation Trials* include West Greenland minke whales, and that animals in that area are also being considered by the Standing Working Group on the AWMP.

7.3.3 Sightings surveys

SC/51/RMP12 presented the results of a minke whale survey in the EN *Small Area* of the Eastern *Medium Area* used in the RMP implementation for minke whales in the eastern North Atlantic. This was the third in a planned six year series of surveys designed to cover the Eastern *Medium Area* and the CM *Small Area* of the Central *Medium Area* (IWC, 1997c). The entire series is planned to be used to provide new abundance estimates for the implementation of the RMP. Following Committee recommendations, adjustments had been made to ensure greater comparability over years. This included making arrangements to use the same ships as in 1997, with the expectation that they would be used until 2001. No progress had been made on the distance and angle estimation experimental methodology, although more effort had been put into training and reporting procedures. The survey planned for 1999 will cover the ES *Small Area*, i.e. the northern Norwegian Sea including Svalbard. In 2000 the EB *Small Area*, north and east of Norway in the Barents Sea, will be the target area. The sightings survey vessels were not allowed in Russian EEZ waters when this *Small Area* was surveyed in 1996. If present difficulties in obtaining entry of Norwegian research vessels into Russian EEZ waters continue, portions of that area may remain unsurveyed in this series.

The Committee had previously noted the importance of collecting additional surfacing rate data (IWC, 1998c, p.70). Øien reported that no progress had been made in obtaining additional surfacing rate data. Research continued to concentrate on satellite tag attachment devices, with the expectation that additional data could be obtained by a data-logging device. The Committee noted that the surfacing rate data obtained previously, and used in conjunction with the sightings survey data for estimating abundance, were not extensive. It anticipated that additional data would probably be necessary to obtain additional abundance estimates.

The Committee thanked Øien for his oversight role in 1998, and **agrees** that he should serve in this capacity during the 1999 survey. The Committee noted the difficulty in obtaining entry to Russian EEZ waters for sightings surveys, and **recommends** that the Commission contact the relevant authorities of the Russian Federation to request that they grant permission in a timely manner for future surveys.

7.4 Work plan

The Committee **recommends** that the following work (listed in order of priority) should be undertaken during the intersessional period.

(1) Conduct final North Pacific minke whale trials (Secretariat under guidance of Intersessional Steering Group, see Annex U(6) and Item 7.1.4).
(2) Code and conduct initial western North Pacific Bryde's whale trials (Secretariat under guidance of Intersessional Steering Group, see Annex U(7) and Item 7.2.1.5).

This is discussed further in Item 17.

The agenda for next year's meeting will include:

(1) to review results of final North Pacific minke whale trials;
(2) to review progress towards coding initial western North Pacific Bryde's whale trials;
(3) to review reports of sightings surveys (North Pacific minke, North Pacific Bryde's, North Atlantic minke).

8. ABORIGINAL SUBSISTENCE WHALING MANAGEMENT PROCEDURE (AWMP)

This Item continues to be discussed as a result of Resolution 1994-4 of the Commission (IWC, 1995a, pp.42-3).

The report of the Standing Working Group (SWG) on the Development of an Aboriginal Subsistence Whaling Management Procedure (AWMP) is given as Annex E. The Committee's deliberations, as reported below, are largely a summary of Annex E and the interested reader is referred to it for a more detailed discussion.

A glossary of terms is given in Annex E, Appendix 2. For ease of reading, unless another reference is given, 'Last year' refers to last year's report of the SWG (IWC, 1999g).

8.1 Likely form of the AWMP

Last year, the Chair of the SWG presented its work to the Commission. The Committee thanks the Commission for its prompt response to requests for advice (IWC, 1999a). The results of this dialogue have been taken into account in the discussion below.

A major feature of the Commission's discussion was its endorsement of the scenario put forward last year by the Committee with respect to the development of an Aboriginal Whaling Management Scheme that comprises the scientific and logistical (e.g. inspection/observation) aspects of the management of all aboriginal fisheries. Within this, the scientific component will comprise some general aspects common to all fisheries (e.g. guidelines and requirements for surveys and for data cf. the RMP) and an overall AWMP within which there will be common components and case-specific components.

Recognising that it will be possible for the Committee to develop *SLA*s for some stocks before others, the Commission agreed that the Committee can best fulfil its role of providing advice on stocks subject to aboriginal whaling by presenting available components of the AWMP to the Commission as and when they are ready.

8.2 General issues relating to trials

A major implication of the Commission's discussions last year is that the Committee can now develop case-specific trials for at least some fisheries, notably the Bering-Chukchi-Beaufort Seas stock of bowhead whales and the eastern stock of gray whales - these are the equivalent of *Implementation Simulation Trials* in the RMP.

8.2.1 Common Control Program

The Common Control Program is the computer code used by developers to run trials. It also calculates the performance statistics and the information needed to compare the performance of candidate *SLA*s. Progress on the work that had been identified last year to modify the Common Control Program had been slower than anticipated. The Committee reiterates its view that the availability of an up-to-date Common Control Program is vital to the development process of the AWMP. The work required during the year to update the program is identified in Annex E, table 4. The Committee noted that the SWG had agreed that it was necessary to ensure that it:

(1) is realistic when estimating the amount of time needed to conduct computing tasks;
(2) provides a realistic estimate of the resources required and a proposal for how this might be achieved; and that
(3) tasks are completed in the order of priority established by the Committee for its overall computing needs.

This is discussed further under Item 17.

8.2.2 Statistics and performance plots

Performance statistics are used for two purposes: (i) to compare competing candidate *SLA*s; and (ii) to understand and test the performance of a preferred *SLA* subsequently chosen by the Committee. During previous meetings, the Committee has refined the set of performance statistics and has divided them into those that are 'mandatory' and those that are 'optional'. The primary purpose of the optional statistics is to explain the behaviour of any final *SLA* to the Committee and the Commission.

In the light of discussions of SC/51/AWMP3, the Committee **recommends** the revised reporting requirements summarised in Table 3. Developers need only to present in their papers the 5th and 50th percentiles of the D1, D2 and R1 statistics based on a 100-year time horizon and the same percentiles of the N9 statistic based on 20- and 100-year time horizons. However, they must bring to meetings electronic versions of the raw output files produced by the Common Control Program for all trials for their *SLA*s, in case more complete results are desired.

Presenting the value of the N9 statistic based on the first 20 years of application of the *SLA* allows consideration of how well the *SLA* is able to satisfy short-term need, an issue identified in Commission discussions (see Annex E, item 2.1, Appendix 4 and SC/51/AWMP6). Given that candidate *SLA*s will be used to set 5-year block quotas (see Item 8.3.4), the Committee **agrees** that the need-related statistics should be computed based on five-year blocks rather than single years (and see Annex E, Appendix 3).

Considering recent Commission comments (IWC, 1999a and see Annex E item 7 and Appendix 4), the Committee **agrees** to add two new statistics (N10 and N11) that assess performance in terms of the variation over time in strike limits. Both are mandatory for the year 2000 meeting so that they can be compared.

Table 3 summarises the SWG's consideration of performance statistics thus far in the development process.

Summarising and interpreting the vast array of results from different developers is greatly facilitated if the format used for presentation of statistics is standardised. Zeh has

Table 3
Performance statistics.

ID	Mandatory	Optional	Time periods	Name	Comment
D1	1+, mature		100	Final Depletion	Delete 20, 50 years (1999)
D2	mature		100	Lowest Depletion	Delete 1+ and 20, 50 years (1999)
D6		1+, mature	100	Trajectories 1 and 2	Demote to optional (1999)
D7		1+, mature	100	Pointwise Quantile Trajectories	Demote to optional (1999)
N1		Yes	20, 100	Total Need Satisfaction	Delete 50 years (1999)
N2		Yes	20, 100	Longest Shortfall	Delete 50 years (1999)
N4		Yes	20, 100	Shortfall Frequency	Delete 50 years (1999)
N5		Yes	20, 100	Block Need Satisfaction	Demote to optional and delete 50 years (1999)
N7		Yes	100	Percent Need Satisfaction Pointwise Quantile Trajectory Plot	Agreed in 1996
N8		Yes	100	Percent Need Satisfaction Trajectories 1 and 2 Plot	Agreed in 1996
N9	Yes		20, 100	Average need satisfaction	Delete 50 years (1999)
N10	Yes		100	Average Annual Variation in Catch	See Item 3.2.1
N11	Yes		100	Anti-curvature Catch Variation Statistic	See Item 3.2.1
R1	1+, mature		100	Relative Recovery	Redefined in 1997
R3		1+, mature	100	Time Frequency in Recovered State after Recovery	Delete 20, 50 years (1999)
R4		1+, mature	100	Relative Time to Recovery	Delete 20, 50 years (1999)

been developing *S-Plus* software for this purpose. The Committee **reconfirms** the value of this plotting software. Zeh and Allison will update this intersessionally for distribution on the SWG's website. The Committee thanked Givens for maintaining this website.

8.3 Review of simulation framework

The SWG reviewed a number of modelling issues previously identified, to determine progress. Details of these are given in Annex E, item 3.3. Some of these issues are also discussed below.

8.3.1 Density-dependent survival rate

The Common Control Program had assumed 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 could be avoided by allowing density-dependence to act on the non-calf survival rate. SC/51/AWMP1 showed that if density-dependence is assumed to be a function of the 1+ depletion, oscillatory population trajectories are not a problem regardless of whether density-dependence is assumed to act on fecundity or survival. However, if density-dependence is a function of the depletion of the mature component of the population, oscillatory trajectories can occur when density-dependence acts on fecundity (but not when it acts on survival). The Committee **agrees** that density-dependence should be considered to act on fecundity because: (1) this approach is not likely to lead to oscillatory trajectories in the cases under consideration; and (2) it requires no changes to the existing simulation framework.

8.3.2 Density-dependence on the mature rather than 1+ component

SC/51/AWMP1 showed that when density-dependence is modelled as a function of the mature female population component, it is difficult to find sensible, self-consistent sets of biological parameters to use for modelling, especially when MSYR is assumed to be high. This problem is markedly less severe when density-dependence is modelled as a function of the 1+ component. The Committee **agreed** that the Common Control Program for fishery type 2 should be changed to model density-dependence as a function of the 1+ component of the population.

8.3.3 Self-consistency of scenario assumptions and correspondence of scenarios to data

One topic previously considered by the SWG was the confounding of the bias factor and the carrying capacity (IWC, 1998e). At past meetings, the SWG agreed to continue to use the current protocol to allow for bias in the *Initial Exploration Trials* and encouraged development of alternatives. No papers dealing with this issue were presented during the meeting. The SWG **agreed** to retain this item on its agenda. On a related issue, the Committee **agrees** to use the method proposed in SC/51/AWMP2 to condition trials for scenarios where bias is assumed to exist in past surveys (see Annex E, Appendix 3).

8.3.4 Block quotas and carryover

As a result of discussions in the Commission (IWC, 1998a), the Committee had noted the importance of incorporating a mechanism for block quotas and carryover into the final *SLA*s. In fact, some developers have already begun to implement block quota assumptions in their results, purely to speed computer programs. The Committee **agrees** that all bookkeeping of strike limits, whether for calculation of need satisfaction statistics, strike limit trajectory plots, or otherwise, should assume 5-year block quotas with equal catch in each year. No carryover is assumed between blocks. Details are given in Annex E, Appendix 3.

The Committee recognised that this is a simplification of likely scenarios given *inter alia* the weather and environmental conditions prevalent in many fisheries. It **agrees** that it will later consider: (1) sensitivity trials where the strikes are assumed to be taken within any block in non-uniform manners; and (2) the issue of within-block carryover.

8.3.5 Multi-species issues

When Greenland presented its need request to the Commission, it expressed this as a number of tons of whale meat, with need not assigned to species. The Committee recognised the importance of multi-species issues, noted the comments made at the Commission meeting last year (IWC, 1999a) and welcomed the information presented in Annex E, Appendix 4. It recalled the discussion from last year's meeting on possible approaches to this issue (IWC, 1999d,

p.28). The development of the multi-stock fishery type 1 *Initial Exploration Trials* and the development of a long-term whale research programme for Greenland (e.g. see Item 8.9.3 and Annex N) will help advance work in this area.

8.3.6 Survey frequency

The Committee has agreed that 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 the broader Aboriginal Whaling Management Scheme, which will include certain data requirements. For the present, it plans to consider survey frequency on a stock-specific basis. Details of present assumptions used in the trials are given in Annex E, Appendix 3.

8.4 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 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.

Last year, the Committee had agreed that results should be presented for both *depletion tuning* and *H-tuning*. The former was used in the RMP development process and aims to achieve a pre-specified median final depletion on a trial, whereas the latter (described in Givens, 1998 and Givens *et al.*, 1999) considers need and recovery as well as final depletion. Both approaches were used in SC/51/AWMP3 to equivalence two *SLA*s. The Committee **agrees** that *depletion tuning* provided an equivalencing of *SLA*s from which comparisons can more easily be made. It **recommends** that only this method be required henceforth, although it recognised that *H-tuning* had some appealing aspects for equivalencing *SLA*s. The preferences between *SLA*s may depend on the manner in which they are *equivalence tuned* and the Committee therefore **agrees** that any comparison between *SLA*s should be based on several *equivalence tunings* (it does not preclude the use of *H-tuning* for variety if later desired). The Committee **agrees** that the choice of tunings should be discussed intersessionally and a recommendation should be made at the forthcoming intersessional Workshop discussed under Item 8.9.6.2.

Other issues related to tuning were discussed (see Annex E). *Inter alia* the Committee agrees: (1) that future *depletion tuning* should be based on the 1+ stock component; (2) to retain use of the 50% quantile for *depletion tuning* because this option required no changes in the Common Control Program; and (3) that the actual tuning targets used should be chosen on a case-specific basis (these targets need not be the same as the tuning chosen to be optimal for any *SLA* or the tunings to be presented to the Commission for its final selection).

8.5 Description of potential procedures

The Committee **strongly recommends** that an AWMP chosen for an aboriginal fishery should be validated by the Secretariat before it is recommended to the Commission. This will prevent the awkward situation in which unintended consequences of incompletely tested AWMP specifications are prematurely ratified and the AWMP must then be coded or altered to reflect such consequences.

SC/51/AWMP3 presented an application of the H-optimisation method for finding an optimal variant of an *SLA* for fishery type 2. Simulation results indicated that the optimisation improved *SLA* performance relative to that of the initial *SLA* by usually simultaneously allowing more strikes while reducing depletion risk. The SWG had noted that SC/51/AWMP3 demonstrated that the H-optimisation process can significantly improve *SLA* performance in realistic applications. Therefore, the Committee **agrees** that the development of an *SLA* for this fishery type might comprise initial development of a nominal *SLA* plus subsequent H-optimisation.

8.6 Trials

The full trial specifications, incorporating the issues discussed below, are given in Annex E, Appendix 3.

8.6.1 Fishery type 1

Fishery type 1 is defined as a case where there is relatively little available information, stock identity problems and where the Committee has had considerable problems in providing advice under Para. 13(a) of the Schedule (IWC, 1999b). It should be noted that the present *Initial Exploration Trials* for this fishery type are loosely based on the case of West Greenland minke whales. The existing trial structure is summarised in Table 4.

Last year, the Committee had noted that it was very unlikely that an *SLA* could be developed that would fulfil all the Commission's objectives for the West Greenland case. A major factor in this is the lack of information on minke whales in this area, in particular, with respect to stock identity. This led to the strong recommendation last year that the Committee cooperate with Greenlandic scientists to develop a research programme. Trials should represent plausible scenarios for the fishery, and research should be directed towards assessing which of the scenarios are implausible. Reduction of the uncertainty spanned by the current set of trial scenarios could permit an *SLA* to better satisfy need given the adequate performance in terms of risk. This is discussed further under Item 8.9.3 and Annex N. The need to also try to develop a range of *SLA*s was noted, e.g. one that behaves conservatively with few data but is able to react to new data and hence distinguish the true status of the stock(s). The Committee **recommends** that such approaches be explored and was pleased to note that Cooke is hoping to address this issue in the coming year.

8.6.2 Fishery type 2

Fishery type 2 is a case where there is a relatively large amount of information and Para. 13(a) of the Schedule has largely been met. The trials given in Annex E, Appendix 3 for this fishery type are effectively case-specific implementation trials for the Bering-Chukchi-Beaufort Seas stock of bowhead whales. The timetable for the development of a complete set of such trials as well as the equivalent trials for the Eastern stock of gray whales is considered under Items 8.9.1 and 8.9.2.

The method developed in 1996 to condition the trials for fishery type 2 led to values for the maximum pregnancy rate which have previously been considered unrealistic (IWC, 1999h). *Conditioning* refers to the selection of a self-consistent set of biological assumptions and data used to represent a specific scenario about a stock. Last year, a revised method for conditioning the trials had been agreed as had the need to move from a deterministic to a stochastic operating model.

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[1]	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[1]	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

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

SC/51/AWMP2 reported results obtained by applying the revised method for conditioning the fishery type 2 trials. The SWG had agreed that this method generally overcame the problems identified with the earlier method. With the slight modifications shown in Annex E, Appendix 3, the Committee **recommends** that this method is used to condition all future trials.

Three stochastic models (SC/51/AS1, SC/51/AWMP8 and SC/51/AWMP9) were presented to the SWG. The Committee concurred with the SWG's agreement that trials should be developed based on a stochastic operating model but that the deterministic operating model would form the base-case for the evaluation of candidate *SLA*s. The Committee **recommends** the stochastic operating model specified in Annex E, Appendix 3. This utilises the best features from the models proposed. The Committee **agrees** that the SWG should not base its stochastic operating model on an individual-based model or on one that is integer-based, because this would substantially complicate the task of conditioning the trials. Even though introducing demographic and environmental stochasticity increases 'realism', the operating model is still inevitably a simplification of reality. However, the agreed model is sufficiently realistic for the Committee's purposes.

The Committee **agrees** that the conditioning of trials for fishery type 2 should be consistent with the actual assessment of the Bering-Chukchi-Beaufort Seas stock of bowhead whales, to the extent possible. To this end, the SWG reviewed the prior distributions and the data used when conditioning the type 2 trials. To facilitate conditioning, some of the agreed priors and likelihoods (see Annex E, Appendix 3) differ slightly from those used during the 1998 assessment of the B-C-B bowhead stock.

The Committee **agrees** that additional trials assigning a Unif(1,4) probability distribution to $MSYR_{1+}$ rather than a fixed value, should be added to the trial specifications. These reflect a sufficiently close approximation to the 1998 assessment. Table 5 summarises the trials for the bowhead whale fishery.

Hatanaka raised the question of sub-stock structure for the fishery type 2 cases. The SWG Chairman noted that this question had not previously been raised in discussions within either the AWMP or the sub-committee on aboriginal subsistence whaling. Until now, the Committee has considered the B-C-B stock of bowhead whales as a single stock for assessment purposes. This is discussed further under Items 6.4 and 8.9.1.

Table 5
Trials for the Bering-Chukchi-Beaufort Seas stock of bowhead whales.

		Need					
Trial #	$MSYR_{1+}$	Initial level	Final level	CV_{est}	$\gamma_{12.9}$	$\lambda_{12.9}$	Bias B_4
B1	0.025	68	68	0.25	0	1	1
B3	0.04	68	204	0.25	0	1	1
B6	0.01	68	68	0.25	0	1	1
B7	0.01	68	204	0.25	0	1	1
B7a	0.01	68	204	0.125	4	2	1.5
B10	0.04	68	68	0.25	0	1	1
B11	Unif(1,4)	68	68	0.25	0	1	1
B12	Unif(1,4)	68	204	0.25	0	1	1
B13	Unif(1,4)	68	204	0.125	4	2	1.5

8.6.3 Fishery type 3

Fishery type 3 involves the harvesting of a population whose current size was 'small' (~ 300) and where demographic and environmental variability may have an impact on recovery time.

SC/51/AWMP8 presented an evaluation of the effects on population trajectories of different levels of harvest, based on an individual-based model that incorporated stochastic birth and death rates and patterns of environmental variation in natural mortality. It concluded that it is not possible to set a population level below which additional aboriginal hunting should not be allowed without quantitative information on the magnitude and frequency at which environmental variation causes the survival rate to decrease. The SWG discussed how the magnitude of environmental variation could be estimated for a real case. The Committee welcomed SC/51/AWMP8 and **encourages** the authors to complete the work by modifying the functional form used to model environmental variation according to the specifications in Annex E, Appendix 3.

The Committee noted that an *SLA* for a type 3 fishery might have to be largely free of population modelling, as the data for such fisheries are likely to be even sparser than those for a type 1 fishery. Due to the lack of data for some stocks, it is unclear whether any current aboriginal whaling fishery dealt with by the Commission resembles type 3, and thus the Committee cannot yet indicate a relative priority for developing trials and *SLA*s for this fishery type.

The Committee noted the relevance of work on fishery type 3 to its discussions of severely depleted populations not subject to aboriginal subsistence whaling, for example, in attempting to assess the impact of other anthropogenic removals (e.g. entanglements); see Item 9.4.

8.7 Planning for future selection of *SLA*s

*SLA*s for some fisheries may take the form of a statistical optimisation or merging of one or more nominal procedures; a reasonable concern is that the optimisation avoids overfitting to the available trials. If an extreme case of overfitting was encountered, it could lead to a procedure which performed well on existing trials but very poorly or unpredictably on new trials, whether they are more or less extreme than the original set of trials. Furthermore, because trials are specified by a large number of parameters, it can be very difficult to determine whether any new trial actually is more or less extreme in the high-dimensional space of scenarios. Although overfitting may not actually be a problem, the Committee agrees that the SWG should develop, on a case-specific basis, a collection of cross-validation trials to be held aside from *SLA* development so that resulting *SLA*s, whether optimised, merged, or otherwise, could be subjected to a subsequent independent test. The development of these trials will begin intersessionally and will be discussed at the proposed intersessional Workshop (see Item 8.6.2).

SC/51/AWMP7 presented a new method called U-optimisation for tuning and optimising the performance of *SLA*s. It can be used to control management risk in an explicit fashion and one goal is to scale *SLA* strike limits so that the risk due to uncertain status is directly controlled. One or more *SLA*s can be, for example, scaled so that an agreed-upon risk measure is set to a chosen level. Such a method is appealing because it focuses explicitly on risk. The alternative approach of H-optimisation addresses risk, need satisfaction and recovery simultaneously through the choice of scenario weightings, loss functions, and an idealised catch control law H. SC/51/AWMP5 compared H-optimisation and U-optimisation. It argued that the current specification of U-optimisation uses an inadvisable and statistically unjustified estimation strategy, and provided specific examples of instances where U-optimisation led to unintended and undesirable *SLA* performance.

The Committee recognises that the application of innovative quantitative methods for tuning, optimising and merging *SLA*s is contributing towards the AWMP development process (such approaches had not been available during RMP development). It **encourages** further work on these methods.

8.8 Dialogue with Commission and hunters

The Committee reiterates the importance it attached to continuing dialogue with the Commission and hunters throughout the development process. It agreed that the procedure adopted in previous years, i.e.:

(1) a presentation by the Chairman of the SWG of its report and a less technical Chairman's discussion paper; and

(2) informal discussions with interested Commissioners,

had proved successful. It **recommends** that this procedure continues.

As noted earlier, the Committee had taken into account the Commission's discussions under the relevant Agenda Items. For this year's meeting, it recognises that the work plan and timetable (Item 8.9) are of particular interest to the Commission. In addition, it draws the Commission's attention to its discussions on the incorporation of block quotas and carryover (Annex E, item 3.3.4.5), catch variability considerations (Annex E, item 3.2.1) and need satisfaction (Annex E, item 3.2.1).

8.9 Work plan (including computing needs and financial implications)

The Committee recognises the need to ensure that as rapid progress as possible is made towards providing the Commission with recommendations that satisfy the specified management objectives to the greatest extent possible for the fisheries of concern.

In 1997, the Committee had noted that the speed of the development process was related to a number of factors. These included: some continuity of membership; several groups of developers; experts from the management procedures field who were not developers; and suitable levels of resources. With respect to groups of developers, the Committee recognises the major contribution made by those already participating in the development process but also noted the value of additional groups joining. It welcomes the fact that Magnússon and Cooke had indicated their intentions to work on the development of candidate procedures during the coming year. The other issues are discussed below, after considering likely progress on a fishery-by-fishery basis.

8.9.1 B-C-B stock of bowhead whales

Considerable work has already been undertaken on this stock. The Committee recognises the difficulty of predicting in advance the results of the development process given the iterative nature of such work. Any timetable is inevitably somewhat tentative. It therefore presents the Commission with two scenarios (Table 6), one labelled 'faster' and one labelled 'slower'. Every effort will be made to follow the faster timetable and, of course, progress will be regularly reported to the Commission.

Given the discussions of stock structure under Items 6.4 and 8.6.2, it was noted that if more than single stock trials are required, then the above timetables will be significantly underestimated.

8.9.2 Eastern stock of gray whales

Prior to this meeting, the SWG had not considered the specifics for this stock, other than recognising it as a type 2 fishery. Annex E, Appendix 5 presents a discussion of those issues related to the specification of trials. The issue will be considered by an Intersessional Working Group (see Annex U(8)) with the aim of enabling the intersessional Workshop to finalise the necessary trial structure. Assuming this is the case, the Committee **agrees** that the timetable and work plan options would mirror those for the Bering-Chukchi-Beaufort Seas stock of bowhead whales given above.

8.9.3 Greenland fisheries

Last year, the Committee informed the Commission that with currently available data, it will be extremely difficult, if not impossible, to develop an *SLA* that will satisfy all the

Table 6

Approximate timetable for developing an *SLA* for the Bering-Chukchi-Beaufort bowhead whale.

Time	'Faster'	'Slower'
Summer-1999	Punt/Allison meeting. Address outstanding coding issues arising from implementing decisions taken at Grenada meeting.	Same
Intersessional Workshop - late 1999	Finalise the necessary *Implementation Simulation Trial* and *Evaluation Trial* structure for bowhead whales and if possible, gray whales; finalise *cross-validation trials*; try to finalise robustness trials.	Same
2000 meeting	Complete *Robustness Trial* structure if necessary; coding completed. Presentation of candidate *SLA*s.	Same
Intersessional Workshop - *ca* 2 months before 2001 meeting	Consider results from *Evaluation Trials* for candidate *SLA*s (incl. H-opt); narrow choice of *SLA*s to those for *Robustness Trials*. Determine tunings for presentation to the Commission and begin to prepare explanation for Commission.	Possible
2001 meeting	Examine results of *Robustness Trials*. Make recommendation to Commission with suggested tuning options. Receive feedback from Commission.	Examine results of evaluation trials. Narrow choice for robustness trials. Revise *Evaluation Trials* as needed.
Post 2001 meeting	Incorporate feedback from Commission.	Intersessional work continues.
2002	Formally present recommendation on all scientific aspects to the Commission.	Examine trial results and narrow choice of *SLA*s. Revise and extend *Robustness Trials* as needed. Prepare explanation of *SLA* for Commission. Present tentative recommendations for feedback from Commission.
2003		Develop and present final tuning options to Commission. Incorporate Commission feedback.
2004		Formally present recommendation on all scientific aspects to the Commission.

Commission's objectives for these fisheries. To that end the Committee recommended, and the Commission accepted, the need to develop a cooperative research programme that will enable the Committee to provide satisfactory advice to the Commission.

Developing such a programme was a priority topic for the sub-committee on aboriginal subsistence whaling this year (see Item 9.2.1). The Committee **agrees** that given the vital link between potential management procedures and data requirements, input from AWMP participants in such discussions is essential. Examination of the preliminary results in earlier years showed the particular importance of obtaining information to limit the range of plausible stock hypotheses that must be considered by any *SLA*. Such work must be a vital component of any research programme.

As noted last year, the Committee will be in a better position to provide a timetable when the results of the research programme become available. Progress with the research programme is therefore a critical factor in developing a timetable for the development of an *SLA* for the Greenlandic fisheries. There must be considerable feedback between the development of the research programme and the development process of potential *SLA*s. The need to explore a range of *SLA* types with differing data requirements is essential. The success of the research programme is dependent on a number of factors, some of which, such as funding, are potentially within our control, whereas others, such as weather conditions, are outside it. In any event, the resultant uncertainty means that any timetable must be highly tentative at this stage. At present this timetable does not separate minke whales from fin whales.

With these provisos, the Committee offers the tentative development scenario given in Table 7, noting that intersessional workshops will also be required.

The Committee **reiterates** its view from last year that it will 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.

8.9.4 St Vincent and The Grenadines humpback whales

The Committee has not yet considered this fishery in any detail. A major review of North Atlantic humpback whales will occur at the 2001 meeting (see Item 9.4.2). It is already clear that an important part of any trial structure development will be concerned with the relationship between animals taken in this fishery and those found in the wider western North Atlantic. Given the very large catalogue of identified whales (both via photo-identification and DNA fingerprinting) available for the western North Atlantic, particularly after the extensive YONAH programme, the

Table 7

Tentative timetable for developing *SLA(*s) for the Greenlandic fisheries.

Year	AWMP	Research programme
2000/01	Continue to develop the trial structure for *Initial Exploration Trials* and explore a range of *SLA* types that e.g. require different data requirements.	First field season Second field season
2002	Incorporate data from the field programme in order to develop *Implementation Simulation Trials.* Present candidate *SLA*s.	Third field season
2003	First round of evaluation trials.	Fourth field season?
2004	Second round evaluation trials.	Etc.
2005	Robustness trials.	Etc.
2006	Possible recommendation to Commission.	Etc.

Table 8

Work to be carried out in the coming year.

Task	Estimated time	Target deadline
Secretariat computing (Item numbers refer to Annex E).		
(1) Statistics portion of control program: Add calculation of N10 and N11 statistics (Item 3.2.1); delete unwanted statistics from output; change need statistics to block quota periods (Item 3.3.4.5).	1 week	1 August
(2) Control programs for fishery types 1 and 2: amend to use block quotas (Item 3.3.4.5); change density dependence to 1+ (Item 3.3.2). Amend to set year t=0 to 2003; Add additional output to aid development of H optimisation.	1 week	1 August
(3) Amend code to select fishery type 2 parameters with replacement from the posterior distribution (Item 5.2.1.1 and SC/51/AWMP2) and to input rather than to fit P_0; amend code to add trial which assigns Unif (1,4) probability distribution to MSYR (Item 5.2.1.2).	2 weeks	1 August
(4) Merge three stochastic models SC/51/AS1, SC/51/AWMP8 and SC/51/AWMP9 into control program for type 2 fishery (Item 5.4.1.2).	1month	1 September
(5) Finalise the plotting program (in collaboration with Zeh) (Item 3.2.2).		1st day of Workshop
(6) Code cross-validation trials (following development by workshop) (Item 6.3)		To be decided by Workshop
Other	**To be carried out by**	
Continue development of *SLA*s (Item 8.9).	Various developers	
Begin work on gray whales (Item 8.1.2).	Punt, Wade, Breiwick and others	
Develop trials as discussed under Item 8.	Intersessional Workshop	
Choice of three depletion tunings (Item 3.4).	Intersessional Workshop	
Further work on H- and U-optimisation (Item 6.4).	Givens, Witting	
General work on development of AWMP (Item 8.9.6.4).	Donovan	
Model environmental variation in Fishery type 3 model (Item 5.3).	Breiwick and DeMaster	

Committee reiterates previous **recommendations** on the importance of collecting at least tissue samples from any animals taken in this fishery (and see Item 9.1.4.3).

