Report of the Scientific Committee

The meeting was held at the Kaikyo Messe Conference Centre, Shimonoseki, Japan, from 27 April – 9 May 2002 and was chaired by J.E. Zeh. A list of participants is given as Annex A.

1. INTRODUCTORY ITEMS

1.1 Chair's welcome and opening remarks

Zeh opened the meeting and introduced Hatanaka who welcomed the participants to Shimonoseki. After the customary introductions, Zeh brought to the Committee's attention the sad death of Dr Fujio Kasamatsu the previous year. Dr Kasamatsu played a significant role in the IWC Scientific Committee for many years. He made significant contributions to the Southern Hemisphere minke whale assessment cruises, participating from 1979/80 to 1988/89, acting as senior scientist from 1983/84 and cruise leader from 1988/89. A moment of silence was observed in his memory.

In regard to the participation of Iceland, Zeh read the following statement on behalf of the Chairman of the Commission:

> Iceland's instrument of adherence to the International Convention for the Regulation of Whaling is expressly conditioned on a reservation with respect to paragraph 10(e) of the Schedule. This Committee is not an appropriate forum to discuss this or issues related to this. The participation of Iceland in this meeting does not prejudice the positions of individual members of the International Whaling Commission regarding the issue of Iceland's adherence to the International Convention for the Regulation of Whaling.

1.2 Appointment of rapporteurs

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

1.3 Meeting procedures and time schedule

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

1.4 Establishment of sub-committees and working groups

The meeting was preceded by a two-day (25-26 April) Working Group to continue to review Southern Hemisphere minke whale abundance estimates. As last year, the agenda items covered by this meeting were subsumed into the main agenda and the report of the sub-committee on In-Depth Assessments (Annex G). A number of sub-committees and Standing Working Groups were established:

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

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

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

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

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

Annex I – Working Group on Stock Definition;

Annex J – Standing Working Group on Environmental Concerns;

Annex K – Standing Sub-committee on Small Cetaceans;

Annex L – Sub-committee on Whalewatching;

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

Annex N – Working Group to Review Sanctuaries and Sanctuary Proposals.

Working groups (under Zeh and Bjørge) dealt with DNA testing and the review of JARPN II, respectively. Their reports appear in this report under Items 15 and 16, respectively.

1.5 Computing arrangements

Allison outlined the procedures for participants requesting computing work from the Secretariat, and the printing facilities available for delegate use.

2. ADOPTION OF AGENDA

The adopted Agenda is given as Annex B1. Statements on the Agenda are given as Annex R. The Agenda took into account the priority items agreed last year and approved by the Commission (IWC, 2002d, pp.69-71). Annex B2 links the Committee's Agenda with that of the Commission.

3. REVIEW OF DATA, DOCUMENTS AND REPORTS

3.1 Documents submitted

The list of documents is given as Annex C.

3.2 National progress reports on research

Progress reports presented at the 2001 meeting are now accessible on the IWC website. Reports from previous years will also become available in this format.

The Committee reaffirmed its view of the importance of national progress reports and **recommends** that the Commission continues to urge member nations to submit them following the approved guidelines (IWC, 1998f). It was also noted that non-member nations wishing to submit progress reports are welcome to do so.

As discussed under Item 7, the Committee also **recommends** that the Commission:

(1) encourages member nations to report details about the type of fishing gear involved in large whale bycatches (Item 7.1.4) and;
(2) again encourages member nations to submit more complete records of ship-strikes (Item 7.3).

A summary of the information included in the reports presented this year is given as Annex O.

3.3 Data collection, storage and manipulation

Borodin requested that the following statement appear in the report.

For the last few years (IWC, 1997b, pp.137-8; IWC, 1998d, p.177; IWC, 2002d, p.2) the Russian delegation has made a statement about the necessity for independent experts with primary information of whaling (vessel logbooks, scientific reports, etc.) to present these materials at the national level so that they may undergo an expert review. This has not been done. This year we repeat our statement and the need for it to be included in reports.

3.3.1 Catches and other statistical material

Table 1 lists data received by the Secretariat since the 2001 meeting.

3.3.2 Progress of data coding and validation projects

Allison reported that the format of the IWC catch database had been amended to allow inclusion of data from the year 2000, and that the opportunity had been used to add new fields to allow additional reproductive and maturity data to be incorporated into it. During the year, coding of the outstanding pre-1945 individual catch data from the North Pacific had been completed and was being validated. Work had begun on encoding the revised Soviet catch data, the first phase of which is anticipated to take about two years to complete.

The backlog in validation of the SOWER sightings data had been overcome, thanks to the hard work of Marion Hughes in the Secretariat. Data from both the 1999/00 and 2000/01 SOWER sightings cruises had been validated and incorporated into the DESS database. The validation process has been speeded up with the use of new validation software developed within DESS in 1999/2000 under contract, and assistance from another member of staff who is being trained in this work.

Hedley is undertaking validation of the 1999/2000 joint IWC/CCAMLR cruise data as part of the DESS contract, and is developing new software for that purpose. It is hoped this software will also be of use in validation of the IWC/SO-GLOBEC cruise data.

Smith expressed his appreciation to the people involved in the data encoding work.

3.3.3 Progress on program verification and other computing tasks

Allison reported on progress with the computing work identified last year (IWC, 2002d, p.71).

The Common Control Program implementing the Fishery type 2 model had been amended to implement changes agreed last year and at the Intersessional meeting of the

Table 1

List of Data and Programs received by the IWC Secretariat since the 2001 meeting.

Date	From	IWC ref.	Details
Catch data			
1-3-02	Norway: N. Øien	E35	Individual catch records from the Norwegian 2001 commercial catch. Access: restricted.
27-4-02	Japan: T. Sakamoto	D172	Individual catch records from the Japanese 2001 North Pacific Special Permit catch (JARPNII) and 2001/02 Antarctic Special Permit catch (JARPA).
21-4-01	T. Miyashita	E37	Japan 2000 minke bycatch data by sub-area.
Sightings data			
25-2-02	L. Burt	CD25	New version of DESS database: version 3.2 (includes 1999/2000 + 2000/01 data).
15-3-02	L. Burt	CD26	New version of DESS database: version 3.2 rev (corrects year 2000 problem).
25-2-02	P. Ensor	D171	2001/02 SOWER cruise data (sightings, effort, weather, ice-edge, inter-stratum & way pts.). 2002 report with figures and tables (including blue whale cruise data).
8-2-02	D. Thiele	CD15-24	SO-GLOBEC 2001 cruise data, USA + German boats (sightings, biopsy data, behaviour logs, reports + scanned photos).
25-4-02	D. Thiele	CD27-28	SO-GLOBEC 2002 cruise data.
16-10-01	S. Hedley	CD14	Data checking program DAS check (for possible use in CCAMLR and GLOBEC data validation).
Data for North Atlantic Minke *Implementation Review*			
1-11-01	Norway: N. Øien	E32-33	1996-2001 Norwegian sightings survey data – Access: *IR* only.
20-12-01	Norway: N. Øien	E34	Dive time data for 2 VHF radio tagged minke, Aug/Sept 2001 – Access: *IR* only.
13-12-01	Norway: H. Skaug	D170	Norway 1997-99 minke genetic data: DNA micro satellite, MtDNA + catch positions. Access: *IR* only.
25-3-02	Norway: H. Skaug	E36	Norway 2000-01 minke genetic data. Access: *IR* only.
Other Programs			
30-4-02	A. Punt	D173	Programs developed under contract for North Atlantic humpback assessments (see Item 10.5.1).
12-4-02 +17-4-02	G. Givens	E38	G-G Candidate *SLA* program.
9-4-02 + 17-4-02	E. Dereksdottir	E39	D-M Candidate *SLA* program.

Standing Working Group (SC/54/Rep2). The changes included both amendments to the bowhead whale trials and the new factors for use in the gray whale trials. The code for the five potential *SLA*s had been forwarded to Allison and she had applied the *Evaluation* and *Robustness Trials* to each of them. Results are discussed under Item 8.2.

The Control Program for the North Pacific minke whale trials had been amended as specified in IWC (2001e, pp.114-125) and used during the Intersessional Workshop (SC/54/Rep1). During the Workshop, modifications were made to the trial structure and two new baseline models added. The work to implement these changes within the control program for two baselines had been carried out together with some initial conditioning runs. This is discussed under Item 6.1.

Allison expressed her gratitude to Punt for his great assistance with modelling issues.

There had not been time to make progress on the Control Program for North Pacific Bryde's whale trials because of the additional work arising from the intersessional meetings noted above.

Progress made on the DESS contract is reported and discussed under Item 10.1.1.

4. COOPERATION WITH OTHER ORGANISATIONS

4.1 Convention on the Conservation of Migratory Species (CMS)

4.1.1 Scientific Council

The 2002 meeting of the Scientific Council had not occurred during the IWC intersessional period. Perrin will attend as IWC observer at the meeting in September.

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

The 2002 meeting of ASCOBANS had not occurred during the IWC intersessional period. Donovan will attend as the IWC observer in June. Reijnders informed the Committee that a Workshop to Draft a Recovery Plan for Harbour Porpoise in the Baltic had taken place in Jastarnia, Poland in January 2002 (this is discussed under Item 13.2.3).

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

The report of the IWC observer at the 1st Meeting of Parties to ACCOBAMS held in Monaco is given as IWC/54/10H. A Scientific Committee was established and will include on it a representative from the IWC Scientific Committee. A number of resolutions were adopted including: (1) establishment of a stranding network and database; (2) establishment of Guidelines for the regulation of whalewatching; and (3) conservation of bottlenose dolphins in the Black Sea. The Committee thanked Allison for attending this meeting and providing the report.

The first meeting of the ACCOBAMS Scientific Committee is provisionally scheduled for September 2002; Donovan will represent the IWC.

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

The report of the IWC observer at the ICES Annual Science Conference (ASC) held in Oslo, Norway is given as IWC/54/10B. The ICES Working Group on Marine Mammal Population Dynamics and Habitats (WGMMPH) met in April 2001 and addressed the status and ecology of marine mammals in the North Sea, in particular questions concerning ecological quality objectives (EcoQO) and possible indices. Other topics included the impact of fisheries on marine mammals, contaminants and diet.

Development and implementation of EcoQOs for marine mammals were discussed by the Working Group on Ecosystem Effects of Fishing Activities (WGECO), and the Study Group on Ecosystem Assessment and Monitoring (SGEAM) at their 2001 meetings.

A new action plan developed for the Living Resource Committee (LRC) includes marine mammals as an integral part. LRC theme sessions at the ASC meeting contained several marine mammal papers including ageing of minke whales and reproduction and growth in harbour porpoises. Suggested future theme sessions of relevance to marine mammals include titles such as 'Environmental Influences on Trophic Interactions' and 'Biological Effects of Contaminants in Marine Pelagic Ecosystems'.

The Committee thanked Haug for attending the meeting on its behalf. He will be unable to attend the next ICES meeting, but the Norwegian delegation agreed to provide an IWC observer.

4.3 Inter-American Tropical Tuna Commission (IATTC)

The reports of the IWC observer at the 68th Meeting of the IATTC and the 5th Meeting of the Parties to the International Dolphin Conservation Program held in San Salvador, El Salvador are given as IWC/54/10A.

Items of relevance to cetaceans at the IATTC meeting were the International Dolphin Conservation Program (AIDCP) and bycatch issues.

The main topic addressed at the International Dolphin Conservation Program (AIDCP) meeting was adoption of a new certification and labelling system for 'dolphin safe' tuna, under the definition 'Dolphin safe tuna is tuna captured in sets where there is no mortality or serious injury of dolphins'. Several resolutions addressing new government-administered regimes for verifying and tracking tuna catches to be labelled as dolphin safe were adopted. Other topics included placing observers on vessels transiting the eastern Pacific *en route* to the western Pacific (where dolphin-based fishing is reported not to occur), fishing by non-members of the IDCP and development of a system for implementing per-stock per-year mortality caps.

For the year 2000, the total dolphin mortality from tuna purse-seine fishing was reported as 1,636, from eight species/stock categories. The reported levels of take are less than 1% of the estimated abundance for all stocks.

4.4 International Commission for the Conservation of Atlantic Tunas (ICCAT)

The Committee had no observer's report from the most recent ICCAT meeting, but Kell agreed to act as observer at the next meeting.

4.5 Convention for the Conservation of Atlantic Marine Living Resources (CCAMLR)

The report of the IWC observer at the 12th meeting of the CCAMLR Commission held in Hobart, Australia is given as IWC/54/10D. No discussions were specifically related to the cetaceans. The Committee thanked Fernholm for attending the meeting on its behalf.

The report of the IWC observer at the 20th meeting of the CCAMLR Scientific Committee held in Hobart, Australia is given as IWC/54/10C. The main items of relevance to the

IWC were the Ecosystem Monitoring Program, management of krill and ecosystem management.

The Ecosystem Monitoring Program meeting began work on defining 'Small Scale Units' for exploitation (based on the needs of predators) for better management of the krill fishery. The expertise accumulated by members of the IWC during its own discussions on this subject may be helpful to CCAMLR. It was suggested that IWC members with knowledge of Small Scale Unit development could attend the forthcoming meeting of the CCAMLR Working Group on Ecosystem Monitoring and Management.

The Total Allowable Catches (TACs) calculated for the CCAMLR western Atlantic Ocean sector in July 2000 were 4 million tonnes. The annual krill catch is anticipated to rise from the current catch of around 100,000 tonnes to 150,000 tonnes. No TACs were available for the eastern Atlantic Ocean sector, and it was suggested that old datasets are analysed to achieve first estimates of the standing stock of krill that may serve as the basis for the estimation of preliminary TACs.

Regarding ecosystem management, the CCAMLR Scientific Committee encouraged its working groups to focus on ecosystem models rather than single species models, a first step being the estimation of temporal and geographical scales of environmental variables and their relationship to krill distribution and abundance. New methods to better estimate the consumption of krill were also presented. It was noted that the effects of water and air temperature increases on ecosystems in the Antarctic Peninsula region, the Scotia Sea and the peripheral parts of the Southern Ocean need to be considered. It was thought that development of a management strategy for the krill-based system may take another 5-10 years.

In regard to collaboration between the IWC and CCAMLR, a paper reporting the results of cetacean sightings made on the CCAMLR 2000 krill survey was submitted at the meeting. A combined IWC-CCAMLR workshop linking cetacean distribution and krill abundance is envisaged to take place in 2002/2003. Further discussion of IWC-CCAMLR collaboration is given under Item 12.1.1 and in Annex J.

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

4.6 Southern Ocean GLOBEC (SO-GLOBEC)

Matters relating to IWC collaboration are discussed under Item 12.1.2 and in Annex J. The Committee thanked Thiele for her work in promoting the collaboration.

4.7 North Atlantic Marine Mammal Commission (NAMMCO)

The report of the IWC observer at the 11th meeting of the NAMMCO Council held in Ilulissat, Greenland is given as IWC/54/10E. Agenda items of relevance to the IWC included: the NASS-2001 synoptic survey; white whales and narwhals; and marine mammal-fisheries interactions. Concern was expressed regarding the status of white whale stocks. The importance of continued research into marine mammal-fisheries interactions was stressed and priority recommendations included estimates of consumption by minke whales.

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

The report of the IWC observer at the NAMMCO Scientific Committee meeting held on board the Norwegian coastal steamer *MS Nordkapp* is given as IWC/54/10F. Items of relevance to the IWC included the role of marine mammals in the marine ecosystem; marine mammal stock status and advice; and North Atlantic Sightings Surveys.

A conference due to be held in January 2003 will aim to facilitate the incorporation of user knowledge into management advice provided by the Scientific Committee. The preparation of Stock Status Reports has begun so that users can supply information to these Reports.

The Working Group on the Economic Aspects of Marine Mammal-Fisheries Interactions concluded that significant uncertainties remain in the calculation of consumption by marine mammals, and that this uncertainty is the most important factor hampering the development of models linking consumption with fisheries economics. A further workshop was convened to investigate the methodological and analytical problems associated with estimating marine mammal consumption. Two approaches were considered: (1) analyses of stomach contents in combination with estimates of stomach evacuation rates; and (2) analyses of stomach or intestinal contents or faeces scaled to satisfy the estimated energy expenditure of the animals. Problems with both were discussed and a series of research need recommendations were made. IWC plans to convene a Workshop on a similar theme were noted. Results from this workshop would be taken into account in preparations for an ecosystem modelling workshop planned to investigate the ecological role of minke whales, harp and hooded seals in the North Atlantic.

The NASS-2001 synoptic survey covered the areas around Iceland, the Faroe Islands and west Norway including parts of the North Sea. The priority target species were minke and fin whales. The Icelandic coastal shelf was covered by an aerial survey, whilst the Faroese and Icelandic portions were ship borne and used identical survey methodology for the first time. The abundance estimates from these surveys were reviewed by a NAMMCO Working Group in March 2002. Preliminary estimates for minke whales concluded that the abundance of minke whales around Iceland has been stable or shown a moderate increase over the period 1986-2001. Abundance estimates for fin, humpback, sperm whales and dolphins were also presented.

The Committee thanked Øien for attending the meeting on its behalf. Øien will be unable to attend the next meeting of the NAMMCO Scientific Committee. The Committee thanked Walløe for agreeing to represent it at that meeting.

A number of papers (SC/54/H2, O8, O9, O10, O12) concerning abundance estimates from the NASS surveys were presented and discussed at the relevant sub-committee.

4.8 FAO – Committee on Fisheries (COFI)

The report of the IWC observer at the FAO COFI conference on Responsible Fisheries in the Marine Ecosystem, held in Reykjavik, Iceland is given as IWC/54/10I. The Reykjavik Declaration on Responsible Fisheries in the Marine Ecosystem was adopted at the conference. The Declaration is relevant to the work of the IWC Scientific Committee in relation to the Commission's decision to make the study of interactions between whale and fish stocks a priority topic. The Declaration incorporates the belief that including ecosystem considerations in fisheries management provides a framework to enhance management performance. It also affirms that the incorporation of ecosystem considerations implies more effective conservation of the ecosystem, sustainable use and an increased attention to interactions,

such as predator-prey relationships, among different stocks and species of marine living resources. Areas identified for investigation include the structure, components and functioning of relevant marine ecosystems, diet composition and food webs, species interactions and predator-prey relationships, the role of habitat and the biological, physical and oceanographic factors affecting ecosystem stability and resilience.

The Committee thanked Komatsu for attending the meeting on its behalf and agreed that he, or an alternate member of the Japanese delegation, should represent it at the next meeting.

4.9 United Nations Environment Programme (UNEP)

During the intersessional period the Secretariat received a letter from UNEP documenting plans to produce a World Digital Atlas on Marine Mammals (SC/54/O24). Zeh summarised the initiative, the objective of which is to create a global overview and information resource on the conservation and sustainable management of marine mammals. The Committee noted the ambitious nature of the plan and the difficulties encountered in establishing population estimates and trends. It **agreed** that the IWC should send a letter suggesting guidelines and advice on how the objectives could be achieved. Individual members of the Committee wishing to be involved should contact the organisation directly.

4.10 Other

4.10.1 North Pacific Marine Science Organisation (PICES)

Kato introduced the current activities of PICES. Following on from the Working Group convened to assess the feeding impact of marine birds and mammals, PICES have established a Bird and Mammal Advisory Panel whose aim is to send experts to other committees and organisations to provide scientific advice on ecosystem modelling and other information relevant to marine birds and mammals. At the 2001 Annual Meeting held in Victoria, Canada a workshop was convened entitled 'Changes in prey availability to mammals, seabirds and fish: mechanisms and effects'. The 2002 meeting will be held in October and has scheduled a symposium entitled 'Responses of upper trophic level predators to variation in prey availability: an examination of trophic linkages'. Further information on the activities of PICES is available from its website (*www.pices.ios.bc.ca*).

The Committee thanked Kato for this report. It was agreed that he should serve as IWC observer at the 2002 meeting and that his report should be included in the compendium of observers' reports at the next and future meetings.

4.10.2 Eastern Caribbean Cetacean Commission (ECCO)

The Committee also agreed that it should have an observer at meetings of ECCO. Rambally agreed to represent the Committee at future ECCO meetings.

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

5.1 Adjustment of the convergence criteria for the CATCHLIMIT program

Last year, one of four tasks remained incomplete: adjustment of the convergence criteria to be robust when less precise integration is used, possibly optimising the two-level convergence criteria (IWC, 2002d, p.5, item 5.1, task (3)).

This year Allison reported that lack of time had prevented her from examining the convergence criteria. She suggested that this work was best done in conjunction with using the program for *Implementation Simulation Trials*. The Committee **agreed** that this item should be carried forward to next year's meeting.

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

This issue is related to both the RMP and AWMP. The calculations specified at the 2000 meeting to inform discussions on this issue (IWC, 2001d, pp.91-2 and p.106) had not been conducted owing to time constraints. However, Allison reported that many of the preparatory changes to programs had been done. The Committee **recommends** that these calculations be conducted intersessionally and reported to next year's meeting.

5.3 Evaluation of abundance estimators against simulated datasets

5.3.1 Report of the intersessional working group on abundance estimation

The intersessional working group (IWC, 2001c, p.6) had continued its work of expanding the existing set of simulated datasets to enable evaluation of performance over a wider range of potential survey and biological conditions. Its report is given in Annex D (Appendix 2).

The program used to create simulated line transect abundance data had been expanded to include responsive movement and the models of measurement error used in the analytical methods to estimate abundance of North Atlantic minke whales (SC/54/RMP5). Evaluating the performance of new methods to estimate abundance is an ongoing process and the Committee **agreed** that the item should be a standing item on its agenda. In addition, it **recommends** that existing simulated datasets and associated documentation should be archived with the Secretariat.

5.4 Work plan

The Committee **agreed** to re-establish the Working Group, under Palka, with the priority task of expanding the existing set of simulated datasets with the features needed to evaluate the new methods being developed to estimate the abundance of Southern Hemisphere minke whales using IDCR/SOWER data (see Annex G, Appendix 5). In addition, the Committee **recommends** that existing simulated datasets and associated documentation should be archived with the Secretariat.

6. RMP – PREPARATIONS FOR IMPLEMENTATION (ANNEX D)

6.1 North Pacific minke whale *Implementation*

6.1.1 Report of Implementation Simulation Trials group

6.1.1.1 REPORT OF THE INTERSESSIONAL WORKSHOP

Donovan summarised the results of the Workshop, held in Seattle on 19-22 January 2002 (SC/54/Rep1). In its deliberations, note had been taken of the Committee's strong desire for the *Implementation* to be concluded at its 2002 meeting. Decisions had been taken on diagnostics for conditioning of trials and abundance estimates had been reviewed. The question of data availability had been raised and was referred to the Committee for further consideration (see Item 6.5.4). Genetic data analysis had been discussed at length, including hypothesis testing methods, a Bayesian approach and the Boundary Rank method. However, there was not complete agreement as to the plausibility of four resultant hypotheses on stock structure, involving from two

to four stocks. Japan had advised on its harvest plans, and these had been taken into account in the conceptual specification of a number of revised trials. A number of other issues requiring Committee consideration had been identified, and an ambitious work plan had been developed to complete the trials in time for the 2002 Committee meeting.

Thanks were expressed to Donovan and the other Workshop participants. It was noted that some of the stock-related issues raised at the Workshop would require consideration under Agenda Item 11, Stock Definition.

6.1.1.2 REPORT OF THE *IMPLEMENTATION SIMULATION TRIALS* GROUP

Butterworth presented this report (Annex D, Appendix 3). It had not been possible to have trial results ready for consideration at this meeting, mainly because further consideration of the genetic analyses in terms of the Group's mandate had led to the necessary development of substantial new hypotheses, which required further trials to be conducted to be able to report that any RMP variant recommended had been tested under trials that adequately spanned the plausible range of uncertainty.

As part of the Group's activities, a small group of US and Japanese genetics experts had met in Tokyo in December 2001; the participants were thanked for their contributions. However, attention was drawn to certain problems that had arisen, ascribed to lack of clarity in the meeting's Terms of Reference.

Taylor commented that overburdening of the Secretariat and inadequate time allocations for meetings were major reasons for the failure to complete the trials by the deadline. Kawahara remarked that the Terms of Reference for the Workshop mentioned only modification of trials, whereas two quite new scenarios had been put forward, consideration of which, he felt, should have awaited the next *Implementation Review*.

Miyashita had been asked by the Workshop to prepare revised abundance estimates (see Annex D, Appendix 4).

6.1.2 Consider relative plausibility of trials

Given the concerns raised under Item 6.1.1, particularly the inability to complete the *Implementation* as originally determined (see IWC, 2002d, p.8), this item and Items 6.1.3 and 6.1.4 were discussed after Item 6.2.

Under this item, the Committee reviewed the trial structure as well as the relative plausibility of trials. Because of its inability to complete the trials prior to the meeting, the Committee established three small groups to:

(1) consider the initial results from conditioning of the *Baseline-A* trials (convened by Allison);
(2) examine the specifications for the distribution of putative W stock in sub-areas 12SW and 12NE (convened by Allison);
(3) work on details of the specification for the *Baseline-D* trials (convened by Smith).

The Committee endorsed the conclusions of small group (2), contained in Annex D (Appendix 5). However, lack of time prevented the other two small groups from completing their work during the meeting, and they will be taken further by the intersessional Steering Group set up under Item 6.1.4.