8.9.5 General issues

8.9.5.1 COMPUTING REQUIREMENTS

The Committee identified a number of AWMP-related tasks that require work during the coming year, including computing tasks for the Secretariat. These are given in Table 8 with an indication of both priority and target date. The SWG had stressed that the pace of the development process was critically dependent on the appropriate software being available as soon as possible. Noting that Punt would visit the Secretariat in the summer to facilitate the coding work, the SWG had agreed that, subject to consideration of the Committee's overall computing requirements, this year's computing needs could probably be met by the existing resources. However, the SWG was concerned that the computing needs identified in the timetables for individual stocks represent a large volume of work and that this probably could not be achieved in the required time frame by existing Secretariat resources. The SWG also recognised that its computing requirements could not be viewed in isolation from other Committee needs and it had recommended that this matter be considered by the full Scientific Committee. This is discussed further under Item 17.

8.9.5.2 Intersessional meetings and workshops

The Committee recalled the importance to the development process of the RMP of holding intersessional Workshops. Workshops play an important role in the work plan for type 2 fisheries (see Items 8.9.1 and 8.9.2) and will do so for the Greenlandic fisheries. The Committee **recommends** that an intersessional Workshop be held as indicated under Item 8.9.1. The Workshop should last for five days (based on four days for bowhead whales and an additional day for gray whales) and £12,000 is required. The tasks of the Workshop will be to: finalise the necessary implementation trial structure for bowhead whales and if possible, gray whales; finalise *cross-validation trials*; try to finalise *Evaluation Trials and Robustness Trials*; and recommend the choice of depletion tunings (see Item 3.4).

8.9.5.3 Resources for developers

Last year, the Commission had agreed to establish a fund of initially £5,000 to help support the work of developers. The Committee welcomed this. However, it **agreed** that the restriction of a maximum of £1,500 available annually to each developer was unnecessarily restrictive and it believed that the decision as to how much should be made available, within the total, should be taken jointly by the Chairman of the SWG and the Chairman of the Committee.

8.9.5.4 Aboriginal Whaling Management Scheme - scientific aspects

The Commission had recognised that an Aboriginal Whaling Scheme (AWS) will comprise 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). The SWG agreed that it would be valuable to begin the process of developing the scientific aspects of this at an early stage, in order to enable dialogue with the Commission to occur. Donovan agreed to produce a discussion paper for the next Annual Meeting.

9. ABORIGINAL SUBSISTENCE WHALING STOCK ASSESSMENTS

9.1 Annual review of catch limits

9.1.1 Bering-Chukchi-Beaufort (B-C-B) Seas stock of bowhead whales

9.1.1.1 ASSESSMENT

A thorough assessment of this stock of bowhead whales was carried out in 1998. This year, the Scientific Committee reviewed 15 reports on the biology of bowhead whales from the B-C-B stock and on methods for estimating its stock size and status. Detailed discussions are given in Annex F.

SC/51/AS8 reported on a female reproductive tract from a sexually immature bowhead whale. Findings were morphologically comparable to those described in other

mysticetes. SC/51/AS6 examined the accumulation and persistence of corpora albicantia in the bowhead whale ovary. SC/51/AS7 reported on observations on ovarian morphometrics and morphology in the bowhead whale. The authors suggested that the presence/absence of lumens in corpora is not useful in distinguishing corpora of pregnancy from those of ovulation.

SC/51/AS16 evaluated a putative genetic bottleneck in the B-C-B Seas stock of bowhead whales and found no evidence that a bottleneck had depressed the level of genetic variability. SC/51/AS17 presented information on the historical demography of the B-C-B stock from mitochondrial DNA sequence polymorphism data. Results from two different approaches supported a model of historical expansion of the B-C-B stock, probably initiated approximately 8,500 years ago, subsequent to the formation of the M'Clintock Channel sea-ice plug. Given the results in SC/51/AS16, this study indicated that the pre-1848 population was in equilibrium.

SC/51/AS14 considered the gross anatomy and histology of Harderian and conjunctival glands of the bowhead whale and SC/51/AS15 discussed the basic structural characteristics of the bowhead whale eye.

SC/51/AS28 summarised bowhead whale vocal behaviour. For the past 20 years bowhead sounds have been recorded during the bowhead spring migration off Barrow, Alaska. Results from these acoustic location and tracking studies have shown that bowheads are very vocal during their migration off Point Barrow. The extensive dataset provides the opportunity to examine bowhead acoustic behaviour at several different levels.

SC/51/AS22 examined the Alaskan Eskimo subsistence harvest. During 1998 there were 54 strikes resulting in 41 whales landed, giving an efficiency rate of 76%, one of the highest observed to date. Two of the four mature females that were landed were pregnant. The pregnancy rate for mature females ($\geq$14.2m in length) from 1980-1998 was 25%. One landed whale was a calf with milk in its stomach. An 11.7m male had several lesions in the thoracic cavity resulting from an earlier harvest attempt, indicating that at least some of the whales struck with explosive projectiles, but not landed, survive their injuries.

A bowhead whale census had been planned for spring 1999 but owing to a record ice retreat during the 1998 summer and the late formation of ice during the 1998-99 winter, it was postponed until 2000. The landfast ice, upon which the census is conducted, was unsafe and unsuitable for a census in 1999.

SC/51/AS23 presented statistical models and maximum likelihood methods for estimating bowhead whale population size from photo-identification data. These were tested on both simulated and actual data from 1985 and 1986 photographic studies. The resulting estimates of 1+ population size for 1985 and 1986 ranged from 4,719 to 7,331. Standard errors are comparable to those obtained from ice-based census in years with suboptimal environmental conditions. All confidence intervals include the ice-based census estimates for 1985 and 1986, as well as the corresponding values of 1+ population size in the most likely trajectory from a Bayesian synthesis analysis. These most likely values (6,649 and 6,820) incorporate the ice-based census estimates and additional data on bowhead whale population dynamics.

The Committee welcomed this analysis, noting that it confirmed, from completely independent data and methods, the abundance estimates from the ice-based census currently used by the Committee in providing management advice.

SC/51/AS5 introduced a Bayesian approach to the estimation of bowhead survival rates from mark-recapture data. The method was tested on simulated data because the re-scored bowhead photographs are not yet available. Assuming uniform priors on survival, the method yields accurate, high-precision estimates when the sightings probabilities are at least moderate.

A number of papers presented analyses relevant to the assessment of the B-C-B stock of bowhead whales (SC/51/AS1, AS2 and AS4; SC/51/AWMP9). These are discussed in detail in Annex F. A number of points of general interest were raised:

(a) differences between 'backwards' and 'forwards' approaches to a Bayesian assessment are less if demographic stochasticity is introduced (SC/51/AS1);
(b) results using a stochastic model are broadly similar to those obtained using previous approaches (SC/51/AWMP9);
(c) using a stochastic model removes some of the undesirable features of the BALEEN II model in the bowhead case (SC/51/AWMP9);
(d) allowing for environmental variation in fecundity may impact estimates of key model parameters including current replacement yield (SC/51/AS1); and
(e) no conclusion was reached over the appropriateness of using a 'bounded' maximum likelihood approach (SC/51/AS2).

SC/51/AS4 confirmed the results of the 1998 in-depth assessment of this stock. The analyses using the backwards and full pooling methodologies were repeated after the 1998 meeting. The results were consistent with those obtained last year. The results suggest that the full pooling method may be superior to the backwards method for this application, but the results were not considered conclusive. In discussion it was noted that the paper provides a valuable review of last year's in-depth assessment of the B-C-B stock of bowhead whales.

9.1.1.2 MANAGEMENT ADVICE

Last year's in-depth assessment was based on Bayesian methodology and a reference set of prior distributions and likelihoods. Assessments using BALEEN II were based on both the forwards and backwards methods as well as one that pools prior distributions. Assessments using a Leslie model were also carried out.

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

9.1.2 Eastern North Pacific stock of gray whales

9.1.2.1 ASSESSMENT

SC/51/AS10 reported on abundance estimation of the eastern North Pacific gray whale stock from the 1997/98 southbound migration, using methods similar to those of previous surveys. The analysis differed from that used prior to 1995/96 because detection probability of pods varied significantly with recorded pod size. Ignoring this effect does not greatly change the abundance but almost doubles the standard error, suggesting that the CVs have been underestimated for surveys prior to 1995/96. A total of 2,318 pods representing 3,643 whales was counted. The population estimate is 26,365 (CV 10.06%; 95% log-normal confidence

interval of 21,900 to 32,400). The previous estimate based on the 1995/96 counts was 22,263 (CV = 9.25%, 95% CI, 18,600 to 26,700).

SC/51/AS11 analysed the timing of the 1998/99 southbound migration of gray whales. Prior to 1980, median dates of sighting ranged from 5-14 January, with a median date of 8 January. Since 1980, there has been a one-week delay in the peak, so that the median date is now around 15 January.

SC/51/AS30 reported on gray whale strandings at Baja California Sur, Mexico, during the winter of 1998/99. During the past winter season, the strandings attracted an unusual amount of public attention and considerable concern was expressed in both the local and international media. A total of 89 stranded whales was recorded at the end of the season. Although this is a high number, it is probably due to increased effort. Differences with previous years included: more stranded females and more stranded adults than calves (the reverse is usually true in the wintering grounds).

SC/51/AS31 described changes in abundance, distribution and mortality of gray whales at Laguna San Ignacio, Mexico during El Niño (1997-98) and La Niña (1998-99) relative to the winter seasons of 1996 and 1997. The maximum counts occurred from the second week of February (1998) to the first week of March (1996). The maximum counts were 1996: 207 (115 single whales and 92 cow-calf pairs); 1997: 253 (127 single whales and 126 cow-calf pairs); 1998: 230 (178 single whales and 52 cow-calf pairs); and 1999: 161 (144 single whales and 17 cow-calf pairs). Single whales always predominated and there was no significant change in their abundance. In contrast, cow-calf pairs displayed significant changes in number relative to their general distribution in the Mexican Pacific. In the 1998 (El Niño year) breeding season, their distribution moved towards northern latitudes whereas the opposite occurred during 1999 (La Niña year) when gray whales were observed inside the Gulf of California and Bahía de Banderas in mainland Mexico. These changes in the general distribution pattern were related to higher temperatures in 1998 and lower temperatures in 1999. The minimum calf-mortality rate in 1999 was twice that in 1996 and 1997. The authors hypothesised that the El Niño and La Niña events affected the nutritional condition of the whales, particularly mature females. This may reflect a reduction in food availability caused by oceanographic changes in the feeding areas.

SC/51/AS9 discussed vessel surveys and photo-identification carried out along the northern Washington coast and the southwestern coast of Vancouver Island, Canada during the summers of 1996 and 1997. The surveys were designed to investigate the abundance, distribution, duration of stay and movement patterns of gray whales in the region. Over the two seasons, 18 individuals were photo-identified from 97 seen in 1996 and 158 in 1997. There was an indication of a possible distributional shift in whales between 1996 and 1997; in 1996 they were sighted primarily on the outer Pacific Coast of Washington whereas in 1997 they were sighted mostly in the western Strait of Juan de Fuca. Whales appear to move freely between feeding sites on the outer Pacific coast and the inland Strait of Juan de Fuca and also between these sites and southwestern Vancouver Island. Multiple identifications of whales within a season indicated that some individuals remained in the area for up to four months, whereas others were only sighted once or twice over a short period of time.

During 1998, a collaborative widespread effort was made to survey and photograph whales throughout the known feeding range from northern California to southeastern Alaska. The survey analyses are not yet complete but initial results indicate that the true range of southern summer feeding groups of gray whales may be greater than previously believed, extending from northern California at least to southeastern Alaska.

SC/51/AS12 summarised the results of six aerial surveys conducted for gray whales from November 1998 to January 1999 along the northern Washington Coast. The objectives were to attempt to determine the migratory timing and corridor for the southbound migration in the region.

SC/51/AS21 reported preliminary results from an examination of 44 animals taken in the coastal waters of Chukotka from 15 July to 1 September 1998. All were aged and species composition of food items was analysed in 26 whales. Unlike previous years when females predominated in the catch, the 1998 catch sex ratio was 50:50. The author noted that the current method of whaling will continue and that immature whales will be the main object of the hunt. In 1998, the number of harvested animals increased significantly. Before 1990 all whales were taken on behalf of the local people by a catcher boat. However, by the end of 1991 there was no system in place for whales to be taken. As a result the local people began to return to their traditional methods of hunting. Last year, in cooperation with the Alaskan Eskimo Whaling Commission, whaling equipment was transferred to the Chukotkan people to enable a more efficient hunt to take place.

9.1.2.2 MANAGEMENT ADVICE

A major assessment of this stock took place in 1997 (IWC, 1998f). The Committee **agrees** that it has no reason to change the advice given then, i.e. that a take of up to 482 whales per year is sustainable, and is likely to allow the population to stabilise above *MSYL*.

9.1.3 Minke whales and fin whales off Greenland

9.1.3.1 DEVELOPMENT OF A RESEARCH PROGRAMME FOR STOCK STRUCTURE AND ABUNDANCE

Due to a lack of requisite data to provide satisfactory advice to the Commission, last year the Committee recommended the establishment of an intersessional group to work in collaboration with scientists from Greenland to develop a costed research programme for minke and fin whales off Greenland.

The Committee welcomed a review document by Born (1999) which examined the major topics of interest, particularly stock identity and abundance. It noted that a stock sub-structure study was underway that included material from the hunt in West Greenland and the Northeast Atlantic.

The Committee noted that the Commission did not expect Greenland to bear the total cost of the research programme. Information from this research is needed for the development of a Greenland fishery management procedure. The focus of the research programme should allow the AWMP SWG to narrow down the number of trial scenarios. The SWG is also encouraging the development of *Strike Limit Algorithms* with varying data requirements.

Donovan noted that biopsy samples, in addition to more traditional genetic analyses, can be used to obtain individual identification data. Previously, it has been difficult to obtain biopsy samples from minke whales. The feasibility of obtaining a large number of biopsy samples using the newly developed *Larsen* gun should be investigated. Power analyses should be undertaken to determine the necessary sample size for obtaining mark-recapture population estimates. Comparison of the results with a visual-based

estimate from aerial survey data could also provide information on stock identity. He also noted the lack of information on site fidelity important for ensuring that management considers the sustainability of the whales available to the Greenland fishery. Donovan's suggestions received strong support. The results reported in SC/51/AS23 indicated that mark-recapture data may yield relatively accurate estimates of abundance and other information. Biopsy sampling may also prove to be a cost-effective way to obtain samples from Canada, Iceland and East Greenland. It was also queried whether, if a NASS-2000 survey takes place (see Item 5), it might be useful to tie in the proposed research with that programme. Øien noted that NASS-2000 could be moved to another year. The Committee **agrees** that it will be useful if surveys around Greenland occur simultaneously with the NASS-2000 survey (either in 2000 or 2001).

The report of the *ad hoc* Working Group established to examine this matter further is given as Annex N. The Committee **endorses** the report of that group, **recommends** that the feasibility study it contains takes place (and see Item 18) and establishes the intersessional Working Group (see Annex U(9)).

9.1.3.2 ASSESSMENT

There were no papers submitted on the two management stocks of minke whales that occur off Greenland. Denmark reported that in 1998 a total of 163 minke whales (118 females, 39 males and 6 with sex undetermined) was landed in West Greenland and that three were struck and lost. A total of 10 minke whales (9 females, 1 male) was landed in East Greenland.

There were no papers submitted on fin whales off Greenland. Denmark reported that in 1998 a total of nine fin whales (8 females, 1 male) was landed and two were struck and lost.

9.1.3.3 MANAGEMENT ADVICE

The Committee noted that it has never been able to provide satisfactory scientific advice on either fin or minke whales off Greenland. The Committee **strongly recommends** the establishment of a research programme for fin and minke whales off Greenland and endorses the plans given under Item 9.1.3.1.

9.1.4 Humpback whales off St Vincent and The Grenadines

9.1.4.1 SIZE OF HUMPBACK WHALE CALVES

SC/51/AS3 used published and unpublished data from strandings and catches to estimate length at birth and at independence in humpback whale calves. A calf can be defined in one or more of three ways: (i) by absolute length (3.96-4.57m at birth and approximately 8-10m at independence for humpback whales); (ii) by relative length to that of a larger adult (i.e. the mother) with which the animal is closely associated (the upper 95% CI for this ratio is 0.63 for 3-month old humpback whales); or (iii) by the presence of milk in the stomach. The paper concluded that absolute length was a sufficient criterion with which to determine unequivocally the status of young calves found on the breeding grounds in winter.

Hester commented that SC/51/AS3 provided little data on the lengths of neonates and young animals for the North Atlantic. He noted that the von Bertalanffy analysis used to define 'calf' in terms of upper 95% relative length for a 3-month old animal is based on Stevick (1999) and the data were not available at the meeting. The use of relative length as proposed in SC/51/AS3 is probably not practical for a small-boat whale fishery such as that at Bequia. He also noted that the lengths for two of the 10 northwestern Atlantic animals in the sample, and the 1998 and 1999 small whales from the Bequia hunt, indicated dates of conception earlier than is usually assumed for the West Indies.

Clapham responded that the lengths of the two animals from SC/51/AS3 referred to by Hester were consistent with births during the normal West Indies breeding season, which is several months in duration. He agreed that the 1999 St Vincent whale, at 20-23ft, was probably born earlier in the winter but that it was still within the range defined for a calf by SC/51/AS3. He further noted that the length of the 1998 whale, at 4-6m in late February, was entirely consistent with a birth that winter and that 4m was in fact close to the mean length at birth for this species.

Rambally commented that data on length at independence was mainly from the Southern Hemisphere and that the studies of Chittleborough (1955; 1958) and Nishiwaki (1959) were based mainly on growth curve extrapolations. In her opinion, more studies have to be conducted before length at independence can be used as a criterion to determine mother-calf relationships.

Clapham noted that the most reliable data (four animals) came from the Gulf of Maine. Rambally responded that it was an assumption that these four were independent of their mothers. Schweder noted that the Maine animals were strandings and there were problems with small sample size and selectivity. Clapham agreed, but noted that if the four animals were not independent of their mothers, their length at independence, had they survived, would have been even longer. The Committee **agrees** that there is a high probability that any humpback whale < 8m in the breeding area during the winter season is a calf.

9.1.4.2 CATCH INFORMATION

Ryan presented information on the two whales taken on 6 March 1999 in St Vincent and The Grenadines. The larger whale was a 46ft female (not lactating) and the smaller was a 20-23ft female with milk absent from the stomach.

In response to a query as to why the size of the smaller animal was given as a range, Ryan replied that the length was estimated by the whalers. He also noted that tissue samples for genetic analysis would be sent to Japan, as last year, in order to determine the relationship between the two whales taken.

The Committee noted that in previous years it had urged that additional information be provided from this harvest and was pleased that more information was provided this year (see also Item 8).

9.1.4.3 MANAGEMENT ADVICE

The Committee **repeats its advice** from the 1997 meeting that a catch of up to three whales annually is unlikely to harm this stock. The Committee noted that a multinational survey of the Eastern Caribbean proposed for 2000 (see Item 10.5) should provide additional information (abundance, photo-id and genetic data) that will allow substantial improvement in the quality of its advice in the future.

9.2 Bowhead whales other than the Bering-Chukchi-Beaufort Seas stock

9.2.1 Baffin Bay, Davis Strait and Hudson Bay stocks

SC/51/AS18 reported sightings of bowhead whales from a shipboard survey in the North Water Polynya in northern Baffin Bay, mainly in May-June 1998. There were 14 sightings of at least 10 individual bowhead whales and five

additional unidentified large baleen whales. The authors noted that, historically, bowhead whales were abundant in the Baffin Bay-Davis Strait area, but that the current population is believed to be in the low hundreds.

SC/51/AS24 reported on an aerial/boat survey in August-September 1984 for bowhead whales in northern Baffin Island waters. Ten sightings, totalling 13 bowheads, were recorded. The authors concluded that Admiralty Inlet is probably one of several 'nursery' areas for bowhead whales in the eastern Canadian High Arctic archipelago.

SC/51/AS19 reviewed the distribution and movements, population size, life history, behaviour, environmental threats, protection and local knowledge of bowhead whales in the northwest Atlantic, including Baffin Bay-Davis Strait. The author noted that the low number of whales, persistent hunting by Inuit and killer whale predation, could explain the lack of recovery of this stock.

SC/51/SM57 dealt with, among other things, a survey estimate of 104 (95% CI = 68-141) bowhead whales in the Canadian High Arctic. The area surveyed included most of what is considered nursery area for the Baffin Bay bowhead stock.

No new information was available on the Hudson Bay stock. The Committee noted that both of these stocks are endangered and have small populations. There is no new information from last year except that a bowhead whale was taken at Pangmirtung, eastern Baffin Island, in the summer of 1998. Accordingly, the Committee reiterates last year's advice, i.e. (IWC, 1999d, p.35):

> Given the apparent interest in continuing harvests from these two stocks (Baffin Bay-Davis Strait and Hudson Bay) that were depleted by commercial whaling, additional knowledge of their status is crucially needed.

The Committee also noted an urgent need to resolve the question of stock identity of these two stocks using genetic samples and any other data.

9.2.2 Other stocks

Brownell reviewed information on Okhotsk Sea bowheads in a recent English translation of Doroshenko (1996). The paper supports the opinion that bowheads are isolated in the Okhotsk Sea. Soviet scientists first rediscovered bowheads there in 1967. Based on various surveys up to 1989 these researchers estimated bowhead population size in this sea as 400 whales, *ca* 100-150 in the Shelikhov Bay region and 250-300 around the Shantar Islands. However, the Committee noted that the methodology for estimating these numbers is not given; they thus have no quantitative basis. The relationship between those two groups of bowheads needs to be further investigated, e.g. using photo-identification and genetic information. In addition, better information on abundance of the bowheads in the two regions is needed. Unless measures to protect bowhead whales in the Sea of Okhotsk are taken, their future is threatened by environmental pollution, oil exploration and construction work on the continental shelf.

SC/51/AS27 reported that a bowhead whale was retrieved dead in September 1995 in a Japanese-type crab trap from a depth of 230-250m in the north central Okhotsk Sea.

The Committee **recommends** that the joint Russian-American research be continued on Okhotsk Sea bowheads. Additional work is needed to better understand the number of vessels, area and season of operation of the pelagic crab-pot fishery in the north central Okhotsk Sea, whilst additional monitoring is required to better document the incidental take of bowheads in this fishery. It was noted that the Japanese research plan for a minke whale sightings survey in the Sea of Okhotsk from August to September 1999 (SC/51/RMP19) would transit the northern Okhotsk Sea. The Committee **recommends** that in addition to bowhead whale sightings being recorded, time is allocated for the collection of biopsy samples.

No information was available on other bowhead stocks, but Øien noted that Norwegian researchers have repeated observations of small numbers of bowheads, including calves, around Franz Josef Land and western Spitsbergen. These observations show that bowheads are still extant in these regions.

9.3 Western North Pacific stock of gray whales

A number of papers on western (or Asian) gray whales were discussed (SC/51/AS20, 25 and 26). The history of exploitation was reviewed. The last commercial catches were made off Korea in 1966. In 1995, a joint American-Russian project was started on western gray whales in their summer feeding grounds off Sakhalin Island. By September 1998, 69 individuals had been photographically identified. Given the limited summer range, the authors believe the population to be about 100 whales. This is much smaller than the frequently cited estimate of 250 whales for which no quantitative data exist. In 1996, development projects for offshore oil and gas reserves began on and around the summer feeding grounds off the northeastern coast of Sakhalin Island.

In May 1996 one gray whale was killed off the western coast of Hokkaido, Japan. Results from a recent review to consider the status of western gray whales, human-related threats to the population, and research and monitoring were also reported. A summary of a 10-year research and monitoring programme throughout the range of the western gray whale was presented.

The Committee **endorses** and **encourages** this joint research. It recalled it had already identified this population as one of the most endangered baleen whale populations in the world. It again **recommends** that a long-term research, monitoring and management programme be continued and expanded for these whales and their habitat. The Committee **strongly requests** that the Commission urges the relevant authorities to develop and implement a comprehensive, long-term conservation and monitoring programme.

9.4 Long and short term priorities

9.4.1 Research priorities

A number of research items for bowhead whales had been discussed. These included studies of the stock structure and abundance of animals in the Okhotsk Sea, Baffin Bay-Davis Strait, Hudson Bay and Spitsbergen areas. The possibility of sub-stocks in the B-C-B stock was also raised.

The Committee gave priority to the incorporation of information on the longevity of the B-C-B bowhead whales, including survival rates from photo-identification data in stock assessments. The Committee encourages this and similar future work to improve the Bering-Chukchi-Beaufort bowhead assessment model.

The Committee **agrees** that consideration be given in the Committee's work plan to in-depth discussion of endangered small populations of whales (e.g. Atlantic/eastern Canadian bowheads, western North Pacific gray and bowhead, all Northern right whales and most blue whales), especially in the light of anthropogenic threats such as incidental capture and ship strikes.

As discussed further under Item 10.3, the in-depth assessment of North Atlantic humpback whales could better

be held in 2001 than in 2000. This would allow the Committee to incorporate the results of a planned multi-national survey in 2000.

9.4.2 Work plan

The Committee **agrees** (Table 9) that at its meeting in 2000 it will give highest priority to further planning of the Greenland research programme. In addition, possible revisions of the B-C-B bowhead whale assessment model, and information about the smaller stocks of bowhead and gray whales will be considered to the extent that new information becomes available.

Table 9

Timetable for stock assessment consideration at future Annual Meetings.

Year	Items to be considered
2000	Greenland research programme
2001	North Atlantic humpback whales
2002	Fin and minke whales off Greenland
2003	Eastern and western Pacific gray whales
2004	Bering-Chukchi-Beaufort Seas bowhead whales

10. COMPREHENSIVE ASSESSMENT OF WHALE STOCKS

10.1 Southern Hemisphere minke whales

10.1.1 JARPA – progress in addressing outstanding issues

This is discussed under Item 14.2.1.

10.1.2 VPA analyses

VPA analyses by Butterworth *et al.* (1999), based on commercial and JARPA catch-at-age data and abundance estimates from sightings surveys, had indicated an increasing trend in recruitment of minke whales in Area IV prior to exploitation. The issue of whether spatial or temporal patterns in the age of the catch would support selectivity assumptions different from those used by Butterworth *et al.* (1999) was considered first.

SC/51/CAWS18 presented an update of information on segregation of minke whales in Antarctic Area IV, including preliminary results of an analysis incorporating the distance from the ice-edge as one of the environmental factors. Sex ratio and maturity rates for males and females were examined in the samples taken in the JARPA surveys from 1989/90 to 1997/98 using logistic regression. Results suggested that:

(1) males, especially mature males, were dominant in the research area with their proportion tending to decrease with increasing latitude;
(2) mature males tended to form larger schools; and
(3) females, especially mature females, tended to be distributed in the southern part of the research area.

An exception to this general problem was observed for numbers of mature females in 1997/98, when the pack ice extended farther northward than in normal years (Ishikawa *et al.*, 1998). Further details are given in Annex G, item 4.1.

The question of selectivity in the catch of older animals (first raised last year) was considered next. SC/51/CAWS21 examined the JARPA minke whale age distribution data from Area IV from 1989/90 to 1995/96 for evidence of significant explanatory variables. There was no indication that the non-random nature of the commercial whaling operations led to a decreasing trend in selectivity-at-age for animals above age 10.

SC/51/CAWS31 provided further examinations of the relationship between age, sex, location, month and season for the commercial and JARPA minke whale catch-at-age data. Results indicated that for adult minke whales (older than 10 years) there were no large and consistent spatial, temporal or sex-related patterns in the distribution of ages of the catches taken within the Antarctic (Areas IV and V). While the regression analyses did suggest significant latitude, month and sex effects in the commercial catches, the magnitude of the effects was small. The regression analyses for the JARPA data provided even less indication of substantial age-related spatial and temporal patterns. There was little indication of spatial/temporal heterogeneity among the age distributions of the commercial catch within a whaling season. Overall, the analyses in SC/51/CAWS31 provided little basis for supporting any specific selectivity hypothesis for the minke whale catches other than that of a constant one for ages 10 years and older.

These results are similar to those presented in Cooke *et al.* (1997), which indicated essentially no selectivity after age 10. Further discussions addressed a number of issues without changing this conclusion. In response to a question about the inter-annual variability in population structure indicated by the 1997/98 data and what effects that might have on the analysis, it was noted that similar phenomena may have occurred during the days of commercial whaling. In this connection, Shimadzu agreed to look at past operational reports issued by the commercial fleet. Butterworth believed that unusual ice conditions probably did occur and had contributed to variability in the data, but there was no evidence that they affected the conclusions of the VPA analysis.

SC/51/CAWS20 conducted sensitivity analyses of the ADAPT VPA assessment results of Butterworth *et al.* (1999) to address concerns raised last year. The Area IV assessment showed no evidence of a peak in the commercial selectivity-at-age below age 23 in likelihood ratio terms. Preferential location of older animals outside the area sampled by commercial whaling and JARPA would increase estimates of natural mortality M rather than affect estimates of historic recruitment trends. Conducting the analyses without a three-year – three-age grouping of the catch-at-age data made little difference to results. Forcing the historic recruitment trend to be zero increased the estimate of M substantially and suggested a 90% decline in recruitment over the last three decades which is not explainable by the effects of harvesting alone. The ability of the ADAPT procedure to estimate the historic recruitment trend did depend on the assumption that commercial selectivity at age was time-invariant over ages 17-29. A lower rate of increase in this trend than estimated by Butterworth *et al.* (1999) would require the selectivities for the lesser of such ages relative to the greater to have first increased and then decreased over the period of commercial whaling, corresponding to deliberate increased targeting on smaller compared to larger animals towards the middle of this period, which seemed unlikely behaviour by whalers.

SC/51/CAWS40 provided additional analyses of the Butterworth *et al.* (1999) VPA model. The analyses involved alternative selectivity/separability assumptions for the commercial catch and were undertaken in order to further examine the sensitivity of the results (particularly pre-exploitation recruitment trends) to these assumptions. Its conclusions are detailed in Annex G, item 4.1. In brief,

models that assumed constant selectivity for younger (10-15) or older (> 30 years) animals provided a statistically poorer fit to the actual data than models that assumed constant selectivity only for ages between these ranges. For fully separable (constant over time) selectivity models, the estimates of the age-specific selectivities are quite variable depending upon the age ranges over which the assumption of separability applies. Estimates of pre-exploitation recruitment trends are sensitive to the selectivity/separability assumptions. Dome shaped, time invariant selectivity patterns with a peak at younger ages can result in non-increasing trends. However, such models show significant lack of fit and provide a poorer fit in terms of their likelihood values than comparable models which result in an increasing trend.

Overall, the results in SC/51/CAWS40 suggested that recruitment was increasing prior to exploitation in Area IV. However, the results also indicated that selectivities varied both substantially and significantly with age and time. In particular, for adults < 22 and > 30 years old, selectivities were estimated to be generally substantially less than for the middle age range and to have varied over time. SC/51/CAWS40 suggested that it would be important and valuable to explore the robustness of the conclusions about the selectivity patterns and the problems in developing a separable model that includes the plus group (age > 30) catches by extending the analyses to Area V and to the consideration of alternative stock hypotheses.

SC/51/CAWS40 concluded that the model framework developed by Butterworth *et al.* (1999) provides a useful quantitative and statistical framework for addressing the long-standing question of the implications of the large negative slope seen in the catch-at-age curves for minke whales. However, the framework is critically dependent upon the assumption that selectivities are time invariant over some portion of the age range. Without this the recruitment and other outputs of the model are inestimable. The assumptions regarding selectivity and separability must be consistent and plausible given the way the commercial fishery operated and the biology of minke whales.

The Committee considered possible explanations for the decline in selectivity after age 30 suggested by the analyses. These included errors in ageing and/or higher natural mortality among older animals.

The estimate of natural mortality in the current analyses was dependent upon assumptions about the selectivity/separability in the commercial catch and/or about recruitment trends. There is little direct information on natural mortality rates contained in the current analyses. However, future JARPA data may provide a more direct basis for estimating natural mortality rates.

The issue of why animals in the 20-29 age range might have been 'targeted' in the commercial catch, given little growth after age 10 was considered next. Although Best (1984) had shown that whalers could not estimate absolute size precisely, they could probably estimate relative size in a school and target the largest of the animals. When males and females were fitted separately, selectivities for males, which grow very little after age 10, were similar for all ages 15-30, while females, which keep growing until around age 20, showed lower selectivity for ages 15-20 compared to 21-30.

The Committee **agrees** that the papers show that parameters potentially important for management (natural mortality, trends in recruitment) can be estimated from age data obtained from the catch. However, some work remains to be done. For example, the robustness of the results should be checked further by additional applications of the model to Area V data, and effects of ageing errors and stock mixing on selectivity estimates should be examined explicitly. A fully agreed approach for computing abundance estimates used in the VPA analyses from the JARPA data is not yet available. Progress on such an approach is reported below.

10.1.2.1 ABUNDANCE ESTIMATES

The Committee considered work undertaken to understand and correct the apparent negative bias in abundance estimates obtained from JARPA survey data due to the non-random location of effort.

SC/51/CAWS12 examined possible biases of three types of abundance estimates on the basis of a simple model. In one-dimensional space, one high density area is included, in which the speed of the sampling vessel is reduced to v from unity. Within possible ranges of parameter values in JARPA, the bias of the Burt and Borchers (1997) estimate could be 25% to 80% and that of the standard IWC abundance estimate - 50% to 5%. Small values of v give negative bias in the third (lognormal) estimator considered. The bias in abundance estimates suggests a distorted sampling ratio. SC/51/CAWS12 suggested three approaches to problems caused by the non-random location of effort: studies of segregation between high and low density areas; development of a bias-free abundance estimation method; and revisions of sampling procedures in JARPA.

SC/51/RMP16 addressed the biases described in SC/51/CAWS12 and examined the performance of model-based and design-based abundance estimators on simulated JARPA survey data. The design-based estimators, which assume effort is located independently of density, were both found to be biased as a result of the correlation of the actual effort with density. The standard IWC abundance estimator tended to underestimate school abundance from the simulated JARPA data, whereas the adjusted estimator implemented by Burt and Borchers (1997) tended to overestimate abundance. The model-based estimator (described in SC/51/O13) was more robust to different clustering scenarios than the design-based estimators and appeared to correct for the reduction in effort caused by sampling whales. With appropriate degrees of freedom, this GAM-based estimator could be relatively unbiased.

The Committee **strongly encourages** further work on the GAM-based estimator, including the development of a standard method to determine the degrees of freedom and an investigation of whether bias in trend estimates can result from changes over time in type of clustering. Concerns about the variance estimate, discussed below, need to be addressed. The number of scenarios that would need to be considered in testing model robustness could be reduced by even closer cooperation between the model developers and the scientists who conduct the surveys. The latter could provide data on the likely range of densities and types of clustering for a given stock of whales.

It was **agreed** that the approach offered a way to correct bias in IDCR/SOWER estimates from closing mode data as well as JARPA estimates; the sighting and sampling survey mode is an extreme form of closing mode. The ability to incorporate environmental and other covariates also broadens the applicability of the approach.

SC/51/O13 called the above GAM-based estimator the interval data model, and described a second GAM-based estimator called the count data model. In the interval data model, the response variable is defined as the 'waiting area' to the next sighting. This approach is derived in detail to obtain the likelihood function for the waiting distances,

conditional on an estimated detection function. Variances were estimated using both the jackknife and the parametric bootstrap.

Although both estimators are computationally intensive, they can be fitted using standard statistical software. Both were computed from IWC/IDCR Antarctic survey data, fitting GAMs to obtain maps showing the estimated spatial density surface of minke whales in Area III. Numerical integration under a given area of the surface yields an estimate of abundance for that area. Results were compared with the results of a conventional stratified analysis by Borchers and Cameron (1995). The point estimates for number of schools were similar. Jackknife CVs were similar to those from the stratified analysis for the count data model but higher for the interval data model. Parametric bootstrap CVs were lower for both models.

In discussion, it was pointed out that simulation studies are needed to determine whether the lower CVs estimated from the parametric bootstrap are accurate or whether they might be negatively biased. The latter is a possibility because spatial correlation should be, but had not been, accounted for in the variance estimates. Hedley noted that work on this was in progress, and preliminary results indicated that this was not a source of substantial negative bias.

SC/51/CAWS17 gave estimates of minke whale abundance in the part of Area II surveyed in 1996/97 obtained using standard IWC methods with regression-based estimation of mean school size. The combined closing and IO mode estimate of abundance in the survey area is 28,140 whales (CV = 24.1%) with 95% confidence interval (17,700; 44,800). Comparisons with estimated abundance from past surveys are difficult because the 1996/97 survey achieved substantially less longitudinal coverage than earlier surveys in Area II and because past surveys occurred earlier in the season. A substantial increase (16% for closing mode, 35% for IO mode) in the abundance estimates occurred when 'like-minke' sightings were noted. In earlier cruises, the corresponding values seldom exceeded 10%, but recently they had increased markedly. The Committee **agrees** that the issue of 'like-minke' sightings was one that needed attention in an overall review of the SOWER cruises and abundance estimates computed from them.

The Committee also considered an unpublished manuscript by Palka and Hammond that used data on swimming direction to estimate the distance from a survey ship at which responsive movement occurs. The purpose is to validate the line transect assumption that animals are detected before responsive movement. If it is determined that responsive movement is occurring, the authors also suggested modifying the Buckland and Turnock (1992) method to estimate density accounting for responsive movement. Data from Southern Hemisphere minke whales should be analysed to determine if the responsive movement assumption is valid for surveys targeting them.

10.1.2.2 OTHER ANALYSES, INCLUDING GENETICS

SC/51/CAWS9 presented a microsatellite analysis to investigate stock structure in the Antarctic minke whale. JARPA samples from Areas IIIE, IV, V and VIW were examined. Allele frequencies of five microsatellite loci were similar among areas. A significant deviation from Hardy-Weinberg equilibrium was found in the total sample, suggesting some degree of genetic heterogeneity. Analyses by area showed significant departure from Hardy-Weinberg in Areas IIIE and VIW. The authors emphasised the preliminary nature of these analyses.

SC/51/CAWS11 gave results of an RFLP analysis of mtDNA conducted on JARPA samples from Areas IIIE and IV on two surveys, 1995/96 and 1997/98. No significant differences were found between males and females or between area/time groups of the two surveys. Most of the area/time groups were similar to the 'core' sample of Areas IV and V but Area IVW late was similar to the 'western' sample (Area IVW early of the previous surveys 1989/90 and 1991/92). These results are consistent with the view that different stocks interact in the western part of Area IV; however, it seems that their pattern of distribution could change not only within a survey but also between surveys. A more detailed analysis showed that most of the mtDNA heterogeneity in Area IVW is attributed to the offshore component (whales distributed at least 45 n.miles from the ice-edge). To cover Task 3 (SC/51/CAWS13), an analysis of mtDNA considering school size as a covariate was conducted. Samples from Area IVE from 1989/90 to 1997/98 were considered and three categories of school sizes examined: $n = 1$, $n = 2$ and $n \geq 3$. The total PHIst value was small and not significant ($p = 0.0816$) and none of the pairwise comparisons was significant.

The question was asked whether, given the substantial sample sizes already available, it was planned to collect more samples, and, if so, from which areas and could they be collected non-lethally. The Committee agreed with Pastene that the main need was for samples from the breeding grounds in low latitudes. However, there were still regions within the Antarctic (particularly adjacent to Areas IV and V) that needed further sampling.

SC/51/O6 outlined studies being conducted by ICR in cooperation with several research institutions in Japan, using JARPA minke whale samples. These included studies on taxonomy using morphometric characters, phylogenetic relationships using sequencing analysis of the mtDNA control region, reproductive endocrinology, cryo-preservation of immature follicular oocytes, dietetics and examination of new methods to estimate individual age.

10.2 Southern Hemisphere blue whales

10.2.1 Differentiation of subspecies

SC/51/CAWS7 examined surfacing behaviour and blow-hole shape of blue whales using a total of 575 high-resolution video sequences including 353 from 101 putative pygmy blue whales and 162 from 25 putative 'true' blue whales obtained on four cruises. In the absence of a reliable genetic basis for separating the subspecies, the authors provisionally allocated the sequences to putative pygmy or true blue whales based on their known geographical locations in mid summer (Kato *et al.*, 1995). The video sequences were separated by behavioural state in analyses. The results were similar to (but not as clear as) those from the first two cruises (Kato and Komiya, 1998), in that putative pygmy blue whales tended to submerge without exposing the caudal keel (or sometimes even the dorsal fin). In 67 individuals the blowholes were scored as either 'neat' or 'skewed' in shape, and the 'skewed' type was rare in the small sample of putative true blue whales. During the 1997/98 and 1998/99 cruises, the topmen also categorised the overall body shape of 118 blue whales seen. The results indicated that the 'tadpole' shape category (larger head and shorter tail) was peculiar to pygmy blue whales, and the authors believed that this is a strong field character for subspecies recognition.

Of the videotaped animals, about 20% had been biopsied but few were putative blue whales. The Committee agrees that while the morphological and behavioural criteria discussed in SC/51/CAWS7 might allow a statistical differentiation between the two forms, they did not appear to be adequate to make a positive allocation of an individual to a subspecies in the field. Nevertheless it was valuable to record these characteristics for whales that were biopsied or recorded acoustically. The Committee noted that it would be useful to collect long-term surfacing behaviour data from one of the better known concentrations of pygmy blue whales to see if both types of surfacing behaviour occur in this subspecies.

On the question of possible genetic distinction between the two subspecies, the earlier apparent separation between the two had become less distinct now that a larger sample size had been examined (although there was still the problem of whether the biopsy samples had been properly allocated to subspecies in the field). According to the report of the 1998 Tokyo planning meeting, three of four samples from whales south of 60°S identified as pygmy blue whales subsequently proved to have haplotypes identical to those previously identified as true blue whales. The Committee **agrees** that voucher material was urgently needed, especially from true blue whales. Museum specimens were one such source, but even the identification of some of these was problematical, as the locality of the specimen could no longer be used as a reliable criterion. Suitable DNA could be extracted from bone, but not consistently. Formalin-fixed material such as ear plugs was even more difficult to use. Nevertheless, it would be worth trying to extract DNA from bone or fixed soft tissue from indisputable (e.g. based on very large size) true blue whales. In the meantime, the Southwest Fisheries Center, La Jolla, California, was now looking at microsatellites to see if they could possibly provide a better basis for separation between the two subspecies.

Annex G, Appendix 2 reports on progress in distinguishing between the two subspecies acoustically. Acoustic recordings made on the 1998/99 SOWER cruise in the vicinity of Antarctic blue whales showed some features in common with recordings made on the 1996/97 and 1997/98 Antarctic cruises. All three sets of recordings were different from those made south of Madagascar in December 1996. Those made off the coast of Chile in 1997/98 proved to be more like the vocalisations of blue whales from the eastern North Pacific than blue whales from the Antarctic, and were different from those made south of Madagascar at the same time of year. The Committee **agreed** that acoustics had not yet provided a definitive answer on how to recognise the subspecies, and that what was needed was a positive link between the call types recorded and one or more of the other (e.g. morphological) features of the two subspecies.

10.2.2 Abundance estimation

SC/51/CAWS35 presented estimates of abundance of blue whales from the IWC/IDCR-SOWER sightings surveys from 1978/79 to 1996/97. These estimates were based on the DESS software, which implements the methodology previously agreed by the Committee for the analyses of these data. Because of small sample size, estimates of mean school size and effective search half-width were based upon data pooled over all the surveys. The surveys were grouped for convenience into the first circumpolar set from 1978/79 to 1983/84 (which covered about 65% of the area south of 60°S) the second circumpolar set from 1985/86 to 1990/91 (which covered some 80% of this area) and the third circumpolar set which has so far covered about 65% of the area. The abundance estimates for these three sets of estimates were 500 (CV 0.54), 700 (CV 0.45) and 1,300 (CV 0.42). Assuming (very coarsely) that the areas covered in each case were representative of the total area south of 60°S, these estimates extrapolated to comparative values for this total area of 800, 900 and 2,000 whales respectively. The extrapolated value from the third set of circumpolar surveys was significantly larger than the extrapolated values for the first two sets.

The analysis used sightings recorded as 'blue whales' as true blue whales. There was extensive and inconclusive sub-committee discussion (see Annex G, items 5.2 and 5.3) concerning whether and when pygmy blue whales might have been found south of 60°S, the effect this would have had on abundance estimates and whether survey data were recorded in a way that would permit adjustment for them.

Although the sub-committee (see Annex G) had suggested that a new 'best' estimate could be proposed, the Committee agreed that it was preferable for additional analyses to be completed first. These include:

(1) extrapolation using the JSV data (see Item 6.3.2);
(2) examination of the most appropriate truncation distance;
(3) standardisation on common northern boundaries for estimating rate of increase; and
(4) investigation of issues regarding sub-species identification.

As a contribution towards (4), Donovan undertook to examine the catch database for records of unusually small pregnant females, although the possibility that pygmy blue whales might have been selected against, particularly in earlier years, cannot be ruled out.

The Committee **recommends** that consideration of estimates of abundance of blue whales be accorded high priority at next year's meeting.

10.2.3 Other

SC/51/CAWS41 reported on recently retrieved data on blue whale catches by the *Slava*, 1946-1957. True catches of blue whales were frequently smaller than those reported; this was apparently so that blue whale catch limits would not be reduced and to hide the undeclared catches of other species. Certain biological characteristics of the catch were also misreported – the proportion of undersized blue whales, for instance, was reported as 1.6-3.4% of the catch whereas it was actually 22.2-36.7%. There were also significant alterations to the catch positions, apparently to hide the locations of whaling grounds from competitors. Mikhalev reported that work on restoring the actual Soviet catch data would continue. The Committee expressed its sincere appreciation to Mikhalev and his colleagues for their persistence in carrying out this very important task, and encouraged them to continue. The view of Vladimirov on this issue is given under Item 7.2.1.3.

10.3 North Atlantic right whales

10.3.1 Abundance, trends and vital rates

10.3.1.1 REPORT ON INTERSESSIONAL PROGRESS

Last year an Intersessional Steering Group had been set up to review ongoing work in relation to the status and trends of the North Atlantic right whale population, and to consider whether sufficient progress had been made to hold a special meeting on this topic. Its report is given as Annex G, Appendix 14 (SC/51/CAWS15).

Discussion first centred around a recently published analysis of trends in the survival probability of North Atlantic right whales (Caswell *et al.*, 1999) that estimated a decrease in annual survival rate from 0.99 in 1980 to 0.94 in 1994 and an expected time to extinction of less than 191 years. An earlier version of this analysis had been submitted to the 1998 Cape Town Workshop on Right Whales. Following comments received at that meeting, and because of the importance of the implications of the analysis, Clapham had sent the paper to seven specialists for review; this process was proposed before it was known that the paper had been accepted for publication. Reviewers comments were summarised in SC/51/CAWS15 along with responses from Caswell *et al.* (1999). A number of the reviewers participated in the discussion of the paper (see Annex G, item 6.1).

The Committee concluded that whilst it had some questions on the approach used, these did not alter its conclusion of last year that there are 'serious concerns over the status of the stock' (IWC, 1999d, p.17). These concerns are based on *inter alia* the small size (300-350 animals) of the stock; an increase in calving interval from an average of 3.67 years in the 1980s to over 5 years now; poor recent calf production (only nine in the past two years); the possibility of an unusually high degree of female senescence (only 38% of females are reproductively active); and the level of anthropogenic mortality (see below). Under these circumstances the Committee **strongly recommends** that:

(a) the comprehensive assessment of this stock should remain of high priority;
(b) research into the status of the stock and the possible causes for its reproductive impairment and decreased survival should be intensified in the USA and Canada;
(c) information on human-inflicted mortality should be reported to the IWC on a regular basis, as had been done in the latest USA Progress Report; and
(d) measures to mitigate the effects of ship strikes and entanglement on the population should be implemented as soon as possible.

In connection with (a) the Committee **recommends** that the proposed Workshop should occur during the intersessional period, provided that the intersessional Steering Group (see Annex U(10)) believes that sufficient progress has been made in the development of a spatial and age-structured model and that the necessary participants are available. The model should be brought to the Workshop so that various combinations of parameters can be explored.

The high anthropogenic mortality in this population motivated (c) and (d). Between 1970 and May 1999, 45 right whale mortalities have been recorded: 13 (28.9%) were neonates which are believed to have died from perinatal complications or other natural causes; 16 (35.6%) were determined to be the result of ship collisions; two (4.4%) were related to entanglement in lobster fishing gear; and 14 (31.1%) were of unknown cause. Thus, at least 18 deaths were attributable to human impacts; this represents 40% of the observed total for the period, and 56.3% of the 32 non-calf deaths. There are undoubtedly many unreported right whale deaths. In addition, more thorough necropsies in recent years have revealed that damage from ship collisions is not always evident from superficial examination of carcasses, so it is likely that some of the 'unknown cause' mortalities were in fact due to ship strike.

In connection with (d), attention was drawn to Annex O of last year's report (IWC, 1999k), in which the Scientific Committee had endorsed many of the recommendations arising from the Cape Town Workshop concerning mitigation of anthropogenic impacts on North Atlantic right whales. A report on progress with these had been requested and Clapham provided this (see Annex G).

Relative to these recommendations, Clapham summarised the status of management actions as follows.

(1) Ship strike mortality: dissemination/publication of information in Notices to Mariners, charts and brochures (done or in production); development of early warning system surveys (done in NE and SE USA, with effectiveness being evaluated); development of areas to be avoided and acoustic deterrents (in discussion); development of sonar detection of whales (research projects in progress); proposal of Mandatory Ship Reporting System (accepted by the International Maritime Organisation and to be implemented in July 1999); consideration of ship speed reductions (in discussion but legally very complex) or shifting of shipping lanes (probable in the Bay of Fundy, in discussion or in need of data elsewhere).
(2) Entanglement mortality: research gear modifications (much progress and likely to be technically feasible, though politically difficult to implement); monitor entanglement rates (study complete, further monitoring planned), continue/expand disentanglement programme (underway); consideration of gear closures (some seasonal closures mandated, others considered but unlikely soon).
(3) Facilitation of research: permit facilitation (done for biopsy of calves, still a major impediment to sample transfer through CITES); facilitation of necropsies for right whales (done); mitigation of potential harassment from whalewatching (in discussion); and establishment of protected areas (done in some areas, but associated regulations still in discussion).

It was noted that a moratorium on attachment of satellite tags to North Atlantic right whales was in effect, pending results of a study of long-term effects of tissue reaction to tag implantation. The Committee looks forward to receiving a report on this issue at its next meeting.

10.4 Southern Hemisphere humpback whales

10.4.1 Preliminary assessment

10.4.1.1 REVIEW INTERSESSIONAL PROGRESS

It had not been possible to make any progress with the modelling of the pre-exploitation sizes of southern humpback whales, as envisaged in last year's report (IWC, 1999d, p.19). The Committee **recommends** that such an exercise should be attempted intersessionally and at its next meeting, particularly now that revised estimates of humpback whale abundance from the IDCR/SOWER cruise programme are available. This was considered further under Item 10.8.

10.4.2 Establishment of Southern Hemisphere directory and Antarctic catalogue

SC/51/CAWS37 provided an interim report on the IWC research contract to set up an Antarctic humpback whale catalogue. The contract has recently been finalised and photographic collections are still being received (notably 96 fluke photographs of an unknown number of individuals supplied by Brazilian Antarctic research workers, and 11 fluke photographs from the Antarctic Peninsula). The JARPA collection of humpback whale photo-identifications will also be submitted to the catalogue. This amounts to 337 photographs of 134 individuals (including 71 photos of 33

flukes) taken between 1989/90 and 1997/98, mostly from Areas IV and V. The Committee **agrees** that past researchers on IDCR/SOWER cruises should be approached to submit pictures from their private collections, using the IWC's Southern Hemisphere directory.

The Committee welcomed this progress and looked forward to receiving an annual update on the development of the catalogue.

The question of access to the Antarctic catalogue was then raised. The existing protocol limited access to contributors to the catalogue and the Secretariat, and to others on a case by case basis only with the permission of the contributors. During the year, researchers who have submitted photographic collections from humpback whale breeding areas requested access to the Antarctic catalogue. It was suggested that such researchers have access to the catalogue, provided they comply with all conditions specified by the IWC Secretariat for contributors to it.

Some members felt that this in effect meant the catalogue was turning into a Southern Hemisphere catalogue. There might be cost implications because some of the breeding ground collections were very substantial (4,000 individuals off western Australia). In previous discussions it had been felt that regional breeding ground catalogues were preferable to one unified Southern Hemisphere catalogue (IWC, 1996a, pp.128-9). Carlson responded that this was not a proposal for a Southern Hemisphere catalogue but rather a request for access to the Antarctic catalogue for those researchers who have submitted photographic collections from breeding areas. It was suggested that such researchers who do not wish to submit photographic collections to the Antarctic catalogue might consider developing a website which could be linked to or accessed through the Antarctic catalogue. This would require discussion with contributors once the IWC Antarctic catalogue website is established.

Best suggested that having a small group to decide on the 'case by case basis' access would make the procedure less unwieldy. Clapham noted that the North Atlantic Right Whale Consortium accepts and reviews proposals for access to their catalogue. Gambell explained that the current request for access involved only a couple of research groups who had submitted their breeding ground collections, and it would be simplest to make an exception for these groups, and allow them access under the same conditions as the Antarctic contributors, pending adoption of a general policy. The Committee **agreed** to this solution.

The Committee **recommends** the funding of the maintenance of the Antarctic catalogue as detailed in SC/51/CAWS37 and discussed under Item 18.

10.4.3 Comparative data from northern stocks on rates of increase

10.4.3.1 REPORT OF INTERSESSIONAL GROUP

Annex G, Appendix 13 (SC/51/CAWS14) reported work done by this group. Opinions had differed on the approach to be taken, recognising that differences in estimated population growth rates could arise from a number of methodological and biological factors. They recommended the following approaches to future exploration of the problem:

(1) senior authors should be asked to provide comments on possible biases in their methodology (several had responded to date);
(2) analyses should be conducted to assess the impact of changing age structure on recovery rates, and to consider whether this is likely to be a factor in any of the populations concerned;
(3) analyses of maximum theoretical rates of increase should be further investigated to provide realistic bounds with which to judge results from field studies;
(4) papers giving apparently conflicting rates from the same population should be examined in the context of how differences in methods may affect results;
(5) published data on differing age and sex structures of a population at different stages of the life cycle should be examined, and simulations conducted to determine the impact of such differences on apparent rates of increase;
(6) a summary of published information relating to vital rates in each humpback whale population should be produced (partly addressed in Appendix I of Annex G, Appendix 13).

The East Australian population was one where (4) could be applied; shore-based censuses (Brown *et al.*, 1997) gave an increase rate for the period 1986-96 of 12.1% (95% CI 8.4-15.8%) whereas mark-recapture analyses (Chaloupka *et al.*, In press) gave an increase rate from 1988-1996 of 6.3% (95% CI 2-11%). After considerable discussion, summarised under Annex G, item 7.3 it was concluded that not only were the two rates of increase not significantly different, but it was highly likely they were measuring different components of the population (a core area and the migratory stream). Increase rates in a core area of an expanding population (such as Hervey Bay) might be expected to be lower than those on the fringe, and not representative of the population as a whole. In addition, the use of mark/recapture methods in Hervey Bay did not seem an appropriate sampling design for estimating population abundance. While the shore-based surveys seemed a more appropriate method of measuring population trend, the magnitude of the estimated rate of increase in relation to possible combinations of biological parameters made it more likely that the real rate of increase may be below rather than above the point estimate, especially if the survival rate of 0.966 from Chaloupka *et al.* (In press) was accepted. Both studies indicated continued growth in the East Australian population.

SC/51/CAWS34 (now Annex G, Appendix 8) was prepared in response to (3). Maximum possible increase rates had been calculated using a range of reasonable values for post-first-year annual survival rate, age at first parturition and annual pregnancy rate, and assuming an equal sex-ratio of calves and that first-year survival cannot exceed that of post-first-year survival. The results showed that population growth rates of 10% or more could be obtained if the average pregnancy rate was 0.5, survival rates were at least 0.96 and the age at first parturition $\leq$8 years.

Independent estimates of age at maturation/first parturition or calving interval/pregnancy rate will assist greatly in deciding which population growth rates are more likely to occur than others. These parameters have been established quite precisely in some populations and not so precisely in others. For example, long-term photo-identification studies in the Gulf of Maine had shown that the average age at first parturition was six years and the mean calving interval 2.3 years, whereas in southeastern Alaska the age at first parturition appears to be considerably later.

The best data on these parameters for Southern Hemisphere whales came from Chittleborough's work in the 1950s and 1960s (Chittleborough, 1965) based on the examination of whales landed at Australian shore stations.

However, it was difficult to compare the age at maturity of 4-5 years that he obtained for Southern Hemisphere whales with Northern Hemisphere values because there was uncertainty as to whether all researchers interpreted Growth Layer Groups (GLGs) in the same way. The Committee would be most grateful if Chittleborough would be prepared to examine a sample of humpback whale earplugs and explain his interpretation of GLGs. It was felt that this would be most appropriately done as a calibration exercise involving a number of researchers reading a number of plugs independently. A small group under Bannister designed such an exercise (Annex G, Appendix 9) which would be conducted in the coming year and reported at the 2000 meeting.

The relative merits of various approaches for estimating the above parameters in the Southern Hemisphere are discussed in Annex G. Without data on these parameters, further investigation of differences in rates of increase between southern and northern stocks is unlikely to be productive. The Committee noted that different rates of increase should not be unexpected from populations with different catch histories and potentially different environmental conditions. Of the six approaches recommended in Annex G, Appendix 13 (SC/51/CAWS14), the first five had either been completed or deemed not useful. The Committee **recommends** completion of a tabular summary of published vital rates for different humpback populations, including data from the most recent periods of whaling. It also **recommends** incorporation of vital rates, where believed reliable, into the framework developed by Brandão, Butterworth and Brown (Annex G, Appendix 8) for maximum possible increase rates.

SC/51/CAWS35 provided estimates of abundance of humpback whales from the IWC/IDCR-SOWER surveys using the same approach as for blue whales. Due to large sample sizes, mean school sizes and effective search half-widths were estimated separately for each circumpolar set of surveys. The consequent estimates of abundance for the first, second and third sets of cruises, corresponding to different extents of partial coverage of the area south of 60°S (as detailed above for blue whales), were 7,400 (CV 0.38); 10,000 (CV 0.27); and 9,300 (CV 0.23). Extrapolating to the complete area south of 60°S by the same coarse method as used for blue whales yields values for this total area of 11,400, 12,400 and 14,200 respectively, reflecting a non-significant annual increase rate of about 2%.

Some concern was expressed over the method of extrapolation used to make the third circumpolar set comparable with the first two. The missing sectors included the whole of Area IV, which in the second circumpolar set had contained the biggest population of all the areas and was known to be increasing. Hence, a simple extrapolation from the ratio of unsurveyed to surveyed areas might have underestimated the contribution of Area IV to the total. In addition, it was preferable to standardise on common northern boundaries, as proposed for the equivalent blue whale estimates. However, unlike the situation for Antarctic blue whales, there was likely to be a substantial proportion of the humpback whale population north of 60°S in mid-summer, suggesting the need for extrapolation further north, perhaps using JSV data.

Further discussion is summarised under Annex G, item 7. The Committee considered that the present situation, in which the Commission had no agreed estimate, was inappropriate given the amount of information that was available. The Committee **agrees** that the unextrapolated estimate 10,000 (CV 0.27; 95% CI, 5,900-16,800) from the second circumpolar set represents the best estimate of humpback whale abundance south of 60°S in summer for 1988, the median year of this set of surveys. Southern Hemisphere humpback abundance will be considered again next year as part of the scheduled preliminary assessment.

With respect to increase rate, the Committee agrees that the surveys on the west and east coasts of Australia had shown that those populations are increasing at the rates given in Brown *et al.* (1997) and Paterson *et al.* (1994) for East Australia, and the rate given in Bannister (1994) for Western Australia, i.e. East Australia; 1981-96 12.3% (10.1–14.4%); 1984-92 11.7% (9.6–13.8%); West Australia 1977-91 10.9% (±3.0%).