6.1.2.1 PLAUSIBILITY OF DIFFERENT STOCK STRUCTURE HYPOTHESES

SC/54/RMP15 gave the results of an AIC (Akaike's Information Criterion)-based evaluation of the plausibility of baseline stock scenarios defined in SC/54/Rep1. They were based exclusively on mtDNA data derived from JARPN and JARPN II surveys. The four mtDNA haplotypes that presented the highest frequencies in sub-areas 7, 8 and 9 were used as independent parameters in the AIC. Different combinations of these haplotypes were used in evaluating the baseline scenarios and some of their variants. In addition, five groups of haplotypes, defined by a phylogenetic approach, were used for the AIC-based evaluation. The relative weighting of the model was assessed following the methodology of Burnham and Anderson (1998). Results of the AIC for the different combinations of haplotypes used were consistent, providing the best evaluation for *Baseline-A*. That scenario suggests that sub-areas 7, 8 and 9 comprise a single stock (O) with sporadic occurrence of individuals from a different stock (W) in part of sub-area 9. Although the AIC revealed that *Baseline-A* was the most consistent with the available mtDNA data in those areas, the authors noted that a more comprehensive evaluation of stock structure in the western North Pacific was still needed. Such comprehensive evaluation should consider the results of several approaches, both genetic and non genetic.

In response to a question for clarification, the authors indicated that the analyses in SC/54/RMP15 were based on all the genetic samples from sub-areas 7, 8 and 9, including possible J-stock animals.

There was extensive discussion of this paper with respect both to the appropriateness of using AIC criteria in this situation for assessing relative plausibility, and to the implication of the results of the analyses for the trials. Details are given in Annex D (item 6.3.1). In summary, there was general agreement that developing objective measures for evaluating plausibility and assessing relative plausibility or weightings is highly desirable. However, there was substantive disagreement about the general applicability of the AIC approach used in SC/54/RMP15, its application to genetic data with a large number of haplotypes and its relevance for assessing the plausibility of the different scenarios being considered in the trials. Nevertheless, the Committee **agreed** that further simulation testing of the other methods is desirable. It also **agreed** that the baseline scenarios defined in SC/54/Rep1 should be retained.

Information and analyses on the proportion of immature animals by sex taken in the JARPN and JARPN II surveys from sub-areas 7W, 7E, 8 and 9 are given in Annex D, Appendix 8. The results indicated that the proportions of immature and mature animals by sex in sub-areas 7E, 8 and 9 are similar, and different from the proportions in sub-area 7W. The main source of the difference is the occurrence of a higher proportion of immature males in sub-area 7W than in the other areas. Sub-area 7W was consistent with the inshore waters where many immature animals had been taken by small-type whaling. The authors believed it reasonable to conclude that immature animals are distributed in coastal sub-area 7W and that mature males are distributed in offshore waters from 7E to sub-area 9. They concluded that the results are consistent with the occurrence of a single stock in sub-areas 7, 8 and 9 which aggregates by sex and reproductive status.

In discussion, Butterworth suggested that the high proportion of immature males within sub-area 7W compared to sub-areas 7E to 9 raised the question of whether there could in fact be many separate stocks to the east of Japan. The most parsimonious interpretation of the data on maturity status and sex is that there are not.

It was pointed out that there was a very low proportion of immature females in all of the samples from areas 7, 8 and 9 and that there was no difference in the proportion of

immature females by longitude. Thus, the lower proportion of immature females in areas to the east of 7W indicates that sampling is missing a high proportion of the population no matter what stock structure model is assumed. Taylor, Martien and Polacheck considered that the information provided in Annex D, Appendix 8 was consistent with the hypothesis of only a single stock in the areas to the east of Japan; however, it was not inconsistent with the existence of more than one stock in those areas either. They further noted that if there are two or more stocks in the area east of Japan, the habitats for the more coastal and pelagic ones are substantial and very different. In such circumstances, it would not be unexpected that the latitudinal, spatial and temporal distributions of mature and immature animals by sex within each stock might be quite different, even though there may be substantial segregation by maturity state and sex within each stock.

The Committee also briefly reviewed Hatanaka and Miyashita (1997) which provided data on the proportion of mature animals by sex taken in the commercial coastal catches along the eastern side of Japan. It reported a similar pattern to the pattern found in the JARPN and JARPN II samples. The authors concluded that immature females as well as males were found in the western part of Area 7 early in the season (April to May) as well as in Area 11 in May and June. Hatanaka considered that these results further confirmed the consistency of the single stock hypothesis. There was limited time for further discussion of this question but there was no agreement about whether the available data on the proportion of immature animals by area and time were consistent only with a single stock hypothesis.

SC/54/RMP16 considered stock archetypes for North Pacific minke whales. Five archetypes were depicted: panmixia (corresponding to *Baseline-B*); maternal feeding ground site fidelity (*Baseline-C*); isolation-by-distance (*Baseline-C*); intrusion (*Baseline-A*); and broad mixing (*Baseline-D*). The authors discussed how these models relate to genetic measures. They emphasised that there were a number of reasons that no signal would be detected using nuclear data when a signal was detected using mtDNA data, including the fact that the effect size is much smaller for nuclear data, resulting in much lower statistical power and male biased dispersal estimates. As long as statistical power remains low, it is not possible to distinguish between maternal feeding ground site fidelity and actual separation of breeding grounds without data from the breeding ground. They also noted that the performance of analytical methods using genetic data to define stock structure has not been tested for any method other than Boundary Rank (Martien and Taylor, 2001).

In discussion, the difficulty of making inferences about breeding stocks simply based on detected differences in mtDNA frequency on the feeding grounds was further noted. There was general agreement on the importance and need to obtain data from the breeding grounds in order to make conclusive inferences about stock structure.

SC/54/RMP17 explored use of the trend in *p*-values as sample size increases to assess the probability that the observed trend in *p*-values for North Pacific minke whale samples taken in sub-areas 7 and 8 came from a panmictic population. Following detailed discussion, reported in Annex D (item 6.3.1), Taylor concluded that the results in SC/54/RMP17 provided support for hypotheses which included a potential coastal stock. Further, it was important to consider the power of the statistical tests to distinguish a difference in hypothesis-testing when considering the plausibility of different hypotheses.

6.1.2.2 DISCUSSIONS RELATED TO DETAILS OF THE TRIAL SPECIFICATIONS

SC/54/RMP18 raised detailed concerns from one Workshop participant who had been unable to attend the final part of the meeting when much substantive agreement had been reached. They related to: inter-annual variability in mixing proportions; assignment of W stock whales between Areas 12NE and 12SW; *Small Area* definitions and RMP variants; and finality of the specifications. They were referred for consideration, respectively, to the relevant groups already established to deal with: (a) finalising the *Baseline-D* trial specifications; (b) finalising the trial specifications with respect to the distribution of putative W stock animals within Area 12; and (c) considering further various aspects of the *Baseline-D* trial specifications. The Committee **agreed** that, as in the past, an intersessional Steering Group is required to oversee the finalisation of the trial specifications (see Item 6.1.4).

6.1.2.3 DISCUSSIONS RELATED TO THE BYCATCH LEVELS TO USE IN THE TRIALS

SC/54/RMP8 reported results from market surveys of North Pacific minke whale products conducted in Korea from May 1999 to November 2001, and from market surveys in Japan from February 1999 to January 2002. A total of 315 products were identified as North Pacific minke whale, based on sequencing of the mtDNA control region and by DNA profiling. Eight market surveys in Korea over the period yielded 193 separate North Pacific minke whale products, comprising at least 126 individual whales, 95% of which showed the characteristic mtDNA haplotype of the J-stock. In Japan, five market surveys yielded 122 North Pacific minke products, representing at least 97 individuals, 42% of which showed the characteristic mtDNA haplotype of the J-stock. Relatively few replicate products were found, indicating that products from many other individuals probably remained unsampled. Replicate samples of a small number of individuals were detected in consecutive survey periods, 2-7 months apart, but very few replicate samples of individuals were shared between surveys more than seven months apart, suggesting that products from an individual whale are not stored long-term and are sold in less than seven months. The duration of products from an individual on the Korean market was probably much less. Given the conservative nature of these censuses, it appeared that the total yearly Korean bycatch of North Pacific minke whales remains high, as does the Japanese catch of J-stock minke whales. This indirect evidence of high bycatch is confirmed by the reported bycatch (SC/54/ProgRep Japan; SC/54/ProgRep Korea).

As well as comparing the genotypes of all products within each of the markets sampled, SC/54/RMP8 also compared genotypes of products between markets. Surprisingly, two individual multi-locus genotypes were also shared between the Korean and Japanese market samples. Using the conservative Korean allele frequencies, the probability of these particular genotype matches occurring purely by chance was less than 0.05. Additional data are needed to ascertain with more confidence if these products represent the same individual whales in both markets. However, the small number of potential matches between the two countries indicate that bycatch products from Japan and Korea must be considered additive rather than overlapping.

There was extensive discussion on the possible implications of the information in SC/54/RMP8 and of other new information on what values to use for the level of

bycatch in the simulation trials. It was noted that the plausible range of values to use in the trials has been the subject of considerable debate.

Annex D, Appendix 9 reviewed changes in specifications over time and the new information available at the meeting, and proposed a range of plausible values for consideration in the trials. However, full agreement on the proposals could not be reached. There was lack of agreement on procedural aspects. Most members agreed that it was appropriate to consider revising the values to use for the level of bycatch in the simulation trial; in their view such a decision was fully consistent with the general procedures and timeframes recommended for conducting future implementations (see Item 6.2 and Table 2). Hatanaka and Kawahara disagreed because of the extensive amount of time spent on this issue in the past and because the trials are in their final stage of specification. Kim believed that new information had to be considered later, at the time of the in-depth assessment as the RMP reached its almost final stage. The sub-committee had not been able to reach consensus on this question and its Chair determined that it would consider possible revision to the level of bycatch to be used in the *Implementation Trials.*

Details of the sub-committee's lengthy discussions on this subject, and the decisions reached, appear in Annex D (item 6.3.1).

6.1.3 Consider Implementation options

SC/54/Rep1 included consideration of an RMP variant involving 'partial-cascading' (item 10.2). In this option, two *Small Areas* are defined (one comprising sub-area 9 and the other comprising sub-areas 7, 8, 11 and 12). In addition, these two *Small Areas* are defined as a combination area for the purpose of cascading. However, the catch cascades into the *Small Area* 7+8+11+12 are all taken from sub-areas 7W and 11. This 'partial cascading', as noted in SC/54/Rep1, is not in accord with the definition of *Catch-cascading* included in the RMP specifications. The Workshop had recommended that the Scientific Committee should review the concept of 'partial-cascading' and, if deemed appropriate, should develop any necessary additions to the RMP annotations.

There was general agreement that the issue of partial cascading and appropriate *Small Area* definitions for situations involving coastal whaling needed further discussion and consideration, and that a solution to this general problem was not possible at this meeting. However, a decision was required in terms of the North Pacific minke *Implementation Trials*, to allow work to proceed. For pragmatic reasons, the Committee **agreed** to use the RMP management variants defined in SC/54/Rep1 in the simulation trials. It emphasised that this decision should not be considered a precedent for future trials and that the issue will need to be further considered next year. Acceptable performance could still be achieved (in part relying on some of the conservative features within the *CLA*). However, this would mean that a solution to the multi-stock problem for any proposed 'RMP' implementation would be highly dependent upon the specific details and set of assumptions about mixing and migration. SC/54/RMP18 considered that such a change would represent a fundamental change in how the RMP was conceived to be implemented and would impose a substantially larger burden upon the *Implementation Trial* process.

There was extensive discussion about the partial cascading concept and the concerns raised in SC/54/RMP18 about the appropriateness of the *Small Area* options that would intentionally allow for and probably result in the catches within a *Small Area* being taken not in proportion to the stocks contained within it.

There was general agreement that the concept of partial cascading and the definition of a number of the *Small Area* variants being considered in the North Pacific minke whale *Implementation Trials* were not fully in accord with the definition of *Small Areas* in the RMP. There was also agreement that the definition of *Small Areas* created problems in the application of the RMP to whaling on the migration route, particularly in the context of coastal whaling and the North Pacific minke whale situation. This is because synoptic abundance estimates used to calculate the catch limits for a *Small Area* are from the feeding and migration areas when a large proportion of the animals are on the feeding grounds, as this is the best time for conducting such surveys.

6.1.4 Specify intersessional work to permit completion of Implementations

The Committee recognised that substantial intersessional work was still required if final *Implementation Trial* results were to be available at next year's meeting. While some of the work may be possible to complete via e-mail, there was general agreement that it was impractical to complete most of the substantial work required in this way and that an intersessional Workshop would be necessary. The Committee noted that two of the small groups concerned with substantive issues related to the *Implementation Trials* had been unable to report on progress directly to the plenary. In those circumstances the Committee agreed that the Terms of Reference for the intersessional Workshop should be similar to those adopted last year, (see SC/54/Rep1) apart from term of reference (1). It therefore **recommends** that such a Workshop be held as proposed. A Steering Group chaired by Butterworth was set up to prepare for the Workshop (see Annex S).

With respect to the small group looking into the conditioning of the *Baseline-A* trials, it was reported that technical problems were being encountered in conditioning. There were indications of minimisation problems in the estimation of the parameters as well as concerns about lack of fit to some of the abundance estimates. Since these problems had not been solved before the end of this year's meeting, the Committee **recommends** that Punt and Allison collaborate to try to find an acceptable solution. Once this was achieved, the results would be circulated to the small group reviewing the conditioning results (under Allison, see Item 6.1.2 above) for comments and suggestions. A final review and agreement on the conditioning will take place at the proposed intersessional Workshop.

Concerns were expressed about the problems being encountered with the conditioning of the *Baseline-A* trials and possible implications for completion of the simulation trials. It was agreed that the same procedure as outlined in the preceding paragraph be followed to complete the conditioning of *Baseline-C* and *D* trials and the sensitivity trials to each of these baselines.

6.2 Procedures and scheduling of *Implementations (Implementation Reviews)*

As already noted (Item 6.1.2) the sub-committee on the RMP had discussed this item before considering Items 6.1.2-6.1.4.

6.2.1 Proposals from last year and experience to date

Last year, the Committee expressed concern about the length of time taken to complete the RMP *Implementation* for North Pacific minke whales, and made some preliminary proposals for expediting the conduct of future *Implementations (Implementation Reviews)*, noting that they should be considered further this year (IWC, 2002d, pp.12-13).

This year, the Committee noted that, once again, its own timetable for the completion had not been met (Item 6.1.1). In view of the fact that the *Implementation* Trial process for North Pacific minke whales had taken longer than envisaged, the Committee first heard individual members' comments on the causes for the delays, then went on to draw lessons as a Committee from the experience gained and finally proposed a procedure for ensuring that future *Implementations* be completed on schedule once the prerequisites are met. Details of the lengthy discussions on this subject are given in Annex D (item 6.2.1).

The Committee noted that expeditious completion of RMP *Implementation*s was possible, because this had been achieved in the case of North Atlantic and Southern Hemisphere minke whales in the early 1990s. However, both biologically and operationally, North Pacific minke whales were a more difficult case because: (1) coastal whaling was concentrated into limited areas; (2) harvesting took place on migration routes, as well as on the feeding grounds, so that the temporal as well as the spatial dimension needed to be taken into account in understanding and modelling stock structure; and (3) related to the temporal dimension, the clear evidence of stock differentiation, e.g. between J and O stocks, did not automatically make area delineation easy because of the seasonally-dependent overlap proportion in different areas. Past exploitation and potential depletion of some stocks was also an exacerbating factor. However, it was noted that to a greater or lesser extent some of these factors also applied to the Southern Hemisphere case, and more to the North Atlantic.

The reasons why the *Implementation* had proved so difficult to complete were manifold, but nine issues were identified in this context, and are detailed in Annex D (item 6.2.1).

With respect to determining plausible scenarios, some members considered that a hypothesis must be supported by some data to be considered plausible. Others noted that this left the question as to what is the appropriate null hypothesis in the absence of informative data. Assuming a single stock for an entire region may not be a reasonable null hypothesis; experience with other species and areas shows that this is rarely the case. The Committee **agreed** that there needs to be a minimum level of information to start the *Implementation* process, so that the question of choosing null hypotheses in the total absence of suitable information would not arise (see recommendations below). However, a choice must be made regarding how wide a range of hypotheses to begin with, and whether the intention should be that hypotheses should only be narrowed as the *Implementation* process progresses.

The Committee also identified issues that arose after the results of initial *Implementation Simulation Trials* were available, where these suggested problems with the *Implementation*.

Hatanaka noted that in some cases, the results implied very small RMP catch limits for stocks from which several hundred animals had been taken annually over several decades without signs of depletion. This would be difficult to explain to those with an interest in the harvesting whales in the area.

The Committee recognised that this could occur, but noted that the RMP is designed to be conservative in cases where the data are insufficient. The option of basing catch limits on estimates of abundance in *Small Areas* at one time of year would tend to be the one selected when data are sparse, and could often result in rather low catch limits in areas where the historical harvest had been high. The Committee felt that in such cases it was necessary to explain the reasons for this and to identify what improvements to the data could change the outcome (such as more appropriate abundance data, better information on stock structure to enable the more conservative hypotheses to be excluded, etc). It may also be possible to identify changes in harvesting strategy that would solve the problem without the need for additional data. The experience had shown that it would not generally be appropriate to continue postponing completion of the *Implementation* indefinitely until such data were forthcoming.

There was considerable debate over whether an alternative version of the RMP needed to be developed to cover 'difficult' coastal whaling cases such as the North Pacific minke whale. The Committee noted that management of coastal whaling was clearly one of the main interests of the Commission in developing the RMP. It was also noted that none of the specific problems associated with the North Pacific minke *Implementation* were caused by specific provisions of the RMP. However, the problem of defining *Small Areas* for whaling on migratory corridors will be a recurring problem.

After considerable discussion of the issues involved, the Committee agreed that the RMP could be implemented for coastal whaling, taking advantage of the flexibility already provided for in the RMP provisions, and the potential to consider operational measures, such as spreading catches spatially with *Small Areas*.

6.2.2 Proposed process

The Committee went on to consider solutions to the problems identified. They could be usefully divided into two types: (1) general policy and scientific issues; and (2) process issues (as discussed in Annex D, item 6.2.2) as listed below:

(1) General policy and scientific issues, e.g.
   (a) What level of population structure merits conservation?
   (b) What constitutes plausible hypotheses, and how to rank or weight these?
   (c) How should *Small Areas* initially be chosen, i.e. how should the RMP definition be converted to a more applicable working definition?
   (d) How should balance in trials be achieved, in particular to avoid excessive emphasis on scenarios which are more difficult in a conservation context?
   (e) How should abundance estimates be calculated for cascading when the main synoptic survey estimates for the total stock size are not very applicable to the size of a (sub-) stock migrating through a coastal whaling area?

(2) Process issues, e.g.
   (a) Where and when is the dividing line between an In-Depth Assessment and the start of an *Implementation*?
   (b) How to ensure that the In-Depth Assessment results in a suitable range of hypotheses about stock structure?

(c) How and when to determine whether a sufficient baseline of information exists to begin the *Implementation* process?
(d) How and when to select factors of sufficient potential relevance to include in hypotheses for *Implementation Simulation Trials*?
(e) When and how should plausibility of hypotheses be assessed in order to narrow down the range?
(f) What arrangements are required to ensure adequate access to the data by Committee members?
(g) What data should be used for conditioning and how precise does the conditioning need to be?
(h) When should it be determined that new data cannot be considered for the current *Implementation*?
(i) How can it be ensured that final specification and conduct of trials proceeds expeditiously after this point?
(j) How can the description and results of the trials be presented in a sufficiently transparent manner to be comprehensible to non-specialist Committee members?
(k) What kind of accompanying advice/information/ explanation should be included with the final recommendation for an *Implementation*?

Suggestions for dealing with each are given in Annex D (item 6.2.2).

The Committee **agreed** that the *Implementation* process should proceed expeditiously once it had been ascertained that the basic requirements to proceed had been met. However, it was emphasised that decisions made in order to complete the *Implementation* should not set an immutable precedent for future *Implementations* and *Implementation Reviews*. To proceed expeditiously with an *Implementation*, it is often necessary to make provisional decisions about certain factors, that should not be taken as final judgements that bind future *Implementations*.

Whatever the results of an *Implementation*, they should be presented to the Commission. It may also be appropriate to include recommendations as to how the *Implementation* might be improved in the future, particularly with respect to new information. It was noted that the RMP provides for the subsequent *Implementation Review* to be brought forward in the event of major new data becoming available.

The Committee **recommends** that *Implementations* and *Implementation Reviews* be conducted according to the schedule shown in Table 2.

In that context, the assessment that precedes an *Implementation* is termed *Pre-Implementation Assessment* to distinguish it from the In-Depth Assessments conducted for species on which whaling is not currently envisaged. The *Pre-Implementation Assessment* should take account of all relevant knowledge on the species in the region. The proposed schedule does not define the length of time required for this assessment. As part of that assessment, the Committee would decide whether to proceed with an *Implementation*. Once the decision to proceed is made, the process should be completed according to the schedule in Table 2.

Annex D (item 6.2.2) lists five general issues requiring serious consideration: (1) issues related to stock structure; (2) plausibility and levels of uncertainty; (3) spatio-temporal considerations; (4) data availability and transparency; and (5) levels of information needed both for conducting a *Pre-Implementation Assessment* and for proceeding to an *Implementation*. Action to resolve items (1), (2) and (4) had already been initiated at this meeting. A report from the sub-group established to advise on (2) is attached as Appendix 13 to Annex D. The Committee **recommends** that items (3) and (5) should be discussed next year; papers or submissions on each are encouraged.

6.3 North Atlantic minke whale *Implementation Review*

6.3.1 Report of steering group

An e-mail correspondence group under Smith was established last year under terms of reference given in IWC (2002d, p.12). Working from the six items described there, the group identified data sources and analysis steps required for preparations to conduct an *Implementation Review*. The timing requirements for data and analysis availability under the RMP were noted.

The following identified items are described more fully in Annex D (item 6.4.1):

(1) new data from sightings surveys, and information on dive times;
(2) new abundance estimates, together with analyses of surfacing rates;
(3) information on stock structure from DNA studies;
(4) potentially relevant ecological information.

The correspondence group had noted that the availability of new estimates of abundance did not meet the three months' lead-time required under the RMP. The delay in making estimates from the new data available was necessitated by the need for 'quality control of the analyses'.

6.3.2 Implementation Review

Annex D (items 6.4.2.1-6.4.2.3) reports information provided to the meeting on stock structure and abundance, based on analyses of genetic data (SC/54/RMP6); a sightings survey in 2001 (SC/54/RMP1); radio tracking experiments (SC/54/RMP2); estimation of bias and variability in radial distance (SC/54/RMP3); and spatial distribution (SC/54/RMP4). SC/54/RMP5 presented an analysis of data from Norwegian annual surveys 1996-2001.

The Committee concluded that the analyses suggest that animals in the North Sea *Small Area* may be differentiated from animals in other areas. Further, there is the possibility that the distinction made between *Medium Areas* E and C may need to be reconsidered. The Committee was interested in seeing further application of the boundary rank method to the genetic samples collected from catches since the last *Implementation* was completed. Further, Walløe indicated that Norway was interested in removing the Lofoten Island *Small Area* distinction and combining that area with surrounding areas.

Examination of the previous *Implementation Simulation Trials* indicated that these possibilities had not been completely considered then. Further, the RMP specification suggests that *Implementation Simulation Trials* may be required when *Small Area* definitions are changed.

Given the limited time available, further consideration of this item was left to a small group under Cooke (Annex D, Appendix 14). The Committee noted that any decisions concerning *Implementation Simulation Trials* would be taken next year.

The Committee noted Norway's plans to continue undertaking surveys in the North Sea, and **recommends** that the Commission requests the relevant UK Government authorities to grant permission in timely fashion for the Norwegian vessels to undertake surveys in its EEZ.

Kell reported that at the Commission meeting in 2001 the UK had indicated that it had regretted denying access but had

Table 2

Recommended schedule for an *Implementation* and subsequent *Implementation Reviews*.

(1) x+ Annual meetings		(2) Intersessional workshop		(3) Annual Meeting		(4) Intersessional workshop		(5) Annual meeting
'Pre-implementation assessment'[1]	→	Trial structure development	→	Conditioning and final trial structure	→	Review results of final trials	→	Committee oversight
The assessment will be geared towards answering specific questions agreed by the RMP Scientific Committee, including: (a) plausible stock hypotheses consistent with the data (taken *inter alia* from the agreed list of archetypes); (b) abundance estimates; and (c) level of information available in the context of 'likely' whaling operations - taking into account the complexity of the situation with regard to spatio-temporal issues. Will use a 'simple model filter' (à la Punt) to assess importance of hypothesised factors in terms of management. (d) specification of plausible hypotheses should be inclusive enough that it is deemed unlikely that the collection of new data during the *Implementation* process would suggest a novel hypothesis not already specified in the basic trial structure. On the basis of this the Committee will recommend whether or not to move to the IST stage (2) or not. If not it will make research recommendations to try to obtain necessary information.		To determine the appropriate trial structure. This will include a precise specification of the plausible hypotheses and 'units to conserve' arising from stage (1), and elimination of those inconsistent with the data. This will interact with more detailed information in operations, including whether coastal, pelagic, on migration, on feeding, on breeding or combinations of these – comments from 'users' and scientists (who may suggest modifications). The basic building blocks for constructing *Small Areas* will be determined, along with options for *Small Areas* and management variants. Data and methods for conditioning of trials will be specified (but e-mail group can adapt them if problems). After this stage, there shall be no changes to the agreed trials structure that implements the agreed plausible hypotheses.		The meeting will review the results of conditioning. *Trials* may be modified based on these results, but trial structure will not change. If an otherwise plausible hypothesis is poorly implemented, modify its implementation. Results of new analyses of data presented at stages (1) or (2) may be considered as part of this process. Final *Trials* will be determined following further consideration of plausibility: ranking or weighting of hypotheses. Specification of scenarios, management areas, and cascading variants to include in the final trials. Updates to standard data series (e.g. abundance, catches, bycatch) will be included in the final *Trials*. Include discussion of what research may reduce range of uncertainty and likely time frame of such research.		The meeting will review the results of final *Trials* and make recommendations on: (a) management areas; (b) RMP options, e.g. cascading, capping; (c) associated operation restrictions (e.g. in time) (d) research needs (either within or outside operations) to narrow range of plausible hypotheses. If more than one RMP implementation variant is supported, it might be appropriate to link recommendation for 'less conservative' option with recommended research. If results not forthcoming to support this by next *Implementation Review*, then limits will be set at that time on the more conservative variant.		Review and agree recommendations for implementation, and final abundance estimates.[2] Calculate catch limits using CLA for the recommended management options. Make recommendations to the Commission. This might include more than one management option with advice on the implications of each and recommendations regarding appropriate research. (At this stage the Commission may wish to amend the Schedule and establish catch limits.)

(9) Annual Meeting		(8) Intersessional Workshop		(7) Annual Meeting		(6) Intervening period
						Data collection: see box 4
Carry out *Implementation Review*. Make recommendations to Commission.	←	Determine new trials to account for new information (depending on complexity, this may resemble either stage (2) or stage (3)	←	Examine new information and determine if this is inside/outside tested parameter space and/or if it has narrowed hypotheses. If yes, need new trials and at least one workshop If no, straight to *Implementation Review* at Annual Meeting (9)	←	RMP annotation 9 specifies that an *Implementation Review* should normally be scheduled no later than 5 years since completion of the previous *Implementation (Review)*, but earlier if important new evidence on stock identity, major changes to abundance estimation methodology, etc.

[*Table 2 continues on next page*]

done so after careful consideration for reasons outlined in IWC (2002b). The UK had noted the request to reconsider its decision and had given an undertaking to do so.

6.3.3 Specify intersessional work to permit completion of Implementation Review

The intersessional work required is specified in Annex D, Appendix 14.

6.4 Western North Pacific Bryde's whales

6.4.1 Report of Implementation Simulation Trials group

Allison reported that because of other priorities, there had not been time to code and run any trials as recommended last year. She planned to establish a process for examining catch data prior to trials taking place. The data would be tabled by areas small enough such that any future trials would only use combinations of the prepared datasets and not require any further disaggregation.

In considering the above, the Committee noted its discussions below, concerning the need to reconstruct the past catches. It agreed that Allison's proposals for examining catch data should be held over until that reconstruction had been completed.

6.4.1.1 CATCH DATA TO BE USED IN THE TRIALS

Last year, the Committee had been provided with information on unreported catches of large whales, including Bryde's whales, in Japanese coastal whaling operations, and had encouraged further investigation of the issue. SC/54/O13 had been prepared in response. It contained further information on such catches by species, region and month for limited operations by one whaling company between 1965-78, and compared them with official statistics. The senior author of SC/54/O13 was Mr I. Kondo, whose book on the subject had been drawn to the Committee's attention last year (Kondo, 2001).

SC/54/O13 described major under-reporting of sperm, sei and Bryde's whales taken off the Pacific coast of northern Japan; with catches often over twice the officially reported catch. There were problems with species identity: some fin whales taken in the Sea of Japan and the Okhotsk Sea, for example, had been recorded as sei whales. Sei and Bryde's whales were not completely separated in the record. The information had been derived from operation summary charts of one company, covering monthly whaling operations by geographical region, giving positions of whales taken, monthly catches by species and cumulative catches by season. Figures derived from those charts differed in some minor aspects from those given in Kondo (2001), but were regarded by the authors as true figures. Kondo (2001) recorded under-reporting of Bryde's whales off the Bonin Islands in 1981-1987 but the original records have been lost.

In discussion, Sakamoto noted that verification of information is essential before the Committee uses it because the accuracy of the information is unknown.

The Committee **agreed** that further work is needed to reconstruct past catches in more detail. An intersessional Working Group under Brownell (members: Kasuya, Smith) was given the task of investigating the quality and nature of data provided in the past, including requesting data from additional whaling companies, and suggesting methods of dealing with it, for use in the *Implementation Trials*. Given that unreported catches are experienced in finfish fisheries investigations, the group was authorised to seek advice from, and as necessary co-opt, someone outside the Committee with relevant expertise. It was also authorised to co-opt

A number of assumptions are made for this process (see Discussion in report). These include:

(1) Agreement within the Scientific Committee of what are the minimum information requirements for a *Pre-implementation Assessment* to occur.

(2) Availability to the Committee of the data on abundance and stock identity at the beginning of the *Pre-implementation Assessment* (see item 6.6.4). This will also be linked with agreed processes to validate new collection/analysis methods before accepted for providing management advice (e.g. abundance estimates, stock-id).

(3) Agreement that once Stage (2) begins, the process will continue until Stage (5) and a recommendation to the Commission on the *Implementation* will occur about 1.5 yrs later.

(4) Agreement on a set of stock structure archetypes for consideration when developing stock hypotheses –will include an initial proposal for appropriate 'units to conserve' (see stage (1)).

(5) Broader agreement on issues surrounding plausibility, appropriate levels of uncertainty – in effect, when is it acceptable to implement.

[1] It is anticipated that the Pre-Implementation Assessment (which is similar to an in-depth assessment, but is more management-oriented) will be conducted with broad-base participation, and will ensure that all relevant knowledge about the species in the region is taken into account. Once the Assessment phase is completed, much of the work will be done by smaller groups, whose mandate is to ensure that the results of the Assessment are adequately reflected in the design and selection of trials.

[2] Definitive abundance estimates, for the management areas being considered, for calculating catch limits (as opposed to conditioning trials) must be available under RMP rules at least 3 months prior to stage (5). Allowing for 3+ months to prepare them, they should be requested at stage (3), since the time following stage (4) may be insufficient.

Committee members with relevant expertise, as appropriate. Copies of the operation summary charts should be lodged with the Secretariat.

Komatsu stated that Japan disagreed that the operation summary charts should be lodged with the Secretariat since the information on the charts has neither been verified nor endorsed by the Government of Japan. He further stated that Kondo had refused to make contact with Japanese Government officials who had requested to see him to provide the information on the past whaling data. Therefore, the Government of Japan was unable to check and verify the information and maintains its position at this time that the statistics already provided are still the official data. Komatsu also indicated that Japanese scientists would not serve on the intersessional group.

Kasuya responded that Mr Kondo saw no reason to meet with the Government of Japan because he had already made details of the statistics available in his book, and because he was making these details available to IWC in the paper written with Kasuya (SC/54/O13).

Smith expressed his considerable regret at the lack of response from Japanese scientists in assisting with the work of the intersessional group.

6.4.1.2 STOCK STRUCTURE

SC/54/O17 (appendix 10) provided information on mitochondrial DNA control region sequencing and microsatellite analyses conducted on samples of the ordinary form Bryde's whales from different localities of the western North Pacific. A total of 58 unique mtDNA sequences (haplotypes) were discriminated in the total samples. No significant differences among the three localities in the North Pacific were revealed. In contrast, striking mtDNA differences were found among oceanic regions. Additional analyses found some degree of heterogeneity between historical samples from Ogasawara and recent JARPN II samples but the same test found no significant heterogeneity between JARPN II and the central western North Pacific (CWMP) or between Ogasawara and CWNP. Microsatellite analysis gave no significant deviation from the Hardy-Weinberg equilibrium or significant differences in allele frequencies. In contrast, striking nuclear DNA differences were found among samples from the western North Pacific, the western South Pacific and the eastern Indian Ocean, confirming the occurrence of different genetic populations in those three regions. Overall the results provided support for the stock structure scenario defined by the Committee during the Comprehensive Assessment (IWC, 1997a, p.83). The authors noted that the mtDNA heterogeneity found between Ogasawara and JARPN II is difficult to interpret at this stage and that other information (apart from genetics) should be considered in future to provide a better interpretation and conclusion.

The Committee noted that sample sizes in the above study remain small, and it was suggested that genetic and pollutant analyses (see SC/54/O17, appendix 13) might be coupled to provide useful information.

It was **agreed** that the results reported in SC/54/O17 provided no reason to change the stock structure in the existing trials, but that as much work as possible should be undertaken before the next meeting to allow a full and detailed discussion at that time.

In discussion of the Implementation Schedule (Table 2) in this context, it was noted that activities so far were still within the *Pre-Implementation Assessment* referenced in 'Box 1'; it would be necessary to review progress at next year's meeting to determine exactly what point had been reached on the schedule. Hopefully by that time, meeting the criteria in Box 1 would be well advanced.

The Committee noted that it may be in a position at the next meeting to complete the *Pre-Implementation.* If so, any new data after that meeting that might indicate additional hypotheses would only be considered in the subsequent *Implementation Review.* Coding of the trials, as specified (IWC, 2000c), would accordingly be suspended until next year's meeting.

6.4.2 Sightings surveys

Information on two Bryde's whale surveys conducted in the western North Pacific, in July-August and August-September 2001, was provided in SC/54/RMP10 and RMP13. Details are summarised in Annex D, item 6.5.2.

Plans for a Bryde's whale survey in the western North Pacific in August-September 2002 were given in SC/54/RMP14. It will only take place if the planned minke whale survey (see Item 6.5.1) does not receive permission to operate in the Russian Federation EEZ.

The Committee **endorsed** the proposal in SC/54/RMP14 and asked Shimada to provide Committee oversight for the survey should it take place.

6.5 Other

6.5.1 Sightings survey plans for North Pacific minke whales

SC/54/RMP9 detailed plans for a sightings survey for minke whales in the Sea of Okhotsk in summer 2002. It will take place from 23 July-20 September, using two vessels, with the objective of estimating abundance using IO passing mode. Biopsy samples for assessing stock structure will be collected opportunistically. Training and experiments in distance and angle estimation will be conducted.

The Committee **endorsed** the proposal and **recommends** that the Commission requests the relevant authorities of the Russian Federation to grant permission in timely fashion for the Japanese vessels to undertake surveys in its EEZ.

SC/54/RMP12 described joint Japan/Korea sightings surveys in the Sea of Japan in 2002. Using two vessels, the main objective is to obtain information on distribution and density of the East China Sea-Yellow Sea-Sea of Japan minke whale stock, using normal closing mode. One vessel will conduct opportunistic biopsy sampling. One survey has already been undertaken (10 April – 9 May) and the other will take place from 13 May – 1 July. Kim reported that one Korean scientist will be participating.

The Committee **endorsed** the proposal and asked Miyashita to provide Committee oversight for the surveys.

SC/54/RMP19 provided information on plans to conduct a sightings survey from 20 August – 19 September 2002 in western Korean waters. Its objective is to estimate minke whale abundance in terms of the RMP, in both closing and passing mode, and to obtain general information on seasonal cetacean distribution.

SC/54/RMP20 detailed a Korean sightings survey in the Yellow Sea, undertaken in September 2001. Due to bad weather, only 49.5% (621.6 out of 1,255.7 n.miles) could be undertaken on effort. Minke whales were aggregated in the southern part of the offshore area.

SC/54/RMP21 described a revised plan for a sightings survey in eastern Korean waters. It had been revised in accordance with discussions at last year's meeting, particularly in terms of coverage probability and randomness of start points. One vessel will operate from 14 May – 18

June. The survey area is divided into seven rectangular blocks taking account of land shapes, with a total predetermined transect distance of 1,370 n.miles (see also Kim, 2001).

The Committee **endorsed** the proposals in SC/54/RMP19 and RMP21 in terms of the RMP and asked Miyashita to provide Committee oversight for the surveys. It **recommends** that the survey report and plans be elevated to full paper status to ensure they are entered into the record (SC/54/RMP19, 20, 21).

6.5.2 Initial planning for an in-depth assessment of North Pacific minke whales

The Committee judged that work on this assessment should be delayed until the North Pacific minke whale *Implementation* is complete. However, members noted with concern the information it had received about much higher levels of bycatch (reported as 148 from Korea in 2001) in the region of the J-stock (see Annex D, item 6.3.1), which, on the basis of some of the current trials, could lead to severe depletion on a short time scale. Some members commented that an updated assessment could lead to a reappraisal of this possibility. The Committee **agreed** that there is a need to address the assessment of North Pacific minke whales as a matter of urgency at next year's meeting, but noted that the *Implementation Simulation Trials* would provide some information on this issue.

6.5.3 Revision of RMP annotations

There were no matters requiring attention at this time.

6.5.4 Data availability

The Intersessional Workshop (see Item 6.1.1 and SC/54/Rep1) had encountered difficulties over access to genetics data important to the development of trials. It had noted that the matter of data availability is complex and sensitive, involving the need to strike a balance between the Committee's needs and the rights of scientists who had collected the data, and the great importance of the issue to the Committee's work in the context both of the development of *Implementation Simulation Trials* and in discussions of their relative plausibility. It had strongly recommended that the question of data availability should be considered at this meeting.

The matter was referred to a working group under Donovan (Baker, Cooke, Hammond, Hatanaka, Perrin, Smith, Walløe). The Working Group had the task of reviewing the question further and recommending possible courses of action, for agreement by the Commission.

Donovan reported that the group had only a limited time to meet and discuss what is clearly a vital issue to the work of the Committee (see SC/54/Rep1 and Annex D, item 6.6.4).

The Working Group had agreed to address issues under two headings: (1) data access and safeguards to protect the rights of data providers; and (2) arrangements for analysis. There was consensus that the data required to develop plausible hypotheses and develop appropriate *Implementation Simulation Trials* are as important as those required for the *CLA* itself in the overall implementation process. Although some useful clarifications were made, no agreement as to how to solve the question of data access had been reached in the time available.

The Working Group also agreed that it would be unhelpful to try to rush through any proposed solution to this issue at the present meeting. The Committee **agreed** that the group should continue to work intersessionally with a view to providing the Committee with either a consensus recommendation, or a limited number of options to consider at the next meeting. It was recognised that a decision on this important issue must be taken at the next meeting.

The Committee also **agreed** that, in order to obtain a better understanding of the current system established in Japan for access to genetic and other data, it would be helpful if members of the Committee requesting data copied both their requests and the replies received to the intersessional group (via Donovan).

6.5.5 Comparison between CLAs and SLAs

Walløe and Hatanaka commented on the comparison of the catch trajectories between the *Bowhead SLA* (recommended by the Committee for the management of the aboriginal subsistence fishery for bowhead whales in Alaska) and the RMP's *CLA* reported in Annex E (Appendix 6). They noted that under the base-case (BE01) trial, the *CLA* did not allocate catches until 2030 and that the catch did not reach the current need level in the 100 year simulation period. They believed that this emphasised that the *CLA* was far too conservative.

The Chair of the SWG on the AWMP drew attention to the reasons why a direct comparison of the *Bowhead SLA* and the *CLA* was inappropriate as summarised under Item 8.2.1.3.

6.6 Work plan

The work plan agreed by the sub-committee on the RMP is given in Annex D (item 6.7). The discussion of the Committee's overall work plan is given under Item 19.

7. ESTIMATION OF BYCATCH AND OTHER HUMAN-INDUCED MORTALITY (ANNEX M)

7.1 Estimation of bycatch based on fisheries data and observer programmes

The Committee reviewed records of large whale bycatch in National Progress reports for the statistical year 2001. Common minke whales were the most recorded species (over 230); the records were very clumped, notably in Japan and in eastern Korea. This raises the question as to whether this is due to better reporting in these areas, or whether there is some aspect of the fisheries in these two regions which made bycatch more likely than elsewhere.

SC/54/ProgRep Japan records that all minke whale bycatches occurred in trap nets. Similar nets in other parts of the world (e.g. Newfoundland, Canada) are also known to entrap large whales (Lien, 1994). The Committee had no information regarding the use of trap nets in other countries and **agreed** that a request from the Commission to member states and other states asking for details of fishery categories might help elucidate this point (see Item 7.1.4).

Issues of reporting efficiency and how current reporting schemes are implemented were discussed in detail, as such matters are crucial to providing advice to the Commission on how best to estimate total large whale mortalities in fishing gear.

In the Republic of Korea, all large whales whether bycaught, stranded or floating at sea, have been subject to a national reporting scheme since 1996. All such animals have to be reported to the marine police agency located in every port. The marine police assess the cause of death and make a thorough report. The Prosecutor then judges whether the law has been breached based on the report. Domestic disposition of bycatch is only allowed through this system,

which now works routinely. It was queried whether marine police officers were qualified to make pronouncements on the cause of death of cetaceans, noting that this requires specialist experience.

Biological sampling has proved difficult because it requires appropriate expertise. Starting this year, a biological sampling programme is being implemented by hiring experts to sample carcasses in collaboration with the regional authorities and the marine police. Furthermore, guidelines on bycatch reporting will soon be incorporated into the fisheries law. Sohn asserted that the existing mandatory reporting scheme in Korea made any further attempts to estimate bycatch unnecessary there. He further pointed out that the bycatch is highly sporadic in a range of coastal fisheries and occurs mainly within three miles of the coast. Fisheries operating in this area are small scale and there are few relevant data that could help in any bycatch estimation methods.

All bycatches of large cetaceans must also be reported in Japan. Recent changes in domestic legislation (since 1 July 2001) now make it possible for Japanese fishermen to market bycaught whales, provided each was recorded and a DNA sample taken (IWC, 2002j, p.363). Prior to 1 July 2001, it had not been compulsory to report bycaught whales, but Ministry guidance encouraged the reporting of any such events.

The number of bycaught minke whales recorded in Japan in 2001 (79) was considerably higher than in 2000 (29). In 2001, there had been 54 minke whales reported over the six months since the new legislation was introduced compared to 25 in the preceding six months. There was some discussion as to why there had been an apparent increase since the introduction of the new legislation, but Nagatomo stated that it was not clear if this was a significant increment, and that several more years of data would be needed to determine this.

Bycatch reports in Japan and Korea might be more complete than in other countries because there was no dis-incentive for reporting. In the USA and some other countries, penalties for reporting bycaught whales might impede accurate reporting. Mattila confirmed that in the USA, records of bycaught whale numbers seemed to be declining in some fisheries, possibly because fishermen were becoming aware of the potential threat to their livelihood posed by the accidental capture of whales.

There was some discussion as to whether incentives for reporting bycatch might actually lead to increases in whale mortalities. Last year, it had been reported that the new fisheries Ministerial Ordinance and related guidelines would allow fishermen to kill animals that could not be released from nets in order to market them (IWC, 2002d, p.15). Nagatomo stated that even though fishermen are now able to market whale meat from bycatches, they must still make best efforts to release whales from nets when caught, and only if they cannot be released can they be killed. It was not known how many bycaught minke whales had died as a direct result of entanglement and how many had been killed in order to remove them from the nets; the operating body itself can decide how to deal with an entangled whale. Japanese fishermen are able to apply for compensation for nets damaged by bycaught whales.

The Committee **agreed** that there is no clear explanation as to why recorded bycatches of minke whales are so much more frequent in some areas than others. The aggregated total number of bycatches in National Progress Reports are unlikely to represent a complete estimate of the total bycatch mortalities, since not all countries are IWC members and not all members submit bycatch records to the IWC. Recommendations regarding this issue are given under Item 7.1.4.

Komatsu stated that Japan cannot agree with the above conclusion and recommendations. He pointed out that Japan voluntarily submits bycatch data in Japan's National Progress Report since this is a matter of responsibility of national governments. He expressed the view that any inference that these data are inaccurate is unacceptable. He also noted that the apparent increase in bycatch may reflect an increase in the stock.

Perrin noted that no data are available to the Committee on the minke whales bycaught but released. If this number has decreased since the fishermen were authorised to kill and market bycaught whales, that could explain the increase in reported bycatches.

7.1.1 Collation of information from fisheries

Last year, the Committee reviewed a list of categories of information that might appear on a form that could be distributed to identify certain fisheries where bycatch is thought to take place, in order to assist in the future design of appropriate sampling schemes (IWC, 2002d, p.13). An intersessional group was established to take this matter further (IWC, 2002k, p.413). The success of this exercise will depend on how the first field of the query (fishery category) is interpreted. Each country is likely to categorise fisheries in an individual manner, based on some combination of target species, gear type and geographical area. A recommendation to help address this issue is given under Item 7.1.4.

This information gathering exercise could be used to identify fisheries for which there is little or no information on bycatch but which share common characteristics with fisheries where bycatch has been monitored. The Committee **agreed** that it is important to consider such fisheries, as well as fisheries where bycatch is known to occur. Consideration of these data might suggest the relative priority of monitoring programmes to assess incidental takes for different fisheries.

The Committee **recommends** that modelling studies should be encouraged to try to estimate how much observer coverage of a particular fishery would be required to allow reliable estimates of large whale bycatch. Such studies should assist in assessing how best to utilise data as they become available from the information gathering process. The Committee encourages papers on these types of statistical studies to be submitted.

Kim questioned the need to consider estimation of bycatch given that he believed the mandatory bycatch reporting system in the Republic of Korea resulted in all bycatch being reported. He suggested that if there was reason to believe that bycatch was occurring in a particular fishery within a country, then the Commission could ask that member government to establish a bycatch reporting system rather than ask for fisheries information. Other members noted examples where independent observer schemes had been established for fisheries that already had reporting schemes. In several cases these revealed much greater levels of bycatch than had previously been reported.

7.1.2 Fatality rates of large whales entangled in fishing gear

The issue of disentangling large whales was raised in Resolution 2001-4 (IWC, 2002c) and is considered in detail under Item 12.3.5. Discussion of this topic under the present

agenda item focused on the entanglement and freeing of large whales from fishing gear, especially in the Northwestern Atlantic. Large whales are sometimes seen at sea entangled in fishing gear and the experiences of researchers in that region working with several species of large whale might be useful in providing a photographic or diagrammatic catalogue of the types of damage likely to prove ultimately fatal and the types that might be reasonably assumed to be non-fatal. Mattila responded that there were some types of damage that were clearly potentially fatal, including those where young animals were entangled and could be expected to 'grow into' ropes that could ultimately result in their death. Minke whales, as one of the smallest of the baleen whales are the most likely to die as a result of entanglement in the short term, whereas larger whales may swim away with gear attached and succumb at a later date if feeding is impaired or if the entanglement leads to serious infection.

The Committee considered whether there is information on the proportion of entangled animals that are ultimately known to have died as a result, and whether there is any relationship with fishing effort or gear density. Researchers at Memorial University in Newfoundland have been involved in such research for over 30 years and may have relevant information. It was **agreed** that the Committee should contact this group to request a paper for next year's meeting.

SC/54/BC6 reported on a bycatch reduction strategy emanating from a Workshop held in Annapolis in January 2002. The strategy includes a suggestion that formal national Plans of Assessment to estimate bycatch rates should be developed. Such Plans would include collection and analysis of data to describe fishing fleets, including the size of the fleet (number of vessels), fishing methods, fishing areas and measures of fishing effort. They should also include, where appropriate and possible, bycatch monitoring schemes based on independent observations. The strategy is currently in draft form for review and is intended to be presented at FAO's next Committee on Fisheries (COFI) meeting.

7.1.3 Other

Last year, the Committee recommended that a request be made for further information about a planned cetacean strandings scheme in China. No information was available at this meeting but the Secretary of the Commission will contact Chinese authorities to ask if some written document on the proposed scheme, together with methods of necropsy that would be used, might be submitted to a future meeting of the Committee.

7.1.4 Recommendations to the Commission

Given the discussions above on information needs, the Committee makes the following **recommendations** to the Commission.

(1) The Secretary be asked to write a letter to the relevant authorities in each member country requesting a list of fisheries, broken down by gear type, target species and geographical area, to the extent to which this is routinely done in each country. This would provide a first step that might assist in developing a sampling strategy for monitoring bycatch.

(2) Member nations are urged to include more specific information on large whale bycatches in the National Progress Reports such that they ideally include not only gear type, but the way in which this gear is being used and the target species. As a minimum, the gear description should correspond to an item listed in the response to the request for information given in (1) above.

In order to encourage cooperation, the objectives of collecting this information must be clearly specified. Data will also be welcomed from non-member states that may be willing to volunteer information even if a formal request from the IWC is not appropriate.

7.2 Estimation of bycatch based on genetic data

SC/54/BC1 updated previous work listing the species of cetaceans determined from DNA analysis from market samples in both Japan and Korea. Several species were found that the authors believed were unlikely to have been derived from either scientific whaling or bycatch.

In Dalebout *et al*. (2002), microsatellite DNA profiling of North Pacific minke whale products from the Japanese and Korean market was used to determine the minimum number of whales available for sale and to track the movements of products from individual whales through these markets. The same methods were used in SC/54/RMP8 and SC/54/BC3, and are very similar to those used in tagging and recapture studies to investigate populations of living animals. Six microsatellites were used to profile market products identified as derived from North Pacific minke whales through phylogenetic analyses of mitochondrial DNA control region sequences. These loci are a subset of those specified in the Norwegian DNA registry and those used by Japanese researchers. These six microsatellite loci, in combination, gave a reasonably low probability of a match (identity) between products by chance for the Japanese market. The probability of a match by chance was higher for the Korean market due to the lower genetic diversity of the J-stock (East Sea/Sea of Japan).