Several studies relating to distribution, migration and stock identity not directly relevant to this agenda item were discussed briefly by the sub-committee (Annex G). In this regard, SC/51/CAWS42 reported on newly discovered recoveries of Soviet (VNIRO) marks from the *Sovietskaya Ukraina* between 1959 and 1972. The Committee **recommends**, in order to facilitate the Comprehensive Assessment of southern humpback whales, that surveys aimed at establishing population size and stock identity for Southern Hemisphere humpback whales should be encouraged wherever possible, especially in areas where there is currently little published information.

10.5 Other stocks

The question of timing of an in-depth assessment of North Atlantic humpback whales was discussed. Last year, the Committee had recommended that this occur in the year 2000. However, uncertainties surrounding the population identity and status of humpback whales in the eastern Caribbean remain, and two pertinent studies were proposed: a review of whaling logbooks to identify historical whaling grounds in the region (this is underway); and a multi-national sightings and acoustic survey in the southeastern Caribbean. There are plans for such a survey to take place from January to April 2000. New data from both projects would make a valuable contribution to the assessment, but are unlikely to be available by the 2000 meeting. Additional data from the eastern North Atlantic may also become available. Finally, the location of the 2000 meeting (Australia) makes it more difficult for scientists from North Atlantic countries to attend. The Committee therefore **agrees** that the assessment be postponed to the 2001 meeting.

Swartz introduced information regarding a proposed cruise in the eastern Caribbean. Last year, the Committee had recommended that the possibility of collaborative research on humpback whales in the southeastern Caribbean be explored with national authorities in the area and that the use of combined acoustic and visual methods be investigated to facilitate the collection of abundance and individual identification data (IWC, 1999d). In response, some US scientists developed a research proposal modelled on the IWC's successful IDCR/SOWER surveys. The USA has offered to provide a research vessel that would support up to 15 visiting scientists from participating nations for a survey lasting up to 60 days each year. The proposal was presented to the Intergovernmental Oceanographic Commission's (IOC) IOCARIBE, an intergovernmental organisation responsible for coordinating scientific research on marine issues in the Caribbean. IOCARIBE endorsed the proposed research programme at its 6th Intergovernmental Session held 25-29 April 1999 in Costa Rica. Recognising the IWC's competence and expertise, IOCARIBE has written to the Committee asking it to review and provide comment on the proposed research.

The primary objectives of the proposed programme are to: (1) obtain information on the current distribution of humpback whales in the southeastern Caribbean; and (2) establish their relationship to the humpback whales in the rest of the North Atlantic. Historical whaling records and current local knowledge will be used to identify specific areas where humpback whales were known to occur. These areas will be visited by a multi-national research team which will use passive acoustic methods to locate aggregations of humpback whales. Once located, photographic identification and genetic (i.e. biopsy samples) information will be collected from each group of whales encountered for population assessment and comparison with humpback whales in the rest of the North Atlantic. Since humpback whales were historically taken throughout the southeastern Caribbean, broad participation by southeastern Caribbean nations and access to their territorial waters is essential to the success of this research programme. The Committee recognises the value of the proposed programme and **requests** that the Commission encourages the relevant nations to consider participation in the research. Results from such a programme will be of great value to the humpback assessment in 2001. The USA has offered to host, on behalf of IOCARIBE, a research planning meeting for participating nations during the 1999 summer to develop the cruise plan and survey design. It is hoped that the first survey would be planned for the months of January to April 2000, with results available to the IWC Scientific Committee at its meeting in 2001. The results of this first survey would be used to plan subsequent surveys, with the results reported each following year.

The Committee recognised the potential importance of the proposed survey for establishing the current status of humpback whales in the eastern Caribbean. It **recommends** that a detailed research plan and protocol be worked out before and during the proposed 1999 planning meeting and offers its support in this process. In order to facilitate matters, an Intersessional Working Group was established (see Annex U(11)). The Committee thanks IOCARIBE for drawing this matter to its attention.

A progress report on eastern North Pacific right whale research (SC/51/CAWS36) was also discussed. Brownell reported that the current catalogue at the Southwest Fisheries Science Center for the eastern North Pacific contained photographs from at least 14 right whale sightings, where a minimum of 17 whales were seen. So far there had been no matches, but only 7-10 individuals are readily identifiable by their callosity patterns. The Committee believed that the situation of eastern North Pacific right whales was as bad, if not worse, than in the western North Atlantic. Numbers were of the order of tens of individuals, with only one sighting of a possible juvenile this century. It **strongly recommends** that research into the status of eastern North Pacific right whales be continued and intensified, specifically that:

(a) surveys to establish the summer distribution and feeding grounds be continued;
(b) photo-identification and photogrammetry effort be combined with attempts to obtain photographs suitable for examination of evidence of entanglement and ship strikes; and
(c) genetic sampling of individuals be continued and the use of genotypic mark-recapture methods for population estimation be investigated.

The Committee also **draws attention** to the situation of right whales in the eastern North Atlantic, where the occasional sighting was still being recorded, suggesting that there might still be a remnant population. Survey efforts by European members of the Committee was encouraged.

10.6 Southern Ocean Whale and Ecosystem Research (SOWER)

10.6.1 Report on the 1998/99 cruise

The 1998/99 IWC/SOWER Antarctic cruise was conducted in Areas III and IV (SC/51/CAWS6) (details are given under Annex G, item 9.1). During the blue whale component of the cruise, no blue whales were found. During the minke whale component, 155 sightings of 390 minke whales were made. Generally good weather conditions were experienced and excellent survey coverage was achieved. There were seven sightings of 10 blue whales (all identified as true blue whales) in the minke whale research area. Video recordings were taken of all 10 animals, seven biopsy samples were obtained and acoustic recordings made. The IWC *Larsen* gun proved to be particularly effective in obtaining biopsy samples of blue whales, with an estimated effective range of about 70m.

In discussion, attention was drawn to the high proportion (about 50%) of sightings scored as 'undetermined minke' and 'like minke' in this year's cruise. There was concern that this proportion had increased on recent cruises, affecting comparability from year to year. Ensor responded that he was not aware of any change in the criteria used to record sightings as minke or like minke. Part of the high proportion of unconfirmed minke whales could be attributed to a single incident, in which a high density area containing some 60 possible minke whales was encountered in good weather, but this was during closure on a sighting of a large whale believed to be a blue whale, so that they were not closed with.

The Committee agreed that a general review of the estimates from the IDCR/SOWER cruises is overdue (IWC, 1997c, p.80; Breiwick *et al.*, 1982; IWC, 1998d), and **recommends** that this should take place in the year 2001.

Two *ad hoc* working groups were established to consider matters relating to SOWER cruises, one on logistics (Annex G, Appendix 11) and the other on survey design, analysis and related matters (Annex G, Appendix 12). Attention was also drawn to new shipboard systems for measurement of distance (see IWC, 2000) and to the value of testing the feasibility of using the *Larsen* gun to collect biopsy samples from minke whales in a high density area. The need to obtain biopsy samples from breeding grounds is discussed under Items 10.1 and 14.

10.6.2 Plans for the 1999/2000 cruise (see Annex G, Appendices 11 and 12)

Last year, the Committee had recommended that: (1) the third circumpolar set of cruises should be completed as soon as possible; and that (2) in 2000/2001 the vessels should be dedicated to working as part of the SOWER 2000 project. In terms of (1) there are four areas left to complete. The Committee **recommends** that in 1999/2000, the region 80-60°W be surveyed; this overlaps with the CCAMLR-48 survey area (see Item 11.2). Blue whale research (for which 10 days were allocated) will be incorporated in the overall cruise. The Japanese Government has offered two vessels (*Shonan Maru and Shonan Maru No. 2*). A planning meeting should be held in Tokyo for four days in September, at which the cruise leader, relevant crew members, the Steering Group (see Annex U(13)), a sightings survey specialist (Hedley) and an acoustics specialist (Clark; plus Ljungblad if available for the cruise) should attend. A total of eight

researchers will be required for the cruise; Japan will provide two. Ensor will be cruise leader. Applications for other researchers will be advertised as usual, with the participants being chosen at the planning meeting. A detailed budget was prepared and the financial implications are discussed under Item 18.

The SOWER analysis group (Annex G, Appendix 12) examined a number of recommendations arising from recent SOWER cruises which required analytical input, as well as queries of a similar nature referred to them by the logistics subgroup. They recognised the importance of maintaining overall consistency between cruises in methodology, and thus made no recommendations for any substantial procedural changes at this time, but noted some for consideration next year. The Committee welcomed this report and **endorses its recommendations**.

The Committee expressed its gratitude to the Japanese Government for its generosity in providing the vessels, and **recommends** that the survey as outlined be supported. The Committee also **recommends** that the possibility of carrying out biopsy trials for minke whales during the cruise be considered seriously by the planning meeting, along with the implications this might have for other components of the cruise programme.

It was noted that permission to undertake research within national EEZs would be required, and such permission should be sought as soon as possible.

10.6.3 Longer term planning

The Committee **agrees** the following schedule for future SOWER cruises to complete the third circumpolar series:

(1) 2000/2001–Cooperation with SOWER 2000.
(2) 2001/2002–140°-110°W.
(3) 2002/2003–170°W-160°E.
(4) 2003/2004–130°-160°E.

The Committee noted that the order of (3) and (4) can be switched, depending upon ice conditions (and the possibility of getting access to the Ross Sea) in the intended year of survey.

10.7 Other issues

10.7.1 Mathematically-based techniques for recognition analysis

Hiby reported on progress in developing methods of automated (computer-aided) photo-identification. He discussed the advantages and disadvantages of 'objective' automated systems that work straight from the photo, e.g. the one for matching sperm whale flukes as described in SC/51/CAWS29. These were compared with 'subjective' systems which required an operator to code the pattern of pigmentation or marks, e.g. the system developed at the National Marine Mammal Laboratory in Seattle, USA, for matching humpback whale flukes with a catalogue of over 25,000 photographs from the North Pacific.

There was an extensive discussion (Annex G, item 10.1) of the risks of missing matches, use of multiple images and scoring of photos for quality and distinctiveness.

The Committee **agrees** that there is no need for an intersessional group in the coming year, but that it will review this next year. In the meantime, it would appreciate receiving reports of new advances in the development of automated matching methods.

Fox reported on the status and planned future efforts in cetacean acoustic research currently being undertaken by NOAA and university collaborators (Annex G, item 10.2). The Committee welcomes this report and encourages the continuation of the research, recognising the major contribution that it could make to an understanding of whale behaviour, distribution and assessment.

10.8 Work Plan

Taking into account discussion in Annex G, the Committee agreed to the following work plan for the year 2000 meeting (for the reasons given above this represents a change from the plan envisaged last year).

(1) North Atlantic right whales:
  (a) receive and discuss the report of the intersessional Workshop (see Item 10.3).

(2) Southern Hemisphere blue whales:
  (a) identify potential areas of concentration (from sightings and catch data) for future study;
  (b) revise abundance estimates (see Item 10.2.2);
  (c) further consider sub-species identification (see Item 10.2.1).

(3) Southern Hemisphere humpback whales:
  (a) carry out the preliminary assessment originally planned for 1999; preparatory work to be carried out by the intersessional Working Group given in Annex U(12);
  (b) possibly consider new information on stock structure and demographic parameters.

(4) Southern Hemisphere minke whales:
  (a) finalise plans for a review of abundance estimates in the year 2001 (it had originally been planned to carry out the review in the year 2000); preparatory work to be carried out by the intersessional Steering Group given in Annex U(4).

Note that the agreed changes in the work plan for 2000 given above imply changes in the work plan for 2001 and beyond as given in IWC (IWC, 1999f, p.133).

11. ENVIRONMENTAL CONCERNS

11.1 Pollution and contaminant issues

11.1.1 Report of Workshop

The report of the Planning Workshop to Develop a Research Programme to Investigate Pollutant Cause-effect Relationships in Cetaceans - POLLUTION 2000+, Barcelona, 14-17 March 1999, is given as IWC (1999c). An outline research proposal, Aguilar *et al.* (1999), had been agreed by the Scientific Committee and the Commission in 1997. Subsequently, the proposal was strongly endorsed by ASCOBANS and the ICES Working Group on Marine Mammal Habitats. The Barcelona Workshop was a direct result of that proposal and its terms of reference were to develop and update the outline into a full field and analytical programme. Details are given below under Item 11.

The Workshop **strongly believes** that the POLLUTION 2000+ project represents fundamental research necessary if the effects of pollutants and contaminants on cetaceans are to be determined. In addition to central IWC funding it therefore urges IWC member governments to consider providing support to this project at the national level.

11.1.2 POLLUTION 2000+ Proposal to the Commission

Annex C to the Workshop was developed after the Workshop by those members of the Steering Group (see Annex U(14)) present in Grenada as well as two national sub-project leaders. It presents a budget and revised work

plan based on the results of the replies from potential collaborating institutes (see below).

The Barcelona Workshop (IWC, 1999c) addressed the request of the Commission, its Scientific Committee and the SWG on Environmental Concerns (SWGEC) to further develop the research proposal on cetaceans and pollutants, hereafter called POLLUTION 2000+. The starting point for the Workshop was established by the SWGEC, Scientific Committee and Commission as given in Aguilar *et al.* (1999, pp.425-8), in which the measured variables, pollutants and biomarkers (indicators of exposure and/or effects) and the target species, had been identified and agreed upon.

PCBs were chosen as model compounds because of their overwhelming anthropogenic origin, very high concentrations in some cetacean populations, recognised effects upon wildlife and the substantial background information already available on patterns in variation, geographical distribution, tissue kinetics and mechanisms of action. By analysing PCBs it was recognised that, from the same samples at no extra cost, information will be obtained on a series of other organochlorines.

The programme will focus on harbour porpoises and bottlenose dolphins. Sample size considerations precluded the inclusion of the white whale and the Amazon river dolphin as had been planned earlier, but studies on these species (and indeed others) are important and may be included in future phases of this iterative project. Interested groups are encouraged to undertake such studies. The collection and at least archiving of samples from these populations should be encouraged by the IWC.

Last year, the Committee stressed that the programme was intended to address specifically the main recommendation of the IWC Pollution Workshop. Researchers are encouraged to address the other recommendations of that Workshop and consider other species and sources of samples. The priorities of POLLUTION 2000+ do not imply that other approaches are untenable but rather that it is important for the IWC to focus its effort on particularly important questions that would have wide ranging benefits to studies of cause-effect relationships in cetaceans. The programme is intended to produce a model for studies of other contaminants in other species and areas, by bringing together biologists, toxicologists, pathologists, toxico/pathologists and others in a multi-disciplinary collaborative programme.

Samples will be archived for further analyses outside the core-programme following the guidelines listed in table 2 of the Barcelona Workshop report. The Committee encourages auxiliary projects to be taken up by national groups and other institutions, for example the assessment of new or recently found compounds in cetaceans, such as organotins and polybrominated biphenyls.

Based on IWC, 1999c the following short-term objectives are identified for POLLUTION 2000+:

(a) to select and examine a number of biomarkers of exposure to and/or effect of PCBs and try to determine whether a predictive and quantitative relationship with PCB levels in certain tissues exists;
(b) to validate/calibrate sampling and analytical techniques to address such questions for cetaceans, specifically
    (i) determination of changes in concentrations of variables with post-mortem times;
    (ii) examination of relationships between concentrations of variables obtained from biopsy sampling with those of concentrations in other tissues that can only be obtained from fresh carcasses.

Given these objectives and the levels of resources and effort necessary to examine them, the Committee agreed that the work should be divided into two phases noting that information from Phase 1 is important in providing the calibration/validation tools necessary to better focus and design Phase 2. Data from Phase 1 will provide information not only essential for completing Phase 2 of POLLUTION 2000+ but also of fundamental importance to many research programmes examining issues of chemical pollutants and cetaceans. Phase 1 concentrates largely on Objective (b) above and comprises two sub-projects: (1) effect of post-mortem time; and (2) relationship between information obtained from biopsy samples with that obtained from live-captured animals or carcasses (either from bycaught or freshly stranded animals).

Highest priority is to be accorded to sub-project 1. Changes in levels of contaminants and indicators of exposure are known to occur after death due to the inevitable physiological changes and breakdown of tissue (e.g. see IWC, 1999c). It is essential that these changes are quantified, to determine the effect of post-mortem time on levels in the various tissues, if the implications of measured levels of those in animals whose time to death is uncertain are to be correctly interpreted with respect to concentrations in the living animal.

The post-mortem experiment can be carried out on a selected subset of the biopsy calibration experiment animals. The absence of a suitable source of fresh carcasses of bottlenose dolphins means that the calibration experiments will be carried out on harbour porpoises. The choice of sampling area or areas needs to be decided by the Steering Group.

Phase 1 includes the field research component as well as analyses of the bottlenose dolphin sub-project in Sarasota Bay and the field research component of the bottlenose dolphin sub-project in Mauritania, Bahamas and the Mediterranean, but only the PCB analyses are being undertaken as part of Phase 1. The rationale for the latter is that: (a) it takes advantage of existing fieldwork; and (b) it will enable selection of a single 'unpolluted' area to focus the Phase 2 segment. The remaining indicator analyses from the samples collected in Phase 1 will be undertaken as part of Phase 2, depending upon the findings of Phase 1.

Phase 1 data will be analysed initially in a specialist workshop, before embarking on Phase 2. This will result in a revised programme to be presented to the Committee and the Commission.

The financial aspects of the programme are dealt with under Item 18.

The Committee endorses and strongly **recommends** approval of POLLUTION 2000+, and encourages the Commission to fund what it can of the costs and to work with national governments and other organisations to secure the rest of the funds.

11.1.3 Other pollution-related topics

The first three papers considered under this section included general overviews of environmental concerns for cetaceans, with parts of their content applying to other agenda items as well.

The authors of SC/51/E14 had endeavoured to identify important developments in the cetacean environment that had arisen since the last meeting. These included: increased concerns about organotin and polybrominated compounds; that the United Nations Environment Programme (UNEP) is beginning negotiations between 120 countries on a global, legally-binding ban on 12 persistent organic pollutants,

including the PCBs; that the Exxon Valdez Oil Spill Council had issued a progress report in 1999, ten years after the spillage of 11 million gallons of crude oil into Prince William Sound, Alaska (the majority of animals affected are not considered to be fully recovered and this includes the local killer whale population); and a morbillivirus infection that had recently been detected in a fin whale stranded in Belgium (the first such infection detected in a baleen species).

SC/51/SM47 noted the enormous potential for environmental degradation and contamination in the coastal waters of Asia and, therefore, potential adverse impacts on the Asian populations of coastal cetaceans (e.g. *Sousa, Orcaella, Neophocaena* and coastal *Tursiops*). The paper identified several areas which were a cause for concern.

SC/51/E3 provided background information on anthropogenic environmental changes that may affect cetaceans. It addressed a range of concerns including climate change, ozone depletion, pollution and effects of fisheries.

SC/51/E4 reported an update on accumulation levels for organochlorines in southern minke whales using 12 blubber samples collected from the 1994/95 JARPA program.

In SC/51/E6 pollutant loads were compared among three of the five different Alaska white whale stocks (Eastern Beaufort Sea, Eastern Chukchi Sea and Cook Inlet).

SC/51/E2 reported levels of artificial radionuclide ^{137}Cs and natural radionuclide ^{40}K concentration in Dall's porpoise, *Phocoenoides dalli*, taken off the Pacific coast of northern Japan in 1996.

SC/51/E11 discussed levels of non-radioactive (i.e. heavy metals) and radioactive elements (i.e. radionuclides) in tissues of white whales from Alaska.

SC/51/AS13 outlined an unusual type of large whale study. Bowhead whale tissues are being cultured in collaboration with NASA, which may send the whale tissues into space to study their (and other cetacean species) capability to tolerate high levels of certain heavy metals. This would be a model for studying the stresses astronauts will face in an enclosed environment where toxic compounds are concentrated by the recycling of materials.

SC/51/E13 commented that considerable concern exists about the implications of the ubiquitous pollutants that bio-accumulate in the food chains of top marine predators, and the implications for both cetacean health and the health of consumers of cetacean products. The paper focused on two regions where cetaceans are still consumed: Japan and the Greater Caribbean. In addition, new data on pollutants from meat purchased in Japan in 1999 were presented.

Parsons *et al.* (1999) reported contaminant levels in an immature female pygmy Bryde's whale from the South China Sea.

11.2 Climate change and habitat

11.2.1 Report of Sightings Workshop

SC/51/Rep2 (IWC, 2000) reports the results of the SOWER 2000 Workshop which was held 1-6 March 1999 at Heriot-Watt University, Edinburgh, Scotland. Its primary aim was to develop proposals for the IWC component of collaborative work in the Antarctic between the IWC, CCAMLR and SO-GLOBEC, to address the aims of the SOWER 2000 research programme.

The Workshop considered background on relevant survey programmes and on relevant analysis methods prior to developing the research proposal. The CCAMLR large-scale survey is aimed primarily at estimating the standing stock of krill in Area 48 (the Atlantic Sector of the Southern Ocean). This survey (known as the CCAMLR-Area 48 survey) will be undertaken during January-February 2000, and will involve three vessels acoustically surveying a set of parallel transects across the Scotia Sea. By placing cetacean observers on board the CCAMLR vessels there will be an opportunity to survey cetaceans and krill simultaneously over a large area. The SO-GLOBEC work is aimed at addressing a set of scientific questions on the interactions between Antarctic krill and its top predators. Work will be focused in the Antarctic Peninsula area and in the area known as 70°E. Field studies will collect a wide range of data on physical and biological oceanography, krill and krill predators. These datasets will encompass a broad range of space and time resolution.

11.2.1.1 CETACEAN COMPONENTS OF THE CCAMLR AREA 48 SURVEY AND SO-GLOBEC SURVEYS

A specific objective of the SOWER 2000 programme is to 'relate distribution, abundance and biomass of baleen whale species to the same for krill in a large area in a single season'. Conducting sightings surveys from the CCAMLR vessels in 2000, and from SO-GLOBEC vessels in 2000/1 will help achieve this objective. While details of the data collection methods will need to be finalised at a future planning meeting, the Workshop recommended the framework of a broad design to accomplish this.

SC/51/Rep2 (IWC, 2000) describes this framework, and some details of cetacean observation methods and platforms, school size and species identification, activities during oceanographic sampling, passive acoustics and biopsy sampling. A number of recommendations were made (see SC/51/Rep 2, item 4.1 (IWC, 2000)).

11.2.1.2 USE OF IWC SURVEY VESSELS IN 2000/2001

The Workshop anticipated that two dedicated vessels will be available. As discussed last year (IWC, 1999l), it was reconfirmed that one vessel will conduct feeding ecology studies involving fine-scale studies of the movements and the behaviour of individual baleen whales in relation to krill patches. The Committee **agrees** that the change of location for the 2001 collaboration with SO-GLOBEC from the Antarctic Peninsula to the vicinity of 70°E is acceptable, and will still allow the programme to achieve its objectives. Details of the proposed methods are given in SC/51/Rep2, item 4.2.1 (IWC, 2000). It was proposed that the second vessel be used to repeatedly survey the wider SO-GLOBEC area which would allow a number of issues to be addressed, including: calibration of relative abundance estimates; estimation of the spatial relationships between whales, krill and oceanographic variables; estimation of the spatio-temporal distribution of whales and krill; estimation of the distribution of whales school/cluster sizes; and estimation of absolute whale and krill abundance. Details of the recommended broad design for this survey are given in SC/51/Rep2, item 4.2.2 (IWC, 2000).

The Committee draws the attention of the Commission to the proposal to attach remote sensing devices (including satellite tags) to minke whales as part of this collaborative research. For some member governments, participation of their scientists will/may require the issue of permits under relevant domestic legislation. Detailed descriptions of the remote sensing devices to be used will be required in sufficient time to allow the permit processes to be followed.

11.2.1.3 LONG TERM OBJECTIVES AND COLLABORATION

The studies proposed for SOWER 2000 in collaboration with SO-GLOBEC and CCAMLR will greatly improve understanding of many aspects of Antarctic whale ecology. However, they are only a first step towards addressing questions about the present or future dynamics of Antarctic whales necessary to meet the long-term objectives of the SOWER 2000 programme. To make further progress, a variety of practical and theoretical problems must be addressed. The Workshop noted that issues concerning future SOWER cruises would be discussed at the 1999 Committee meeting. More generally, the Workshop noted that attention must be given to the overall modelling approach required, and how this might inform and focus future scientific objectives. It recommended the establishment of a modelling group and a list of members is given in Annex U(16).

The Workshop strongly recommended continued close collaboration between the IWC and SO-GLOBEC in the long term. This was essential for the IWC to put its studies of interactions between whales and their environment in the context of long-term environmental monitoring and climate change. It will also facilitate investigation of important issues such as the effects of predators on their prey and whether krill is a limiting resource for some whale species. The Workshop noted that the modelling group established as part of the long term SOWER programme should work closely with the modelling activities ongoing under GLOBEC.

The Workshop also strongly recommended continued close collaboration between the IWC and CCAMLR in the long-term. CCAMLR benefits from IWC work on important krill predators; the IWC benefits from CCAMLR work on important whale prey. The Workshop agreed that this collaboration is best facilitated through continued reciprocal representation of CCAMLR scientists on IWC SOWER working groups and IWC scientists on the CCAMLR Working Group on Ecosystem Monitoring and Management (WG-EMM). It also recommended continued collaboration at the more detailed level of cruise planning for the CCAMLR-48.

Collaboration between the IWC and national programmes was already well established in some cases (e.g. Australia). The Workshop recommended that specific links be established between those responsible for IWC work in the SO-GLOBEC area and those knowledgeable about plans for the Brazilian surveys in adjacent waters. The Standing Working Group on Environmental Concerns (SWGEC) would be the appropriate conduit for this. The Workshop also recommended that member governments keep the IWC informed about relevant scientific activities that may be able to incorporate a cetacean component.

Given the importance of continuing IWC involvement in CCAMLR and SO-GLOBEC planning, modelling and analysis activities and the further work necessary to finalise the practical details for the SOWER 2000 programme, the Workshop recommended that the Scientific Committee should establish a Steering Group to coordinate the planning exercise.

11.2.2 SOWER 2000 Proposal to the Commission

The Working Group had discussed the SOWER 2000 Workshop Report and found the details related to the scientific plan acceptable. The funding implications are discussed under Item 18.

In summary, the Committee **strongly recommends** endorsement and funding of the SOWER 2000 proposal. It established a Planning Steering Group (see Annex U(15)).

11.2.3 Habitat use patterns (other than SOWER 2000)

SC/51/E1 reported on the distribution of minke whales in the Bellinghausen and Amundsen Seas with reference to environmental variations. The distribution and abundance of minke whales in Antarctic Area 1 (60°-120°W) were examined in relation to sea surface temperature, sea ice extension and sea bed type. The analysis was based on sightings data obtained from the 1982/83 and 1989/90 IWC/IDCR cruises.

SC/51/O13 described two approaches being developed to estimate abundance from line transect survey data and attempts to model large-scale spatial trends and smaller-scale spatial correlations. The methods use generalised additive models (GAMs) to estimate a continuous density surface for the survey area, which is then integrated to provide an estimate of abundance for the entire area. The potential use of these models to help explain cetacean distribution using physical variables was described.

SC/51/E5 reported on the application of XCTDs during oceanographic survey in Antarctic Areas IIIE and IV on the 1997/98 JARPA cruise. Whale habitats were associated with a zone of high productivity at the southern boundary of the Antarctic Circumpolar Current.

SC/51/E12 reported on summer habitat characteristics of cetaceans in the western North Atlantic. The study investigated summer (June-September) habitat usage patterns of cetaceans. Data from 10 shipboard sightings surveys conducted between 1990 and 1996 were used to formulate a model of habitat usage patterns. The data from two surveys conducted during 1997 and 1998 were then used to test the predictability of the model.

SC/51/CAWS3 is the report of a multidisciplinary Workshop held in 1998. The Workshop brought together biological and physical oceanographers, right whale biologists, ecosystem modellers and statisticians to discuss whether it is possible to predict the distribution of right whales (notably the location of concentrations) from remotely sensed environmental data.

11.2.4 Environmental research in the Southern Ocean Sanctuary

The Committee received two papers reporting the results of recent research in the Southern Ocean (and Indian Ocean) Sanctuaries. SC/51/O12 reported on a visual survey in the Southern Ocean and Indian Ocean Sanctuaries. Humpback whales were the most commonly recorded of the large whales with a total of 28 individuals. Fifteen humpback whales were photographed for identification purposes. The authors commented on the low number of minke whale sightings especially along the Ross Sea ice-edge.

SC/51/O17 described a passive acoustic survey around the island of South Georgia conducted from the British Antarctic Survey vessel *RRS James Clark Ross*. A simple two element hydrophone array, sensitive to frequencies of between 300HZ and 24kHz, was towed on a 400m cable astern of the vessel. A total of 4,200km of acoustic effort was achieved in two small regions around South Georgia and on passage between the Falkland Islands and South Georgia. The use of this equipment allowed cetacean data to be collected at the same time as other detailed biological and oceanographic research without any dedicated ship time or the need for a large team of visual observers.

The necessity of the Southern Ocean Sanctuary to the conduct of this research was questioned. It was noted that the research could be conducted without such designation but that it did contribute to the objectives for the sanctuary as designated by the Commission.

11.3 Arctic issues

The Committee received two companion documents, SC/51/E9 and SC/51/E10, which together presented the basis for an Arctic Initiative that will address both climate change and pollutant concerns. These documents were prepared in response to requests by the Committee at the 1997 and 1998 annual meetings (IWC, 1997c; 1998c).

SC/51/E9 formed the part of the proposal directed at defining habitat and prey use patterns, and the potential effects of climate change.

Marine mammals have been suggested as effective bio-indicators of global climate change because of their: (1) dependence on ice as substrate-habitat (ice seals and polar bears); and (2) association with the ice-edge and other areas of comparatively high productivity in their role as apex predators (cetaceans and pinnipeds) in Arctic trophic models. In SC/51/E9 and SC/51/E10 the authors focus on this critical role of whales as bio-indicators of climate change in the Arctic. Bowhead, gray and white whales have been suggested as the 'best' cetacean species to serve as indicators of climate change in the Arctic because they sample the environment at three distinct trophic levels.