SC/54/RMP8 reported on eight market surveys conducted in the Republic of Korea between March 1999 and November 2001. Products were purchased in southeastern coastal cities in short periods of a few days in each survey. Surveys yielded a total of 122 minke whale products representing at least 97 unique individuals. Over 90% of these animals were J-stock based on diagnostic nucleotide substitutions at the mtDNA control region (e.g. Baker *et al.*, 2000). Products from the same individuals were generally only found within the same survey. These results suggest that products from individual whales are not stored long-term in the Republic of Korea, and in general pass through the market in a period of less than seven months. Given the conservative nature of these censuses, it appears that the total yearly Korean bycatch of minke whales remains high. This is consistent with SC/54/ProgRep Korea in which 148 North Pacific minke whales are reported as bycatch, 132 of which were taken off the East Sea/Sea of Japan coast.

In SC/54/BC3, 167 minke whale samples, purchased in Japanese markets between December 1997 and January 2002, were found to represent 142 individuals. J-stock products, presumed to come from bycatch in the Sea of Japan, contributed 41% of these, while the remainder were O-stock animals assumed to have come from scientific whaling in the North Pacific. There was no significant difference in the proportion of products from the two stocks among different prefectures.

Pastene noted that the interpretation of market samples is very difficult and referred to Pastene *et al.* (2001) from last year that summarised several molecular surveys conducted in the Japanese retail market. It had identified several factors

affecting the estimation of the mixing proportion between O and J-stocks in the market: (a) randomness of the survey; (b) geographical variation in the distribution of J/O stock products across Japanese prefectures; (c) duplicate sampling; (d) period in which products from an individual remain in the market. On point (d) it was recognised that processed products will stay in the market for a longer period than fresh meat. It was further noted that samples obtained in surveys should be weighted according to the availability of the whale products across the different prefectures.

In response, Baker noted that SC/54/BC1 and SC/54/BC3 had also conducted analyses to evaluate biases. For example, after eliminating replicate products from the sample of Japanese markets there were no significant differences in the ratio of J:O stock animals by prefecture. It was suggested that a larger sample size would still be helpful, but concluded that bycaught whale meat appears to be treated by the market in the same way as JARPN products.

The Committee **agreed** that sample design requires attention, and that a purpose of the proposed workshop (see Item 7.2.1) will be *inter alia* to develop appropriate sampling strategies for the Japanese whale meat market.

There was general agreement that there were currently too few reference samples to assign the sei whale samples in SC/54/BC1 to individual populations or geographical areas. Concern was expressed as to where any such samples might have come from, with no current legal whaling of sei whales. The sei and Bryde's whale products uncovered in the sampling had mostly been unique individuals. This does not support the suggestion that these samples could have been in the supply chain for a longer period of time than the minke whale products, as might be expected for stockpiles.

Morishita noted that in Japan, meat from pre-moratorium whaling is still held in cold stores, as shown in SC/54/BC5, so that meat from such animals is still being marketed, although there are decreasing amounts of it available. It was further noted that the data in SC/54/BC5 on whale meat stockpiles had been updated in 2001. He stated that verification of the origin of sei and other larger whale products in the stockpile has been conducted but the report on this was not yet available.

There was some discussion about the apparent increase in bycatch of minke whales including J-stock animals. Trends in the population size of J-stock minke whales are unknown and J-stock population size has not been estimated.

It was suggested that if samples from reported bycaught minke whales could be compared with samples found in the market, it would be possible to determine what proportion comes from undocumented sources. The Committee **agreed** that this is a promising approach to improve estimation of total bycatch over time.

Kasuya commented on the surprisingly high proportion of J-stock whales in the market samples. Many members noted that the availability of data on the annual proportion of J-stock animals taken in the North Pacific, from incidental catches and JARPN, would allow better estimation of bycatch. They also reiterated that estimation of bycatch would be improved by the ability to compare market samples with a register of all legally caught whales. However, Nagatomo stated that monitoring, control and management of the domestic whale meat market is the sole responsibility of the government based on its sovereign right, and that matters related to their domestic market are therefore outside the jurisdiction and competence of the IWC. The Government of Japan is consequently in no position to provide its market-related genetic data to the IWC. However, Nagatomo indicated that if data from DNA sequence analyses from parties concerned were forwarded to the Institute of Cetacean Research they would compare the data with their database and provide the results.

Funahashi and Kasuya clarified that the request to the Government of Japan was not for market-related genetic data, but for information on the numbers and locations of J-stock animals from bycatch and JARPN II. This information is required to improve estimates of total takes over time from the J-stock, as required for the RMP. Funahashi also stated that she and colleagues would be glad to discuss cooperative research projects involving an exchange of genetic data. Such an exchange would require third party oversight to resolve possible conflicts in identification as already proposed in 2000 by Baker *et al.* (2000).

Komatsu stated that Japan is willing to provide data and receive collaborative scientists following review of any applications. He noted however that as a sovereign government, Japan does not accept the proposal that this should be subject to third party oversight.

7.2.1 Report of bycatch workshop feasibility Steering Group

The use of market survey data to improve on minimum estimates of bycatch and provide more realistic unbiased estimates of whale bycatch will require information not only on reported bycatch rates but also on market structure and product pathways, as well as design input for the collection, storage and analysis of genetic samples in an appropriate manner. To investigate the feasibility of holding a workshop to address these issues, the Committee **concluded** that it would be helpful to: (1) outline the types of information needed in order to design an effective sampling scheme; (2) begin locating potential sources of such information; (3) develop contacts with access to the required information or who could assist in developing methods to obtain such information; (4) locate experts in the design of market surveys; and (5) locate experts who could actually conduct the surveys. It was recognised that such a process would have to be iterative and that a full list of information needed for design of such a system would require the assistance of experts as noted in points (4) and (5) above. SC/54/BC5 lists companies with such expertise who can give advice on best practice to design an appropriate market sampling strategy in Japan, plus an initial bibliography. SC/54/BC3 also contained information available from earlier DNA identification market surveys on sample and market distribution in Japan.

The Committee **agreed** that it appears feasible to hold such a workshop. However, more information should be gathered and the experts from the companies with market sampling expertise contacted; with this additional information it should be possible to develop a draft proposal for the Workshop at the 2003 meeting of the Committee.

The Committee **agreed** that the work in this area should be continued intersessionally and reported next year. Morishita reiterated his concern that the workshop would be unlikely to achieve anything useful, and stated that Japan does not endorse the workshop.

7.2.2 Analytical tests for assignment to stocks and/or areas

The Committee was informed that assignment procedures are becoming more widely used now, so that the geographical provenance of individual samples could be determined, although it was cautioned that this is only possible where there has been sufficient directed sampling to

ensure a baseline of comparative genetic samples. The Committee **agreed** that there are insufficient reference samples to take this very much further at present.

7.2.3 Other methodological advances

SC/54/SD2 described a web-based programme for phylogenetic species identification. This software arose after a forensic identification workshop (La Jolla, California, 1999) at which the need for a database of DNA sequences had been highlighted (Dizon *et al.*, 2000). The web-based software (*http://www.dna-surveillance.auckland.ac.nz*) provides sequence matches, but keeps the reference sequences hidden unless permission is granted by the owner. The sequences are held in a hierarchical structure and the software will provide a closest match. One of the advantages of this approach is that it overcomes the need to export and import samples for comparison, thereby avoiding lengthy permit application procedures. It is discussed further under Item 15.1.

7.3 Further review of information and methods to estimate mortality from ship strikes

There were 10 ship strikes (definition includes hull strikes and propeller strikes) recorded in National Progress Reports for 2001. Additional strikes were also listed for 1999 and 2000. A number of factors might lead to ship struck animals being unrecorded, including: offshore winds and currents; sharks; large ships would be unlikely to notice hitting a whale; even if a struck whale was noticed it would be unlikely to be recorded by many mercantile naval officers, unless noticeable damage had been caused, as striking an obstacle is the fault of the officer on watch, and he would be held responsible. The Committee **agreed** that the existing records of ships strikes, as reported in National Progress Reports, were probably gross underestimates of the total number of actual ship strike mortalities among large whales globally.

In the UK, the Royal Navy had agreed in principle to collate records of naval ship strikes annually and report them to the UK's responsible ministry with a copy to the IWC. US Navy protocol includes routine recording and reporting of whale collisions.

Since the USA has introduced necropsy protocols that included 'flensing to the bone', an increased number of severe traumas and suspected ship strikes have been uncovered among stranded whales. As this work progresses, it may be possible to ascertain whether the ratio of known to cryptic ship strike casualties among stranded animals is consistent enough to use this as an estimator of cryptic ship strike mortalities among stranded animals elsewhere.

The Committee received data on shipping levels in South African waters in relation to ship strikes of right whales. This showed very high levels of shipping activity in South African waters including those adjacent to KwaZulu Natal and the southern Cape in the austral winter when right whales are most numerous locally, with 1,574 ships recorded passing through territorial waters around the southern Cape during the months of peak right whale abundance (July to November). However, despite the high levels of shipping, only four known and seven suspected ship strike mortalities of right whales had been recorded in 30 years, although full necropsies had not been undertaken (Best *et al.*, 2001). It was suggested that right whales were mainly confined to coastal waters and that the main shipping lanes are further offshore, thereby reducing the likelihood of ship strikes. In South African waters the most likely area for ship strikes would be off the eastern Cape and coast of Natal, where migrating humpbacks would cross shipping lanes.

SC/54/BC4 presented a simple modelling approach to ship strikes which attempts to predict a maximum likely strike rate for a given density of ships and whales, assuming a random orientation of the whales and no behavioural response to an approaching ship. Applying the model to the Canary Islands, where ship strikes, mainly on sperm whales, have been recorded for several years, the model predicted a maximum of seven large whale strikes per year in the Tenerife-Gran Canaria Channel. There have been seven large whales recorded as struck and killed by fast (30 knots and above) ferries in this location during the last three years of observation, but this may be a minimum estimate as not all would have been noticed or recorded as stranded animals. The behavioural responses of a whale would greatly influence the predicted strike rate. Ship avoidance would likely be prompted by acoustic cues but sound propagation from an approaching ferry will depend on water depth and stratification. If avoidance responses to such cues are learned over time, then calves and recent immigrants to an area (such as this migration zone) would be most at risk of collision.

The Committee recognised the value of this approach for setting an upper bound on likely strike rates, and also noted that the work in the Canary Islands probably represented the best such dataset in the world, and encouraged it to continue to collect this type of data to improve understanding of ship strikes, and to provide a basis for quantifying actual collision rates. Although priority is given to estimating ship strike mortality in the western North Pacific and the Northeast Atlantic, the Committee recognised that by examining other areas of the world and even protected species such as northern right whales, useful insights into the rates at which animals are struck might be gained.

Some years ago, a fast-ferry line had been introduced between one of the islands in the Sea of Japan and a western Japanese port. Jet-foil ships had suffered collisions with whales. The ship owners had tried to avoid collisions by introducing acoustic warning systems. It was not clear whether this method had worked, but they had also increased the number of people watching out for whales and the numbers of collisions had decreased. The report of this work was published in Japanese. The Committee welcomed this information and asked whether it might be made available to the Committee next year.

The Committee **recommends** that data be collected intersessionally on the amount of high speed ferry and other similar fast-moving vessel traffic. Weinrich agreed to chair a group to collate this information. Emphasis will be placed on two areas, the Northeast Atlantic and western North Pacific. Additional information will be gathered in the western North Atlantic, South America (with a special emphasis on Venezuela where there are reports of collisions with high-speed vessels) and Southeast Asia. It was noted that data relevant to estimating mortality due to ship strikes are so sparse, that data from all areas would contribute to understanding the various factors involved. In addition, a list of areas where high-speed vessels are used for whalewatching should be developed, along with a catalogue of known collisions between vessels and whales where data on the type of vessel involved in the collision are available.

The Committee recalled two suggestions from last year's meeting that biopsy samplers might be fitted to vessels in high-risk areas, and secondly that a decelerometer might be developed that could detect whale strikes on large vessels,

including fast ferries (IWC, 2002d, p.17). Tregenza reported that he had formulated the technical specifications for a decelerometer and that he was in consultation with engineers about its construction. He would report back to the Committee next year.

The Committee **reiterated** its request last year that necropsies on stranded animals should examine animals as thoroughly as possible for evidence of ship strikes. It was suggested that some technical innovations, perhaps through the use of ultra-sound, might be sought to look for evidence of ship strikes on stranded animals without having to remove all the muscle of a large whale during autopsy.

The Committee also repeats its **recommendation** that member nations ensure more complete records of ship strikes in the National Progress Reports.

7.4 Methods for estimating additional human-induced mortalities

As last year, the Committee briefly discussed other sources of human induced mortality including entanglement in marine debris, mortality resulting from acoustic trauma, mass die-offs due to disease that might be induced through the immuno-suppressive action of pollutants, or kills due to oil spills. The Committee recognises that those matters were outside the terms of reference as currently drafted but **agreed** that to the extent that these additional human-induced mortalities could reasonably be estimated, they should be flagged for future consideration.

7.5 Work plan

The work plan agreed by the sub-committee on estimating bycatch and other human-induced mortality is given as Annex M (item 9). The Committee's overall work plan is discussed under Item 19.

8. ABORIGINAL SUBSISTENCE WHALING MANAGEMENT PROCEDURE (ANNEX E)

This Item continues to be discussed as a result of Resolution 1994-4 of the Commission (IWC, 1995, pp.42-43). The report of the Standing Working Group (SWG) on the Development of an Aboriginal Whaling Management Procedure (AWMP) is given as Annex E. The Committee's deliberations, as reported below, are largely a summary of that Annex, and the interested reader is referred to it for a more detailed discussion. A glossary of terms is given in Annex E, Appendix 2. Full trial structure specifications are given in Annex E, Appendix 3. For ease of reading, 'last meeting' refers to the intersessional meeting held in Seattle in January 2002 (SC/54/Rep2). The primary topic for discussion at this year's meeting was the final selection of a candidate *Strike Limit Algorithm* (*SLA*) for the Bering-Chukchi-Beaufort (B-C-B) Seas bowhead whales. Last year, the Committee had reported that it had two excellent procedures available (four variants) which exhibited very similar performance. It had identified some additional work and informed the Commission that it would be able to make a recommendation for an *SLA* for the B-C-B Seas stock of bowhead whales to the Committee at the 2002 Annual Meeting (IWC, 2002d, p.23).

8.1 Review intersessional progress

The intersessional workshop (SC/54/Rep2) continued the work of the SWG as given in table 6 of IWC (2002d, p.27). The main topics discussed were: moving towards finalising the *Evaluation, Robustness and Cross-validation trial* structure and specification for gray whales; reviewing results of trials for the available revised variants of the G-G and D-M *SLA*s for bowhead whales; moving towards selection of a final recommendation to the Commission; and further consideration of aspects of the Aboriginal Subsistence Whaling Management Scheme (AWS). Discussion of these items is part of the ongoing process and such discussions are referred to throughout this report where appropriate. A major proposal emerged at the workshop with respect to the selection of an *SLA*. This referred to the possibility of setting the strike limits by taking a simple mean of the G-G and D-M block strike limits. Such an averaged *SLA* (hereafter termed the GUP[1] *SLA*) would have a number of advantages, and it was agreed at the Workshop to pursue this idea further for consideration of results at the Annual Meeting. A large number of computing and other tasks were agreed at the Workshop, and excellent progress was made with these by both Allison and the developers.

8.2 Bering-Chukchi-Beaufort Seas stock of bowhead whales

8.2.1 Selection of SLA

8.2.1.1 MODIFICATION TO CANDIDATE *SLA*S SINCE THE FOURTH WORKSHOP

Five candidate *SLA*s were tested, the G-G (2 variants), D-M (2 variants) and GUP. These are described in some detail in Annex E (Appendix 4) and are summarised here. The Committee thanked the developers and Allison for their extensive intersessional work, noting, in particular, that the intersessional development period following the January 2002 workshop had been very short.

8.2.1.1.1 G-G *SLA*

SC/54/AWMP3 provided a complete description of the G-G *SLA*. At the core of this *SLA* is a penalised maximum-likelihood estimator that generates estimates of three predictor variables: carrying capacity, net yield and stock size. An optimal Bayes rule linear model is then fit to these predictors and one interaction term using the statistical merging and optimisation strategy published by Givens (1997; 1999; 2000). The goal of this fit is to best match the strike limits provided by the idealised catch control law *H* (IWC, 1998e, p.208) on a weighted subset of *Evaluation Trials*. The final strike limit also includes variability dampening and snap-to-need features[2]. Included in the *SLA* are two protection levels: a 30% reduction in strike limit if the stock is believed to be moderately reduced from the current (i.e. 2002) level and a zero strike limit if the stock is believed to be below 2,000 whales. Several tunings are described.

SC/54/AWMP3 described how the resulting *SLA* generally focuses on safely satisfying moderate need, while favouring stock protection by setting strike limits below what would be required to fully satisfy need in the final portion of this century in extreme scenarios where need might triple from present levels. When faced with plausible data suggesting risk to the stock, the *SLA* is constructed to reduce the strike limit, thereby undesirably reducing need satisfaction when the data are misleading but desirably protecting the stock when the data reflect reality. In terms of need satisfaction, the *SLA* incrementally downweights the importance of greater need satisfaction as the absolute level

[1] Grand Unified Procedure.
[2] The 'snap-to-need feature' involves setting the strike limit equal to the need level if the 'raw' strike limit from an *SLA* exceeds 95% of need.

of need satisfaction increases. In other words, as need approaches full satisfaction, the *SLA* focuses increasingly on risk avoidance.

8.2.1.1.2 D-M *SLA*

SC/54/AWMP5 described the D-M *SLA* and recent modifications. The *SLA* is based on well-established methods (Adaptive Kalman Filtering (AKF)). The *MSYR-K* parameter space is represented by a two-dimensional grid of values that are initially assumed to be equally likely. For each point in the parameter grid an Extended Kalman Filter is applied, which is appropriate when the underlying dynamics are non-linear. Every time a new survey estimate becomes available, the stock estimate is updated and, furthermore, a posterior probability is calculated by Bayesian methods for each point in the parameter grid. A catch control law (of a general form used in the past by the IWC) is specified, and a strike limit then calculated, conditional on the values of the two parameters (*MSYR*, *K*) and the stock estimate, and with its associated posterior probabilty. A cumulative probability distribution is then constructed from the sequence of strike limits and their associated posterior probabilities. The final strike limit is based on a pre-specified percentile of this distribution. The *SLA* is tuned by specifying the steepness of the catch control law and the percentile in the cumulative distribution function for the conditional strike limit. Before the final strike limit is given, a 20% maximum change in strike limits between blocks is imposed and a snap-to-need feature is incorporated.

This version of the D-M differs from that presented last year because: (1) a more flexible catch control law is used instead of the H-rule, resulting in removal of any discontinuities; (2) the number of *MSYR*-filters has been increased from four to seven giving a smoother cumulative distribution function for the strike limit; and (3) two tuning parameters are used instead of one.

The (*MSYR*, *K*) grid for the D-M *SLA* is discrete and was deliberately made fairly coarse for computational reasons. Filters corresponding to seven *MSYR* values are used and this can give the cumulative distribution function a shape of alternating flat and steep parts where the 'plateaus' correspond to the different *MSYR* values. This feature can be removed by using a finer *MSYR* grid, giving a smoother cumulative distribution function. The snap-to-need percentage can be lowered at the beginning of management and then increased to 95% over time if required.

8.2.1.1.3 GUP *SLA*

This *SLA* is based on applying the baseline variants of the D-M and G-G *SLA*s, ignoring their 'snap-to-need' features, to obtain two strike limits. These strike limits are then pooled by simple arithmetic averaging and the 'snap-to-need' feature applied.

8.2.1.2 REVIEW OF RESULTS

The complete set of results for the *Evaluation*[3], *Robustness*[4] *and Cross-validation*[5] *Trials* (see Tables 3-5, for details see Annex E, Appendix 3) are available from the Secretariat. A selected set of the most informative tables and plots in terms of the relative performance of the *SLA*s can be found as Appendices 5-7 of Annex E. The Committee **agreed** that the Chair of the SWG, in consultation with the intersessional Steering Group, should decide on an appropriate selection of results for publication. At a minimum, this will include the results of all of the *Evaluation Trials* in some combination of graphical and tabular presentation.

8.2.1.2.1 FINAL SELECTION OF AN *SLA*

Before considering the formal trials, a series of technical trials ('x' trials) were examined that had been proposed at the intersessional Workshop (SC/54/Rep2). These are discussed in detail in Annex E.

The Committee has spent a considerable amount of time considering the issue of the selection of an *SLA* (e.g. IWC, 2002e, pp.151-2). A variety of factors (e.g. design considerations, structure, elegance and performance) should be considered when selecting an *SLA*, but performance is the key factor. The SWG examined the results for each of the *Evaluation Trials* in detail to assess differences in performance among five *SLA*s (G-G, GUP, D-M, G-G low and D-M low).

The SWG **agreed** that the major conclusion from the examination of the results of the *Evaluation Trials* is that all *SLAs* exhibited extremely good performance. Even where differences were identified these were generally minor. These are noted below:

(i) As expected, the G-G *SLA* achieves greater need satisfaction in the first 20-40 years than the D-M *SLA*.
(ii) The G-G *SLA* is generally (though not always) more precise (in the sense of narrower 90% intervals) than the D-M *SLA*.
(iii) The D-M *SLA* outperforms the G-G *SLA* on trial BE04.
(iv) The emphasis by the G-G *SLA* on need satisfaction in the first 20-40 years leads to wider intervals for strike limits in the last 50 years compared with the D-M *SLA*.
(v) The GUP never performs worse than both of the G-G and D-M *SLA*s, and sometimes outperforms both (e.g. BE07-SE).
(vi) The G-G *SLA* has an undesirable feature in that, for some trials (e.g. BE04, BE14), the strike limits increase in the first 50 years then decrease. This behaviour occurs because of the emphasis placed on satisfying need in the short-term. Givens noted that it would be possible to modify the G-G *SLA* to reduce this effect.
(vii) On the pessimistic set of BE12 trials, median stock increase after 100 years was higher for G-G than D-M. On the risky high need trials (BE16, 16SE), median increase was higher for D-M than G-G.
(viii) Given the use of discrete levels for *K* and *MSYR* in the D-M *SLA*, the strike limits for some of the trials (e.g. BE14) are stratified into several bands. Magnússon commented that increasing the number of filters could be used to remove this feature of the results.
(ix) The 'low' tuning of the G-G *SLA* does not always incur a lower need satisfaction than the baseline tuning of this *SLA* (e.g. BE12, BE12a, BE04).

Although slight, both the G-G and D-M *SLA*s exhibited the undesirable features mentioned above. Both developers indicated that their *SLAs* could be modified in the future to remove these. Various members attached lesser or greater importance to these factors and some members favoured one procedure over the other. Schweder indicated his preference

[3] Trials used for formal comparisons of candidate *SLA*s.
[4] Trials to examine *SLA* performance for a full range of plausible scenarios.
[5] Case-specific trials to be held aside from *SLA* development so that resulting *SLAs* can be subjected to a subsequent independent test.

Table 3

The *Evaluation Trials* for the Bering-Chukchi-Beaufort Seas stock of bowhead whales. (For further details of the factors involving a time lag in density dependence, strategic surveys and the inertia model, see Appendix 3 of Annex E) (10 year surveys unless otherwise specified; differences from the base case are shown in **bold**).

Trial No.	Description	Model	$MSYR_{1+}$	$MSYL_{1+}$	Final need	Historical survey bias	Future survey bias	Survey CV (true, est)	Age data#	Other
BE01*	Base case	D, S_E	2.5%	0.6	134	1	1	0.25, 0.25	Good	
BE02	Constant need	D	2.5%	0.6	**67**	1	1	0.25, 0.25	Good	
BE03	Future +ve bias	D, S_E	2.5%	0.6	134	1	**1→1.5 in yr 25**	0.25, 0.25	Good	
BE04	Future –ve bias	D	2.5%	0.6	134	1	**1→.67 in yr 25**	0.25, 0.25	Good	
BE04a	Future –ve bias	D	2.5%	0.6	134	1	**1→.67 in yr 25**	0.25, 0.25	Good	**5yr surveys**
BE05	Underestimated *CV*s	D	2.5%	0.6	134	1	1	**0.25, 0.10**	Good	
BE07*	$MSYL_{1+}$ = 0.8	D, S_E	2.5%	**0.8**	134	1	1	0.25, 0.25	Good	
BE08	5 yr surveys	D	2.5%	0.6	134	1	1	0.25, 0.25	Good	**5yr surveys**
BE09*	$MSYR_{1+}$ = 1%	D, S_E	**1%**	0.6	134	**0.67 → 1**	1	0.25, 0.25	Good	
BE09a	$MSYR_{1+}$ = 1%	D, S_E	**1%**	0.6	134	**0.67 → 1**	1	0.25, 0.25	Good	**5yr surveys**
BE10*	$MSYR_{1+}$ = 4%	D	**4%**	**0.8**	134	1	1	0.25, 0.25	Good	
BE10a	$MSYR_{1+}$ = 4%	D	**4%**	**0.8**	134	1	1	0.25, 0.25	Good	**5yr surveys**
BE11	Bad data	D	2.5%	0.6	134	1	**1→1.5 in yr 25**	**0.25, 0.10**	**Poor**	
BE12*	Difficult 1%	D, S_E	**1%**	0.6	134	**1 → 1.5**	**1.5**	**0.25, 0.10**	**Poor**	
BE12a	Difficult 1%	D, S_E	**1%**	0.6	134	**1 → 1.5**	**1.5**	**0.25, 0.10**	**Poor**	**5yr surveys**
BE13	Difficult 1%; constant need	D	**1%**	0.6	**67**	**1 → 1.5**	**1.5**	**0.25, 0.10**	**Poor**	
BE14	Need increases to 201	D	2.5%	0.6	**201**	1	1	0.25, 0.25	Good	
BE16	$MSYR_{1+}$ = 1%; 201 need	D, S_E	**1%**	0.6	**201**	**0.67 → 1**	1	0.25, 0.25	Good	
BE20	$MSYR_{1+}$ = 4%; 201 need	D	**4%**	**0.8**	**201**	1	1	0.25, 0.25	Good	
BE21*	Integrated	D	**U[1,4%]**	**U[.4-.8]**	134	1	1	0.25, 0.25	Good	
BE22*	20yr time lag	D, S_E	2.5%	0.6	134	1	1	0.25, 0.25	Good	20yr lag
BE23	Strategic surveys;	D	2.5%	0.6	**201**	1	1	0.25, 0.25	Good	Strategic surveys
BE24*	Inertia Model	D	**0.6%**§	0.6	134	1	1	0.25, 0.25	Good	Inertia model

*Requires conditioning; #Age data: good (no bias or extra variance): $\gamma_{12.9}$=1; poor: $\lambda_{12.9}$=2, $\lambda_{12.9}$=1.5; §$MSYR_{1+}$ here refers to *MSYR* in the absence of inertia dynamics. The value of 0.6% was set intersessionally by the Email correspondence group following inspection of trajectories.

for the D-M *SLA* on the general issue that it is based on the well-known Kalman filter technique and thus took appropriate account of new data (Annex E, items 2.2 and 2.3).