A better understanding of whale ecology and responses to climate change in the Arctic will require coordination among cetacean-focused and oceanographic-focused research programmes. A fundamental problem in relating patterns of cetacean occurrence to climate change models is one of scale. Specifically, Global Climate Models (GCMs) are typically constructed at atmospheric and oceanic basin-scales, while cetacean research is usually conducted at meso- or regional scales. Introducing sub-models to GCMs that incorporate the ecosystem responses to physical oceanographic processes, from phytoplankton productivity through to cetacean population status, is the central goal of this initiative.

The second part of the initiative was described in SC/51/E10, which concluded that tissue and exposure contaminant levels (and likely the expression of adverse health effects), and nutrients are dependent upon: (1) trophic level; (2) geographic region; and (3) biological variables (body condition, stock, prey selection, etc.). These three important factors have been proposed as vulnerable to environmental change and would affect levels of contaminant exposure and subsequently the health of cetaceans.

Changes in oceanographic and atmospheric contaminant input will alter levels at the base of the food web and ultimately alter cetacean exposure (in krill- or fish-based food webs, or both) through various bioconcentration mechanisms. River discharges and associated changes in contaminant loading to coastal environments must be considered if climate change results in increased precipitation and subsequent runoff. It is uncertain how this will affect productivity, nutrition and cetacean health, however it should be examined.

The Arctic Initiative will coordinate with and benefit from ongoing efforts that address this issue, of which the Arctic Environmental Protection Strategy (AEPS) Program and two groups within this organisation, the Arctic Monitoring and Assessment Program (AMAP) and the Conservation of Arctic Flora and Fauna (CAFF), are examples. The authors highlighted that changes in oceanographic and atmospheric processes will affect contaminants, nutrient input and cycling, and that this is critical to our proposal to better understand the linkages to cetacean contamination and health.

The Committee thanked the authors of SC/51/E9 and SC/51/E10 for the contributions made by these documents to advance planning for an Arctic Initiative, and fully supported the Initiative's further development. The Committee **recommends** continued development of the Arctic Initiative, and invites presentation of the revised framework at next year's meeting.

The Committee established an Intersessional Working Group (given in Annex U(17)) using the SOWER 2000 approach as a template to produce a draft Arctic Initiative proposal, provisionally named ARCTIC 2000, by next year's meeting.

11.4 Other concerns

11.4.1 Noise

SC/51/E15 updated SC/50/E8 (Dolman and Simmonds, 1998). It described the range of potential impacts that intense sounds might have on cetaceans and suggested that further work on noise by the Committee might focus on the identification of relevant methodologies, particularly with respect to the biological responses of cetaceans, noting the overlap between such considerations and the interests of the sub-committee on Whalewatching.

The sub-committee on Small Cetaceans discussed the use of acoustic pingers to reduce entanglement of harbour porpoises in fishing gear at this year's meeting (Annex I). Arising from that focus, there was discussion concerning the potential for unintended, negative effects of acoustic devices on cetaceans. These effects potentially work on two levels: overall sound pollution of the environment and possible exclusion of cetaceans from important habitats.

The distinction was drawn between Acoustic Harassment Devices (AHDs) with source level > 180 db re 1 μPa at 1m as used on fixed aquaculture sites to reduce pinniped predation, and Acoustic Deterrent Devices (ADDs) with source level typically < 150 dB re 1 μPa at 1m, which have the implicit function to deny small cetaceans access to the hazardous area immediately surrounding fishing nets.

Although no clear evidence exists yet to support the habitat denial hypothesis, it was recognised that there may be risks associated with ADDs used in long-net and multiple-net deployments. Such deployments will require consideration by fishery management, e.g. as to where a long gillnet with pingers might obstruct access to an important habitat (this problem is addressed also in Annex I, item 5.3.3).

The Committee received a brief overview of some of the major issues involved when considering noise impact. This included differentiating between a noise impulse (seismic pulse or short duration ping) and an average increase in ambient noise, a need for better understanding of auditory physiology, the physical acoustics of a particular region and annual distribution and abundance within the region.

In summary, the Committee **expressed concern** over potential adverse effects of anthropogenic noise on cetaceans. It recognises that this is a complex subject and that scientific study on this issue involves the integration of a broad range of disciplines including acoustics, audiology, physiology, behavioural ecology and population biology. The Committee further recognises that, with our current

limited knowledge of cetaceans, the risks associated with noise exposure cannot be easily quantified for most species.

The Committee recognises that mitigation and careful use of sounds are direct and effective mechanisms for reducing potential impact. It therefore supports measures to mitigate adverse effects of noise wherever possible and emphasises the need for continued research on this matter. Given that the Committee has particular interests and expertise in population level effects from human actions on cetaceans, there would be considerable value in the Committee's continued attention to noise effects.

The Committee discussed how it might become better informed on the subject of anthropogenic noise impacts on cetaceans without expending unnecessary amounts of time and energy. Over the past several years there have been several national and intersessional workshops and special meetings as well as several major research efforts on this subject. One important result of the workshops and research has been that some consensus has been reached on the most important concerns and the most critical research needs. One possible constructive step for next year's meeting would be to have someone provide an overview of these newer materials as well as copies of the relevant reports and papers. The Committee does not recommend convening an IWC workshop on this topic in the near future, as it would not be an effective use of IWC resources. It noted that the Acoustic Society of America will hold a technical session at its Autumn 1999 meeting and that there will be a bioacoustics Workshop preceding the 1999 Marine Mammal Conference in Hawaii.

11.4.2 Ozone depletion and UV/B

Waibel *et al.* (1999) showed that chemical processes that underlie ozone depletion in the Arctic are not the same as in the Antarctic. Even though CFC emissions are decreasing, it is expected that there will be continued loss of atmospheric ozone over the Arctic for at least 15 more years due to nitrification processes. In addition, certain other halons are increasing in the atmosphere and will also contribute to ozone depletion.

11.4.3 Habitat degradation

No papers were received focusing primarily on this topic, but aspects of three documents discussed above (SC/51/E3, E14 and SM47) are relevant.

In discussing references to a reported die-off of gray whales in SC/51/E14, the Committee agreed that caution should be exercised when using reports as sources of scientific information.

Concern was expressed regarding possible habitat degradation for gray whales if a proposed salt works is constructed at San Ignacio Lagoon, Baja California Sur, one of the three main breeding grounds for the eastern North Pacific gray whale. It was pointed out that an environmental impact study is in progress and it would be appropriate for the Committee to wait until that study is received to give the matter further consideration.

11.4.3.1 WORKSHOP PROPOSAL (RESOLUTION 1998-6)

The Committee received a revised proposal for the Workshop on Habitat Degradation (Annex H, Appendix 3). An Intersessional Steering Group (see Annex U(18)) was established to develop a final proposal to next year's meeting.

11.4.4 Disease and mortality events

In response to a concern raised in SC/51/E14, the Committee was referred to information on gray whale mortality at the breeding grounds in the Baja California peninsula, as presented in document SC/51/AS30. During the past winter season (1998/99) strandings of gray whales attracted public attention, particularly after two whales were found dead very close to San Carlos, a small town at Magdalena Bay, from where whalewatching is being conducted. Much concern was expressed in both the local and international media. SC/51/AS30 concludes that the pattern of strandings is in fact not notably different from expectation and that there is little reason for alarm. Authors of reviews are encouraged to use caution in using media reports as sources of scientific information.

11.4.5 Ecosystem-level effects

SC/51/E7 and SC/51/E8 considered the diet of northeast Atlantic minke whales in the Barents Sea. SC/51/E7 highlighted the nature of minke whale feeding habits in relation to large-scale changes in prey abundance. Using the results from the annual studies of whale diets in the Barents Sea since 1992 in combination with results from annual acoustic surveys of herring in the Barents Sea, the authors assessed in more detail the dynamics of minke whale predation on herring.

SC/51/E7 indicated that minke whale prey species (from stomach contents) changed in relation to the fluctuations in abundance of the prey items (herring, capelin and krill). The author noted that top-down predator-prey relationships had been identified for capelin and krill in the Barents Sea. The available data are, however, insufficient to assess whether or not similar top-down relationships exist between minke whales and their prey.

SC/51/O1 investigated species diversity and biomass of the whale community in relation to the distance from the ice-edge in the Indian Ocean sector of the Antarctic. The species diversity was lowest near the ice-edge and increased to a constant level in waters beyond 60 n.miles from the ice-edge. The density and biomass showed an opposite trend, as their values were the highest near the ice-edge and decreased with distance from the ice-edge.

The sub-committee briefly considered Tamura and Ohsumi (1999). In this paper, levels of annual food consumption by cetaceans were calculated for the world's oceans based on available recent abundance estimates of cetaceans. The sub-committee also considered briefly a paper by Young (1999). This paper was produced by CSIRO Australia, to investigate the likely potential of present or future populations of large whales having a significant impact on commercial fishing in the South Pacific Ocean, either directly (by consuming commercial species such as tunas), or indirectly (by competing for prey resources).

During discussion in the Committee, Tamura stated that with reference to Tamura and Ohsumi (1999), further investigations are required to determine the proportion of the estimated total prey consumption of cetaceans that is potentially food for humans.

While the subject matter of these papers is important, no consensus was reached regarding whether any conclusions could be drawn from them. It was agreed that this topic should be considered at a future meeting of the Committee. It should be identified as such sufficiently in advance so that relevant expertise can be made available (see below). A quantitative modelling framework should be used in that consideration.

11.5 Work plan

11.5.1 Longer-term priorities and directions

Many members of the Committee expressed concern that in attempting to address such a varied and complex set of issues each year the effectiveness of the SWG on environmental concerns may become compromised. The Committee agrees that in future one, or at most two, priority topics should be identified for each meeting, as is the case for the Small Cetaceans sub-committee. This is not intended to discourage submission of papers addressing any of the Group's regular topics.

The SWG should, in the course of its regular work, investigate correlations between environmental factors and differences between observed cetacean demographic parameter values, and their predicted trends in the absence of environmental effects. This will aid in better determining how environmental factors affect cetaceans.

Topics suggested for next year by the SWG included: habitat degradation in coastal areas (e.g. for river dolphins, to match the Small Cetaceans sub-committee focus on river dolphins), ozone depletion, disease and mortality events, definition and estimation of cetacean habitat use patterns, and issues related to oil exploitation. It was not possible to come to a decision on which topic should be given priority in the time available. However, noting the extensive work plan identified below, including the need to review the status of the environmental research programmes and further develop other work on habitats, the SWG Convenor will consult with the Chairman of the Scientific Committee and the other convenors, and inform Committee members by e-mail, as soon as possible after the meeting.

It was suggested that the potential for competition between cetaceans and fisheries be added to the list of potential priority topics considered by the Committee. Further, this should be done on a two-year basis. In the first year necessary preparations would be made to allow the informed consideration of issues relevant to such competition, for example as discussed above under Item 11.4.6. An Intersessional Working Group was established (see Annex U(19)) to advance planning for the next meeting. That group would *inter alia* prepare draft terms of reference for the Committee's work on the topic.

It was questioned whether a topic addressing the effects of cetaceans on the marine environment, as opposed to the effects of the environment on cetaceans, was within the terms of reference for the Committee as set forth by the Commission. The Committee agrees that it wishes to address this topic, and seeks confirmation from the Commission that this is appropriate.

A suggestion was put forward for the Committee to compile an annual summary on the 'State of the Cetacean Environment' (Annex H, Appendix 4). The Committee **agreed** to try this on an experimental basis for the next meeting, and established a correspondence group to work during the intersessional period (see Annex U(20)).

11.5.2 Work plan for coming year

(1) SOWER 2000.
  (a) Conduct 2000 field programme with CCAMLR.
  (b) Prepare for 2001 field season with SO-GLOBEC.
(2) POLLUTION 2000+.
  (a) Begin calibration study and field collections for Phase I.
  (b) Prepare and plan for Phase 2.
(3) Complete proposal(s) for Arctic Initiative.
(4) Complete proposal for Habitat Degradation Workshop.
(5) Develop 'State of Cetacean Environment' report.
(6) Prepare for consideration in 2001 of the potential for competition between cetaceans and fisheries.

12. SMALL CETACEANS

12.1 Status of white whales

The Committee last reviewed the status of white whales in 1992 (IWC, 1993a). Since that time a great deal of relevant research had been undertaken.

12.1.1 New information on life history

In SC/51/SM4, Hohn and Lockyer reported their counts of Growth Layer Groups (GLGs) in tooth sections from two wild-caught white whales held in captivity for eight years. They interpreted the counts to indicate a deposition rate of one GLG per year, not two GLGs per year as had hitherto been accepted for the white whale. The paper also argued that the data in the literature used to support the two GLG per year hypothesis may, in fact, support a deposition rate of one GLG per year. If correct, this new interpretation of tooth sections would have far-reaching consequences for our understanding of white whale life history. The Committee does not, however, find the arguments put forward in SC/51/SM4 fully convincing. It agrees that a model of tooth development for this species (i.e. how GLGs are formed) was required before the question could be resolved. It believes that sufficient white whales have been born in captivity to allow the development of such a model.

12.1.2 Definition of 'Stock' or Management Unit

The Committee agreed on the principle that management units should be established with the goal of maintaining white whales throughout the full extent of their historical range (see SC/51/RMP23). To achieve this goal, it is necessary to adopt the smallest reasonable population units. The default position would be to start from the assumption that estuarine groups are separate stocks unless they are shown to be otherwise. This precautionary approach is intended to ensure that removals based on large area population estimates are not inadvertently taken from smaller discrete stocks within the area. Evidence of white whale fidelity to estuaries, bays or other small areas, and persistent local depletion after severe hunting, suggests that such takes could lead to the extinction of small populations. In several areas, there is traditional knowledge and scientific evidence that animals move sequentially between two or more aggregation sites within a season (e.g. Bristol Bay: Frost *et al.*, 1985; Frost and Lowry, 1990; Somerset Island: Smith and Martin, 1994). As such information becomes available, the small 'stocks' defined *a priori* as separate can be combined into larger units. Shifting the burden of proof in this way represents a fundamental change in the policy of this Committee towards white whale stock identity.

Stock boundaries sometimes overlap spatially and in such cases the geographical delineation of white whale stocks must have a temporal component. At some locations along the Alaskan coast, white whales from more than one stock are hunted at different times of the year. Migrating whales from different stocks may approach and move past a given site in 'waves', while a summer 'resident' stock moves into that same area for an extended period. For example, the Eastern Chukchi Sea stock is temporally delineated as the group of whales that arrives in Kotzebue Sound or Kasegaluk Lagoon as the ice begins to break up and remains there for at least several weeks. Earlier in the year, whales

from the Beaufort Sea stock move through this area in the spring lead system. Thus, the annual catch at villages such as Point Hope, Kivalina and Barrow can consist of whales from both of these stocks.

Contaminant data alone are unreliable for identifying stocks. The primary concern for management is likely to be in a coastal area where hunting occurs, and most or all tissue samples will have been taken from that area. If two stocks occur there seasonally and they use a common feeding ground, contaminant comparisons may show a spurious lack of difference. Similarly, if contaminant signatures are labile (e.g. due to interannual or seasonal changes in prey availability and composition, differential metabolism of organochlorine compounds, etc.), spurious differences may be found between samples taken from the same stock at different times. Thus, contaminant data can be useful to supplement or reinforce other evidence, but should not be used as the sole basis for stock identification in the absence of other corroborative evidence.

12.1.3 Review of current knowledge on a stock-by-stock basis

At the 1992 meeting a total of 16 'stocks' were provisionally identified (IWC, 1993a). A large amount of new data has become available since then, particularly with regard to molecular DNA. SC/51/SM37 reviewed current information and identified a total of 22 putative stocks based upon information on distribution and migration patterns, morphology, contaminant profiles, population trends and genetics. The paper reviewed the recent literature on stock concepts and noted that the appropriate unit of species management depends on the conservation goal. It suggested that for a species such as the white whale, which is or has been directly exploited over a large proportion of its range, it may be more relevant to measure the level of dispersal between sub-populations than to determine their evolutionary distinctiveness because the immediate goal of management would be to prevent a stock from becoming depleted due to excessive take. Recent genetic studies of white whales have primarily involved analyses of mitochondrial or nuclear DNA. The mtDNA analyses suggest that there is limited movement between major summering grounds and therefore that colonisation of depleted areas by whales from other summer concentrations would be slow. It was also noted, however, that recent satellite tracking data show white whales to be less ice-limited than previously thought; they travel long distances into the permanent polar ice during the summer. Thus, ideas about the physical barriers to movement and hypotheses concerning the convergence of several summering stocks on a single wintering ground may need to be reconsidered.

The Committee discussed the evidence of stock identity for each part of the white whale's circumpolar range. Proposed stock divisions are shown in Fig. 3. The evidence for those divisions is summarised in Table 10. Discussions pertaining to areas that were particularly difficult to resolve are given in Annex I and see Editor's note on p. 247.

The available information on geographical range and migrations, abundance, directed takes, indirect takes, known and potential threats and the status of each of the 29 putative stocks was reviewed and is summarised in Table 10. The quality and quantity of available information varied greatly among the stocks and confounded inter-stock comparisons. Differing methods of data collection contributed to the uncertainty surrounding some of the stock designations.

White whales are not currently commercially harvested anywhere throughout their range. Direct takes are from aboriginal hunting. Indirect takes are primarily from incidental catch in fishery operations. Current known or potential threats include a wide variety of human activities: oil and gas development, over-harvesting, fisheries, vessel traffic (recreational, commercial and military), hydroelectric development in Hudson Bay, and industrial and urban pollution. The most immediate concerns relate to continuing harvests from small and depleted populations.

The Committee expressed concerns about the conservation status of a number of stocks because of their:

(1) depleted status relative to historical abundance (Cook Inlet, West Greenland, Ungava Bay, Cumberland Sound, East Hudson Bay, St Lawrence River);
(2) likely depleted status relative to historical abundance (Svalbard, Ob Gulf, Yenesy Gulf, Onezhsky Bay, Dvinsky Bay, Mezhensky Bay, Shelikov Bay, Shantar Bay, Sakhalin-Amur);
(3) current small population size or reduced range (Cook Inlet, Ungava Bay, Cumberland Sound, West Greenland, Ob Gulf, Yenesy Gulf); or
(4) recent decline (Cook Inlet, West Greenland).

In the majority of stocks, the Committee **recommends** that surveys be continued to determine current abundance and assess trends. Considering the wealth of information on movement patterns and habitat use gathered from satellite telemetry studies, it was recommended that such studies be continued and expanded. Recent genetic and contaminant analyses have resolved much about stock discreteness in some areas. However, more research is required to resolve microgeographic structure and seasonal movement patterns within some of these areas. In other regions no research of any kind has been conducted to determine stock boundaries. There is very little evidence, other than summer distribution, that supports the stock delineations of many of the Russian stocks proposed in Fig. 3 and Table 10. The Committee **recommends** that studies, including genetics, be undertaken to resolve the stock structure of white whales in Russian waters. Considering the potential impacts of industrial pollution on white whales in some areas of the Russian Arctic, samples should be collected for contaminant analysis and health assessment. Such a sampling programme could assist in stock identity as well as health assessment studies.

12.1.4 Priority Recommendations

(1) The Committee **recommends** that stocks that are either depleted, small in size, or currently declining in numbers or range be considered as of highest conservation concern. Efforts to improve their current status should be undertaken and supported. Particular emphasis should be placed on those stocks where all three characteristics apply, e.g. Cook Inlet, Ungava Bay, West Greenland and East Hudson Bay. It is important to document catch localities and stock affinities of whales taken by settlements in Ungava Bay and Hudson Strait in order to evaluate the implications for the Ungava Bay and East Hudson Bay stocks.
(2) The Committee **recommends** that genetic and contaminant studies continue in order to further resolve questions about local structuring and movement patterns, and that sampling programmes be initiated in other areas, Russia in particular, to resolve questions of stock structure.

Fig. 3. Approximate worldwide distribution of the white whale. Numbers refer to the 29 putative stocks recognised. See Tables 10 and 11.

(3) The Committee **recommends** that sampling programmes to assess the health status of white whales continue throughout Alaska, Canada and Greenland, and that such programmes be initiated in Russia. Of particular concern are areas of high anthropogenic influence, including the southeast Barents Sea, which is the probable wintering ground for many of the Russian stocks (e.g. the Ob Gulf, Yenesy Gulf) and the Sakhalin-Amur region in the Okhotsk Sea.

(4) The Committee noted that tagging and telemetry studies of white whales have provided important new information relevant to stock identity, migrations, habitat use and abundance. It **recommends** that such studies are continued to increase sample size and are expanded to other regions.

(5) The Committee **recommends** that surveys of white whale distribution and abundance continue, particularly in areas where there is little recent information on either.

(6) The Committee recommends further research on age estimation, including the examination of teeth from known-age captive-born white whales, and encourages greater cooperation among relevant institutions and scientists to resolve this important issue.

12.2 Status of narwhals

In comparison with white whales, little new information has become available for the narwhal since the Committee last reviewed the species (IWC, 1993a). Discussions on questions of stock identity, range and migrations, abundance, takes, threats and status are summarised in Annex I. The summer distribution of the narwhal, including new areas identified during the meeting, are shown in Fig. 4. Catches in Greenland and Canada are known to be continuing, but none are thought to be at unsustainable levels. Nevertheless, information on both the biology and hunting pressure on this species is incomplete.

Text continues on p. 46

Table 10

White whale stocks recognised by the Committee, using the precautionary principle that aggregations should be considered independent until proven otherwise. Types of evidence supporting these stock delineations are indicated. NTD = not determined.

	Stock	Summer concentration area	Hypothesised wintering area	Genetics mtDNA	Genetics nDNA	Contaminants	Movements
1	Cook Inlet	Upper Cook Inlet	Lower Cook Inlet-Gulf of Alaska	Yes	Yes	Yes	Congregates in river mouths in summer.
2	Bristol Bay	Bristol Bay	Bering Sea	Yes	Yes	-	Local movements in northeast Bristol Bay in summer.
3	E. Bering Sea	E. Bering Sea	Bering Sea	Yes	Yes	-	
4	E. Chukchi Sea	E. Chukchi Sea	Bering Sea	Yes	Yes	Yes	Migrate along Chukchi coast in spring, congregate in lagoons in summer, move offshore and north into Beaufort Sea late summer-early fall.
5	Beaufort Sea	Mackenzie Delta-Amundsen Gulf	Bering Sea	Yes	Yes	Yes	Migrate through east Chukchi Sea in spring, congregate in Mackenzie Delta and Amundsen Gulf in summer, move offshore and north in late summer, migrate west to west Chukchi Sea in fall.
6	North Water	Canadian High Arctic	North Water (N. Baffin Bay)	NTD	NTD	Yes	Arrive from east into High Arctic in summer, return east and then northeast to North Water in fall.
7	W. Greenland	Canadian High Arctic?	W. Greenland	NTD	NTD	Yes	Overwinter in open water and pack-ice off West Greenland.
8	Cumberland Sound	Cumberland Sound	Hudson Strait	NTD	Yes (not strong)	Yes (but temporal diffs)	Remain in Cumberland Sound in summer and fall.
9	Frobisher Bay	Frobisher Bay??	Hudson Strait	NTD	Yes (not strong)	Yes (but temporal diffs)	Not known to form concentrations in Frobisher Bay in summer.
10	Ungava Bay	Ungava Bay	Hudson Strait		-	-	-
11	Foxe Basin	Foxe Basin	Hudson Strait- Foxe Basin	NTD (may be mixed stocks)	NTD	-	-
12	W. Hudson Bay	W. Hudson Bay	Hudson Strait	Yes	NTD	Yes	Remain near the coast in summer and early fall.
13	S. Hudson Bay	S. Hudson Bay	Hudson Strait	-	-	-	-
14	James Bay	James Bay	Hudson Strait	-	-	-	-
15	E. Hudson Bay	E. Hudson Bay	Hudson Strait	Yes	Yes	Yes	Remain in E. Hudson Bay through summer before moving north along coast of north Quebec to Hudson Strait in fall.
16	St Lawrence	Estuary of St Lawrence	Estuary and Gulf of St Lawrence	Yes	Yes	Yes	Restricted range throughout summer.
17	Svalbard	Svalbard	Barents Sea	-	-	-	Local movements near coast in summer. May occasionally travel to East Greenland.
18	Franz Josef land	Franz Josef Land	-	-	-	-	-
19	Ob Gulf	Ob Gulf	Barents and Kara Seas	-	-	-	-
20	Yenesy Gulf	Yenesey Gulf	Barents and Kara Seas	-	-	-	-
21	Onezhsky Bay	Onezhsky Bay	White-Barents Seas*	-	-	-	Local movements in Onezhsky Bay in summer.
22	Mezhenskyi Bay	Mezhenskyi Bay	White-Barents Seas*	-	-	-	Local movements in Mezhenskyi Bay in summer.
23	Dvinskyi Bay	Dvinskyi Bay	White-Barents Seas*	-	-	-	Local movements in Dvinsky Bay in summer.
24	SW Laptev Sea	SW Laptev Sea	Barents Sea	-	-	-	-
25	W. Chukchi- E. Siberian Seas	W. Chukchi - E. Siberian Seas	Bering Sea	-	-	-	Not seen nearshore in summer or fall. Presumed to migrate offshore and summer in pack-ice.
26	Anadyr Gulf	Anadyr Gluf	Anadyr Gulf	-	-	-	Some migrate north through Bering Strait in spring and south in fall.
27	Shelikov Bay	Shelikov Bay	Okhotsk Sea	-	-	-	-
28	Sakhalin-Amur	Sakhalin-Amur	Okhotsk Sea	-	-	-	-
29	Shantar	Shantar	Okhotsk	-	-	-	-

*and see the Editor's note in Annex I.

Table 11
Summary information regarding the status of white whale stocks recognised by the sub-committee. IA = Initial abundance.

Stock	Range	Abundance[1]	Takes[2]	Known and potential threats	Trends/status	References
1. Cook Inlet	Summer: northern Cook Inlet Winter: unknown (Cook Inlet-Gulf of Alaska)	1998: 347 (CV = 0.29)	1994-96: 72/year 1997: 65-75 average take 94-98 was c. 20% of pop. size	Small stock size; continued harvest; oil/gas development; eco-tourism; shipping; commercial fishing; sewage from Anchorage	15% decline/year between 94-98 Depleted	SC/51/SM8; SC/51/SM9; SC/51/SM11; SC/51/SM12; SC/51/SM15
2. Bristol Bay	Summer: Inner Bristol Bay Winter: unknown* (outer Bristol Bay-Bering Sea) *Some winter observations in Bristol Bay	1993-94: 1,100 (likely conservative)	1994-1998: 13/year 1.2% of estimated pop. size	Interaction with salmon stocks	Stable or increasing	Frost, pers. comm.; SC/51/SM34; SC/51/SM38; Hill and DeMaster, 1998
3. East Bering Sea	Summer: Norton Sound and Yukon Delta Winter: Unknown (Bering Sea)	1992-95: 17,675 (9,056-34,515 95%CI)	1994-98: 130/year 0.7% of estimated pop. size	Interaction with salmon stocks, coastal activity, vessel traffic and noise	Unknown	Frost, pers. comm.; SC/51/SM33; SC/51/SM34; SC/51/SM38; Hill and DeMaster, 1998
4. East Chukchi Sea	Summer: Coastal concentrations in Kotzebue Sound, off Kasegaluk lagoon Winter: Unknown (Bering Sea)	1990: 3,700 Surveyed in 1996-98, but no pop. estimate	1994-98: 70/year 1.9% of estimated pop. size	Coastal mining, coastal activity, vessel traffic and noise	Stable (since late 1970s)	Frost, pers. comm.; SC/51/SM33; SC/51/SM38; SC/51/SM39; Hill and DeMaster, 1998
5. Beaufort Sea	Summer: North Slope of Alaska and Mackenzie Delta Winter: Bering Sea	1992: 39,257 (CV = 0.23) (survey did not cover all areas)	1990-94: 113/year in Canada 1994-98: 61/year in Alaska	Petroleum development	Stable	Frost, pers. comm.; Hill and DeMaster, 1998; Richard, 1999
6. North Water winter (North Baffin Bay)	Summer: Somerset Island Winter: Jones Sound North Water Polynya (Baffin Bay)	1996: 28,000[3]	30-60/year in Canada + possible additional in West Greenland	None documented	Stable	Richard, 1999
7. West Greenland winter	Summer: Somerset Island Winter: West Greenland	1996: 2,000[4]	Recent takes: *ca* 600/year Present takes are not available to IWC SC	Continued harvest	Reduced *ca* 60% between 1981-1994	Heide-Jørgensen and Reeves, 1996; Innes, pers.comm.
8. Cumberland Sound	Summer: Cumberland Sound (Clearwater Fjord) Winter: not confirmed (Hudson Strait, North Labrador)	1986: 485 counted IA in 1922: 5,000	35/year (under quota)	Continued harvest	Trend: unknown Depleted	Mitchell and Reeves, 1981; Richard, pers.comm.
9. Frobisher Bay	Summer: (Frobisher Bay) Winter: not confirmed (Hudson Strait, North Labrador)	No information (no concentration area documented)	5-5-/year	Continued harvest	Unknown	Richard *et al.,* 1990; Reeves, pers. comm.; Richard, pers.comm.
10. Ungava Bay	Summer: S. Ungava Bay (Muclic and Whale Rivers) Winter: Hudson Strait	IA in 1880: 1,000. Present <50	Probably <15	Small stock size, continued harvest	Close to extirpation	SC/51/SM24; Finley *et al.*,1982
11. West Hudson Bay	Summer: Churchill, Nelson and Seal Rivers Winter: Hudson Strait	1987: 25,100 (18,300-32,800)	300-400/year	None documented Hydro-electrical developments	Stable (?)	Smith, pers. comm.; Kingsley, pers. comm.; Richard *et al*., 1990; Richard, pers.comm.
12. Foxe Basin	Summer: Foxe Basin Winter: Hudson Strait	1983: 1,000[5]	Northern Foxe Basin approx. 25/year	None documented	No information	Smith, pers. comm.; Kingsley, pers. comm.; Richard, 1999; Richard, pers.comm.
13. South Hudson Bay	Summer: Northern Ontario coastline Winter: Hudson Strait	1987: 1,299 (counted)	No known harvest	None documented	No information	Smith, pers. comm.; Kingsley, pers. comm.; Richard *et al*., 1990.
14. James Bay	Summer: James Bay Winter: Hudson Strait	1993: 3,300	Little or no harvest in James Bay; Possible takes in other areas	Hydro-electrical developments	No information	SC/51/SM24; Smith, pers. comm.; Kingsley, pers. comm.

cont.

Table 11 continued.

Stock	Range	Abundance[1]	Takes[2]	Known and potential threats	Trends/status	References
15. East Hudson Bay	Summer: Nastapoca and Little Whale Rivers Winter: Hudson Strait	1993: 1,014 (includes Belchers) IA in 1850: 6,600	55/year	Estuaries frequently used for recreational activities, continued harvest, hydro-electrical developments	Depleted, not recovering	SC/51/SM24; Smith, pers. comm.; Kingsley, pers. comm.; Reeves and Mitchell, 1987
16. St Lawrence River	Summer: Central Maritime Estuary of St Lawrence River Winter: Lower estuary and gulf	1997: 1,238 (corrected) IA in 1885: 5,000	None	Marine traffic/harassment; pollution (organochlorines and heavy metals)	Depleted Increasing at 2.9 (SE 1.2)%/year Concern for health status	SC/51/SM22; SC/51/SM23; Reeves and Mitchell, 1984
17. Svalbard	Summer: Svalbard archipelago Winter: Svalbard – Barents Sea	No estimate Assumed population size few hundreds to low thousands	No directed takes Negligible incidental takes	None documented	No information. Likely depleted compared to historical level	Martin, pers. comm.
18. Franz Josef Land	Summer: Franz Josef Land Winter: Barents Sea	Few hundreds	No directed takes	None documented		SC/51/SM21; Belikov, pers. comm.
19. Ob Gulf (Kara Sea)	Summer: Ob Gulf Winter: Barents and Kara Seas	Few hundreds	No directed takes	Chemical and radioactive contaminants from riverine waters and marine dumping	Depleted compared to 1930s	SC/51/SM21; Belikov, pers. comm.
20. Yenisey Gulf (Kara Sea)	Summer: Yenisey Gulf Winter: Barents and Kara Seas	Few hundreds	No directed takes	Chemical and radioactive contaminants from riverine waters and marine dumping	Depleted compared to 1930s	SC/51/SM21; Belikov, pers. comm.
21. Onezhsky Bay (White Sea)	Summer: Onezhsky Bay Winter: White Sea[6]	Few hundreds	No directed takes	None documented	Likely depleted compared to historical levels	Belikov, pers. comm.
22. Dvinsky Bay (White Sea)	Summer: Dvinsky Bay Winter: White Sea[6]	Few hundreds	No directed takes	None documented	Likely depleted compared to historical levels	Belikov, pers. comm.
23. Mezensky Bay (White Sea)	Summer: Mezhensky Bay Winter: White Sea[6]	Few hundreds	No directed takes	None documented	Depleted	Belikov, pers. comm.
24. Southwest Laptev Sea	Summer: Southwest Laptev Sea Winter: Kara and Barents Sea	No information	No directed takes. Few incidental takes	None documented	Unknown	SC/51/SM21; Belikov, pers. comm.
25. West Chukchi Sea/Eastern East Siberian Sea	Summer: Ice edge in Chukchi/ E. East Siberian Sea. Winter: Bering Sea	No estimate, assumed few thousands	No directed takes	None documented	Unknown	SC/51/SM21; SC/50/SM4; Belikov, pers. comm.
26. Anadyr Gulf	Summer: Anadyr Lagoon and River Winter: (Cape Navarin area) Anadyr Gulf	No estimate assumed few thousands	None	Increasing marine traffic	Unknown	SM/50/SM4; Belikov, pers. comm.
27. Shelikov Bay	Summer: Shelikov Bay Winter: Okhotsk Sea	1987: 18-20,000 in the larger Okhotsk Sea. This estimate covers stocks 27, 28 and 29.		None documented	Depleted Stable?	SC/51/SM27
28. Shantar Bay	Summer: Shantar Bay Winter: Okhotsk Sea		Few occasional takes. Few live captures per year for display in dolphinarium	None documented Future petroleum development planned	Depleted Stable?	SC/51/SM27
29. Sakhalin/Amur River	Summer: Amur Lagoon and River Winter: Okhotsk Sea		Few occasional takes. Few live captures per year for display in dolphinarium	Increasing petroleum developments	Depleted Stable?	SC/51/SM27

* Indicates stocks that have annual takes but where data were not available to the sub-committee. [1] Alaska estimates are corrected for availability. (Cook Inlet is corrected for availability and sightability). [2] Takes for Alaska include hunting loss and incidental takes. [3] Abundance estimate for the entire Canadian High Arctic – probably includes both North Water and West Greenland winter stocks. [4] Estimated based on catch analysis. An estimate of 1,077 is pro-rated from Canadian High Arctic based on tagging (Innes, pers.comm.). [5] In 1988, extrapolated from a count of 685. [6]See the Editor's note in Annex I.

The Committee therefore draws attention to, and **reiterates**, its previous recommendations (IWC, 1993a) concerning the importance of genetic and telemetry studies to identifying stocks, and of improved catch reporting (including estimation of hunting loss) in Canada and Greenland.

12.3 Bycatch mitigation - acoustic devices

The need for bycatch mitigation measures has long been acknowledged in view of the large numbers of cetaceans killed incidentally in passive fishing gear, particularly gillnets, around the world (Perrin *et al.*, 1994). The most prominent and widely applied approach to reducing cetacean bycatch in gillnets is the attachment of small sound-generating devices, called pingers, to the fishing gear. The effectiveness of pingers and the difficulties associated with their use were considered at two previous international meetings (see Reeves *et al.*, 1996). The reports of those meetings were treated as benchmarks; the Committee's discussions therefore focussed on new findings and on concerns not previously noted.

12.3.1 Recent experiments

Information was presented about the most recent research on pinger use to reduce cetacean bycatch in the waters of Denmark (SC/51/SM41), Sweden (SC/51/SM20), the Celtic Shelf (Southwest UK/Ireland; SC/51/SM43), Gulf of Maine/Bay of Fundy (Eastern USA/Canada; SC/51/SM3,18), South Africa (SC/51/SM28), Australia (SC/51/SM36), New Zealand, California (SC/51/SM2) and Washington (Pacific coast USA; SC/51/SM13). Most controlled experimentation has been with a single species, the harbour porpoise, and with one type of fishing gear (bottom-set gillnets) which is known to cause high levels of porpoise bycatch in many areas throughout its range. The characteristics of experiments considered by the Committee to be rigorously designed and have sufficient statistical power to evaluate the efficacy of pingers in reducing harbour porpoise bycatch are shown in Table 12. With the exception of the Swedish experiment, in which no porpoises were captured in either pingered or control nets, all have shown substantial reductions in bycatch when pingers were properly deployed. These studies were conducted over several seasons and in three areas (Gulf of Maine/Bay of Fundy/Washington State and Denmark). The Committee agrees that the results of these experiments can be generalised to other situations where harbour porpoises are taken in bottom-set gillnet fisheries. To date, no experiments have been carried out on the use of pingers to reduce harbour porpoise bycatch in driftnet fisheries. However, the results of behavioural studies and experiments with bottom-set gillnet fisheries suggest that the use of pingers may be effective in reducing the bycatch of harbour porpoises in driftnets. The Committee **recommends** that suitable, scientifically

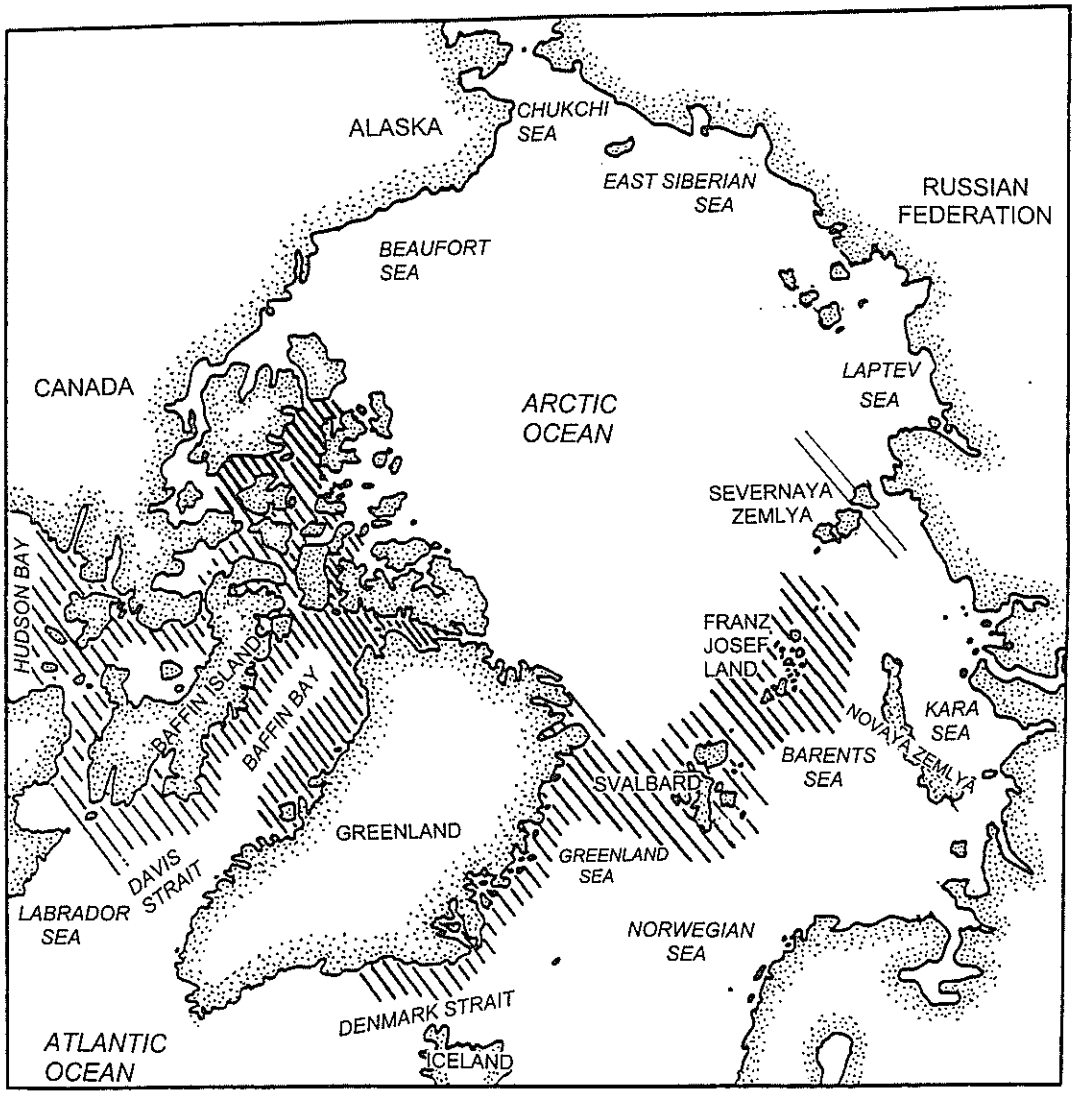

Fig. 4. Summer distribution of the narwhal (cross hatching).

Table 12
Characteristics of successful pinger experiments.

Year	Location	Type of net	Bycatch species	Power analysis	Approx. cost	Pinger type	Significant Reduction	Reference
1994	Gulf of Maine	Bottom set gillnet (cod etc.)	Harbour porpoise	Yes	$500,000	Dukane	Yes	Kraus *et al*., 1997
1997	Gulf of Maine	Bottom set gillnet (cod etc.)	Harbour porpoise	Yes	$200,000	Dukane	Yes	Kraus and Brault, 1997
1995	Washington State	Bottom set gillnet (salmon)	Harbour porpoise	Yes	$20,000	Lien	Yes	Gearin *et al.* (SC/51/SM13)
1996	Washington State	Bottom set gillnet (salmon)	Harbour porpoise	Yes	$20,000	Lien	Yes	Gearin *et al*. (SC/51/SM13)
1997	North Sea	Bottom set gillnet (cod)	Harbour porpoise	Yes	$500,000	Pice	Yes	Larsen (SC/51/SM41)
1995-6	Bay of Fundy	Bottom set gillnet (cod etc.)	Harbour porpoise	No	??	Dukane	Yes	Trippel *et al*., 1996
1997	California	Drift gillnet (shark etc.)	Several including common dolphin	Yes	??	Dukane	Yes	Barlow and Cameron (SC/51/SM2)
1997	Sweden	Bottom set gillnet (cod etc.)	Harbour porpoise	Yes	$80,000	Dukane	*	Berggren (SC/51/SM20)

* No bycatch in either pingered or control nets (Trippel *et al.*, 1996; Kraus and Brault, 1997; Kraus *et al.*, 1997).

monitored, field trials be undertaken with pingers in driftnet fisheries. However, this may not be an appropriate strategy for populations thought to be at low levels (e.g. harbour porpoises in the Baltic Sea) because of unacceptable bycatch mortality during the trials.

Currently, results are available for only one scientific experiment that used pingers on driftnets to reduce the bycatch of small cetaceans other than harbour porpoises (SC/51/SM2). The results of this study are promising, especially in relation to common dolphins. The Committee **recommends** further controlled experiments be conducted to test pingers in fisheries that experience bycatch of delphinids and other small cetaceans.

12.3.2 Implementation

The Committee was informed that pingers are already in use to reduce cetacean bycatch in many fisheries around the developed world. In most cases there was no attempt before implementation to test whether they would be successful, nor is any monitoring programme in place to investigate their effect after deployment. In only three areas, all in US waters, has pinger use become both mandatory in a commercial fishery and is being monitored.

Pingers have been an integral part of the Take Reduction Plan established in the Gulf of Maine to reduce the bycatch of harbour porpoises in the mixed groundfish sink gillnet fishery. As outlined in SC/51/SM18, pingers are now required in several areas and seasons in the Gulf of Maine where the bycatch of harbour porpoises is known to be high. The general strategy of implementation has been to combine the use of time-area closures, in which all gillnet fishing is prohibited, with surrounding times and areas where pingers are required. The total bycatch of harbour porpoises has decreased, although it is not possible to say to what extent this can be attributed to the use of pingers, or to closed fishing zones and other restrictions. This approach to bycatch reduction is accompanied by an extensive monitoring programme using observers (SC/51/SM26). The observer programme monitors approximately 5% of hauls made in this fishery each year. In addition, the US National Marine Fisheries Service is undertaking studies of the distribution of marine mammals and their prey in relation to pinger use, sound levels around gillnets equipped with pingers, pinniped depredation of fish catches in nets with pingers and the effects of pingers on catches of target fish species. Before the Take Reduction Plan was implemented, several smaller-scale experimental fisheries were conducted during 1995-1998, where all bottom-set gillnets used in specific areas were required to use pingers. These experiments were not scientifically designed, however, and no control nets were used. SC/51/SM18 reported that during March and April 1996-97 the bycatch rate of strings with pingers was approximately 50% lower than the bycatch rate of strings without pingers which were set in the same general vicinity. In the same area, during September to December 1994-97, the bycatch rate of pingered strings was an average of 84% less than strings without pingers. The authors of SC/51/SM18 interpreted this to indicate that pingers are effective in reducing bycatch.

As a result of a successful experimental test of pingers in the California driftnet fishery for sharks and swordfish, pinger use has been mandatory in this fishery since November 1997 (SC/51/SM2). Regulations specify the number and type of pingers that are required. However, compliance with regulations has not been complete, even when observers were present on board. This is a highly dispersed fishery operating several hundred kilometers offshore, and as a consequence it is very difficult to inspect or monitor at sea. Penalties for non-compliance are currently being addressed, but there is currently no formal enforcement.

Pinger use was also implemented in the northern Washington marine set-net fishery in 1998 as part of a tribal fishery regulation. Monitoring of this fishery will continue.

When acoustic alarms are being considered to reduce the bycatch of a small cetacean species in a fishery, the Committee **recommends** the following approach:

(1) controlled scientific experiments be conducted to demonstrate whether the devices significantly reduce bycatch;
(2) field trials be conducted to address practical operational issues and acoustic properties with respect to ambient noise and spacing of pingers; and
(3) when the devices are used routinely, a scientific monitoring programme be implemented, preferably using independent observers at sea.

The monitoring programme should evaluate pinger function and note the location of bycatch in relation to functional and malfunctioning pingers. The Committee recalled the Recommendation of the 1990 Workshop on Gillnets and Cetaceans, that fishermen are involved directly in the process of developing and implementing bycatch mitigation measures (IWC, 1994c).

The Committee is concerned that there are a significant number of places around the world where pingers were being deployed without any apparent attempt either to test their efficacy beforehand or to monitor their effects afterwards. Given the poor information on the subject, the Committee **recommends** that a survey of pinger use around the world should be conducted.

12.3.3 General issues concerning acoustic alarms

12.3.3.1 WHY ARE PINGERS EFFECTIVE?

The Committee reviewed the results of recent work to address the question of how pingers reduce the bycatch of harbour porpoises and common dolphins in gillnet fisheries. Kraus *et al.* (1997) noted several alternative hypotheses that could explain the reduction in bycatch associated with pinger use: (1) pingers produce a sound that is aversive to small cetaceans; (2) pingers produce a sound that alerts small cetaceans to the presence of a net; and (3) pingers produce a sound that the prey of small cetaceans find aversive. The Committee addressed these hypotheses in turn.

SC/51/SM48 described an experiment in which harbour porpoise movements were tracked with a theodolite around a single moored Dukane pinger in the Bay of Fundy. The point of closest approach was measured both before and after the pinger had been activated. The point of closest approach to the pinger was significantly greater (about 150m) when the pinger was active compared to when it was not, suggesting that the animals had been displaced by the pinger. This displacement decreased by 50% over five days, suggesting that habituation may have taken place. The Committee agreed that this experiment lent support to the notion that pingers are aversive to harbour porpoises, i.e. they do not simply alert the animal to the presence of a net or other obstacle, but that they actively discourage them.

Observational studies of harbour porpoises in Washington State (SC/51/SM13) also suggest that the aversion hypothesis is more likely than the alerting hypothesis. Harbour porpoises in these studies were displaced from nets a minimum distance of about 125m and generally avoided the areas immediately around active pingers (Laake *et al.*, 1998).

In considering the results of such experiments it was noted that surfacing positions do not necessarily equate to the position of the closest approach to the net underwater.

The Committee then considered the possibility that harbour porpoises might simply be alerted to the presence of the net by pingers. Three studies have now shown that harbour porpoises move away from active pingers; one study has also demonstrated that porpoises respond to pingers by reducing their echolocating click rates. The results of these studies do not support the alerting hypothesis. However, SC/51/SM28 suggested that pingers were not aversive to Indo-pacific humpbacked dolphins and that, instead, they might alert the dolphins to the presence of the nets. Humpback whales also seemed to be alerted to the presence of nets by acoustic warning devices deployed in Newfoundland (Lien *et al.*, 1992). Habituation to an aversive noise might also lead to a longer-term alerting function. On balance, the Committee considered that the existing evidence did not support the alerting hypothesis for harbour porpoises, at least in the short term, but that other species may differ in this regard.

Several approaches were used to test the hypothesis that pingers reduce the bycatch of harbour porpoises by displacing their prey away from gillnets in SC/51/SM14. None of these tests showed any indication that Pacific herring were displaced away from pingers, with the exception of an initial startle response in the observational study. The Committee concluded that the reduction of the bycatch of harbour porpoises attributed to pingers in Washington State salmon nets was not due to an indirect effect mediated through their prey.

The Committee considered several other alternative hypotheses, including 'jamming' (where echoes from the animal's sonar are effectively masked by the pinger noise), passive imaging (where the pinger might 'illuminate' the net sonically) and learning (where animals learn to associate pingers with a net). There is currently no evidence to support any of these hypotheses. It was concluded that for harbour porpoises, in the short term at least, the most plausible hypothesis was that pingers work by aversion. Insufficient evidence was available to allow any conclusion for species other than harbour porpoises.

The harbour porpoise and the short-beaked common dolphin are the only cetacean species for which properly designed studies with sufficient statistical power have been conducted to evaluate pinger effectiveness. In all cases, significant reductions in bycatch have been achieved through the use of pingers. Nevertheless, some bycatch has occurred in nets with active pingers during experiments, sea trials and fishery implementation. Thus, pingers are not 100% effective in eliminating the bycatch of these two species. It is important to consider why pingers do not always work as expected, and may even increase the bycatch if they malfunction (e.g. see SC/51/SM43). The Committee recognised the value of collecting data from observer programmes that would contribute to understanding why pingers are, or are not, effective. Very large amounts of data are potentially available from fisheries in comparison with experiments. For example, it would be useful to know where animals are caught in the net, the environmental conditions when bycatch occurs, failure rates of pingers etc. The Committee **recommends** that observer programmes should collect data on where cetaceans are caught in nets (both in general and in relation to pingers), associated environmental information, pinger failure rates, etc.

12.3.3.2 HABITUATION

Habituation by small cetaceans could reduce the effectiveness of pingers over time. The experiment conducted in the Bay of Fundy in 1998 (SC/51/SM48) showed that harbour porpoises habituate to pingers in a fixed position. Initially, the animals were displaced to a distance of about 150m from the pinger, but this response began to wane almost immediately. This does not necessarily translate into a loss of pinger effectiveness in reducing bycatch. Although the Bay of Fundy experiment suggests a degree of habituation, this does not imply that the aversive affect was nullified, simply that it was reduced. The implications of this habituation for potential bycatch rates are unclear.

The increased bycatch rate of harbour porpoises in the Washington State salmon set gillnet fishery during 1997 also suggests that harbour porpoises habituated to the presence of alarms over the course of the summer (SC/51/SM13). The Committee **agrees** that monitoring programmes are essential to detect the potential for habituation once pingers are implemented in gillnet fisheries.

12.3.4 Other

The Committee agrees that pingers may not be an appropriate solution to the problem of bycatch in all circumstances, e.g. where the cost of pingers is high relative to the economic return to fishermen (Perrin *et al.*, 1994; SC/51/SM31). In such fisheries, there is little hope of enforcing the use of pingers should they be required. Instead, community based management approaches employing alternative mitigation techniques, such as the use of marine protected areas, are more likely to be effective. Unfortunately, in most areas, biological assessments of small cetacean populations have not yet been conducted, precluding the development of any such conservation strategy. Okamoto reminded the Committee that the bycatch

of small cetaceans is not an undesirable feature of fisheries in areas of the world where these animals are used for human consumption.

The Committee discussed a number of practical features that should be incorporated into current and future pinger design. Pingers should: (a) be quieter; (b) have a longer battery life; (c) possibly be incorporated into the headrope or have improved mechanisms for attachment; (d) have an acoustic or visual mechanism for testing functionality; (e) have a guaranteed life span for enforcement and replacement; (f) stand up to operational rigours; and (g) be cheaper.

The Committee **recommends** that future research and development emphasises these aspects.

12.3.5 Use with vaquita

The Committee endorses the recommendation made by the International Committee for the Recovery of the Vaquita (CIRVA) that pingers should not be used to reduce the bycatch of vaquitas in gillnet fisheries in the Upper Gulf of California. CIRVA noted that pingers were not an effective solution to the bycatch of vaquitas because: (a) pingers will not reduce the bycatch to zero; (b) it would be extremely difficult to convince fishermen to use pingers and to ensure that the devices were kept in working order; (c) the need for experimental verification would result in the mortality of some vaquitas; (d) the cost of an experiment would be prohibitive given the low bycatch rate; and (e) that other more effective alternatives exist to conserve this highly endangered species. Two workshops (Reeves *et al.*, 1996) have reached similar conclusions.

12.3.6 Further research

The Committee noted with great concern that, for most of the world's fisheries, there is still no information available on cetacean bycatch, and that this precludes any attempt at mitigation in circumstances where it might otherwise be appropriate and possible. As in previous years, the Committee **recommends** that information on cetacean bycatch be collected from all marine fisheries, preferably using independent observers at sea.

The Committee **recommends** research on potential problems with widespread pinger use, including displacement of small cetaceans from important habitats, habituation, depredation of fish caught and effects on other species.

The Committee noted that pingers are only one of several potential tools to mitigate bycatch and **recommends** that research should be conducted to identify any other measures that could be effective.

12.4 Review of progress of the IWC/ASCOBANS Joint Harbour Porpoise Working Group

At last year's meeting the Committee established a joint working group with ASCOBANS to provide scientific assistance to its Advisory Committee on issues relating to the assessment of the status of harbour porpoises in the North Sea and adjacent waters. This assistance was to include: generating plausible hypotheses regarding population structure; providing information on life history parameters, abundance and trends in abundance; identifying methodology to estimate bycatch levels; identifying demographic models to assess the status of populations in the North Sea and adjacent waters. The report of that Working Group is given as Annex O. The Committee commended the Working Group for the successful outcome to its work, and endorsed its report.

12.5 Review of progress of the vaquita recovery programme

The Committee was informed of the results of the second meeting of CIRVA by its chairman, Rojas-Bracho. The mandate of this group was to develop a recovery plan based on the best available scientific information, taking into account the socio-economic impacts of any necessary regulations. At its second meeting the group reviewed the results of work carried out in response to the recommendations of the first meeting in 1997. The most important activity was a sightings survey carried out in summer 1997 using three research vessels and covering the entire potential area of vaquita distribution. The survey resulted in an estimate of 567 (CV = 0.51, 95% CI 177-1,073) animals.

CIRVA concluded that the vaquita is critically endangered, and that bycatch was the most immediate and direct threat to the survival of the species. To prevent extinction, bycatch of vaquitas must be reduced to zero as rapidly as possible. Complete protection will need to continue for at least 20-30 years. It was recognised that protective measures would have significant economic and social impacts on residents of the upper Gulf and that it was not possible to implement full protection immediately. CIRVA therefore recommended that gillnet fishing in the area inhabited by vaquitas be removed in three stages, starting with large-mesh gillnets. CIRVA noted that protective measures taken on behalf of the vaquita would also improve the health of the upper Gulf ecosystem and thus increase economic opportunities for residents in the long term. CIRVA called upon the international community and non-governmental organisations to join the government of Mexico in this conservation initiative. CIRVA hopes that they will provide technical and financial assistance to implement the conservation measures described in the recovery plan and to support the continued conservation activities of the Biosphere Reserve. The Committee supported this request for help from the international community and, noting it's earlier recommendations and IWC Resolution 1994-3, **strongly recommends** that the Commission calls upon member nations to respond in a prompt and generous manner.

The Committee welcomes the CIRVA report and commends the government of Mexico for the process they have followed to develop a recovery strategy for the vaquita. The vaquita is endemic to the Gulf of California, Mexico, but CIRVA includes scientists from several countries. The recommendations of CIRVA are based on sound science after frank and open discussions. The Committee endorsed the Recovery Plan and urges the Commission to encourage the government of Mexico to implement it urgently. It looks forward to receiving an update on the implementation at its next meeting.

12.6 Review of other presented information on small cetaceans

SC/51/SM42 presented the interim results of an ongoing bycatch monitoring scheme in which independent observers have been monitoring gillnet vessel catches in the North Sea and to the West of Scotland. Between 1995 and 1998, forty-one harbour porpoises and no other cetaceans had been recorded entangled. The authors estimated total harbour porpoise bycatch estimates for the appropriate North Sea fisheries, ranging from 768 (95% CI 619-1,392) to 582 (95% CI 483-1,027) for 1995-1997, and 165 (95% CI 82-365) to 209 (95% CI 95-475) for the same years for the Scottish west

coast. The Committee welcomes this study and **recommends** that the pelagic sector and the freezer-netter fleet should receive increased attention in this regard and that estimates of bycatch in the turbot fishery should also be refined.

The population structure of harbour porpoises in the Barents Sea and northern North Sea was investigated using mitochondrial DNA analysis in SC/51/SM7. Three putative sub-populations had been proposed, in the Barents Sea and Norwegian waters north of 67°N, Norwegian waters south of 66°N and northern UK waters. One haplotype was common in all areas, and there was no difference in molecular variance among males in the areas. Haplotype frequencies among females showed significant differences when UK animals were compared to Barents Sea animals, and also when UK animals, excluding those from Shetland, were compared to southern Norwegian animals. These results confirm those of previous studies suggesting greater philopatry among female harbour porpoises than among males.

SC/51/SM35 reported on a survey of small cetaceans in Ghana. Six cetacean species had been recorded in the region, and surveys of four ports suggested that cetacean bycatches were widespread and frequent, with a local market for cetacean meat, at least some of which is smoked and sold on the bone. Ghanaian fisheries are extensive, with 306 landing sites and over 97,000 fishermen working just 550km of coastline. It was clear that some intentional catches of small cetaceans were occurring in driftnet fisheries in at least two sites, and it seemed that these intentional catches may have developed from pre-existing bycatches in a targeted shark or tuna fishery. None of the catches was documented and there are currently no controls or quota restrictions on the taking of small cetaceans in the region generally. The Committee expressed its concern over the apparent development of a directed fishery for small cetaceans from a pre-existing bycatch without any accompanying controls on the level of take or assessment of the stock. This phenomenon, which had previously been reported in both Peru and the Philippines, clearly presents a risk of over-exploitation in the absence of any controls on the level of exploitation, and the Committee **recommends** that such takes be monitored and their impacts on the stocks assessed.

Recent information on the directed take of Dall's porpoise in Japan was presented in SC/51/SM46. Historically, catch levels had been below 10,000 per annum until the early 1980s, when they increased to a peak of more than 40,000 in 1988. Subsequently, catches fell to around 11,000 in 1992, and thereafter rose towards the quota of 17,700 that was established in 1991 on the basis of an abundance estimate. This quota remains in place to the present time. The most recent abundance estimates came from surveys in 1989/1990, which estimated a central Okhotsk Sea *truei*-stock of 217,000 (CV 0.23) and a stock of *dalli*-type porpoises in the Southern Okhotsk Sea numbering 226,000 (CV 0.15), but no corrections had been made for possible survey bias. The author also provided some data on the age and sex composition of the catch. The proportion of mature and lactating females appears to have increased in recent years. This high proportion was interpreted by the author, supported by Brownell, as a change in hunting strategy in the Sea of Japan whereby some vessels catch porpoises through the extended chase of mother-calf pairs because of a decreased occurrence of porpoises coming to the bow.

The Committee **recommends** that existing biological samples from this fishery are worked up in accordance with the recommendations made in 1991 (IWC, 1992b, p.213).

The Committee recognised that there is a lack of current data on the bycatch of this species. Fisheries of potential concern for these stocks include the Japanese driftnet fishery that operates inside the Exclusive Economic Zone (EEZ) of Russia in the Okhotsk Sea. The Committee learned that Russian observers are present on Japanese driftnetters working in Russian waters and **recommends** that data on porpoise bycatch should be provided from this observer programme.

The Committee reiterated its previously expressed concern for these stocks. The estimate of approx. 440,000 animals has not been revised since 1991, and population surveys planned for 1998 were not completed. Further survey work is planned for 1999.

Considering the question of population structure, the Committee was informed that recent genetic analyses had yielded results consistent with its earlier conclusions for this species. The Committee welcomed this information and **recommends** that further genetic analysis should be undertaken.