The GUP *SLA* does not exhibit undesirable features to nearly the same extent as the G-G and D-M *SLA*s because it averages the strike limits from the component *SLA*s. For example, although the GUP does not always satisfy need in the first 20 years perfectly under all scenarios, it almost never drops the strike limit below the current level of need.

For the *Robustness Trials*, all of the candidate *SLA*s performed well and there was little to choose between them. Attention was drawn to the relatively poor performance of the *SLA*s under the scenario where mortality rate is doubled over the period. Although it was noted that such a scenario might seem extreme (see discussion of SC/54/E11 in Annex E, item 2.2 and in Annex F, item 6.1.1), the Committee **agreed** that mortality should be monitored when conducting the *Implementation Review* process in the long-term. The value of photo-identification results was noted in this case. In accordance with his views on the overall philosophy and the 'x' and *Robustness* trials, Schweder believed that the D-M *SLA* performed slightly better overall. However, there was general agreement that the GUP *SLA* performed better than the other two *SLA*s for most of the *Robustness Trials* although either the D-M or G-G *SLA*s slightly outperformed the GUP for a very small number of these trials. The results of the *Cross-validation Trials* gave no cause for concern.

Given the excellent overall performance of the GUP *SLA*, the Committee considered the implications of selecting it from other perspectives.

There was some discussion of the 'elegance' of choosing the average of two procedures rather than one of the components. Comments were made supporting the view that from that perspective, choice of a single procedure might be considered more elegant, less complex to tune should that ever be required, and easier to explain to the wider scientific community. Other comments were made noting that when an MCDM (multiple-criteria-decision-making) expert was invited to participate in the development of the RMP, he had recommended averaging the results of different management procedures. Furthermore, members noted that averaging two results obtained from very different approaches had the possibility of reducing bias and reducing variability. It was also noted that the excellent performance and innovative nature of both *SLA*s warranted their exposure to the wider scientific community.

After considerable discussion, the Committee **agreed** that the improved performance of the GUP over the other candidate *SLA*s more than compensated for any increased complexity and reduced elegance. It was noted that the GUP *SLA* included a built-in check-and-balance system because, if one of its component *SLA*s behaved somewhat erratically in one instance, the effect would be muted by the better performance of the other *SLA*.

Finally, the Committee noted its agreement early in the development process (IWC, 1999a, p.31) that the goal was to develop an *SLA* that fully met the Commission's management objectives, and that once it had achieved that, it would not waste resources attempting to achieve some hypothetical level of 'perfection'. Whilst the SWG recognised that further work could be undertaken to refine and 'polish' the constituent *SLA*s of the GUP *SLA* (as noted by the developers themselves), it **strongly believes** that these resources should be dedicated to completing the *SLA* for the management of the gray whale harvest and addressing the serious issue of the Greenland fisheries, for which the Committee has recognised that it has never been able to provide satisfactory advice.

Table 4

The *Robustness Trials* for the Bering-Chukchi-Beaufort Seas stock of bowhead whales. (For further details of the factors involving a time lag in density dependence, strategic surveys, time-dependent factors and episodic events, see Annex E, Appendix 3.)

Trial	Factor	Basic trials (Table 7)	Factor Level
BR01	A: Density-dependence	1, 1^S, 9, 9^S	Density-dependence on mature (BE trials use 1+)
BR02	B1: Stochastic dynamics	8^S, 13^S	Stochastic dynamics (with serially-correlated environmental variation)
BR04	E: Survey frequency	9, 13, 14, 16, 20	a) 15 yrs
		16, 20	b) 5 yrs
BR05	F: Strategic surveys	9	a) Yes + CV = (0.25, 0.25)
		9	b) Yes + CV = (0.34, 0.25)
BR06	G: Survey bias time dependence	1	a) Historic bias (1978-2002): 1.5 constant; Future bias: decreasing (1.5→1)
		1	b) Historic bias (1978-2002): 0.67 constant; Future bias: increasing (0.67→1)
		9, 9^S	c) Future bias: sinusoidal from base value in yr 0 to maximum of 150% in yr 40
		12, 12^S	d) Future bias: decreasing (1.5→1) from year 0 to 100
		14	e) Future bias: increasing from 1→1.5 in year 25 and constant thereafter (former BE15)
BR07	H: Future survey *CV*	1	a) CV = (0.1, 0.1)
		1^S	b) CV = (0.34, 0.25)
		9	c) (0.1, 0.1) + sinusoidal survey bias
BR08	I: Historic catch bias	14, 16^S	a) 0.5 bias from 1848-1914
		14, 16, 16^S	b) 1.5 bias from 1848-1914
BR09	K: Time dependence in *K*	1, 9, 10	a) *K* halves linearly over 100 years
		1, 9, 10	b) *K* doubles linearly over 100 years
		1	c) *K* sinusoidal from base value in year 0 to maximum of 150% in year 40
		1, 21	d) Tent *K: K* doubles linearly from years-50 to 0 and halves from years 0 to 50
		1, 9	e) *K* halves linearly over 100 years + strategic surveys
BR10	L: Time dependence in *MSYR*	10	a) Resilience (*A*) halves linearly over 100 years,
		9	b) Resilience (*A*) doubles linearly over 100 years
		1, 8	c) Resilience steps 2½%→1%→2½% every 33 yrs over 100 years
		1, 8	d) Resilience steps 2½%→1%→2½% every 33 yrs over 100 years in sync with *M* (compute MSYR first) – if it is practical halve *M* for each age class
		1	e) *K* and *A* halve linearly over 100 years
		1, 21	f) *K* and *A* vary as tent (see BR09)
BR11	M: Time dependence in *M*	1, 9, 10	a) Natural mortality *M* halves linearly over 100 years (and calculate resulting MSYR)
		1, 9, 10	b) *M* doubles linearly over 100 years
BR12	N: Episodic events	1, 1^S, 9, 9^S	2 events occur, between years 1-50, in which 20% of animals die
BR13	O: Integrated .	1, 11, 14	a) $MSYR_{1+}$~U[0.01, 0.04]; fixed $MSYL_{1+}$=0.6
		11, 14	b) $MSYR_{1+}$~U[0.01, 0.04]; $MSYL_{1+}$~U[0.4, 0.8]
		1, 1^S, 11, 11^S, 14	c) $MSYR_{1+}$~U[0.01, 0.04]; $MSYL_{1+}$~U[0.4, 0.8]; historical catch bias ~U[0.5, 1.5]; Serial correlation ~ U[0.47, 0.95]
		1^S, 11^S	d) $MSYR_{1+}$~U[0.01, 0.04]; $MSYL_{1+}$~U[0.4, 0.8]; historical catch bias ~U[0.5, 1.5]; Serial correlation ρ~ U[0.47, 0.95], time delay in density-dependence ~U[0, 30]
BR14	P: 1st year of population projection	1, 9	1940 (reference or base case level is 1848 or 1748 for stochastic trials)
BR15	$MSYL_{1+}=0.9$	1, 9, 10	
BR16	B2: Different stochastic parameters	1^S	a) Negative correlation in recruitment $\rho = -0.75$
		1^S	b) High correlation in recruitment $\rho = 0.9$
		1^S, 9^S, 10^S	c) High correlation in recruitment $\rho = 0.9$; + Episodic events
		1^S	d) Change σ_ε^2 to give 3* variation in population size at equilibrium
		9^S	e) $\rho = 0.9$ + change σ_ε^2 to give 3*equilibrium variation +episodic events

[S]Stochastic.

Table 5

Factors and ranges for constructing *Cross-validation* trials for the Bering-Chukchi-Beaufort Seas stock of bowhead whales.

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

8.2.1.2.2 CONCLUSION AND RECOMMENDATION

After careful consideration of the results of the trials and the consideration of the other factors noted above, the Committee **strongly recommends** that the GUP *SLA* (hereafter the '*Bowhead SLA'*) be forwarded to the Commission. It believes that this *SLA* meets the objectives of the Commission set out in 1994 (IWC, 1995, pp. 42-43) and represents the best scientific advice that the Committee can offer the Commission with respect to the management of the B-C-B Seas stock of bowhead whales. In making this recommendation, it refers to its comments regarding the nature of the *Implementation Review* process and the other aspects of management discussed under Item 8.5.

The Committee noted that this is the first of the *SLAs* that it has recommended. The Commission endorsed the concept of an aboriginal subsistence whaling scheme with case-specific and generic components in 1999 (IWC, 2000d, p.125) and is expecting to receive a recommended *SLA* for this stock at this year's meeting based on the Committee's report last year.

The Committee particularly wishes to acknowledge the outstanding contribution made by all of the developers to the final recommended *SLA*. It notes that the *Bowhead SLA* contains elements of all of the procedures originally considered. It formally wishes to thank Eva Dereksdóttir, Kjartan Magnússon, Geof Givens, Andre Punt, Sue Johnston and Doug Butterworth for the enormous amount of thought and effort put into developing their candidate procedures and the generosity of spirit in sharing ideas evident throughout the process. It also wishes to acknowledge the tremendous support offered by Cherry Allison, without whom the whole process would have ground to a standstill. Finally, it thanked Greg Donovan for chairing the SWG since 1997.

8.2.1.3 COMPARISON WITH THE RMP

The Committee recalled that early in the development process, some members of the Commission had indicated an interest in a comparison of the AWMP with the RMP. That request predated the decision of the Commission to accept case-specific *SLAs* as part of an AWS. A strict comparison of the *Bowhead SLA* with the *CLA* is not possible for a number of reasons, particularly with respect to: (1) the different objectives of each, notably the difference between management aimed at producing the highest possible continuing yield and management aimed at satisfying a limited need requirement in perpetuity; and (2) the case-specific nature of the *Bowhead SLA* that was tailored to manage a data rich population as opposed to the generic *CLA*, that had to be able to cope with a variety of situations.

The results of the comparison revealed, not unexpectedly (e.g. see Punt and Butterworth, 1997), that the *CLA* whilst performing satisfactorily on the risk-related statistics performed poorly in satisfying need. Comments on this issue from an RMP perspective are given under Item 6.5.6.

8.3 Gray whale trial structure

The SWG discussed gray whale trial structure at its Workshop in Seattle in January 2002 (SC/54/Rep2) where it made a number of modifications regarding structure and conditioning.

8.3.1 Model-related issues

The results of the assessment of eastern gray whales (Annex F) were examined, and the Committee **agreed** that these do not require changes to be made to the basic biological model or parameters used to simulate gray whale dynamics for AWMP trials. However, it noted that two new abundance estimates are available. With respect to the use of stochastic models, based on the results of the bowhead whale trials, it **agreed** that it is sufficient to use 'episodic event' trials as a simple surrogate for truly stochastic dynamics. By allowing frequent, small stochastic events (either positive or negative) with potential correlation (either positive or negative), a wide variety of stochastic dynamics can be approximated.

8.3.2 Trial specifications

Consideration was given as to whether future calf count data should be generated as part of the common control program to be available for use by potential *SLAs*. The Committee **agreed** that this should not be done because: (1) a suitable *SLA* can be developed without reliance on these data; and (2) therefore it could not justify making such data collection a future data requirement. Most of the aboriginal harvest is taken in the Russian Federation whilst smaller catches and the censuses are undertaken in the USA. It is hoped that cooperation between these two countries will continue. Breiwick noted that it is expected that these surveys will continue in the future.

However, it was **agreed** that *Evaluation Trials* should be conditioned on the calf count data, whereas *Robustness Trials* should provisionally ignore the calf count data at this stage. If changes in software or hardware speeded the conditioning process, then Allison would review this decision with a view towards conditioning all trials on the calf count data.

The two most recent abundance estimates for eastern gray whales presented at this meeting (see Annex F) were notably lower than the previous one. The Committee **agreed** that the recent variations in surveyed abundance must be taken into account in its trial structure and that the plausible explanations for the results of the recent survey (Annex F, item 4.1.2) should be covered in the trials and conditioning process as discussed in Annex E.

The anomalies in the CVs of the recent time series of eastern gray whale abundance estimates were considered and it was **noted** that the existing trial structure captured all of these important aspects of the abundance series and its CVs.

The Committee **agreed** that trials with episodic events should play a substantial role in GE/GR trials, to model a plausible biological possibility and as a surrogate for stochastic dynamics as discussed in Item 8.3.1. It was also **agreed** that the episodic event trials should consider episodic changes in mortality rates and/or productivity.

Finally, it was **noted** that further issues related to trial structure (e.g. those raised in SC/54/AWMP2) will be discussed more thoroughly at the proposed intersessional Workshop (see Item 8.7).

8.4 Greenlandic fisheries and the Greenlandic Research Programme

In 1998, the Committee had informed the Commission that it would be extremely difficult, if not impossible, to develop an *SLA* for the Greenlandic fisheries that will satisfy all of the Commission's objectives. To this end the Committee recommended, and the Commission accepted, the need to develop a cooperative research programme. This has been discussed at recent meetings (e.g. IWC, 2001j) and is further discussed under Item 9.1.3.

8.4.1 Stock structure, range and movement

Last year, the Committee provided funds towards an annual programme of satellite tagging, based on a target of four informative tracks per year (IWC, 2002e, p.156). It received SC/54/O21 that reported on the successful tagging of two fin whales in September 2000 and August 2001. The tags transmitted for 76 and 32 days, respectively and the results are discussed in Annex E (item 5.1.1). The movements of the animals suggested that the fin whales off West Greenland are part of a single stock and that previous surveys did not encompass the whole range of fin whales off West Greenland.

The Committee welcomed this report and noted that further work would be carried out in the coming season with IWC funding. It was suggested that, if possible, marking later in the season would provide more information on

migratory routes and wintering areas. Five tags are available and the Committee **agreed** that equal importance be given to tagging minke and fin whales.

The Committee was informed that, dependent upon the year, between 25 and 65% of the harvested minke whales and between 15 and 42% of the fin whales have been sampled. For logistical reasons, last year had not been particularly successful. There had been no new effort to analyse genetic samples collected later than 1999.

The Committee repeats its previous **recommendation** that every effort be made to obtain tissue samples for genetic analysis from the catch and that efforts to compare these samples with those from neighbouring countries be continued.

8.4.2 Abundance and trends

In the original research programme, it had been envisioned that use of coastguard vessels in the inshore waters might provide a time series of index of abundance data, at least for minke whales. These surveys were to have begun in late summer 2002 (IWC, 2002e, p.156). Witting reported that unfortunately these surveys have proved unsatisfactory and have not been pursued further.

The Committee was disappointed to receive this news, noting that the possibility of developing a management procedure that used a combination of an annual relative index and infrequent absolute abundance estimates had been discussed at last year's meeting (IWC, 2002e, p.156).

SC/54/AWMP1 reported that an aerial survey for large cetaceans is to be conducted off West Greenland from July to September 2002. The survey area and effort is similar to the aerial cue-counting survey conducted in 1993 (Larsen, 1995), but the 2002 survey will be an aerial strip-transect survey based on digital photos. There was considerable discussion of this survey and the new methodology by the SWG, and this is given in Annex E (item 5.1.4.2).

The Committee welcomed the fact that a new abundance survey is to be undertaken and hopes that this innovative approach proves successful, not least because any *SLA* will require periodic abundance estimates if strikes can safely be allowed. It noted that whatever approach is used, the primary factor involved in determining the success of surveys in Greenland is the weather. It looks forward to receiving a full report of the survey at its next meeting.

8.4.3 Biological data

In response to a question regarding the collection of other biological samples, it was noted that hunters have forms to record length, sex, pregnancy status, etc.; logistical difficulties regarding timing and location of the flensing of the hunt make sampling by biologists impractical. It was suggested that training hunters to take specific biological samples might prove fruitful if allied to some type of reward system.

8.4.4 Preliminary consideration of management procedures

Last year, the Committee had nominated a small group to conduct exploratory simulation studies involving the use of an annual index of abundance and an infrequent absolute abundance estimate. In light of the decision not to pursue the index of abundance cruises above, this approach became unnecessary. However, the Committee **agreed** that the small group should correspond intersessionally on possible future approaches.

8.4.5 Conclusion

Given the extreme importance of the Greenlandic Research Programme to the Committee's ability to provide management advice to the Commission, the Committee **agreed** that reviewing progress and developing further recommendations should be a high priority item for discussion at the next annual meeting (and see Item 9.1.3).

8.5 Scientific aspects of an Aboriginal Subsistence Whaling Scheme

8.5.1 Carryover

The Commission has requested the Committee to include provisions for carry-over in its consideration of an AWMP. In IWC (2001c, p.18), the Committee presented the Commission with an illustration regarding block quotas and carryover. The Commission considered this and agreed

> …that blocks of five years with an interannual variation of fifty percent were satisfactory in terms of allowing for the likely variability in hunting conditions. It therefore agreed that these values are appropriate for use in trials. It was recognised that this does not commit the Commission to these values in any final aboriginal whaling management procedure. (IWC, 2001a, p.20).

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

*For the years **[2003-2007]** inclusive, the total number of strikes shall not exceed **[335]**. The Strike Limit in any one year shall not exceed [100[6]].*

The Committee had also agreed that the same 50% allowance may be carried over between the last year of one block and the first year of the next. It is emphasised that from a scientific perspective, the *Bowhead SLA* is robust to such a scenario with respect to carryover provisions and the harvest at such a level.

In order to illustrate this, a number of examples are given in Annex E (item 6.1). The Committee agreed that a full explanation of these examples be presented to the Commission by the Chair of the SWG (see Item 8.6).

8.5.2 Grace period and survey interval

In considering this item last year, the Committee had discussed what process it might need to follow in the absence of data essential to the *SLA*, notably a lack of a new abundance estimate. It was **agreed** that the concept of phaseout (also present in the RMP) was appropriate, i.e. the process by which strike limits are reduced in the absence of new abundance data. In presenting the Committee's report to the Commission (including representatives of the AEWC – the Alaska Eskimo Whaling Commission) last year, the Chair noted that this concept was the most contentious.

Some views were expressed that the phase-out concept should apply only to commercial whaling and is overly harsh, and even suggests mistrust of aboriginal whalers and hunters. The AEWC believed that AWMP 'rules' should provide hunters with as much freedom as possible to cope with environmental variability, since it has such a significant effect on surveys and hunting success.

[6] The Commission's present paragraph also includes a limit on the number of landed animals. This is outside the scope of the SWG whose simulation exercises assume that all strikes result in death.

At the intersessional Workshop, the SWG noted these concerns (SC/54/Rep2). It referred to its earlier discussions of the difficulties in carrying out successful censuses[7] (and hunting) in the Arctic environment and its efforts to take this into account both by using a survey interval of 10 years and in the carryover provision described above. However, it noted that it was not possible to successfully manage in the absence of data; it is *not* acceptable for strikes to be allowed to continue at level of need if there is no new abundance information for long periods, should such an unlikely situation arise. Under the grace period scenario, it would be up to 15 years after the previous survey that the *SLA* will set strikes to zero. This certainly does not imply mistrust of hunters and in the case of the bowhead whale situation, the cooperation and major contribution of the AEWC in the census effort is well recognised and greatly appreciated. Whilst it is hoped and expected that any 'grace period'[8] rule will never need to be utilised, it is important that any comprehensive management procedure includes rules for such an eventuality. The Committee **strongly endorsed** these views and the principles developed in SC/54/Rep2 given below:

(1) the grace period should not exceed five years (after which time, the *SLA* will set strikes to zero and it is likely that an *Implementation Review* will be initiated);
(2) for the five-year grace period, the block limit shall be reduced by 50%;
(3) carryover from the last block is permissible (the same conditions that can render a survey unusable can also preclude the hunt);
(4) the use and distribution of strikes during the grace period is the responsibility of the user (for example it may be decided to place no restrictions at the beginning of the period – but in the absence of an estimate in that period the catch will be reduced to zero in less than the five years – see Annex E, table 4, for example);
(5) when a survey is successfully conducted during the grace period, the *SLA* is applied and a quota generated – the quota is then applied retroactively to the current block and the 'used' strikes subtracted from the resultant block limit.

It was also noted in discussion that the Scientific Committee could offer advice about the best strategy to use in the event of a series of poor surveys or similar problem, so that action can be taken well ahead of any grace period deadline.

A number of examples of scenarios where the grace period is invoked are given Annex E (item 6.2.1). The Committee agreed that a full explanation of these examples be presented to the Commission by the Chair of the SWG (see Item 8.6).

In SC/54/Rep2, it was recognised that setting limits by five-year blocks could result in some scenarios where there was a period of greater than 10 years between survey intervals (although it is not possible to have more than one such lengthy period in succession). Childerhouse commented that a greater than 10-year period between surveys was too long. A number of different scenarios incorporating survey interval, carryover and grace period are illustrated in Annex E (item 6.2.2). The Committee, noting the results of the strategic survey trials and those with a 15-year survey interval, **agreed** that there is no need to set any further 'rules' to accommodate these scenarios. It also draws attention to the guidelines for surveys discussed under Item 8.5.4 in which survey plans must be submitted to the Committee in advance; it will expect attempts to survey to begin at least by year seven. It also noted that it will be happy to provide advice on survey related issues if required.

8.5.3 Implementation Reviews

It has been recognised from the start of the development process that any individual factor or combination of factors that occurred in the future which suggested that the range of explored parameter space covered in the present trials might have been exceeded will result in an *Implementation Review*. It was noted that there are many potential outcomes from an *Implementation Review* including recommendations to continue use of the current *SLA*; to set a zero strike limit; to carry out an abundance estimate immediately; and/or to establish further trials. It is possible to examine through simulation any 'meta-rules' that might be developed in conjunction with the *Implementation Review* process. Such an examination would necessarily consider the probability of: (1) unnecessarily initiating an early *Implementation Review*; and (2) not initiating an early *Implementation Review* when this is, in fact, needed.

8.5.3.1 REGULAR IMPLEMENTATION REVIEWS

Implementation Reviews will be scheduled every five years and will normally contain at least the following elements: (1) a review of information required for the *SLA* (i.e. catch data, abundance estimates); and (2) a review of information (e.g. biological and genetic data) to ascertain if the present situation is as expected and within tested parameter space (thus the review may result in the need to determine new trials). In order to account for the need for further action (e.g. before agreeing an abundance estimate or running new trials), the Committee **recommends** that *Implementation Reviews* are initiated the year before advice on a new block limit is expected. It is not expected that every such review will entail a large amount of work. This will of course depend on a number of factors, largely dependent on the level of information available. This latter factor is related to discussions under Item 8.5.4.

8.5.3.2 UNSCHEDULED IMPLEMENTATION REVIEWS

Throughout its discussions, the Committee has also seen early *Implementation Reviews* as a safety feature to enable swift reaction if new information arrives that causes concern. It is recognised that calling such a review does not necessarily mean revising the Committee's advice to the Commission, although it may do so. The Committee did not believe it appropriate to try to compile a formal list of what factors might 'trigger' such an early review (by its very concept it implies unexpected/unpredictable factors). The following list is thus provided to give examples of some possible factors:

(a) major mortality events (e.g. suggested by large numbers of stranded animals);
(b) major changes in whale habitat (e.g. the occurrence of natural or anthropogenic disasters or changes, such as an oil spill, dramatic change in sea-ice);
(c) major ecological changes resulting in long-term changes in habitat or biological parameters;
(d) a dramatically lower abundance estimate (although the *SLA* has been tested, the Committee would review the potential causes of unexpected very low estimates);

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

[8] This seems to more accurately reflect the philosophy than the term phaseout.

(e) information from the harvest and hunters (this might include very poor harvest results, reports of low abundance despite good conditions, reports of large numbers of unhealthy animals);
(f) changes in biological parameters that may result in changes to management advice (e.g. reproduction, survivorship);
(g) if there are cases when need is not being satisfied, significant positive information that might narrow the plausibility range and allow an increase in block limits.

8.5.4 Guidelines for surveys

The Committee reviewed and reconfirmed the principles for surveys developed at last year's meeting and agreed by the Commission regarding: survey/census methodology and design; Committee oversight; and data analysis. It **agreed** that it is not necessary to develop these into a formal document for inclusion in the overall AWS at the present time. It noted that if the *Bowhead SLA* is adopted at the present meeting, some consideration will be need to be given to the fact that some of the criteria (e.g. submission of data by a particular time) may need to be relaxed (see Item 8.6.2).

8.5.4.1 SURVEY/CENSUS METHODOLOGY AND DESIGN

The Committee **agreed** that plans for undertaking a survey/census should be submitted to the Scientific Committee in advance of them being carried out, although prior approval by the Committee is not a requirement. This should normally be at the Annual Meeting before the survey/census is due to be carried out. Sufficient detail should be provided to allow the Committee to review the field and estimation methodology. Considerably more detail would be expected if novel methods are planned. Survey timing should be such that successful surveys occur at no more than 10-year intervals.

8.5.4.2 COMMITTEE OVERSIGHT

The Committee **agreed** that it is could nominate one of its members to observe the survey/census to ensure that proposed methods were adequately followed. This would be more important if novel methods were being used.

8.5.4.3 DATA ANALYSIS AND AVAILABILITY

The Committee **agreed** that it is appropriate that all data to be used in the estimation of abundance were made available to the Scientific Committee suitably in advance of the Annual Meeting at which an estimate was to be presented. If new estimation methods are used, the Committee may require that computer programs (including documentation to allow such programs to be validated) be provided to the Secretariat for validation.

8.6 Presentation of results to the Commission[9]

8.6.1 General presentation

The Committee noted that this was a particularly important meeting for the presentation of results to the Commission. In accordance with the Commission's instructions it was presenting the first case-specific *SLA* as part of the overall AWS. It noted that this was part of a long process that involved continual consultation with (and feedback from) the Commission.

It **recommends**, as in previous years:

(1) a presentation of the Committee's report by the Chair of the SWG; and
(2) informal discussions among the Chair of the SWG and interested Commissioners.

The Committee also noted the success of informal discussions with interested members of the Commission's sub-committee on aboriginal subsistence whaling (including hunters' representatives) and **agreed** that this would be valuable.

In terms of the presentation, the Committee gave considerable freedom to the Chair of the SWG to decide the format but **agreed** that it should include aspects of the following: the history of the development process (including the concept of the need envelope); explanation of the factors examined in the *Evaluation* and *Robustness Trials* (see Table 6); graphical presentation of results (including catch and population size trajectories) for *inter alia* the *Bowhead SLA* from Trials BE01, BE09 and BE14 encapsulating a range of scenarios; and description and illustrations of the aspects of the AWS (see Appendix 8 of Annex E) described above.

8.6.2 Management advice and incorporation into the Schedule

The Commission is aware that the Committee will be presenting it with an *SLA* for bowhead whales at the forthcoming annual meeting. It is also noted that the Commission will be establishing catch limits for bowhead whales at this year's meeting. Some time was spent considering the procedural aspects of how to present its results.

It was noted that from a purely scientific viewpoint, the *Bowhead SLA* represents the best tool for providing management advice to the Commission[10] on the bowhead whale harvest. On these grounds alone it would be prepared to use the *SLA* to calculate block strike limits and present that advice to the Commission. However, it recognised that there are some procedural issues that need to be considered (i.e. that the Commission has not formally approved the approach) and that the strict conditions for the Guidelines for Surveys would not have been met in terms of data provision for the 2001 abundance estimate, if that is to be used (see Item 8.5.4). Given this, it requested that the Secretariat be prepared to use the *SLA* to calculate block strike limits, should the Commission request it. This can easily be done at the Commission meeting.

To do this, in addition to incorporating the latest catch and strike data, a decision needs to be taken on whether to include the new 2001 abundance estimate discussed in Annex F and partially referred to in the management advice provided in that Annex. Whilst this represents a good estimate (and certainly within the tolerance covered in the trials), a revised estimate using different methodology is expected to be received next year. It was unlikely that this would be very different from the present estimate. The Committee **agreed** that the Secretariat should be prepared to run the *SLA* both with and without the latest estimate if required.

[9] In plenary, Childerhouse asked for an appropriate costing of the development process. Donovan noted that was not a trivial task but that he would try to develop such an estimate.

[10] It was also noted that the sub-committee on bowhead, right and gray whales had provided management advice based on the present situation but had also noted that the SWG was expecting to complete its work on an appropriate *SLA*.

Table 6

Factors tested in bowhead trials. Reference levels shown bold and underlined.

Factors	Other levels
MSYR $_{1+}$	1%, **2.5%**, 4%
MSYL $_{1+}$	0.4, **0.6**, 0.8
Density dependent component	**1+** or mature
Population dynamics model	**Deterministic**, Stochastic (demographic), **Stochastic (demographic + serially corr.env.var.)** Inertia model
Time dependence in *K* *	**Constant**, Halve linearly over 100yr, Double linearly over 100yr, Sinusoidal from a base value in year 0 increasing to a maximum of 150% in year 40 Tent *K: K* doubles linearly from years-50 to 0 and halves from years 0 to 50 *K* halves linearly over 100 years + strategic surveys
Time dependence in resilience *	**Constant**, Halve linearly over 100yr, Double linearly over 100yr, Step *MSYR* 2½%→1%→2½% every 33 yrs Step *MSYR* 2½%→1%→2½% every 33 yrs, in sync with halving / doubling *M* *K* and *A* halve linearly over 100 years *K* and *A* vary as tent
Time dependence in natural mortality, *M* *	**Constant**, Halve linearly over 100yr, Double linearly over 100yr.
Episodic events *	**None**, 2 events occur, between years 1-50, in which 20% of animals die
Initial year of population projection	**1848**, (or 1748 for stochastic trials), 1940
Stochastic parameters	
i) correlation in recruitment	***ρ = 0.752***; Negative (*ρ = -0.75);* High (*ρ = 0.9*); High + Episodic events
ii) variation in population size	σ_ε^2 **=0.0254**; σ_ε^2 changed to give 3* variation in pristine population size *ρ = 0.9* + change σ_ε^2 to give 3*pristine variation + episodic events
Time lag in density dependence	**None**; 20yr time lag in density dependence
Need in final year (linear change)	**67**, 134, **201**
Survey frequency	5yr, **10 yr**, 15 yr
Strategic surveys	**No**, Yes
Survey bias	0.67, **1.0**, 1.5
i) constant	
ii) historical time dependence	**None**, Increase by 50% from 1978 to 2002 (0.67→1, 1→1.5)
iii) future time dependence	**None**, Decrease by 50% from year 0 to year 100, Increase by 50% from year 0 to year 100, Sinusoidal
Survey CV: (true, estimated)	(0.1, 0.1), (0.25, 0.1); (**0.25, 0.25**); (0.34, 0.25)
Historic (1848-1914) catch bias	0.5, **1.0**, 1.5
Integrated	**NA**, priors for *MSYR*, *MSYL*, historical catch bias, extent of environmental variation in the probability of birth, time lag in density dependence

* Effects of factors begin in the year 2003 (i.e. at the start of management).

With respect to incorporation into the Schedule, the Committee **agreed** that this should not be seen as a necessary prerequisite of use of the *Bowhead SLA*. In or out of the Schedule, it represents the best method for the Committee to provide advice and could be used as the basis for modification of the current Schedule provisions with respect to bowhead whales which refer to catch and strike limits. This issue of whether (and how) to incorporate the use of the *SLA* into the Schedule is not a Scientific Committee matter and is the responsibility of the Commission.

8.7 Work plan

The Committee noted that without intersessional workshops, it would have taken at least three more years to develop the *Bowhead SLA*. It believes that work to complete a similar exercise for gray whales and make progress on the Greenland fisheries case requires a similar strategy. With such a workshop it may be possible to recommend a gray whale *SLA* at next year's meeting; without one it will certainly not. The Committee therefore strongly **recommends** that a four-day intersessional workshop be held, probably in December, and thanks Breiwick and DeMaster for once again offering the facilities of the National Marine Mammal Laboratory in Seattle. The Workshop will concentrate on reviewing the first results of *Evaluation* and *Robustness Trials* for gray whales and initiating the major review of the Greenland Research Programme.

Similarly, the Committee notes the vital importance of continuing the Developers' Fund, if it is to make progress on the remaining issues. Details of the work plan agreed by the SWG are given in Annex E. The Committee's final work plan is discussed under Item 19.

9. ABORIGINAL SUBSISTENCE WHALING STOCK ASSESSMENTS (ANNEX F)

Annual review of catches and catch limits

9.1.1 Bering-Chukchi-Beaufort Seas stock of bowhead whales

9.1.1.1 NEW SCIENTIFIC INFORMATION

The last successful census of this stock was in 1993. Two census attempts (1999 and 2000) failed due to unstable ice and closed leads, respectively.

SC/54/BRG5 described the results of a bowhead whale census conducted near Barrow in 2001. Observers recorded a total of 3,295 'new' (not seen before) and 532 'conditional' (possibly seen before) bowhead whales during 1,130 hours of watch effort. Only half of the watch period (572 hrs) was scored as 'fair-excellent' visibility, compared to 74% in 1993. The number of calves counted in 2001 (n = 121, 3.7% of the new whales) was nearly twice the 1993 count (n = 66) and the highest ever recorded. Passive acoustic surveillance was used to estimate the proportion of whales within viewing range.

The estimated number of whales within 4km (N_4) of the perch was 8,637 (SE = 1,019). The preliminary estimate of the proportion of whales within 4km of the perch (P_4) was 0.876 (SE = 0.033). Combining these, the preliminary (N_4/P_4) abundance estimate for 2001 is 9,860 (SE = 1,222; 95% CI 7,700-12,600). Generalised least squares was used to estimate rate of increase (ROI), taking into account the correlations among the pre-2000 abundance estimates given by Punt and Butterworth (1999). The estimated annual ROI from 1978-2001 was 3.3% (95% CI = 2%, 4.7%). This was almost the same as the ROI estimated from 1978-1993 data (3.2%), but the addition of the 2001 estimate improved the precision. While the N_4 portion of the estimate will not change, further acoustic data and analysis may change the P_4

and variance estimates. Therefore, although the estimates of abundance and ROI are preliminary, they are not expected to change substantially.

An acoustic survey was performed as part of the bowhead census off Point Barrow in 2001 (SC/54/BRG18). The basic methods used to record and analyse array recordings were the same as in previous years. Analysis of 757 out of 1,044 hours of acoustic array data resulted in the detection of over 73,000 bowhead sounds and 26,606 reliable locations. Of these, 13,637 were used to calculate the offshore distribution of vocal animals throughout the season. These results indicate that most (88%) vocal whales were within 4km of the perch. This is slightly less than in 1993 (93%), a year with exceptionally good ice, visibility and acoustic conditions.

SC/54/BRG15 presented the results of the shore-based counts of bowhead whales along the Chukotka Peninsula, Russia between 1999 and 2001. The purpose of this work was to determine the number of whales migrating along the western shore of the Bering Sea, where they were probably missed by counts from Point Barrow, Alaska. In spring 2001, 149 bowhead whales were counted, which is similar to the results from 1999 ($n = 115$) and 2000 ($n = 162$).

The Committee discussed the issue of climate change and its relevance to the bowhead whale assessment. Tynan summarised relevant climate oscillations, trends and predictions for the Arctic, particularly changes in sea ice extent and area. On shorter time scales (e.g. four-year period), the Arctic Oscillation (Thompson and Wallace, 1998) greatly affects the sea ice distribution in the Chukchi and Beaufort Seas (Wang and Ikeda, 2000). On decadal time scales, a trend of loss of sea ice area of 11% is reported for the Chukchi and Beaufort Seas. Models of sea ice show that by 2080 only a 'speck' of seasonal winter ice will remain in the Arctic (Vinnikov *et al.*, 1999).

SC/54/E11 presented stochastic bowhead population models that examine impacts of climate change and habitat degradation in the context of natural variability, such as decadal climate oscillations. Models predicted major bowhead population declines despite a rising trend in the near term. The author argued that such scenarios, while uncertain, are supported by evidence, and were suggested for incorporation into AWMP trials. In discussion, many members questioned the methods and interpretations given in the paper and stressed that the bowhead whale robustness trials investigated changes in productivity, carrying capacity and mortality, as well as random episodic mortality events (see Annex E, item 2.2 and Annex F, item 6.1.1).

9.1.1.2 CATCH INFORMATION

Catch information was summarised in SC/54/BRG20; 75 bowhead whales were struck during the 2001 Alaskan hunt, resulting in 49 animals (30 males, 19 females) landed. The efficiency (the ratio of the number landed to the number struck) of the hunt was 65.3%, which is less than the average efficiency over the past 10 years (76.5%). In 2001, ice conditions made hunting difficult, leading to a lower efficiency. Of the 19 females, two were presumably mature ($>$ 14.2m in length) but neither was closely examined to determine if they were pregnant. Since 1980, 27% of the landed females $>$ 14.2m in length were pregnant, although this is probably an underestimate because not all females were examined closely for small foetuses.

Ohsumi asked whether reproductive tissues could be collected from harvested animals for future laboratory analysis. Thorough examinations of bowheads and tissue collection occur primarily at Barrow, where most of the whales are harvested. Examinations and tissue collections occur opportunistically in other villages. The Committee **encouraged** continued collection and examination of reproductive organs.

One female bowhead whale (15.2m; estimated 46.8 tons) was harvested off of Chukotka, Russia in 2001 (SC/54/BRG21).

9.1.1.3 MANAGEMENT ADVICE

The Committee noted that although the current catch limit ends in 2002, an in-depth assessment of this stock of bowhead whales is not scheduled until 2004. However, preliminary results from the successful new census conducted near Barrow indicate that the stock is larger than it has been in the last century and is still increasing. The Committee in addition noted that it has **agreed** the *Bowhead SLA* at this meeting (see Item 8.2.1.2.2) which it believes is its best tool for providing management advice for this stock (see Item 8.6.2). On the basis of the information discussed under Item 9.1.1 alone, the Committee **agreed** that there is no reason to change the management advice it had given last year, namely, that it is very likely that a catch limit of 102 whales or less annually would be consistent with the requirements of the *Schedule*.

The Committee reviewed data requirements for the proposed bowhead assessment in 2004. In particular, there was an interest in resolving the conflict between existing age data and the catch and abundance data. It was noted that photo-identification data, such as those collected near Point Barrow, which provide an estimate of adult survival rate, can help to resolve this. In addition, further genetic data would assist with stock assessment. However, it was noted that the SWG on the AWMP has carried out a thorough review of the sub-stock question and the Committee believes that the single-stock hypothesis is most consistent with existing data.

9.1.2 In-depth assessment of eastern North Pacific gray whales

The Committee welcomed new data on gray whale abundance, distribution in the lagoons, migration, strandings and catch. Two papers (SC/54/BRG7 and SC/54/BRG10) presented assessments for this stock.

9.1.2.1 CATCH AND STRANDING INFORMATION

SC/54/BRG21 provided details on the 2001 aboriginal catch of gray whales in the waters adjacent to Chukotka, Russia. The harvest was carried out in the Gulf of Anadyr, the Senyavin Straits and in the open waters of the Bering Sea. A total of 112 gray whales was harvested, including 62 males and 50 females.

There was some discussion of strandings in the Chukotka region. Borodin noted that while it is difficult to accumulate stranding information over such a large coastline, he believes that most have been entrapments in ice. Melnikov added that he has been collecting information over a ten-year period and believes that many gray whales are killed by killer whales. When asked whether these were mainly attacks on calves, Melnikov replied that 2-3 year olds were more frequent targets. It was also noted that the presence of killer whale scars is routinely documented when animals are harvested.

SC/54/BRG27 summarised basic biological data collected from harvested gray whales in Chukotka primarily since 1980. Most of the discussion focused on two discrete periods: 1980-1992 and 1994-2000, the latter period marking a shift to a more traditional type of hunting in

coastal areas. The data obtained from harvested animals included sex, size (length), age, physiological condition and a thickness of blubber indicator (blubber thickness in millimetres divided by whale length in centimetres). Following the change in the harvest method, there was a decrease in the number of whales taken, the ratio of females in the catch and the length and corresponding age of harvested whales. A total of 542 whales were caught between 1994 and 2000, compared to the 2,137 taken between 1980 and 1992. Females dominated the catch in the earlier period, probably due to a hunting preference for larger animals. However, the sex ratio of catches has not differed from parity since 1998. In subsequent years, the whales harvested were predominately juveniles with an average age of less than two years. The percentage of pregnant whales among mature harvested females prior to 1992 was 13.4%. However, caution should be exercised regarding the use of such data as an indicator of the true pregnancy rate in this population. The Committee **recommends** that reproductive organs be collected and archived for detailed determination of pregnancy rates, as these are some of the few animals for which this will be possible. Borodin noted that Russia would welcome such a request.

SC/54/BRG23 summarised available information on the unusual mortality of eastern North Pacific gray whales in 1999 and 2000. The number of strandings documented along the west coast of North America increased to approximately eight times the annual mean calculated between 1995 and 1998. The unusually high number of strandings in 1999 ($n = 283$) continued in 2000, with 368 animals recovered from Mexico to Alaska. Several factors may have contributed to the large number of strandings reported in those years. Since most of the whales were not examined thoroughly, the actual cause of death is unknown. There was also a change in the demographics of stranded animals during this period relative to 1995-1998, with an increase in the proportion of females and adult whales. However, the total number of strandings recorded in 2001 was only 21. This number is within the range of annual strandings in the period 1995-1998. It was also noted that very few strandings have been recorded in 2002 (as of 1 May).

9.1.2.2 NEW SCIENTIFIC INFORMATION

SC/54/BRG24 presented a study of the distribution and abundance of gray whales in the Magdalena Bay complex at Baja California Sur, Mexico. This work compared cow-calf pairs to other whales in three well-defined zones: Santo Domingo Channel (north), Magdalena Bay (central) and Almejas Bay (south). The authors proposed that Magdalena and Almejas bays were mainly used for courtship and mating, or as congregation areas for young and immature whales that do not take part in active breeding. By contrast, Santo Domingo Channel was an important nursery ground.

SC/54/BRG26 described the movement patterns of mothers and single whales in Laguna San Ignacio based on satellite telemetry. Twelve gray whales (six mothers and six singles) were instrumented with Argos satellite-monitored radio tags in February 1996. Mothers stayed in the lagoon longer, made repeated excursions to and from the lagoon, and had a significantly higher percentage of locations inside the lagoon than single whales.

SC/54/BRG11 examined trends in relative abundance of adults and calves in Laguna Ojo de Liebre and Laguna López Mateos (in the Magdalena Bay complex) based on a series of air and vessel surveys between 1980 and 1998. Temporal and seasonal patterns of abundance were estimated by fitting generalised linear models to weekly counts with a Poisson regression. The authors concluded that lagoon use and calf production were severely disrupted around 1990, at least in the two areas studied.

SC/54/BRG16 reviewed existing information on gray whales in their wintering grounds in Mexican waters. This review included the history of exploitation in Baja California, the formal protection of gray whales in Mexico, research in Mexican waters, abundance within the lagoons, distribution, calf production and mortality, duration of stay within the lagoons, birth rate, mortality, movements from telemetry studies, site fidelity from genetic studies, environmental and anthropogenic threats, and future research and monitoring needs.

For the winter seasons 1997-2002 estimates of annual calf production suggest a decrease in calf production from the 1997 high (910 calves estimated) to a low in 1999 (286 calves), followed by a gradual increase to 670 calves during the period 2000-2002. Photographic identification of 975 single whales and 519 mothers with calf obtained during the winter seasons of 1996-2000 in Laguna San Ignacio revealed that the cow-calf pairs remain within the area approximately three times longer than single whales. Based on the photo-identification of 34 females seen in more than one year, and 18 with calves in different winter seasons, calving intervals were estimated to range from 2-4 years. The mean length of the calving interval was estimated as 2.50±0.29 years (95% CI = 2.21-2.8; $n = 19$). This interval is significantly higher than 2.11 (SD = 0.403) years estimated for the period 1977-1982.

SC/54/BRG25 described the northern migration route and speed of one gray whale tracked with an Argos satellite-monitored radio tag. During migration, the whale maintained an average speed of 134 km/d (5.6 km/h), suggesting a total coastal migration period of 49 days from Laguna San Ignacio to the Bering Sea.

Perryman *et al*. (2002) summarised results of seven shore-based sightings surveys for gray whale calves during their northbound migration. Calf estimates and a calf production index for the survey years (1994-2000) were given. In addition, the relationship between the duration of seasonal ice coverage over primary gray whale feeding grounds and the fluctuations in calf estimates was examined. The authors then examined the correlation between the length of the feeding season (the period free of ice at a point along the selected meridian near the centre of the Chirikov Basin feeding grounds) and the calf estimates in the spring season immediately following the feeding season. A significant positive correlation resulted between the duration of the feeding season and the calf estimates.

SC/54/BRG4 examined the relationship between sea-ice and calf production more closely. A log-linear model was developed to examine the relationship between this ice-free index and calf production, as measured by the estimates of the number of calves passing central California during the northbound migration. A potential relationship was examined at three different lags. The best fitting model indicated that calf production was correlated with both sea-ice cover in the first half of the feeding season and with year. The sea-ice effect accounted for the most inter-annual variability in calf production, but there was also a slow decline in average calf production. The authors interpreted this as potentially representing a compensatory decline in fecundity as the population approaches carrying capacity. Sea-ice cover in 2001 was also measured, and the authors predicted calf production in the spring of 2002 would be from 349-703.

SC/54/BRG3 provided an estimate for 2001 northbound calf production. A total of 87 calves were counted in 714 hours of watch, and the resulting estimate of 256 is the lowest estimate in the entire time-series which started in 1980. Photogrammetric data has also been collected on the width and length of whales for several years in the same area. The whales measured during the 2001 count appear to have been in better condition than in the two previous surveys. Urbán noted that the same pattern was seen in the lagoons, where fewer skinny whales have been seen since 2001, and a higher calf production has been documented.

SC/54/BRG6 documented the shore-based counts of southbound migrating eastern North Pacific gray whales carried out by the National Marine Fisheries Service (NMFS) in the winters 2000/01 and 2001/02. Research protocol was essentially identical to that used in previous surveys. The provisional abundance estimate from the 2000/01 census was 18,761 whales (CV = 0.10; 95% CI = 15,429-22,812), and the 2001/02 provisional estimate was 17,414 whales (CV = 0.10; 95% CI = 14,322-21,174). Both of these estimates are well below the previous (1997/98) estimate of 26,635 whales (CV = 0.10; 95% CI = 21,878-32,427).

9.1.2.3 ASSESSMENT MODEL RESULTS

A revised assessment of the eastern Pacific gray whale population was presented in SC/54/BRG7. Previous gray whale assessments were presented to the Committee in 1997, with papers SC/49/AS3 and SC/49/AS24 (based on methods subsequently published as Punt and Butterworth (2002) and Wade (2002), respectively). Since those assessments were completed, new abundance estimates are available for three years (1997/98, 2000/01 and 2001/02). Additionally, there is now an eight-year time series of annual estimates of the number of calves passing central California during the northbound migration, data which had been used in only a preliminary way in Wade (1997). SC/54/BRG7 presented four analyses, one using only the population estimates, and three variants using both the population estimates and the calf production estimates. The model and statistical techniques were essentially the same as used in Wade (1997). Over the four scenarios run, current carrying capacity (*K*) was estimated to be about 22,000, with 90% probability intervals between 19,000 and 35,000.

The maximum population growth rate was estimated to be about 7% to 8%, with 90% probability intervals from about 4% to 11%. The population was estimated to be at *K*, although lower bounds of the intervals were as low as 71%. There was essentially zero probability that the population was currently below MSYL. It was noted that the use of the calf estimates did not substantially change the results, but made the results more precise, particularly the estimates of *K*.

The quantities Q_0 and Q_1 have previously been recognised as the most appropriate for management advice on gray whales (IWC, 1998c, p.94). These quantities are identical for populations above MSYL (as estimated here), so that it was **agreed** to express results in terms of Q_1. The point estimates for Q_1 ranged from 605-669, with the lower 5th percentile of the posterior distributions ranging from 455-490.

The model estimates that a density-dependent decline in fecundity occurred throughout the 1980s and 1990s, that the population had nearly levelled off by around 1990, and that average calf production should have levelled off by 2000. It was noted that the abundance estimates have been roughly stable since 1984. In the single analysis in which the model was not fitted to the calf production data, the model still estimates that a compensatory decline in fecundity occurred throughout the 1990s. This is consistent with the independent results of an analysis of the calf estimates themselves, which indicated a slow decline. Higher mortality of gray whales in 1999 and 2000 (suggested by higher stranding rates) along with lower calf production from 1999-2001 could have led to a decline of gray whales in those years. Population estimates in 2000/01 and 2001/02 that were lower than estimates in most recent years are consistent with this idea, although it is impossible to determine how much of the drop in the estimates is due to a real decline in the population and how much to sampling error in the estimate.

In SC/54/BRG10, assessments of this stock were performed using the standard BALEEN II model (Punt, 1999) and the inertia model developed by Witting (2000; 2001). The inertia model is a density-regulated model that uses between-generation changes in the heritable component of fecundity to induce additional density-dependence that is delayed one generation. The advantage of this model is that it reconciles abundance estimates with historical catches, which traditional assessment models cannot do without assumptions such as an increase in carrying capacity. The results of the analyses based on the BALEEN II model are qualitatively and quantitatively very similar to those of SC/54/BRG7, although the results are not identical owing to slight differences in the model formulation, the choice of the model parameters and the data included in the likelihood function. Analyses based on the standard BALEEN II model fit the calf count data better than the inertia model and indicate a population at its (current) equilibrium level and that the current catches are sustainable.