The Committee has offered advice on Dall's porpoise to the Government of Japan in the past, and such advice has led to very positive responses from the Government of Japan. The Committee looks forward to continuing this productive process.

The Committee **agrees** that the issue of Dall's porpoises should be reviewed in the near future (see Item 12.8).

12.7 Takes of small cetaceans in 1998

The Committee noted that the table of recent small cetacean catches (Annex I, Appendix 2) is incomplete. In particular, it does not contain information about known or presumed high levels of bycatch in many parts of the world. The Committee therefore reiterates its **recommendation** of previous years that member nations should submit full and complete information about all direct and indirect takes in their progress reports. Without such information the Committee is unable to carry out its work in assessing the conservation status of small cetacean populations and identifying areas of particular concern in this regard.

12.8 Work plan

The Committee reviewed its proposed schedule of priority topics (IWC, 1999i, p.218) in light of the unacceptably high workload it had undertaken at these 1999 meetings. It **agrees** that the list of topics previously identified should remain unchanged, and **recommends** that the second 'bycatch mitigation measures' topic should be addressed in a separate two-day meeting, preferably immediately before the Scientific Committee's meeting in the year 2000 (Table 13). This meeting should, however, be considered part of the normal Scientific Committee meeting. It also **agrees** that the status of freshwater cetaceans topic scheduled for 2000 should be expanded to embrace coastal marine populations of tucuxi, Irrawaddy dolphin and finless porpoise. The species to be considered are boto, baiji, Indus and Ganges susus, tucuxi, Irrawaddy dolphin and finless porpoise. No new priority topics were added to the list for consideration in the years 2001 and later.

13. WHALEWATCHING

At last year's meeting the Committee reaffirmed the four priority areas it had identified for future work at its 1996 meeting (IWC, 1997f) and also agreed that a further item on assessment of long-term effects be included as a future priority.

Table 13
Small cetaceans work plan.

Year	Topic	Justification
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

The Committee had recommended the formation of an intersessional Correspondence Group to review (especially in the context of focusing its work) the four priority areas first agreed in 1996:

(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.

The Committee had identified a number of priority areas for further work. These areas formed the basis of the agenda for this year's meeting and included:

(1) 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;
(2) an assessment of current studies of the effects of different approach distances and platforms;
(3) a review of the quantitative methods used to assess the short-term reactions of cetaceans and the basis for judgements of adverse effects;
(4) comparative studies on different approaches/distances and other controls which may be required on areas important for feeding, resting, and reproduction.

The Committee believed that the concept of dolphin feeding did not concur with the principal that cetaceans should 'be allowed to control the nature and duration of interactions', and **agrees** to keep this item on its agenda.

Finally, the Committee noted that the 1996 document 'A review of whalewatching guidelines and regulations around the world' (Carlson, 1996) was an ongoing matter that would be revised to include new developments and implementation of new guidelines and made available to the Committee for review.

One member of the Japanese delegation noted that it was the view of his government that issues dealing with whalewatching were outside the competence of the IWC. However, the Japanese government can support the Resolution adopted by the IWC establishing the standing Sub-Committee on Whalewatching (IWC, 1997a) and will provide such scientific advice as may be warranted to Contracting Governments.

13.1 Commission's comments from last year

In 1998, the Commission had agreed that the general principals for whalewatching should apply to all whalewatching activities (IWC, 1999a).

The Commission had also agreed to:

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

13.2 Review of the guidelines

13.2.1 Report of the intersessional correspondence group

The intersessional group was convened to examine priority items (1)-(4) identified above.

The effects of whalewatching vessels on research activities were also discussed. The Committee noted that whalewatching activities could hinder or assist research activities depending on the nature of the research. The Committee has agreed that a list of references of ongoing or completed research activities that would help to further discussions on whales and vessel impacts should be compiled and a preliminary listing was initiated.

The Committee focused on information necessary to assess long-term effects of whalewatching on the status of the affected whale stocks. It proposes that a workshop be convened immediately before the 2000 meeting of the Committee to expedite the collection, exchange and synthesis of information necessary to assess long-term effects of whalewatching on cetaceans. This is discussed further under Item 13.7.

13.2.2 Others

SC/51/WW4 examined the expanding scale of whalewatching in the Caribbean. SC/51/WW7 described the current state of whalewatching for dolphins and sperm whales in the Azores and new biological findings relevant to its future development and management. The Committee noted that the existing extent and potential growth of whalewatching in the Caribbean underscored the importance of monitoring the potential effects of whalewatching in the region. The regulation of whalewatching in the Azores included research and monitoring of the potential effects, but researchers are required to 'give precedence to commercial operators...'. The Committee **agrees** that, in the context of conducting research aimed at evaluating the potential effects of whalewatching on whales, scientific research should be given high priority. The Committee understood that fees collected from the industry were intended to support the cost of management and monitoring. Future research and monitoring will probably be conducted by local university scientists to avoid a conflict of interest. The existing Azorean dataset can serve as a baseline for future studies involving the whalewatching industry.

13.3 Assessment of short-term reactions

SC/51/WW2 presented the results of surveys on the reactions of humpback whales to whalewatching boats in the Bonin (Ogasawara) Islands, Japan. Whalewatching guidelines were developed and agreed to by members of the Ogasawara Whalewatching Association, and that these were followed by all whalewatching operators on a voluntary

basis. Surveys to assess the reactions of humpback whales to whalewatching were conducted in 1996 and 1997 by a combination of a land-based sightings survey and an acoustic survey designed to characterise vessel noise. The Committee noted that an *a priori* assumption in the paper, that a particular behaviour was associated with disturbance, was difficult to justify and that a more powerful comparison would be between the behaviour of individual whales in the presence and absence of whalewatching vessels.

SC/51/WW3 described an unusual event where two bottlenose whales (*Hyperoodon ampullatus*) which are usually observed in deep water entered a shallow bay in Scotland in the summer of 1998 and remained in the bay for over a month. The paper described the whales' behaviour from three days of land-based observations. The presence of the whales in the small bay provoked considerable public interest and, at the time, there were no official guidelines for the regulation of the public approaching the whales and there was concern that overwhelming interest in this unique event could seriously disturb the animals. SC/51/WW3 also made recommendations for monitoring such situations and, in particular, believed that continuous acoustic recording might aid in the interpretation of whales' behaviour. The Committee noted that unique events like this often attract public and media attention, and that mitigating the potential disturbance to these whales can be difficult even with regulations or guidelines for whalewatching in force.

SC/51/WW8 described South African right whales that are being exposed to increasing levels of vessel traffic, with the long- or short-term consequences being unknown. Behaviour of groups of southern right whales was monitored from shore based platforms before, during and following controlled approaches by vessels and by vessels attempting to obtain biopsy samples. The results suggest that they can be approached by vessels with little or no change in their short-term behaviour; however, the long-term consequences of such exposure remain unknown.

SC/51/WW11 addressed the increased risk to whales due to high-speed whalewatching vessels, noting that there has been a recent dramatic increase in such vessels (capable of cruising $\geq$25kts) in the New England area of the USA. The Committee noted that the use of high speed vessels in areas populated by whales needs to be examined due to the increased risk of collision associated with increased speed (e.g. owing to the search and reaction time of vessel operators being reduced). The use of acoustic devices to warn whales to the presence of approaching vessels does not appear promising (see Annex J). The Committee discussed methods of allowing a more quantitative assessment of collision risk. Although this concern was raised in the context of whalewatching vessels, it is clearly applicable to all vessels travelling at high speed. The Committee **concluded** that vessels travelling at high speeds pose an increased risk of collisions with whales, and **recommends** that authorities discourage the operation of vessels at high speed in areas where whales occur and, where possible, vessel operators should post observers on vessels when transiting through such areas.

The Committee discussed several aspects of the interactions between whalewatching and scientific research. Whalewatching activities can in some instances prevent research from being conducted or confound results. For example, (1) the noise produced by whalewatching vessels will confound acoustic research on whale vocalisations, or (2) the public sensitivity to invasive research methods, such as biopsy collection, may prevent such samples from being collected. The Committee agreed that researchers' efforts to inform the public about the importance of the research and its objectives could improve the public's view of scientific research. In this regard, researchers need to be aware of the restrictive effects research activities can have on limiting whalewatching activities, such as limiting the number of vessels allowed to be around whales. The Committee recognises that in some cases whalewatching provides the only means for researchers to gain access to whales for the purpose of obtaining information that they otherwise would be unable to obtain. The Committee agreed that, depending upon the circumstances, whalewatching could aid or hinder scientific research.

13.4 Assessment of long-term reactions

SC/51/WW1 explored the questions of whether whalewatching activities could provide useful information towards assessing the long-term status of whales and, if so, the best methodology and most appropriate data to use. The author noted that while organised whalewatching constituted searching effort for whales similar to a dedicated scientific survey, that effort was not based on any statistical sampling design. Similarly, although whalewatching vessels can serve as observation platforms, there must be a specified mechanism for collecting this information which can then be passed to a dedicated research organisation or scientific group for archiving, analysis and interpretation.

The author suggested that data most useful for assessing the long-term status of whales should include:

(1) some measure of whalewatching effort;
(2) seasonal presence or absence of whales within the whalewatching area;
(3) changes in the use of specific habitats by the whales (subset of 2);
(4) reproductive success of known individuals (e.g. number and frequency of calves produced);
(5) evidence of physical injury or illness.

The author concluded that examples of successful contributions from whalewatching activities to the long-term assessment of whale status were those that were linked to dedicated independent scientific investigations.

SC/51/WW1 described a data gathering system that was similar to scientific sampling carried out in many commercial fishing operations, where it is mandatory that certain information on catch and fishing effort is collected and recorded in logbooks. Thus, the data recorders are aware of the importance of the data because they are used to manage the fishery. The Committee recognises that data collected solely by industry interests may be unreliable, and cannot be confidently used to assess the status of stocks.

The Committee discussed several aspects of contributions from whalewatching to the long-term assessment of whales. It noted that, while there may exist concerns about short-term effects to whales from whalewatching, often those were not matched by concerns for long-term changes in the whales' utilisation of the areas where they were exposed to whalewatching activities. The Committee noted that whales exposed to whalewatching may represent only some unknown portion of a stock, and that drawing inferences about long-term effects on the entire stock from information on only a portion of a stock could be biased. In contrast, the Committee agreed that in instances where annual reproduction occurred in a specific location (e.g. a particular portion of coastline or bay), any detrimental effects from exposure to whalewatching in those areas could affect an entire year's production and ultimately the status of the stock.

The Committee discussed the issue of the reliability of information from non-scientific observers and agreed that data collectors should be trained scientists or naturalists. Research objectives need to be clearly defined beforehand so that relevant data are collected. In this regard, the Committee noted the research programme described in SC/51/WW2 where a well organised whalewatching organisation was established and was responsible for conducting research on the effects of whalewatching, thus assuring that the information required to evaluate the effects of whalewatching would be collected by professional researchers. The Committee also cautioned that encouraging whalewatching operators to obtain information, such as photographs, could encourage them to get as close as possible to the whales. This could increase disturbance to the whales and possibly cause the operators to violate regulations governing minimum approach distances.

The Committee also recognised that successful 'citizen science' model programmes exist that involve private citizens and provide them with opportunities to make contributions to scientific investigations, and that some aspects of these programmes could serve as useful examples for whalewatching programmes.

The Committee discussed the scale of population changes that would need to be considered to assess the status of whale stocks. It noted for example that the limited scope of whalewatching activities could not be expected to detect population effects attributable to global warming, but could be useful in describing reactions to vessel disturbance in the short- and long-term, and could augment dedicated research programmes by providing ancillary information.

The Committee discussed various experimental designs that could be used to assess long-term effects of whalewatching on whales (see Annex J). It recognised that there are a number of models for the design of such experiments, and that the appropriate design would depend upon the specific situation to be investigated and its objectives. The Committee agrees that this topic requires further discussion and **invites** members to submit examples of research and monitoring programmes that utilise various experimental designs (e.g. with and without controls) and other research approaches to the convenors of the proposed workshop to assess long-term effects.

The Committee **agrees** that whalewatching programmes have a limited capability to provide information to assess the long-term status of whales. However, to varying degrees they have the potential to contribute valuable information to dedicated scientific research programmes aimed at this. It **agrees** that: (1) whalewatching programmes should include a scientific monitoring programme to gather information on the potential effects of whalewatching on whales; (2) such programmes should be conducted by qualified scientists; (3) such scientific monitoring programmes should be impartial; and (4) management authorities need to utilise the information generated by monitoring programmes to review, evaluate and, as appropriate, modify the regulations governing the whalewatching operations to avoid long-term irreversible effects.

The Committee therefore **recommends**:

(1) wherever practical and appropriate, the assessment of the potential effects of whalewatching operations on cetaceans should be undertaken and overseen by independent scientists;
(2) whalewatching interests (i.e. members of the industry and national licensing authorities) need to be sensitive to the need to effectively monitor cetacean populations that are the focus of whalewatching activities to ensure that whalewatching activities are sustainable and not otherwise detrimental to the cetaceans concerned;
(3) national licensing authorities or other regulatory bodies should:
    (i) ensure that investigations into the effects of the industry on cetaceans and other scientific studies are accommodated along with the interests of the industry; and,
    (ii) encourage industry to recognise the value of scientific research for its own benefit and for wildlife conservation in general.
(4) in instances where there are no national licensing authorities or regulatory bodies, the whalewatching industry should conduct the activities listed under (1) and (2) as part of their operations.

13.5 Comparative studies

SC/51/WW10 described a method for tracking whales and measuring distances between whales and vessels using a combined video and compass binocular system. This system can provide accurate data on the position of whales and vessels from a moving vessel at sea similar to that obtained by land based theodolite tracking studies. The Committee noted that the accuracy of these measurements could be improved considerably by using a higher observer platform and differential GPS system. The Committee welcomes the application of this technology for behavioural research as it provides a cost-effective means to accurately measure the distance between whales and vessels. Such a system could also potentially aid with enforcement of whalewatching regulations.

13.6 Dolphin feeding programmes

The Committee received no new information on dolphin feeding programmes. It **reiterates** its view that the concept of dolphin feeding does not concur with the principle that cetaceans should 'be allowed to control the nature and duration of interactions', and **agrees** to keep this item on its agenda. It requests member governments to provide new information next year.

13.7 Work plan

The Committee believed that the Whalewatching Workshop proposed for next year's meeting would expedite the collection, exchange and synthesis of information necessary to assess long-term effects of whalewatching on cetaceans, and **recommends** that this workshop be convened immediately before the 2000 meeting of the Scientific Committee. It may also allow Committee members to participate who otherwise would not be able to attend these discussions during the regular Scientific Committee meeting. The Committee **agrees** that the workshop should begin three days before the 2000 Scientific Committee meeting: two days for presentation and discussion of the issues, and one day to produce a report. Approximately £8,000 is required for invited participants. The Terms of Reference for this workshop are:

(1) the identification and presentation of case studies of established whalewatching programmes and accompanying research programmes to monitor the potential effects of whalewatching on whales (e.g. history of the whalewatching programme, trends in whalewatching effort, cetacean species observed, experimental design utilised to monitor these programmes including data collection techniques and analyses);

(2) the development of a list of population parameters that can be monitored in conjunction with whalewatching programmes and used to assess the long term status of whale stocks. Such parameters might include: seasonal abundance and density in whalewatching areas; habitat use patterns; measures of fecundity or calving rates of individuals; and evidence of physical injury, etc.

The Committee established an Intersessional Steering Group (see Annex U(21)) to develop the agenda and to plan this workshop. A statistician should be included on the planning group to advise on the development of a list of suitable population parameters to be monitored.

One member of the Japanese delegation registered his reservation on holding the workshop since issues of whalewatching are outside the competence of the IWC. He believes that the limited budget should be primarily used for the original objectives of the IWC.

The Committee accepted the workplan for next year's meeting which includes, in priority order:

(1) review the findings of the Workshop on Assessing the Long-term Effects of Whalewatching on Whales;
(2) review the updated report on National Whalewatching Guidelines;
(3) review new information on dolphin feeding programmes;
(4) review 'swim with' programmess that involve whales and dolphins;

Other matters, including ongoing research programmes and new methods to assess the effects of whalewatching on whales, will be considered as a matter of course.

13.8 Other matters

The Committee was informed that the UK Foreign and Commonwealth Office (FCO), through the Department of Environment, Science and Energy in London, had written to the British Overseas Territories in the Caribbean on the possibility of hosting a workshop on whalewatching in the Caribbean in one of the territories next year. Fulford reported that Turks and Caicos had offered to host this meeting and that there are no financial implications for the IWC.

The Committee welcomed this information, encouraged the proposed workshop on whalewatching in the Caribbean to go forward and looks forward to the workshop report.

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. It had last been discussed in 1996 (IWC, 1997c, p.93). In the absence of any documentation it was again not discussed.

14.2 Review of results from existing permits

14.2.1 Japan–Southern Hemisphere

In 1998, the Committee had undertaken a detailed review of the JARPA programme and had identified a number of areas for future work (IWC, 1998c, p.103, table 2). Progress on that work is given in SC/51/CAWS13 and discussed in Annex G (under item 4.1). This included: (1) developing methods to correct bias in abundance estimates; (2) stock definition; (3) statistical analysis of mtDNA; (4) a pilot study on nuclear DNA; (5) availability of low-latitude genetic material; (6) analysis of morphometrics; (7) examination of stock boundaries between Areas IV and V; (8) a segregation study; (9) recalculations of biological parameters by biological stock; (10) a mesoscale survey plan for ecosystem and environmental change. In addition, the Committee had discussed the question of sampling bias and the problem of representativeness of samples. Most progress had been made on items 2-5 and 7, all of which relate to the stock identity issue, although work on the other tasks progressed.

A number of documents relating to the JARPA programme were presented to the meeting (SC/51/CAWS9-13, 18, 20, 21, 30, SC/51/E4, E5 and SC/51/O6) and these are discussed in Annexes G and H.

The research activities of the 1998/99 JARPA cruise had to be modified due to a fire on board the research mother ship *Nisshin Maru* on 19 November 1998 during transit to the Antarctic (SC/51/CAWS19). The vessel returned to Japan on 20 December 1998, and departed again on 5 January 1999 for the Antarctic; this resulted in a seven week delay to the original schedule.

Due to the delay, it was decided to change the timing of research in Area VI West to after that in Area V and that the work in Area V, originally planned to last for 10 weeks (7 January to 15 March), should be the focus of the survey. However, the revised research plan had to start two weeks later than planned resulting in further adjustment to the programme by reducing survey time in the Northern strata from four weeks to two weeks. In total, seven weeks were allocated to Area V. It was also decided that the research period should be extended until the end of March if weather and other conditions permitted, and this turned out to be the case. Additional sighting effort was made in the Northern strata using two other research vessels.

SC/51/CAWS10 summarised the programme. Research in Area V began on 13 January 1999. Due to the late melting of the Ross Sea ice cover, the central and southern Ross Sea could not be surveyed. Newly developed pack-ice meant that in Area VI the survey was carried out between the ice-edge and 45 n.miles north of the ice-edge. Research finished in Area VI on 31 March 1999.

The sighting vessel covered almost 3,200 n.miles and made 540 primary sightings of minke whale schools (1,670 animals). Minke whales predominated throughout the research period. Compared to previous cruises in this region, more minke whales and less fin, sperm and southern bottlenose whales were seen.

Following the sampling protocol, 435 animals were targeted for sampling of which 389 (247 males, 142 females) were collected. Mature males predominated throughout the research area. Apart from in the western stratum of Area V, small numbers of pregnant females were found. No mature females were found in the western part of Area VI. Natural marking photographs were taken for seven schools of blue whales and 24 schools of humpback whales. Biopsy samples were collected from 2 blue, 30 humpback and 3 fin whales.

In response to questions about the likely influence of the change from the original plan on the results, for example in the proportions of males to females and the various reproductive classes, Fujise replied that he is considering two hypotheses. One concerns the lower sampling coverage due to the wider distribution of the pack-ice in that season; mature females are found inside of pack-ice, but the vessels cannot survey there and hence mature females were not sampled. It is not clear whether the change in the pack-ice distribution reflected normal annual variability or long term environmental change. Ensor noted that this pattern concurs with the propagation of the Antarctic circumpolar wave. The other hypothesis is that there was a change in the migration

pattern of females; this had also been observed in Area IV in 1997/98 (SC/51/CAWS18). Satellite information revealed that the timing of pack-ice melting in the Ross Sea region (early March) was four weeks later than in normal years. However, the Ross Sea was closed again at a time similar to or even slightly earlier than in normal years (mid-late March). At present it is not possible to distinguish between these hypotheses but work is continuing.

Smith encouraged continued comparison of the data from this year with earlier years, noting the importance of the difference between normal annual variation versus changing trend for interpreting, for example, VPA analyses (see discussion under Item 10.1).

Commenting on the lack of success of the satellite tagging experiment, the Committee suggested that the organisers consult with a number of US researchers who had now developed a reasonably reliable system for at least the larger rorquals.

14.2.2 North Pacific

SC/51/RMP7 summarised the 1998 JARPN survey which took place in the eastern part of sub-Area 7 and sub-Area 8 from 26 April to 21 June 1998. The survey also covered the early period of migration as had the survey in 1997, in response to the comments made by the Working Group on North Pacific Minke Whale Trials in 1996 (IWC, 1997e). One sighting vessel (SV), three sighting and sampling vessels (SSVs) and one research mothership were used as in previous surveys. The SV covered about 2,760 n.miles of searching, whilst the SSVs search distance was about 5,000 n.miles. Primary minke whale sightings comprised 15 schools (17 animals) and 155 schools (165 animals), respectively. Sampling was also conducted by the SSVs, with 100 minke whales being collected in sub-Areas 7E and 8 (89 males and 11 females). One offshore-type Bryde's whale was mistakenly sampled. With respect to the sex and reproductive status of the animals sampled, mature males predominated with a few immature animals and mature females being found in early summer in sub-Areas 7E and 8. Japanese anchovy was the dominant prey species for these minke whales, rather than the Pacific saury, which is the dominant prey species of minke whales in summer.

The Committee noted that several documents relating to the JARPN programme were presented to the meeting (SC/51/RMP7, 8, 15) and these are discussed in Annexes D and J.

14.3 Review of new or revised proposals

14.3.1 JARPA–Southern Hemisphere

SC/51/O1 outlined the JARPA survey plan for the 1999/2000 season. This is a continuation of the programme that has been extensively discussed previously by the Committee. This is the 11th full-scale survey of a 16-year research programme, and the objectives, survey items and methods are the same as previous years. The survey will cover Area IV and the eastern half of Area III to focus on the issue of stock distribution within the framework of the objectives of the programme. The major reason for this focus is that mtDNA analysis of the available commercial and JARPA samples up to 1997/98 shows not only that more than one stock is found in the western part of Area IV, but that the pattern of distribution can vary considerably from one season to the next (see SC/51/CAWS11). It was therefore decided to conduct a further survey in the adjacent eastern half of Area III in order to examine further the temporal/spatial and inter-annual variations of these stocks. In addition, morphometric and reproductive studies will be carried out on the whales sampled in Area III East. No informative additional samples exist for Area III. The plan can be summarised as follows:

(1) the research vessels leave Japan at the beginning of November 1999 and return in the middle of April 2000;
(2) the sample size is 300 animals in Area IV and 100 animals in Area III (with a 10% allowance);
(3) the type and the number of vessels are the same as in previous years (one research mothership, three sighting and sampling vessels and one dedicated sighting vessel).

As in previous years, the participation of foreign scientists in the programme is welcomed. For the 1999/2000 JARPA, in order to ensure comparability of data, the survey period and the sample size remain unchanged. However, in response to constructive comments by Committee members in 1997, it is planned to employ a modified sampling method in part of the survey area as a feasibility study.

In discussion, a number of points were raised.

Smith queried the addition of a biological parameter study to the Area III animals, rather than just stock identity-related studies, noting that the sample size was too low to meet the objectives of the study.

Hatanaka replied that the words 'biological parameters' used in the plan were perhaps a little misleading in that it was intended to refer generally to biological markers and other biological information relevant to stock structure questions. However, he believed that it was important to collect data on biological parameters if the stock structure studies revealed that the animals were part of the 'core' stock. Fujise emphasised the importance of the questions surrounding the boundary of these stocks. The results of mtDNA analyses, suggest different stocks in the western part of Area IV. However, the geographical and temporal position of the stock boundary is not fixed and may not always occur in the western part of Area IV (IVW). If the boundary occurs in the eastern part of Area III, the samples from Area IIIE should be included in the estimation of biological parameters. He therefore believed that it was also important to collect biological information from Area III as well as in the major research area (Area IV).

Smith expressed his concern that what had been envisaged as a short-term investigation of the boundary would become a longer-term expansion of the programme. In particular he believed that (a) this might impede progress on reaching the original objectives of the programme, and; (b) that the question of sample size must be properly investigated and reviewed by the Committee.

Hatanaka replied that the aim of the research was to explore the question of the border between the 'core' stock and the 'western' stock. However, the level of variability in the position of the border was surprising and necessitates further examination for a number of years (how many years depends on the results obtained). With respect to the question of sample size and the estimation of biological parameters, he agreed that the required number was considerably greater than 100 but believed that the approach of fixing the number at 100 and planning a multi-year survey was appropriate.

Taylor commended the work on stock identity reviewed in SC/51/CAWS30. However, she queried why there was no component of breeding ground research in the proposal, including directed biopsy sampling and telemetry studies.

This was particularly important given the fact that there may well be no 'boundary' in the normal sense in the feeding grounds.

Hatanaka agreed that work in the breeding areas was important and noted that Japan was beginning such work. However, he believed that given the genetic differences found between the 'core' and the 'western' stocks it will be possible to characterise the boundary in the Antarctic via a multi-year survey.

The Committee emphasised the contribution that satellite telemetry could make to determining important breeding areas and the suggestion for collaborative studies was reiterated (see Item 14.2.1).

14.3.2 JARPN–North Pacific

The Committee first received a proposal for a special permit for minke whales in 1994 when it undertook a detailed review (IWC, 1995b, pp.82-5). Subsequent discussions for future years largely referred to the comments in the 1994 review. After some general discussion, last year, the Committee was informed that more detailed information would be presented. The research plan for this year is included as Annex P.

After reviewing briefly progress to date, two options for the 1999 JARPN survey were proposed in Annex P. The first was for the survey to occur in sub-Areas 7W and 11 from June-August with 50 individuals in each area. The second was for the survey to occur in sub-Areas 7 in June, 11 in July and 12 in August with 25 whales being taken in each of sub-Areas 7 and 11 and 50 individuals in sub-Area 12. Sampling in sub-Area 12 requires sampling in the waters of the Russian Federation. To date, no such permission has been granted. Based on earlier data on mixing rates, the expected number of J stock animals to be taken under option (1) is 4.7 whereas that for Option (2) is 3.1. However, the proposers believed that the number of J stock animals may be overestimated given the indicated decline in J stock revealed in the simulation trial results (see Item 7). A major aim of the programme is to provide information on plausible stock hypotheses for the *Implementation Simulation Trials* being undertaken by the Committee. The proposers emphasised the need to obtain scientific samples via JARPN in 1999 in order to resolve questions surrounding stock structure and mixing rates between the sub-Areas. They noted that when JARPN was first reviewed by the Committee it stated that 'the Committee agreed that the objectives directly addressed questions of interests to the Scientific Committee and that the proposal fulfil these guidelines' (IWC, 1995b, p.83). The proposers also believed that the materials collected in 1999 would be of great importance to the success of the review meeting to be held next year (see Item 14.3.3).

14.3.2.1 CONCERNS EXPRESSED

In discussion, a number of concerns were raised. These included the fact that the focus of the research whaling plans described by Japan for 1999 (Annex P) is in areas (sub-Areas 7, 11, 12) where minke whales from the so-called 'J' stock (primarily occurring in the Sea of Japan and Yellow Sea) mix with animals from the genetically distinct 'O' stock, occurring in the Pacific side of Japan. The specific objectives of this year's research includes estimating mixing rates of J stock animals with O stock animals in these sub-Areas. The principal objective of JARPN is determining the mixing rate between the O stock and the putative W stock further to the east, not between the O and J stocks. Further, such information is not needed to improve the already specified *Implementation Simulation Trials*.

Another concern raised was the prospect that it was expected that the programme would take three to five J stock animals; given the uncertain status of the J stock due to the continuing incidental takes and historical overexploitation referred to by the Committee under Item 7, these removals have the potential for an adverse effect on this stock; given the uncertainties involved, conducting this research, especially in sub-Areas 7 and 11, is not consistent with the precautionary principle. Historical catches from sub-Area 12 give a limited idea of stock structure as the few samples come from two small areas. There may be areas of high concentrations of J stock within the unsurveyed areas.

Concern was also expressed that to address mixing rates, greater statistical power is required than the proposed catches would allow. It was suggested that this could be remedied by using non-lethal biopsy sampling. The potential for this methodology for minke whales has improved in recent years and the Scientific Committee has recommended feasibility testing in Greenland waters (Item 9). Additionally it was suggested that genetic tools were more powerful than either pollutants or parasites for identifying mixing rates; pollutant information can, in any case, also be obtained from biopsy samples, as can information on sex. The substantial incidental catches and strandings in this area were also proposed as a useful source of data.

14.3.2.2 POINTS IN RESPONSE

A number of points were raised in response to these concerns. One was that the precautionary arguments raised above must be weighed against the important information that a sample in Areas 11 and 7 will produce. Firstly, the clarification of J/O mixing was chosen as one of the objectives for the 1999 survey, in response to concerns raised in conjunction with results derived from market samples, irrespective of their use in the RMP. In fact, the information on the mixing rate of J and O animals is not sufficient, and therefore it is necessary to collect such information. However, the most important objective remains to determine whether the W stock exists or not. Samples from commercial whaling in sub-Areas 7 and 11 are available but these can only be used for genetic studies and not those related to other approaches to stock identification studies using biological markers such as pollutant burden, parasites, sex ratio, length, etc. Only 30 JARPN samples from sub-Areas 7W and 11 are available and more biological marker data are required from coastal waters. Option 1 will only indirectly provide information about 'mixing rates' in area 12, but some information may be obtained, since animals from the J-stock will have to swim through area 11 to 7 to reach area 12. Option 2 has the possibility of answering the main remaining outstanding problem concerning the O and the hypothetical W stock. A viable separate W stock hypothesis requires juvenile and adult animals of both sexes to be found in its hypothetical area of distribution. So far, sampling in areas 8 and 9 have predominantly given large males with a low proportion of adult females and no juveniles.