The Committee **agreed** to seek management advice in quantities such as Q_0 and Q_1, and to compare that advice for model uncertainty against the inertia model that uses exponential functions and a catch history starting in 1600. Without commenting further on the plausibility of the inertia model governing gray whale population dynamics, the Committee noted that the model results did not give cause to modify management advice from the BALEEN II or similar models.

The Committee **recommends** additional research to investigate the observed changes and differences in the counts of gray whales, particularly gray whale calves observed in the breeding lagoons and along their migration routes, and to better understand the factors that are influencing the productivity of this population. It further **recommends** that the Commission co-sponsors[11] an intersessional workshop to bring together the most recent and historical data with which to examine process error in gray whale abundance, including: mother/calf counts; pregnancy rates in catch data; and seasonal distribution at the end of the southbound census. This workshop should also review relative habitat information (e.g. prey base) for examination and analysis relevant to the dynamics of the population. If the workshop is held, the report should be available for the 2003 Committee meeting.

9.1.2.4 MANAGEMENT ADVICE

The Committee noted that the assessments in SC/54/BRG7 and SC/54/BRG10 (using the BALEEN II model) used similar methods and yielded similar results, although they differed in some details, such as the behaviour of each model close to its unexploited equilibrium level. The Committee **agreed** that management advice can be formulated on the

[11] There was insufficient time to develop a funding proposal at the meeting.

basis of the results from the approaches in SC/54/BRG7 and SC/54/BRG10. Both assessments indicated that the population was above MSYL, and may be close to or above its unexploited equilibrium level.

In the previous assessment, the Committee agreed that management quantities such as Q_0 and Q_1 were more appropriate for management advice than RY for populations possibly above MSYL. In this case, the point estimates of population size are well above MSYL, and Q_0 and Q_1 are identical for such population sizes; the Committee **agreed** that Q_1 is the appropriate quantity for providing management advice for the eastern Pacific gray whale. The lower 5th percentiles for estimates of Q_1 in SC/54/BRG7 and SC/54/BRG10 were 482 and 475, respectively, using the methods of the last assessment. When the estimates of calf production were additionally used, the lower 5th percentiles for estimates of Q_1 were 463 and 466, respectively.

The last full assessment of this stock was in 1997 (IWC, 1998c, pp.92-94), and substantial new information has become available since then. The estimates of Q_1 are very similar to the estimates from the previous assessment (e.g. the lower 5th percentile from Wade (1997) was 472 compared to 482 from the new assessment). Based on data and analyses examined this year, the Committee **agreed** that a take of up to 463 whales per year (the lower of the 5th percentiles of Q_1) is sustainable for at least the medium term (~ 30 years), and is likely to allow the population to remain above MSYL.

The Committee noted that it hopes to be able to recommend a gray whale *SLA* at its next meeting (see Item 8.7).

9.1.3 Minke and fin whales off West Greenland

The Greenland catch for 2001 included 137 landed minke whales from West Greenland (32 males, 91 females, and 14 unknown sex, plus 2 struck and lost), 14 landed minke whales from East Greenland (14 females, 0 males, with 3 struck and lost) and 7 fin whales (3 males and 4 females, and 1 struck and lost).

The Committee has never been able to provide satisfactory management advice for either the fin or minke whales off Greenland. This reflects the lack of data on stock structure and abundance and is the reason for the Committee to first call for the Greenland Research Programme in 1998 (IWC, 1999c).

This **inability to provide any advice on safe catch limits is a matter of great concern**, particularly in the case of fin whales where the best available abundance estimate dates from 1987/88 and is only 1,096 (95% CI 520-2,106). The Committee notes that there is to be an abundance survey (see Item 8.4.2) this year. The Committee stresses that obtaining adequate information for management should be seen as of very high priority by both the national authorities and the Commission. Other recommendations related to the Greenland Research Programme are discussed under Item 8.4.

Without this information, the Committee will not be able to provide safe management advice in accord with the Commission's management objectives, or develop a reliable *SLA* for many years, with potentially serious consequences for the status of the stocks involved.

9.1.4 Humpback whales off St Vincent and The Grenadines

Hester reported the catch of a 55ft non-lactating female and a 28ft male (no milk present in stomach) at Bequia on 27 March 2002. He stated that photos and skin samples had been taken. However, he noted that the animal's ventral side may not have been photographed due to problems turning it over. More information on these catches is given in SC/54/ProgRep St Vincent and The Grenadines. Hester confirmed that a straight-line measurement was used to determine length. However, the whale was measured in water, which would have been logistically more difficult and may have introduced measurement error. Brownell and Clapham noted that a length of 55ft for a North Atlantic humpback whale was highly improbable (Clapham and Mead, 1999) and suggested that this reflected a measurement error.

Based on the available data, the Committee believed it is most plausible that eastern Caribbean humpbacks are part of the West Indies breeding population (Item 10.5.3.1). However, the Committee reiterated its view of last year that the question of abundance and population identity of humpback whales in the eastern Caribbean remains unresolved.

The Committee **recommends** that collection and analysis of photographic, genetic and abundance data be undertaken as a matter of urgency and referred to its discussions under Item 10.5.3.1. It noted that information on stock identity and abundance would be required in any future AWMP for humpback whales in the North Atlantic.

In response to a specific request to the Chair of the Scientific Committee from the Commissioner for St Vincent and The Grenadines, the Committee considered the likely impact on the stock of an annual take of four whales. Assuming that the humpback whales found in the eastern Caribbean are part of the West Indies breeding population, the Committee **agreed** that a catch of up to four whales taken annually will be unlikely to harm this stock.

9.2 Catches by non-member nations

No catches by non-member nations have been reported.

9.3 Contaminated gray whales from the eastern North Pacific stock

SC/54/BRG21 reported that two whales were 'stinky' (smelled of medicine) during the 2001 season, and samples from those animals are currently being analysed by Russian and North American scientists.

Rowles commented that samples from these whales had been shipped to Fairbanks, Alaska and would be analysed for ketones and anthropogenic contaminants sometime after this meeting. Brownell noted that discussions are underway for Japanese scientists to undertake additional studies on these samples.

9.4 Work plan

The work plan agreed by the sub-committee on bowhead, right and gray whales is given in Annex F and considered further under Item 19.

10. WHALE STOCKS

10.1 Matters relevant to more than one stock (Annex G)

10.1.1 DESS: Progress with data entry and analysis options

Data from the 1999/2000 and 2000/01 SOWER surveys have been validated and included in DESS (Database Estimation Software System). It was noted that the variance calculation in DESS uses each segment of survey mode on a transect as an independent sampling unit. The Committee **agreed** that there should be an option in DESS to use other sampling

units. It also **agreed** that a feature to be considered in future modifications of DESS is to include the surfacing data from sightings tracked during IO mode. These data would need to be entered into the database and an extraction query written. The Committee also **agreed** that the default option for school size estimates be changed so that the size bias regression method is used, even if the regression was not significant (for more details see IWC, 2002g, pp.196-7).

10.1.2 SOWER circumpolar cruises

10.1.2.1 SOWER 2001/02

Following last year's recommendation (IWC, 2002d, p.30), the cruise started approximately three weeks earlier than the six most recent previous surveys. This strategy was adopted to facilitate the temporal compatibility with earlier cruises (those prior to 1994/95), with the aim of ensuring that the survey took place during the peak migration period of minke whales. The planned survey area was the western half of Area V. However, extremely poor weather was encountered, and so longitudinal coverage was restricted to the area between 130°E and 150°E, in which good coverage was obtained in both the northern and southern strata. As a consequence of the poor weather, it was not possible to carry out the biopsy sampling feasibility study of minke whales, although the Estimated Angle and Distance Experiment (and training) was conducted.

Minke whales were the most commonly sighted species in the research area, with 123 groups comprising 358 animals seen. A surprisingly high number of blue whales were encountered (14 groups; 35 animals). The acoustic element of the blue whale research resulted in an unprecedented number of good quality recordings of sounds attributed to true blue whales.

Notwithstanding the numerous changes that have occurred during the course of the circumpolar cruises (e.g. reduced working hours, increased latitudinal coverage), a concern was raised regarding the relative lack of longitudinal coverage compared to earlier cruises (20° on this cruise compared to 60° on earlier surveys, both with two vessels). It was emphasised that the weather on this survey was *exceptionally* poor, and that this was the main reason for the particularly low coverage attained. On this survey, the vast majority of blue whale research was conducted in such conditions, barely impinging on potential minke whale research time.

The Committee expressed its gratitude to the Government of Japan for providing the vessels to conduct the survey. The Committee also thanked the officers and crews of both vessels, the Cruise Leader (Ensor) and the researchers for their efforts during a difficult cruise due to the exceptionally bad weather conditions encountered.

10.1.2.2 PLANS FOR FUTURE CRUISES

Given the poor coverage in 2001/02, SC/54/IA20 proposed a revised plan for the completion of the third circumpolar set of cruises, comprising coverage of the eastern area of Area V in 2002/03 and the western area in 2003/04.

Noting the importance of the SOWER surveys to its work, and of completing the third set of circumpolar surveys, the Committee expressed its gratitude to the Government of Japan for the offer to make the survey vessels available for this purpose in 2002/03 and 2003/04, for a time period longer than usual.

Some members were concerned about the simultaneous operation of SOWER and JARPA surveys in Area V and the possible effect that this could have on results. It was suggested that the two sets of survey tracks be planned such that: (a) a comparison of the resulting estimates of minke whale density from JARPA and SOWER is possible; and (b) disturbance effects are reduced by the SOWER vessels always preceding the whaling vessels in time and space. The Committee **agreed** that this is feasible and details will be finalised at the planning meeting (and see Item 16.4.1).

The remaining areas to be covered are disproportionate in size, with Area V East (which encompasses the Ross Sea) being much larger than Area V West (and especially the remaining unsurveyed area of Area V West). The plans outlined in SC/54/IA20 accommodate this concern to some degree by increasing the number of days allocated for research to 60, compared to the normal 40+ days. Noting the difficulty in surveying Area V East because of its wide latitudinal range, the Committee **agreed** that emphasis should be placed on surveying the southern (and mid-) strata in this Area. It was **agreed** that the survey should be designed to ensure full longitudinal coverage in these strata, but in order to accommodate this priority, the northern strata should be restricted to 20° longitudinal coverage in 2002/03, leaving the remaining 5° northern sector to be added to the area covered in the 2003/04 survey, although it should be attempted if the schedule of the cruise allowed.

10.1.3 NASS cruises

The coordinated international North Atlantic Cetacean Sighting Surveys (NASS) started in 1987 and have since been conducted in 1989 and 1995. In these surveys, large areas of the northern North Atlantic have been covered simultaneously by up to 15 vessels and two aircraft with participation of up to five countries (NAMMCO, 1998). The fourth international sightings survey (NASS-2001) was coordinated by the NAMMCO Scientific Committee and was carried out during the 2001 summer by the Faroes, Norway and Iceland. On two of the Icelandic vessels acoustic surveys for redfish were conducted simultaneously without any particular conflicts. The aerial survey component of NASS 2001 (SC/54/O12) covered the inshore areas of Iceland. This was the third NASS aerial survey carried out since 1987, using essentially the same survey design and procedures.

The Committee welcomed the report of these surveys, however, due to the lack of time, it was not possible to fully explore the methods and results. The Committee noted that sharing the survey platforms with the redfish survey on the Icelandic vessels had apparently been successful. It was noted that the international redfish surveys included a large area to the south and west of the NASS survey areas; had participation from Germany, Iceland, Norway and Russia; and will be carried out on a three-year rotation schedule. The Committee **recommends** that the nations participating in the next redfish survey incorporate a cetacean survey, if feasible. This would extend the geographical range of the NASS surveys to cover a larger area of the North Atlantic.

10.2 Antarctic minke whales – abundance estimates (Annex G)

10.2.1 Review of new data

Using standard IWC methods, estimates of Antarctic minke whale abundance from the 1999/2000 IWC-SOWER cruise in Area I, which surveyed the area south of 60°S to the

ice-edge, between 60° and 80°W was 5,910 whales (CV = 0.339). Using standard IWC methods, estimates of minke whale abundance from the 2000/01 IWC-SOWER cruise in Areas I and VI, which surveyed the area south of 60°S to the ice-edge, between 110° and 140°W, was 35,150 (CV = 0.309).

Comparing these estimates to other years in which parts of these areas were surveyed was difficult due to different longitudinal coverage. The Committee **agreed** that it is important to assess the longitudinal consistency of density estimates between surveys, and to gauge the scale at which different densities could be expected to be found, i.e. would a high density area seen one year on a longitudinal scale of 30° (say) be expected to be detected in another year, on the same scale, or it is more appropriate to compare densities on a smaller or larger longitudinal scale?

It was noted that there appeared to be a difference in the estimated detection functions in IO mode between the *Shonan Maru* (SM1) and the *Shonan Maru No.* 2 (SM2). In principle, there should be little difference between these vessels since they have the same design and engine. It was not possible to determine the cause of this difference, nor indeed whether the difference should be of concern at all, given the fairly low sample sizes, different observers and different conditions encountered during the survey imparting a composite effect on the fitted detection function. Some members suggested it would be useful to look at the noise profiles of the two vessels from acoustic tests at different operational speeds to investigate whether the differences might be due to more vibration on the SM2 at typical survey speed (11.5 knots). This is of particular importance as it could provide evidence of responsive movement being the cause of the differences between vessels seen in the analyses.

10.2.2 Updated estimates by area

Using the estimates reported under 10.2.1, the third circumpolar series of surveys now encircles the Antarctic, although the surveys in Area V do not extend completely from the ice-edge northwards to 60^0S. The percentage of ice-free area between 60^0S and the ice-edge covered by CPI, CPII and CPIII is 63.1%, 79.5% and 91.1% respectively. The updated estimate of abundance for CPIII is 312,000 (CV = 0.086). Abundance estimates for comparable areas indicates the CPIII estimate is now 46% of that in CPII. This is statistically significant at the 5% level.

10.2.3 Inter-year comparisons and trend

10.2.3.1 METHODOLOGICAL ISSUES THAT MAY INFLUENCE ABUNDANCE ESTIMATES AND THEIR TRENDS

10.2.3.1.1 EFFECTIVE SEARCH HALF-WIDTH AND SCHOOL SIZE ESTIMATION

The effects of different pooling strategies on the estimation of abundance of Antarctic minke whales, using data from the CPII and CPIII were explored in several papers, and details can be found in Annex G. SC/54/IA13 found that whilst stratum had a significant effect on both perpendicular sighting distance and school size, there were no significant differences between the two primary survey vessels. SC/54/IA15 reported revised minke whale abundance estimates for the 1998/99 circumpolar cruise in Area IV, by adopting the pooling strategy suggested in SC/54/IA13. The revised estimate increased by 47% to 10,470 (CV = 0.35). SC/54/IA5 also examined the effect on the abundance estimate for the 1998/99 survey of different pooling strategies. The changes in the abundance estimates from the estimates of a standard analysis, which was presented in Burt and Stahl (2001), ranged from 0% to 23% in closing mode and from −3% to 18% in IO mode. Although SC/54/IA5 and SC/54/IA15 analysed the same data, the abundance estimates were substantially different because of the different ways in which mean school size was estimated. SC/54/IA32 presented Akaike Information Criterion (AIC) estimates for different pooling options for the IDCR/SOWER surveys. Using the authors' preferred north vs south strategy only increased the ratio of abundances from CPIII/CPII by a factor of 1.04 compared to the estimates using the standard method.

The purpose of estimating the Closing:IO mode density ratio (*R*) is to correct for bias caused by surveying in Closing mode. SC/54/IA26 investigated possible changes in *R* for minke whales on the IDCR/SOWER surveys with: (1) time; (2) the inclusion of like-minke sightings; and (3) whale density. It was shown that estimates of (average) *R* for minke whales (which ignore any whale density effect) were generally identical for CPII and CPIII, but lower (though not significantly so) for CPIII when like-minke sightings were also taken into account. For pragmatic reasons, the authors suggested that adopting different *R* estimates for specific time periods (e.g. CPII and CPIII) avoids the problem of continual updating of the historic abundance estimates as more data by which to calculate this ratio become available. The Committee **concurred**.

The above papers came to the conclusion that pooling by stratum fits the data better than pooling by vessel. Pooling by stratum may be preferred *a priori* on biological grounds, especially if the two survey vessels are operationally similar.

The Committee concluded that whilst different analysis options may produce different point estimates, it would be unlikely that these differences would generally be substantial, even if they happened to be so for a particular dataset. It **endorsed** the view that decisions regarding general methodology should be based upon data from more than one survey, and pooling should not solely be based upon statistical criteria, but also on biological or environmental evidence, when available. Where appropriate, this strategy should be adopted even if it leads to higher variance estimates.

10.2.3.1.2 POTENTIAL COVARIATES

SC/54/IA17 investigated the effects of sighting conditions (school size, sighting cue, latitude and sea state) on Antarctic minke whale abundance estimation parameters (effective search half-width, sighting forward distance and mean school size). As school size decreased, the effective search half-width and the sighting forward distance decreased. Cues from schools of size 1 or 2 were usually 'body', which is generally considered more difficult to find in high sea states as compared to 'blow' cues. The proportion of schools of size 1 or 2 increased with decreasing latitude. Small school sizes and bad weather conditions prevailed in the northern part of the survey area. Because the survey area was extended northwards in the third circumpolar survey, the effects of small school size and bad weather conditions were substantial.

It was suggested that a 'synthetic sightability' variable that is some, perhaps non-linear, combination of other variables might be a better covariate than any single covariate. It was agreed that the IDCR/SOWER data should be used to determine which covariate or group of covariates provides the best estimate of optimal sighting conditions and

should be included in any method to estimate abundance. The Committee **recommends** that a synthetic sightability variable be investigated.

SC/54/IA16 explored the effect of different factors on the probability of a duplicate sighting of several species, and investigated any change in these probabilities between CPII and CPIII. The effect of school size on the probability of duplicate sightings was statistically significant for minke, humpback and southern bottlenose whales. For minke whales, the probability of a duplicate sighting for schools of size 2 was 1.56 times larger than for solitary animals (95% CI = 1.21-1.78), and for schools of 3 or more animals, it was 1.84 times larger (95% CI = 1.68-1.93). This provides strong evidence that $g(0)$ depends on school size. For minke whales, the duplicate sighting probability was about 20% smaller in CPIII than CPII, with this effect being more appreciable for the northern strata. This may be because solitary whales constitute a greater proportion of the schools in the northern regions, and survey effort was extended northwards in CPIII. A similar reduction was found for humpback whales; this suggests the possibility that humpback and minke whales have similar habitat preferences. In addition, it was shown that as visibility improves, the probability of a duplicate sighting tends to increase significantly. There is also a similar decreasing non-significant trend with sea state and a weaker trend with sightability, for which variation may not change in a systematic manner. In addition, when inexperienced observers (those with experience of less than five surveys) were observing from the IO platform, the duplicate sighting probability was 20% less than when observers with at least five years experience were there. This effect was not statistically significant, but sample sizes were quite small.

Whilst recognising that differential observer experience is a plausible explanation for changes in the duplicate sighting probabilities, the Committee noted that the effect is difficult to tease out from the data. The Committee concluded that the hypothesised observer experience effect contributes less to differences in $g(0)$ than does school size, but should be considered further.

The Committee cautioned that prior to the completion of CPIII, it is difficult to interpret some of these results because they may be strongly influenced by a particular survey area. For example, Area V East, which has not yet been surveyed, contributes a large proportion of the sightings.

The Committee **agreed** that these papers provide evidence supporting the assertion that $g(0)$ could be less than 1, at least in some of the circumstances investigated, and covariates that should be considered in future analyses include sighting cue, observer experience, survey mode, sightability (synthetic or that recorded in the field), Beaufort sea state, school size, distance from ice and stratum (North or South).

10.2.3.1.3 METHODS TO INCORPORATE COVARIATES AND ESTIMATE $g(0)$

SC/54/IA29 explored the use of the covariate estimation framework available in the program Distance 4 (Thomas *et al.*, 2001) for improving detection function estimation in the computation of minke whale abundance estimates for the IDCR/SOWER surveys. Estimation from pooled data including environmental and other covariates was attempted for the CPII. Annex G, Appendix 4 examined data from CPII, and showed that including covariates when estimating the search half-width improved the fit in all cases except when weather was included. In all cases, the AIC value was lower for the hazard-rate model than for the half-normal. A correlation matrix was obtained between all the covariates; although most factors were significant, correlations > 0.2 were only obtained for sightability with weather and wind speed, and confirmed sightings with closing mode.

SC/54/IA23 investigated generalisations of size bias regression methods for estimating school size from line transect data.

The methods were illustrated using data from the 1999/2000 and 2000/01 circumpolar surveys. There appeared to be little gained from applying GLMs (generalised linear models) or GAMs (generalised additive models) in the perpendicular distance based model. However, the inclusion of a regional effect in the detection function did provide improvement over the perpendicular distance only approach, yielding increased precision, and possibly more reliable estimates. Including unconfirmed sightings was not successful and possible reasons for this were suggested.

The Committee **agreed** that this method is a promising way to extend the standard method that could produce less biased abundance estimates and could be relatively easily incorporated into DESS. However, it requires evaluation with respect to its robustness and accuracy.

The 'Big Beautiful Model' estimates abundance by accounting for variations in $g(0)$ caused by size bias, changes in school size distribution and changes in sighting conditions (SC/54/IA21). The method provides estimates of $g(0)$ independent of double-platform data and so avoids some of the complexities and sensitivities associated with double platform estimation. The Committee welcomed this new approach and **recommends** its further development (see Item 21).

Spatial modelling potentially provides a better insight into true uncertainty than stratified estimation, since the latter tends to yield fluctuating estimates of variance. However, in practice, developing well-behaved spatial estimators can be difficult. Five linked issues requiring further work were raised:

(1) estimating variance (dealing with clustered sightings, and incorporating uncertainty from earlier steps in the analysis, e.g. in effective search half-width);
(2) choosing the scale of smoothing, when sightings are clustered on small spatial scales;
(3) allowing for spatial variation in the scale of smoothing, perhaps linked to localised environmental factors;
(4) changing the form of the underlying smoother, e.g. to accommodate non-smooth changes in density;
(5) restricting the fitted density surfaces to realistic values in regions of rectangular strata that are far from the zigzag track.

The Committee **encourages** further intersessional work on these issues.

SC/54/IA10 introduced a relatively simple hazard probability model using perpendicular and forward distance data for double-platform line transect surveys in which the independent observers have the same visual searching area. This model can provide an abundance estimate of diving animals without the assumption of $g(0) = 1$, and takes account of unmodelled heterogeneity derived from the whales' surfacing behaviour. The proposed model may be viewed as an integration of the Skaug and Schweder (1999) and Cooke (2001) approaches, but is more general and tractable. It may be easily extended to a model with only perpendicular distance data or to include data from 'incompletely independent' observers.

A simulation study and an application to actual IDCR/SOWER sightings data suggested that the proposed method performed well and could be useful for the future analyses. In particular, simulation tests indicated that using other available data, such as incompletely independent observer sightings data and mean surfacing rate estimated from external data, can improve the performance of the model. The ability to utilise the former is important because such data can easily and economically be collected. The provisional results from applying the model to actual sightings data when $g(0)$ is assumed to be 1 and when it is not, yielded considerably different abundance and trend estimates.

In discussion of SC/54/IA10, it was noted that the results presented were considered preliminary by the authors, the main aim of the paper being to introduce the methods. Key points raised were: (1) the improvement in precision obtained when the IO platform data were added to the model was likely to be an artefact of increasing sample size (since a common detection function was assumed across all platforms); (2) school size was not included in the current simulation (although this is planned – with simultaneous surfacing of all animals in a school); it is however presently incorporated as a covariate in the model; (3) the reversal of the trend in abundance estimates seen when comparing those from the proposed methods and those from Branch and Butterworth (2001b) was not fully understood – in particular, neither the difference in the methods used to estimate school size, nor $g(0)$ estimation were thought to be responsible – it seemed most likely that the reversal was a result of different stratification options used in the analyses; and (4) the apparent gain in precision using the proposed methods compared to the standard methods was due to assuming independence between sightings, which is invalid in the presence of clustering.

SC/54/IA30 examined the discrepancy in whale density between the true value and an estimate assuming that $g(0) = 1$, using a simple mathematical equation. Whale density was defined as the product of the school density estimate and mean school size. Estimates of $g(0)$ from the 1989/90 and 1993/94 IDCR/SOWER surveys (SC/54/IA10), stratified by school size class (1, 2, 3+), were assumed to apply for all years in the 2nd and 3rd circumpolar surveys respectively. This approach was taken for illustrative purposes only; clearly it is preferable to estimate $g(0)$ separately for each survey. The discrepancy between density estimates which assumed that $g(0) = 1$, and those which used $g(0)$ stratified by school size class, ranged from −18% to −39%.

SC/54/IA1 reported progress on (1) estimating strip width without the assumption $g(0) = 1$; and (2) estimation of additional variance. Estimation of strip width was based on the method described and tested in Cooke (2001), which the Committee had recommended last year (IWC, 2002g, p.199). The two tasks were addressed together using the integrated modelling framework outlined in Cooke and Leaper, 1998. The method for treating the three platforms on IDCR/SOWER cruises was similar to that used in SC/54/IA10. The data collected in IO mode are necessary for the estimation of $g(0)$, but school sizes estimated in this mode appear to be biased low, hence a method was developed for allowing for school size bias in the estimation.