With respect to adverse effects on the J stock, the mixing rates data available to try to estimate expected numbers of J stock animals were obtained in the time of commercial whaling. The present mixing rate of J stock animals will be much smaller. Even so, the expected catch of J stock whales is negligible compared with the annual bycatch by Korea and Japan. Similarly, the available information suggests that J

stock animals are sparse in sub-Area 12. From this it is believed that the taking of less than 50 whales in a sub-Area is sufficiently precautionary.

With respect to the usefulness of samples from stranded and incidental catches it was stated that many of the stranded animals were unhealthy and had died of disease. It was also stated that the samples from incidental catches are not representative of the stock. Data from the market samples obtained suggested that such data were not representative of those in the area.

With respect to biopsy sampling from minke whales, up until last year everyone had agreed that it is difficult. This year, reports regarding the *Larsen* gun are promising but it would seem wise to wait until the Committee has time to discuss the results from the Greenlandic feasibility study, before giving evidence-based advice on the possibility of obtaining biopsy samples from a large number of minke whales.

A member from the Russian Federation supported the Japanese research plan in principle.

14.3.2.3 CONCLUSION

After this full discussion, a majority of the Committee was unable to respond positively to a request for the Committee to ask the Commission to urge the Russian Federation to allow access to the JARPN vessels to sample minke whales in sub-Area 12.

14.3.2.4 JARPN REVIEW

Last year, the Committee agreed that a comprehensive review of JARPN should be planned for the year 2000.

An *ad hoc* group was convened to examine this further. The proposal for this review was patterned on the review of the Japanese Southern Hemisphere research programme (IWC, 1998b, p.377-412). However, one difference was that that previous review was a mid-point review, while this is a review at the end of the planned research period.

The Committee agrees the following terms of reference for the review meeting.

(1) Review methods and results of the research programme, 1994-1999.
(2) Assess further potential of existing data for:
  (a) meeting JARPN objectives;
  (b) other objectives.
(3) Evaluate whether the main objectives have been achieved.

The main objectives of JARPN were (1) to determine whether or not the W stock exists (IWC, 1995b, pp.82-5), and if so to estimate mixing rates between the O and W stocks, and (2) determine the feeding ecology of minke whales in the North Pacific.

It is expected that the report of the results of this review will inform the Scientific Committee relative to the plausibility of options being considered in the *Implementation Simulation Trials* of the RMP when those results are considered during the next annual meeting.

The Committee **recommends** that the review meeting outlined in Annex Q should be adopted. It established an Intersessional Steering Group (see Annex U). Funding implications are given under Item 18.

15. WHALE SANCTUARIES

15.1 Commission Resolution

In recent years the Committee had 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. Last year the Commission provided such advice in Resolution 1998-3 (IWC, 1999a).

The Commission stated that the agreed objectives of the Southern Ocean Sanctuary are to provide for:

(1) The recovery of whale stocks, including the undertaking of appropriate research upon and monitoring of depleted populations;
(2) The continuation of the Comprehensive Assessment of the effects of setting zero catch limits on whale stocks; and
(3) The undertaking of research on the effects of environmental change on whale stocks;

The resolution also directed the Committee to undertake a number of tasks. These are listed below along with comments by the Committee regarding progress on these matters in the context of the recommendations of the Norfolk Island Intersessional Meeting of the Working Group on a Sanctuary in the Southern Ocean (IWC, 1995b).

(1) *Increase cooperation with governmental, regional and other international organisations working on related issues in the Southern Ocean.*

The Committee refers to its discussions under Item 11.2 regarding the SOWER 2000 research programme and the collaboration with CCAMLR and SO-GLOBEC.

(2) *Further develop and support existing international and national non-lethal cetacean research in the Sanctuary which will contribute to the conservation objectives of the Sanctuary.*

The Committee noted its work on the SOWER cruises in the context of both the monitoring of the abundance of species south of 60°S and its blue whale research project (see Items 10.1.1.2, 10.2 and 10.4).

(3) *Provide the Commission with a long term framework for non-lethal research, including multidisciplinary research, on environmental changes and their impact on cetaceans in the Southern Ocean Sanctuary, so that the Commission is able to make appropriate decisions to ensure effective conservation of whale stocks in that region.*

The Committee noted the development of the SOWER 2000 programme, SC/51/Rep2 and the Report of the Workshop on Climate Change and Cetaceans (IWC, 1997b) and the recommendations for a longer-term framework for research given therein. It noted that the SOWER 2000 programme has long-term components in its proposal to continue (after 2001) working collaboratively with the field programmes of CCAMLR, SO-GLOBEC and national programmes.

Under this item, the Committee also briefly considered a document produced by Japan related to the Commission Agenda Item on the abolition of the Sanctuary. The document outlined Japan's reasons for believing that the IWC's adoption of the Sanctuary was invalid and not based on science.

Discussion in the Committee centred on the question as to whether designation of the Sanctuary was important for research. Japan argued that the research being conducted in the Sanctuary would have occurred whether or not a Sanctuary had been designated. In response to a comment that little research occurred in the Sanctuary apart from the SOWER cruises and the JARPA programme, a number of other programmes including national programmes by Brazil, Australia, Germany and New Zealand, UK and USA, were cited. Morishita commented that none of these programmes

required the Sanctuary. Thiele noted that the Australian programme was a direct response to the establishment of the Sanctuary. Fabbri believed that there was a conflict between lethal research carried out by Japan, and the Sanctuary provision. Hatanaka commented that the Sanctuary was unnecessary in the light of the success of the development of the RMP.

The Committee recalled its earlier inconclusive discussions concerning the issue of the Southern Ocean Sanctuary. It agreed that those discussions covered the wide spread of views on this issue and refers the Commission to those discussions (IWC, 1993a; b; 1994a; b).

A number of papers relating to activities within the Sanctuary had been presented to the meeting. These are discussed in Annex H, item 6.3.

16. RESEARCH PROPOSALS

16.1 Review research results from 1998/1999

The Committee noted that it would receive a report at next year's meeting concerning the research proposal funded last year (Borchers *et al.*, 1998).

16.2 Review proposals for 1999/2000

Four proposals were reviewed by the intersessional review group and outside reviewers and discussed further during this meeting (Annex R). The Committee's views on each proposal are summarised below. Financial implications are considered under Item 18.

SC/51/RP1 (Baldwin and Best) is a proposal for investigation of cetaceans in waters off Tristan da Cunha, South Atlantic Ocean. Major objectives of particular interest to the Committee are to photo-identify and biopsy southern right whales. The request for funds is modest and the proposers highly competent. The only reservations expressed by reviewers concerned the level of importance of the work relative to the Committee's priorities and difficulties that might be experienced in matching photographs they take from boats to aerial photographs in Best's catalogue. This proposal was scored medium to high.

SC/51/RP2 (May and Conway) requested funding for PCR reagents and other material needed for genetic analyses of blue whale samples using introns of conserved nuclear genes. Their objectives include delineation of breeding stocks of blue whales worldwide and analysis of phylogenetic relationships between blue whale populations. The funding request was modest, but reviewers were dubious about the probability that these objectives could be achieved. Given Committee priorities, it is unlikely that this proposal could be funded this year or in the near future. The proposal was scored medium.

SC/51/RP3 (Strindberg, Burt, Hedley, Borchers and Buckland) proposed to provide a user-friendly data entry system for DESS and software for data checking, retrieval and summary. These would be designed for use on IWC-SOWER and SOWER 2000 cruises. Reviewers praised the competence of the proposers and relevance of the work to the Committee, giving it a high score.

SC/51/RP4 (Ainsley and Spear) proposed to analyse data already collected on minke whale abundance and distribution in the Amundsen and southern Bellingshausen Sea, Antarctica. Reviewers believed the data were of interest to the Committee but were concerned about the data collection and analysis methodologies described, which were not 'state of the art'. This proposal received a low score, but might be reconsidered in a future year if evidence was provided that someone with expertise in the analysis of line transect data would be involved in the work. However, funding requirements of Committee sponsored research in the next two years make the probability of funding rather low.

17. DATA PROCESSING AND COMPUTING NEEDS FOR 1999/2000

The Committee identified the requests for intersessional computing work given in Table 14. In the light of its discussions on Committee priorities (Item 21), the Committee agrees that the work identified for furthering the AWMP and RMP should be accorded highest priority. It noted that target dates had been included for the highest priority tasks. 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** that an Intersessional Steering Group (see Annex U(23)) will review progress during the year to decide if priorities needed to be changed in the light of Commission decisions and/or experience. Given the comments about future workload under Item 8.9.5.1, the Committee **agrees** that the Intersessional Steering Group should also develop a draft proposal, in consultation with Allison, to address the concerns expressed.

18. FUNDING REQUIREMENTS FOR 1999/2000

The Committee reviewed a list of items and their associated estimated costs which had been drawn up by the Convenors (Table 15). The items had been identified by the sub-committees or in the course of discussion under other agenda items.

The Committee recognised that this year's proposed expenditure falls into two major categories:

(i) items associated with the Committee's work over a number of years, such as the proposed JARPN review meeting, the SOWER Antarctic cruise, analyses requested under the DESS programme - these appear 'below the line' in Table 15;
(ii) items associated with the Committee's recently developed Environmental Concerns programme - 'above the line' in Table 15.

Not included in Table 15 is the already committed expenditure carried over from 1998/99, i.e. the AWMP developers fund (Item 8.9.6.3) and the Workshop on the status of western North Atlantic right whales (Item 10.1.3.1).

In considering (i) above, the Committee **agreed** that funding should be sought for the items proposed in Table 15. In recognition of the large amount of money being requested under the Environmental programme, the Committee had not included everything that it would like to have requested. For example, in the case of the DESS programme, a reduction of some £10,000, to £20,500, was achieved by omitting two of the items (E, F in Annex M). Taking that into account, the total requested under (i) above, £157,700, is £26,421 less than the original estimated expenditure of £184,121 prepared by the Secretary.

In respect of (ii), in **strongly recommending** its endorsement of the proposals and their funding, the Committee emphasised that the two environmental programmes, POLLUTION 2000+ and SOWER 2000 each form an integrated package, developed over the past two years in response to the direction from the Commission at its

Table 14

Computing needs for 1999/2000. A: work to be done by Allison; S:work to be done by other members of the Secretariat; Small ≤ one week.

Task	By	Estimated time
AWMP		
Minor amendments to fishery type 1 control program (block quotas, density dependence to 1+ and starting date) + amendments to statistics portion of program.	A	1 Week (Target: 1 August)
Modify fishery type 2 control program (minor amendments as for fishery type 1 + selection of parameters from posterior distribution).	A	3 Weeks (Target: 1 August)
Modify fishery type 2 control program to implement stochastic model.	A	1 Month (Target: 1 September)
Finalise the plotting program (in collaboration with Zeh).	A	Small (Target: Start of Intersessional Workshop)
Work from Intersessional Workshop.	A	? (Target: by next meeting)
RMP		
Test NCC program and conduct tuning according to the procedures given in Annex D, Item 2.	A	2-4 weeks (by next meeting)
Amend the control program and run final set of the North Pacific minke whale trials (Annex D, Appendix 5).	A	1-2 months (by next meeting)
Develop the control program to run the initial North Pacific Bryde's whale trials (Annex D, Appendix 7).	A	2-6 months
Validation of 1997/98 SOWER cruise data and incorporation into sightings database. (Validation includes testing new validation software from St Andrews).	S	6 months
Coding of 1998/99 SOWER cruise and blue whale cruise data.	S	3-4 weeks
Validation of 1998/99 SOWER cruise data and incorporation into sightings database.	S	4 months
Validate pre and post IDCR data 1978/79-1991/92.	S	3 months/year of data
OGW: held over from last year		
Code any revised Soviet catch data if they become available.	S	Depends on extent of data.
Complete coding and continue validation of Southern Hemisphere catch records for the period 1900-1939.	S	Coding 1 month; validation 8 months
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
Remove false Soviet data from database and collate new data.	A/S	1 month
CAWS		
Coding of North Atlantic catch data pre 1945 (for North Atlantic humpbacks).	S	
SM		
Collection of statistics of small cetacean catches and compilation of the table for the Scientific Committee report.	A/S	1 month
Carried over:		
Collate statistics of incidental catches of great whales and incorporate into database.	A/S	?

Table 15

Funding requirements (UK £).

Item	Agenda Item	1st year	2nd year
Environment			
POLLUTION 2000+	Item 11.1		
Phocoena		260,000	
Tursiops		90,000	
Total		350,000	650,000
SOWER 2000	Item 11.2	250,000	390,000
AWMP			
Intersessional Workshop (invited participants)	Item 8.9.5.2	12,000	
AWMP + RMP			
Faster computers for trials	Item 17	2,500	
Greenland Research			Large but not
Biopsy feasibility study	Item 9.1.3	1,500	known
CAWS			
SOWER Antarctic cruise	Item 10.6.2	77,000	
Antarctic humpback photo-id catalogue	Item 10.4.2	4,000	
Whalewatching			
Long-term Effects Workshop (invited participants)	Item 13.7	8,000	
Small Cetaceans			
Bycatch pre-meeting (room hire)	Item 12.8	2,000*	
DESS			
Additional items to DESS contract 14	Item 6.3.2	7,700	
Analyses requested	Item 6.3.2	13,000	
JARPN Review meeting			
Six invited participants	Item 14.3.3	12,000	
Research Proposal No. 3			
DESS data entry system	Item 16.2	20,000	
TOTAL FUNDING REQUESTED:	excluding Environment i.e. below dotted line	**157,700**	
* Plus from small cetacean fund		2,000	

1997 meeting (Resolution 1997-7)(IWC, 1998a, p.48). Costs for Phase 2 of the POLLUTION 2000+ programme are included in Table 15, even though they are more uncertain than for Phase 1 (first year) as they are dependent on the outcome of Phase 1 as discussed under Item 11.

As the Committee had noted last year, the costs for each programme exceed by a considerable margin those for any research programme so far funded by the Commission. The Commission has previously recognised that both are very large, multidisciplinary, multinational cooperative projects. The Committee draws the Commission's attention to the items below in its evaluation of the proposals.

POLLUTION 2000+

The total estimated cost for Phase 1 is £350,000, of which £260,500 is for the post-mortem calibration study. The total estimated cost for Phase 2 is approximately £700,000. This depends to a large extent on the results from Phase 1 but is provided for information. The level of support already expressed for this proposal is extremely encouraging. The programme as outlined in SC/49/Rep6 was strongly endorsed by ASCOBANS at its Meeting of Parties. The recent Advisory Committee meeting of ASCOBANS also endorsed the report on the basis of a verbal summary prepared by Reijnders (the Committee's rules meant that the written report could not be submitted as a document to that meeting). SC/49/Rep6 was strongly endorsed by the ICES Working Group on Marine Mammal Habitats and used by them to develop a similar programme for pinnipeds.

Although it has not been possible to calculate the exact value of the 'in-kind' funding offered by the cooperating institutions, even a crude estimate reveals that over £200,000 is being offered and probably considerably more. Further potential funding sources include: the European Commission; the joint USA-EU programme; the Nordic Council of Ministers; and certain Fishermen's Associations. It is to be hoped that IWC member nations may also offer direct or indirect funding in addition to any core IWC funding. Non-governmental organisations are also encouraged to contribute.

A steering group has been established and a programme coordinator designated. A major task of the coordinator of POLLUTION 2000+ will be to follow up on these and other sources of funding.

SOWER 2000

First year costs (£250,000) will be related primarily to the IWC-CCAMLR collaboration during the Area 48 synoptic krill survey: training and placing observers on the krill vessels, meetings for modelling and planning etc. It will also be necessary in the coming year to begin some activities in preparation for the SO-GLOBEC collaboration, especially development of the remote sensing tags for following whales in the vicinity of krill patches studied by GLOBEC. Second year costs (£390,000) include those related to use of the IWC vessels, plus additional equipment, observer, logistics and meeting costs.

One relatively less expensive but essential item relates to coordination of logistics and training. The Research Unit for Wildlife Population Assessment (RUWPA) at St Andrews, UK, was approached for its interest in conducting these tasks, and it prepared the proposal attached to Annex H, Appendix 2 (the estimated cost for both years is approximately £17,000). The Committee **recommends** RUWPA be funded for this task.

With respect to many of the equipment items, their value extends well beyond the two-year period of this project. In particular, much of it will be of value to future surveys under the SOWER programme or in conjunction with other collaborative 'platforms of opportunity' work.

In addition, although the development costs of the remote sensing devices are relatively high, the costs of the devices themselves will be relatively low, and the devices of value to many aspects of the Committee's work as well as other research programmes.

Similarly, the value of several of the meetings, particularly the modelling and analysis meetings, is of long-term benefit to the Committee's attempts to address a number of issues related to distribution, abundance and monitoring as well as to environmental issues. Again, improvements and standardisation of data collection (and subsequent analyses) arising from collaborative 'platform of opportunity' work is of long-term benefit to many aspects of the Committee's work. Linked in with this is the value of having a pool of experienced and well-trained observers.

There is considerable opportunity for national governments to make contributions 'in-kind' to this programme. For example, the costings exclude the enormous contribution made by the Government of Japan in supplying vessels and crew. It would be appropriate for other nations to consider *inter alia* donating or loaning equipment, paying for experts to attend meetings/workshops or paying for observers on vessels.

In **strongly urging** the Commission to regard the two Environment programmes as an integrated package, as above, the Committee asks the Commission to indicate the level of funding it is able to support from its own resources, recognising that the remainder would be sought externally.

19. COMMUNICATIONS

19.1 Communication with the Commission

Last year, the Commission had passed Resolution 1998-11 (IWC, 1999a) on establishing a mechanism to improve communications between the Commission and the Committee. The Resolution had requested the Commission's Advisory Committee, in close consultation with the Committee, to:

(1) recommend a process to improve communications between itself and the Commission; and
(2) report to the Commission, through its Finance and Administration Committee at its next Annual Meeting.

To this end, the Secretariat, in consultation with the Chairman of the Committee, had produced a discussion paper for the Commission (IWC/51/18). This contained three suggestions. The first is that the Commission origin of each Item on the Committee's Agenda be clearly identified. It noted that this could be accomplished either (or both) at the start of each Agenda Item of the Committee's Report or on the sheet linking the Commission's Agenda to the Committee's Agenda that is prepared by the Chairman and the Rapporteur after the close of the Scientific Committee meeting. The Committee **agrees** that this should be attempted for the present report. It also **agrees** that the Preamble to its revised Rules of Procedure (see Item 21.1 and Annex S) provides an important way of detailing the Commission origin of its major items for discussion.

The second suggestion in IWC/51/18 was that the Committee continues with the practice it had begun last year in including a separate section to its report highlighting its

recommended priority topics and identifying the work programme it envisaged for the coming year. The Committee **endorsed** this approach as detailed in Item 21.

The final suggestion noted the preamble to the Commission's Resolution, which highlighted the value of the approaches adopted firstly for the RMP and currently for the AWMP discussions where the respective Chairmen of those sub-committees were available for informal discussions with Commissioners during the period of the Commission meeting. IWC/51/18 had suggested that it might be possible to extend this to perhaps one additional topic at each annual meeting. This would require: the subject(s) for discussion to be decided sufficiently in advance of each Annual Meeting; time to be allocated in the suite of Commission sub-committees/working groups; Commissioners to arrive a day or so earlier than they might normally do; it may also require, depending on who the representative of the Committee is, that that person remains after they would normally depart.

In discussion of this item, the Committee recognised the value of such informal contacts although there was some doubt about the most appropriate process by which the topic for discussion might be chosen.

Bannister explained the current procedure for the Chairman of the Committee to present the Committee's report to the Commission. Most items are reported directly to Plenary apart from matters related to the budget or aboriginal subsistence whaling, where reporting is to the Finance and Administration Committee or the Aboriginal subsistence whaling sub-committee. He noted that relatively few members of the Committee now attended the Commission meeting as advisors to their Commissioners.

The question of whether the Committee meeting should be separated more in time from the Commission meeting was raised. One advantage was that this would give the Commissioners more time to read what is an extensive and technical report. However, a number of disadvantages were also raised ranging from financial and practical difficulties to the possibility that reanalyses might be prepared during the intervening period that could not be reviewed by the Committee.

The Committee considered IWC/51/F&A9, produced by the UK. This proposed that the Commission should appoint a new working group (or possibly the Technical Committee) to review the Committee's report in detail and to advise the Commission on all aspects of the Committee's work including priorities for research. It would also highlight areas that it felt required further discussion or should be drawn to the attention of the Commission. The Chairman of the Scientific Committee would still attend the Plenary sessions of the Commission but apart from formally offering the report for adoption he would not report to that body directly. The proposal required this group to meet before the Finance and Administration Committee so that information on research expenditure could be included in the budget recommended to the Commission. The proposal would shorten the time of the Plenary session of the Commission even if it did not shorten the overall period if such working groups are to be included. It suggested that the approach would allow a more focussed and detailed consideration of the Committee's report and more logical decisions on priorities.

A number of comments were made on this proposal. Concern was expressed that the proposal might result in the Committee's report being 'filtered' before being received by the Commission. Some members suggested that adding an extra layer between the Committee and the Commission might hinder rather than improve communication between the Committee and the Commission.

The Chairman noted the difficulty already experienced in finalising the Committee's report in time for the plenary session. The proposal in IWC/51/F&A9 would inevitably make this even more difficult. Several members stated that they believed it was important that the Committee's report was reported directly by the Chairman of the Scientific Committee to the Commission.

19.2 Transmission of Circulars

The Committee agreed that the current procedure was acceptable, noting that excluding standard artwork (e.g. the Commission's logo) from the message will significantly reduce transmission times.

20. PUBLICATIONS

Donovan reported on progress with the new publications series agreed last year (IWC, 1999d). The supplement to the *Journal of Cetacean Research and Management* (i.e. the Scientific Committee report) was available to the meeting, as was the first volume of the *Annual Report of the IWC 1998* (the administrative papers including the Chairman's Report, the Convention and Schedule, and Rules of Procedure). Technical problems meant that the first issue of the Journal, whilst printed, was not able to be delivered to the meeting in time. It will be posted to members.

Donovan also noted that the Editorial Board will be expanded to include expertise on the new areas that the Committee is considering. Two special issues of the Journal are almost complete: one concerning pollutants and cetaceans, and the other concerning gray whales. They will be published in the intersessional period.

The Committee congratulated Donovan on the new series of IWC publications. In particular, it expressed appreciation at the strenuous efforts he had made in improving the scientific quality of IWC publications, culminating in the establishment of the new Journal.

21. COMMITTEE OBJECTIVES AND PRIORITIES

21.1 Amendments to the Rules of Procedure

Last year, the Committee had developed revised Rules of Procedure and recommended these to the Commission. Lack of time during the Commission Meeting meant that they were not discussed. The Committee considered a small number of modifications to the revised rules, in particular clarifying the process for Invited Participants. It also revised and clarified the preambular material which it believes makes an important contribution to its communication with the Commission (see Item 19.1 above).

Morishita suggested that the old Rule of Procedure providing for a postal review of scientific permit proposals be reinstated. He recognised the rationale for reviewing proposals at meetings but believed that it was wise to retain the flexibility of postal review should circumstances require it. However, the Committee believed that past experience had shown the need for face-to-face dialogue in the review process. Such discussions had often led to improvements in proposals.

The Committee **recommends** that the Commission adopts the amended Rules of Procedure as given in Annex S.

21.2 Longer term priorities and directions

Last year, the Committee identified seven topic areas it believed were of priority in terms of the advice required by the Commission and the perceived links between them (IWC, 1999d). These were subsequently endorsed by the Commission (IWC, 1999a).

The Committee **agreed** that the seven topics, shown in Fig. 5, remain its priority topics. It further **agreed** to slightly modify the links between Whalewatching, Environmental Concerns and Comprehensive Assessment as shown in Fig 5.

The Committee recalled that one of its major functions is to review Special Permits in the light of guidelines developed by the Commission and noted that aspects of the review are covered under several priority topics, including RMP, Comprehensive Assessment and Environmental Concerns, as reflected in the discussions this year. It noted that this is also true with respect to discussions of Sanctuaries, where, in the light of the Commission Resolution (IWC, 1999a), much of the relevant discussion occurred in the SWG on Environmental Concerns.

21.3 1999/2000 work plan and initial agenda for the 2000 meeting

As last year, with the Committee's agreement, after the close of the meeting the Convenors drew up the following as the basis of an initial agenda for the 1999 meeting. They took into account the priority items recognised under Item 21.2 above, and, within them, the highest priority items agreed by the Committee on the basis of sub-committee discussions. The Committee noted that priorities may be revised in the light of the Commission's decisions. Following the Commission meeting, the Chairman will forward a summary of the Commission's conclusions as they affect next year's work to members for information; the summary will form the basis of the draft agenda to be circulated 60 days before the next meeting. It will also provide a framework for determining invited participants to the 1999 meeting.

RMP

(a) General Issues (Convenor – Hammond)
  (1) Consider the new *CLA* program.
  (2) Review the component of the population to which density-dependence should apply.
  (3) Review results of work on the evaluation of abundance estimators.
(b) Preparations for Implementation
  (1) Review results of the JARPN review meeting.
  (2) Review results of final North Pacific minke whale trials.
  (3) Review reports of sightings surveys (North Pacific minke, North Pacific Bryde's, North Atlantic minke).
  (4) Review progress towards coding initial western North Pacific Bryde's whale trials.

AWMP (Convenor – Donovan)

(1) Continue development process including review of intersessional Workshop.

Aboriginal Subsistence Whaling (Convenor – Walløe)

(1) Plan Greenlandic research programme (based on results of the feasibility study) for fin and minke whales.
(2) Review improvements to the Bering-Chukchi-Beaufort Seas stock of bowhead whales assessment model.
(3) Review information on stocks of bowhead whales other than the Bering-Chukchi-Beaufort Seas stock and on the western North Pacific gray whale stock.
(4) Review preparations for the North Atlantic humpback whale Comprehensive Assessment to be undertaken in 2001.

Comprehensive Assessment of Whale Stocks – In-depth assessments (Convenor – Bravington)

(1) Southern Hemisphere minke whales – prepare for revision of abundance estimates.
(2) Southern Hemisphere humpback whales – preliminary assessment.

Fig. 5. Seven priority topic areas and their perceived links. Dotted lines refer to links via simulation testing.

Comprehensive Assessment of Whale Stocks – Other stocks (Convenor – Bannister)
(1) Western North Atlantic right whales – review report of intersessional meeting on status and trends.
(2) Southern hemisphere blue whales – review abundance estimates, concentration areas, differentiation of forms.
(3) Other small stocks – review available information on status and trends.

Environmental Concerns (Convenor – DeMaster)
(1) SOWER 2000 programme – review results of 2000 field programme with CCAMLR; prepare for 2001 field season with SO-GLOBEC.
(2) POLLUTION 2000+ – review results of calibration study and field collections for Phase 1; prepare for Phase 2.
(3) Complete proposal for Habitat Degradation Workshop.
(4) Complete proposals for Arctic Initiative.
(5) Develop 'State of Cetacean Environment Report'.

Small Cetaceans (Convenor – Read)
(1) Review status of fresh water cetaceans.
(2) Continue review of bycatch mitigating methods.

Whalewatching (Convenor – Kato)
(1) Review results of the workshop on long term effects.
(2) Review updated report on Guidelines.
(3) Review new information on dolphin-feeding programmes.
(4) Review whale and dolphin 'swim-with' programmes.

22. ELECTION OF OFFICERS

This year, the current terms of office of the Chairman and Vice Chairman were completed. In accordance with past practice, and as allowed for in the draft Rules of Procedure, these had each been for three years. Appointments to each position were therefore necessary at this meeting.

Following informal discussions at the end of the 1997 meeting over the nature of the process of choosing the Committee's officers, the Chairman discussed the issue with a group comprising the senior scientific representative from each delegation.

Following three meetings of that group, the Chairman reported that the following had been elected: Chairman – Zeh, by consensus; Vice Chairman – DeMaster, by vote.

Morishita asked for the following to be recorded. In many international organisations it is well-established practice for the Chair and Vice-chair to be of different nationalities to ensure balance between the various interests represented. Many organisations actually stipulate in their rules of procedure or even in their conventions that such officials shall be of different nationalities. He and his Japanese colleagues wished to see such a balance of nationalities in the Scientific Committee's officers and noted that this view had the support of many other members. He wished to state for the record that the lack of balance in the outcome had not been what he and his colleagues had wished.

23. OTHER BUSINESS

23.1 Human health effects from the consumption of cetaceans

This item had been added at the request of the UK Commissioner in the context of the Commission's Resolution 1998-11 (IWC, 1999a). The Chairman noted that at the Commission meeting he had specifically asked the Chairman of the Commission if the intention had been for this item to be discussed by the Scientific Committee and had been told that this was not the case. However, the matter was briefly discussed in Annex H, Item 5.3.

The Committee **agrees** that it had insufficient expertise in this field to consider the effects on humans of consuming cetacean products, although it could produce information on levels of pollutants in certain tissues for some species and areas. It suggested that the manner in which the Commission addressed certain issues within the Technical Committee might provide a suitable model for consideration of this issue, e.g. by periodically holding specialist workshops (e.g. whale killing methods).

Some members of the Committee believed that this topic was outside the competence of the IWC.

23.2 Advances in non-lethal methods available for whale research

The Committee received information from Monaco about a Workshop entitled 'Advances in non-lethal methods available for whale research' it would propose to the Commission. The Workshop was to comprise a critical review of recent advances in non-lethal methodologies and technologies now available to whale science. Particular focus would be given to the relevance of tools available for assessing stock structure, population dynamics and cetacean health. It would include a comparison of lethal and non-lethal techniques.

In discussing this outline proposal, the Committee noted that although the topic was extremely interesting, it believed that such a Workshop would be more appropriate in the context of a relevant society such as the European Cetacean Society or the Society for Marine Mammalogy. It noted that the focus of the Committee's work was problem-oriented rather than methodology-oriented. The wide geographical and disciplinary spread of Committee members meant that the Committee was well-informed of recent developments in the methodology and technology relevant to the specific issues it had to address. Given the intersessional workload already identified, it **agreed** that such a Workshop should not be accorded high priority in its work plan at this time.

24. ADOPTION OF REPORT

The Committee adopted the report at *ca* 17:50 on 15 May 1999. It agreed that Item 21.3 would be completed by the convenors, meeting on 16 May.

The meeting expressed its appreciation to Donovan, for his perceptive rapporteuring, drafting and editing (often nocturnal), and to the Secretary and his staff for their customary cheerfulness, support and hard work in difficult circumstances.

On behalf of the Committee, Hatanaka expressed his admiration for the outgoing Chairman, Bannister, complimenting him on his wise and fair chairmanship during a difficult time for the Committee. The meeting rose in appreciation.

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