The Committee noted that this method was promising because it would probably be able to be used to extrapolate to unsurveyed areas, simultaneously accounting for all the potential covariates that have been discussed. Technical questions included: how was the changing ice-edge in the non-symmetrical Antarctic study area incorporated into the Fourier series; was there a conflict between estimating the overdispersion term and automatically selecting the terms for the smoothing function; what should the most appropriate scale for smoothing be; and should that scale vary depending on the amount of variability in a region? After discussion, it was concluded that further work should resolve these technical issues.

The Committee **welcomed** all the new methods, **encourages** further development and simulation testing of these (and other) methods and **looks forward** to seeing the results from applying them to the IDCR/SOWER data.

The Committee **agreed** that $g(0)$ differs by school size, but the difficulty remains as to how to address this in analyses. It is complicated by the fact that in IO mode (which has traditionally been the mode used to estimate $g(0)$), there is negative bias in the size of recorded schools – a large proportion of which are unconfirmed. It was noted that data from Closing mode, for which the recorded school sizes are thought to be unbiased, could be used to calibrate the recorded IO mode school sizes.

The Committee **agreed** that the performance and robustness of any new method should be evaluated. Some new simulation datasets will have to be created for this purpose, since the original datasets were primarily designed for testing North Atlantic minke whale analysis methods. Some of these changes will be minor: a detection function to simulate upper or front bridge observers' sightings, for example. Other changes will require more thought e.g. determining an appropriate way to generate Antarctic minke whale school size distributions and surfacing patterns (as well as detectability based on school sizes and other covariates). To further complicate matters, the fact that recorded school sizes in IO mode tend to be negatively biased estimates of true school size was raised, and its effects should be considered and if possible, accounted for. A more complete description of factors to be included in the simulated datasets was developed, and a timetable was established to ensure results from the simulations could be presented next year.

The Committee **recommends** that simulated datasets be used to evaluate any method that might be used to analyse the IDCR/SOWER data, including the standard method. In addition, the Committee **recommends** that further development of the standard method is, at this time, lower priority than evaluating the performance of the new methods. The Committee also **agreed** that when all the circumpolar data are available, these data are analysed by the standard method, and by any new methods found to be robust to the heterogeneities introduced into the simulated data. The Committee also **recommends** that results of methods when applied to both simulated and actual IDCR/SOWER data be presented at next year's meeting.

10.2.3.2 TIMING OF THE SURVEYS

The JSV, JARPA and IDCR/SOWER sightings data in Areas III, IV and V were used to examine the migration pattern of Antarctic minke whales (SC/54/IA12). The analysis included JSV data from 1971/72 to 2000/01 and JARPA and IDCR/SOWER data from 1987/88 to 2000/01. Five factors were considered as covariates in a GLM: latitude, longitude, time, season and Beaufort wind force. AIC was used to select the final model. It was concluded that in the 1970s, the peak migration was in late January; in the 1980s, it was bimodal, in mid-January and mid-February; and in the 1990s, it was also bimodal, in late December and

mid-February. CPUE data from the 1970s showed a consistent peak of migration in January (Shimadzu, 1980), which is somewhat different than the results of this analysis.

A potential problem with the analysis is the differing nature of the three data sources. It was suggested that including a covariate for JSV vs IDCR vs JARPA might make the analysis more robust. Nevertheless, because of these data source problems, any results would necessarily be rough.

A GLM analysis of daily minke whale density estimates from IDCR/SOWER surveys from 1978/79 to 1997/98 was used to determine migration patterns. The effects of survey mode, latitude, year and Management Area were included. A 20% drop in abundance was seen only after mid-February, although a larger real drop may be masked by a possibly confounding year effect. Inclusion of a year-date interaction term might help with this.

SC/54/IA7 noted that this shift in timing of migration was in the December to January period when the annual decrease in sea ice extent is most rapid and divergent. The author indicated that inter-annual climatological oscillations that affect variability in ice coverage may have indirectly affected the timing of the minke whale migration through changes due to, for example, prey availability or changes in the relative amounts of open water, ice edge and pack ice habitats. A more complete discussion of climatological indices and their relationship to pack ice and minke whale abundance and distribution is given under Item 10.2.3.5 and in SC/54/IA7.

The reason for the investigation into the timing of the minke whale migration was to determine if the recent change in timing of the IDCR/SOWER surveys affects the estimated abundance (IWC, 2002g, p.199). Given the new results presented, the Committee **agreed** that changes in survey timing probably had only a small impact on abundance estimates.

10.2.3.3 USING JSV DATA TO EXTRAPOLATE TO UNSURVEYED REGIONS

SC/54/IA12 extrapolated densities from the IDCR/SOWER (south of 60°S) area to northern areas covered by the JSV cruises (30°S-60°S). The IDCR/SOWER data were from CPII, 1985/86 to 1990/91; the JSV data were collected from 1971/72 to 2001/02. Assuming no difference in conditions, the extrapolation rate was calculated as the ratio of the index abundance between the northern area and the area south of 60°S. This ranged from 5% to 18%. Using estimates from CPII, the population in the northern area is estimated to be about 320,000 in Areas III, IV and V. This may be slightly positively biased, because the sightings in the northern area may include some dwarf minke whales.

10.2.3.4 COMPARING JARPA DATA TO IDCR/SOWER DATA

SC/54/IA14 compared trends in Antarctic minke whale abundance between JARPA and IDCR/SOWER surveys in Areas IV and V. It reported that the trends in abundance estimates from the JARPA surveys (Hakamada *et al.*, 2001) in both Area IV (six surveys examined for the period 1989/90 to 1999/2000) and Area V (six surveys examined for the period 1990/91 to 2000/01) were not significantly different from zero. In contrast, abundance estimates from IDCR/SOWER surveys showed a negative trend in these Areas. The IDCR/SOWER surveys started several years earlier (1978/79 for Area IV; 1980/81 for Area V) but were conducted less frequently. It was suggested that JARPA surveys may better reflect the trend in abundance for minke whales for the following reasons: (1) the estimates of abundance from the IDCR/SOWER surveys in CPIII are negatively biased estimates of true minke whale abundance and thus the downward trend is exaggerated; (2) there have been more JARPA surveys in these Areas than IDCR/SOWER surveys; and (3) there is more consistency among JARPA surveys than among IDCR/SOWER surveys in terms of the survey method, and geographical and temporal coverage of the surveys.

Childerhouse commented that the first five JARPA surveys in Area IV indicated a downward trend similar to the IDCR/SOWER surveys, and that the non-significant result quoted above was a reflection of a particularly high value for the sixth survey within the series. In response, it was pointed out that the low results for the fifth survey (1997/98) were particularly influential in suggesting an initial negative trend. There were reasons related to different ice conditions and a smaller proportion of mature females in the survey region in 1997/98 which strongly suggested that the 1997/98 survey had covered a smaller than usual proportion of the overall population.

The Committee considered that the temporal incomparability and survey design differences between the IDCR/SOWER and JARPA surveys rendered direct comparisons between their trend estimates inappropriate. However, the greater consistency of the JARPA surveys suggests that they may provide information on additional variance.

10.2.3.5 ANIMALS WITHIN THE PACK ICE

The survey ships used to collect IDCR/SOWER data cannot survey within the pack ice at normal survey speed (11.5 knots), so the ice-edge defines the southern border of the survey area. Although it is known that minke whales are within the pack ice during the surveys, it is not known what the order of magnitude nor inter-annual variability of the abundance in the pack ice is. Attempts were made to quantify these unknowns as detailed in Annex G.

One attempt to directly quantify the density of minke whales in the pack ice involved the analysis of data collected on the annual Southern Ocean Cetacean Ecosystem Program (SOCEP) and Australian APIS cetacean survey. This shipboard survey was conducted from 3-28 December 1999 within the pack ice starting at (64°23'S 150^{0}50'E) and travelling westwards through the pack ice to Davis Base (68°34'S 77°50'E). The target species were seals, not cetaceans. In addition to the usual line transect data, they collected an extensive description of patterns of ice distribution. The potential to make inferences about densities in the pack ice is limited due to timing of the surveys and potential violations of line transect assumptions. The Committee **recommends** that methods to obtain unbiased, precise abundance estimates using data collected in the pack ice be developed. Progress on this issue was being developed in the Standing Working Group on Environmental Concerns (Annex J, Appendix 3).

In the absence of Antarctic minke whale abundance estimates within the pack ice for the same times and Areas as the IDCR/SOWER or JARPA surveys, other more indirect ways were explored (see Annex G). Two sources of data were used: JARPA data and previously published estimates of animals in the pack ice.

10.2.3.5.1 JARPA DATA

Based on the observation that mature female minke whales tend to be found further south, near the ice-edge, the sexual maturity rates and ice coverage from years with low

abundance estimates in open water were compared to those from years with high open water abundance estimates. A coarse estimate of the number of whales in the pack ice was calculated by multiplying the observed proportions of mature females from the JARPA samples by the abundance in open water as estimated from the JARPA data.

On the 2001/02 JARPA cruise, a substantial number of minke whales were sighted in the SE stratum and in Prydz Bay, and the sexual maturity rate of sampled females was 74%. In contrast, in the SE stratum in the 1997/98 JARPA survey there were few minke whale sightings, and the sexual maturity rate of sampled females was only 5%. According to the NIC satellite information, there were many ice-free areas south of the ice-edge in 1997/98, where research vessels could not enter. In fact, in Area IV in 1997/98, the ice coverage was higher than in other years in the JARPA series (Annex G, Appendix 6). Using these data, it was estimated that the number of mature females south of Area IV in the pack ice in 1997/98 was 2,876 (Annex G, Appendix 7). It was noted that this figure was probably an underestimate of the total number of minke whales in the pack ice, as the estimate does not include males or immature females.

The Committee spent some time discussing the possible whereabouts of minke whales during years when the open water abundance estimates were low and the various hypotheses included: into the pack ice; north of 60°S; and east or west.

SC/54/IA18 presented the same pattern between ice coverage and abundance from the 1988/89 (CPII) and 1998/99 (CPIII) IDCR/SOWER surveys in Area IV. The 1998/99 season was colder and the estimated abundance of minke whales was very low; it is not clear where they were. On either side of the study area, the Ross Sea and Prydz Bay were both closed in January 1998/99, although they are well known to be high-density areas of Antarctic minke whales. It is possible that the whales scattered widely in the northern stratum, although the abundance in the northern stratum was lower than the southern stratum (Burt and Stahl, 2001). Therefore, the authors concluded that many minke whales could have gone into the pack ice region in 1998/99.

It was further noted that the proportion of mature males in Area IV (greater than *ca* 0.6) always exceeds that observed in Area V (*ca* 0.5) (Annex G, Appendix 8). This is consistent with the differences in ice conditions in Area IV and V. There was also substantial variability in the proportion of mature males by year (i.e. a difference of about 0.25 between the maximum and minimum proportions). In Area IV this appears to be inversely proportional to the JARPA abundance estimates, while in Area V there is little or no relationship. The latter, despite similar levels of variation in the sex ratios in Area IV and V, suggests that either the change in ice cover is not the sole explanation for the observed data in Area IV or that different factors are the source of the variation in Area V. The estimates of the number of mature and immature animals in Areas IV and V, by sex and year, lead to the conclusion that the pattern of abundance estimates cannot be explained simply by increasing proportions of females within the ice, and that if increase in ice is the explanation for the declines, then both males and females must be entering into the ice zone.

During further discussion, it was noted that the analyses in Annex G, Appendix 8 estimated abundance by using Area-specific proportions of mature females. It was agreed that using estimates of abundance by stratum within an Area would provide further information for the Committee to consider, should such data be available.

10.2.3.5.1 PREVIOUSLY PUBLISHED DATA

SC/54/IA19 presented estimates of the abundance of minke whales in unsurveyed regions within the pack ice for three scenarios of the proportion of whales in the pack ice. The closing mode density of Antarctic minke whales in open water was obtained from the southern stratum of each sector in the IDCR/SOWER data from 1978/79 to 1997/98 (Branch and Butterworth, 2001b). This density was applied to areas of open waters inside the pack ice using data from Kasamatsu *et al.* (2000). Scenario 1 was based on 1979 data from Naito (1982); scenario 2 combined the 1979 and 1981 data in Naito (1982); and scenario 3 used data from Ainley (1985). The estimated abundance (for each scenario) within the pack ice in CPII was 18%, 102% and 51% of that in the ice-free area; in CPIII the percentages were 28%, 159% and 72% respectively. The area within the pack ice region in CPII was 123% of that in CPIII. Estimated total abundances in CPII were 100%, 99% and 110% of that in CPIII. This suggests that there could be a substantial difference between CPII and CPIII.

The Committee noted that there are very few surveys on densities of minke whales within the pack ice, and that this paper was useful in presenting calculations of the possible proportion of minke whales in the pack ice. However, certain incompatibilities (the density estimates in the pack ice were not from the same Areas as the open water density estimates; the timing of surveys within the pack ice did not overlap the entire time period of the IDCR/SOWER open water surveys) made interpretation of the results difficult.

SC/54/IA7 noted that the distribution of minke whales may be affected by inter-annual climatological variability that affects the extent and coverage of the sea ice. To try to examine the mechanism behind the inverse correlation between open water abundances and ice coverage, the Committee attempted to link the patterns of proportions of mature females with patterns of pack ice. A list of environmental covariates that might be useful in quantitatively investigating this correlation include: (a) Southern Oscillation Index (Kwok and Comiso, 2002); (b) SAO (Reuter, 1936; Van Loon, 1967); (c) Antarctic Oscillation Index (AOI) (Gong and Wang, 1999); (d) El Niño-Southern Oscillation (ENSO); (e) sea ice-edge e.g. monthly mean sea ice-edge, equator-most position of the 30% isopleth of ice concentration in each degree of longitude (Yuan and Martinson, 2000); (f) sea ice edge anomaly – monthly, removes seasonal cycle, contains inter-annual and longer-term variability as well as linear trends (Yuan and Martinson, 2000); (g) ice concentration – 25 km × 25 km grids; (h) ice area; (i) sea ice motion; and (j) ice thickness.

This information introduces some hypotheses for changes in open water abundance of minke whales; however, more research and data from the pack ice is needed to test the hypotheses. In the meantime, the Committee **agreed** that correlation analyses between open water abundance estimates and environmental factors may help to develop functional/biological connections between climate, ice, productivity (e.g. chlorophyll) and Antarctic minke whale abundance.

One attempt to develop such a functional link between the patterns of proportions of mature females with patterns of ice conditions is given below. In Area IV, the pattern of ice melt is characterised by the southward recession of the ice edge and (based on satellite predicted estimates) the development of ice-free areas inside the pack ice, near the Antarctic coast. In a 'normal' year, the main ice-edge recedes southward, and especially at longitudes corresponding to the ice-free areas inside the pack ice. During the survey period, some, but not

all, of the ice-free areas inside the pack ice become contiguous with the open sea to the north, and characteristically they form bays in the main ice-edge. The pattern of ice melt was considered 'normal' in the following seasons: 1989/90, 1991/92, 1993/94 and 1999/2000. The proportions of mature females in the catch data from the southern stratum for these years were 31.1%, 39.1%, 27.6% and 42.8%, respectively. The pattern of ice melt was 'abnormal' in 1997/98 when the ice-edge was farther north than usual. Based on satellite predicted estimates, extensive ice-free areas were present inside the pack ice this year. The percentage of mature females in the catch was substantially lower (7.1%).

These analyses and observations support the hypothesis that the 'missing' mature females are possibly distributed in the pack ice, but do not preclude other hypotheses, such as longitudinal movement out of the Areas. More work is needed to fully explore these ideas. Despite the difficulties in interpreting the variety of information, the Committee **agreed** that there could be large numbers of minke whales within the pack ice, quite possible some tens of percent of the open water IDCR/SOWER abundance estimates, at least for certain areas. However, potential biases and paucity of surveys in the pack ice make it difficult to be more definitive. The Committee **recommends** the ice-edge information in the analyses of SC/53/IA15 be used to give a simple annual index of the week or month of greatest ice cover and the percent ice coverage for the times and areas of the IDCR/SOWER and JARPA surveys. In addition, it **recommends** that the IDCR/SOWER and JARPA data (which covered a longer time series) be used to investigate if there is a correlation between open water abundance and ice coverage.

10.2.3.6 WORK PLAN

In the light of current uncertainty about the density and distribution of minke whales in the pack ice, and to what extent this might affect interpretations about trend from the IDCR/SOWER and JARPA surveys, the Committee **agreed** that little further progress can be made on this issue without new data and analyses. It therefore sought to identify potential existing sources of data, and to make recommendations on what data would be useful to collect from vessels that operate in the pack ice.

It was noted that the most useful data were those from dedicated cetacean observer platforms, particularly those platforms on which the observations were made both in open water and in the pack ice, such as the 1995/96 BROKE survey (Nicol *et al.*, 2000) and SO-GLOBEC cruises with cetacean observers onboard (SC/54/E12). Other potential data sources include: APIS data; data collected during transits to and from Antarctic bases; surveys in Area III conducted by Australian SOCEP; and data collected during ice navigation modes during the IDCR/SOWER and JARPA surveys. Concerns were expressed regarding the APIS aerial survey data, given that these surveys were primarily aimed at surveying seals (hauled out on to the ice) and hence would not have consistent search effort for whales. Some of these aerial surveys also had dedicated cetacean observers onboard so cross-validation with corresponding dedicated shipboard cetacean observations data would be useful.

Different views were expressed regarding the applicability of conventional line transect estimation methods to data from within the pack ice. However, it was agreed that sighting distance and angle data may have a role to play in any future analyses, and that these data should be collected where possible. The Committee also **recommends** that consistent and regular descriptions of the ice characteristics (see Annex J, Appendix 2) and other factors affecting the detectability of minke whales be collected. Furthermore, the Committee **recommends** that data corresponding to where the IDCR/SOWER 'ice edge' would have been located should be recorded where possible. It was also suggested that satellite telemetry should be used to provide information on the movement of minke whales between pack ice and open water (the IDCR/SOWER survey area).

The Committee also **recommends** the following items to facilitate progress on identifying available data sources and to encourage the collection of new data within the pack-ice region:

(1) the Secretariat should make an official request to the APIS coordinators inquiring about availability and access to any cetacean data that their member countries may have collected within and outside the pack ice;
(2) relevant members of the Scientific Committee should approach individuals whom they know to have been involved with the APIS surveys with the same enquiry as in (1) above (Thiele and Gales will coordinate this effort);
(3) requests should be made to countries that use ice breakers in the Antarctic to conduct dedicated cetacean observations from their vessels (e.g. Australia, France, Germany, Japan, South Africa, the UK and the USA). Thiele will coordinate this effort, and ensure that data are collected in a standardised format.

10.2.3.7 TRENDS IN ABUNDANCE USING POPULATION DYNAMICS MODELS

In SC/54/IA25, the ADAPT VPA methodology of Butterworth *et al.* (1999) was refined and/or extended with catch-at-age and abundance information (from both the IDCR/SOWER and JARPA programmes) in Areas IV and V. The results suggest statistically significant increases in recruitment until a peak in the late 1960s, followed by a drop and then stabilisation for more recent years. Total (1+) population trends over the past two decades show slight non-significant declines of about 1% per annum. The Area IV population is, however, estimated to have declined over the 1970s. Estimates of M for the two Areas range from 0.046-0.070 per year, and are statistically compatible. These results are consistent with supercompensation (with the population having expanded beyond its current carrying capacity) and subsequent reductions in that carrying capacity (the population first having rapidly increased towards an increased carrying capacity earlier in the last century).

The authors noted that the suggestion of only a slight decline in abundance (about 1% per year, or 20% over the timeframe of the IDCR/SOWER surveys) initially appears to contradict the results from the IDCR/SOWER surveys that show an appreciable decrease in abundance estimates between CPII and CPIII. Further examination of the abundance estimates showed that estimates from Areas IV and V in CPIII were 58% of the estimates from CPII. This supports the results from this model. However, the estimates from the remaining Areas I, II, III and VI in CPIII were 36% of that in CPII, a much greater reduction. The difference in circumpolar estimates between CPII and CPIII is therefore not completely addressed by the ADAPT VPA model. However, the IDCR/SOWER survey estimates have wide confidence limits, and are not statistically incompatible with the VPA results.

In discussion, several members argued that other plausible scenarios existed to explain these results. In particular, the analyses presented implicitly require some subjective decisions to be made, fixing some parameters to enable estimation of others. For example, some concerns were expressed about the plausibility of the extent of the increase in population until the 1970s; such an increase would not follow if the natural mortality rate (*M*) was as high as 0.1. Opinions differed on how realistic a rate of 0.1 for *M* was, but Butterworth pointed out that it exceeded the confidence limits of the estimates of *M* provided by the VPA.

Concerns were raised about the selectivity constraints in the VPA model and lack of fit to the age distribution in the 'plus' group. Although some concerns about the selectivity constraints had been addressed in Butterworth *et al.* (1999), further consideration of fit to the age data for older animals was needed in Area IV. Another concern raised was the need to consider the implication of uncertainty about stock structure on the VPA results.

Possible reasons for the estimated decrease in abundance in the late 1960s were discussed. It was noted that the large harvests in Area IV probably contributed. However, it is unlikely that these trends could be explained by supercompensation alone; the postulated decrease in carrying capacity was also essential to explain the observed patterns (unless the current estimates of abundance from the IDCR/SOWER surveys were very negatively biased). Other suggested explanations for the observed changes in population size include an inertial dynamics model, and changes in carrying capacity that were climatologically driven.

It was pointed out that the stock recruitment relationships estimated by the VPA for minke whales in Areas IV and V (particularly the recent large drops in *per capita* recruitment) do not appear to be supported by some of the biological evidence available from commercial catch and JARPA data. If recruitment estimates from the VPA are truly representative, and pregnancy rate and age at first parturition are without trend, then some other mechanism(s) must be postulated to account for a variable stock/recruitment relation. One possible explanation is a decrease in juvenile survival rate (lactation having higher demands on females than pregnancy). It was **noted** that an estimate of body condition, perhaps derived from data on whale length, weight and blubber thickness, as well as apparent pregnancy rate and age at first ovulation, might be a useful diagnostic for future results from VPA or other integrated models. The historical catch records also include data (e.g. oil yield, blubber thickness) that might be useful in determining an appropriate condition factor.

Ohsumi noted that the 1997 JARPA Review meeting had confirmed that blubber thickness had decreased since the JARPA programme began in 1987 (IWC, 1998b). He also expressed the view that blue whales and humpback whales were increasing in the Antarctic, and that consequent competition effects might be restricting the carrying capacity of minke whales.

The Committee noted that whilst the combined three-year-three-age catch-at-age data from these Areas is published, the sensitivity and robustness of the VPA model could only be independently investigated if the corresponding data on a one-year-one-age basis were also available. Kato reminded the Committee that the Institute of Cetacean Research, which owns the JARPA data, established data policies during the JARPA Review Meeting that are applicable in this case. Furthermore, it was noted that details on how the catch-at-age matrices are constructed were also necessary, of which some were provided in Butterworth *et al.* (1999). To address some of the concerns about this VPA analysis, Polacheck agreed to convene an intersessional e-mail group to: (1) request the required summary data following the established data policies; (2) make a list of the concepts that need to be addressed in further analyses (i.e. alter the model structure, incorporate other biological data and stock structure alternatives, and investigate model robustness); and (3) coordinate individuals to pursue analyses to address these concerns.

The Committee **recommends** that the power of different approaches to detecting a trend be investigated, including a simple regression on abundance estimates, the integrated approach suggested in SC/54/IA1 and the VPA approach of Butterworth *et al.* (1999).

10.2.4 Other

10.2.4.1 UPDATE ON mtDNA ANALYSES

An update of the mitochondrial DNA (mtDNA) RFLP analysis in Antarctic minke whales from Areas V and VIW was presented (SC/54/IA9). The analysis used all the available samples from these Areas (1988/89-2000/01 JARPA surveys). Samples were divided arbitrarily as follows: Area V Western (130°-165°E); Area V Eastern (165°E-170°W); and Area VI Western (145°W-170°W), with two temporal periods (Early and Late). A total of 2,228 samples was examined in six longitudinal/temporal groups. Following an examination of yearly variation, a hierarchical analysis by AMOVA was conducted for the total samples. Overall, no significant mtDNA heterogeneity was found in Areas V and VIW. Each of the longitudinal/temporal groups in Areas V and VIW differed significantly from an out-group sample from Area IVWE in both F_{ST} and PHI_{ST} statistics.

It was suggested that information on any geographical and temporal differences in stock structure in the Antarctic Areas could be incorporated into integrated models such as the VPA. Pastene informed the Committee that a new study covering Areas III-VI is underway using nuclear DNA in addition to mtDNA. The Committee **recommends** that attempts be made to collect samples from lower latitudes, recognising that the exact locations of the putative breeding grounds are at present unknown. In this regard, it **recommends** that the use of satellite telemetry to track whales between the Antarctic and lower latitudes should also be investigated.

10.2.4.2 RESPONSE TO RESOLUTION 2001-7

Resolution 2001-7 'requests the Scientific Committee to provide to the Commission at IWC 54 (IWC, 2002c):

(i) a list of plausible hypotheses that may explain this apparent population decline;
(ii) the possible implications that such a decline in abundance may have for the management of minke whales in the Southern Hemisphere, and for ecologically-related species, in particular other cetaceans, and the state of the Antarctic marine ecosystem.

The Committee noted the estimates of abundance using the 'standard methods' of Branch and Butterworth (2001b) for the third circumpolar set of surveys are appreciably lower than estimates for the second circumpolar set of surveys. Last year, after coarsely quantifying many of the factors affecting abundance estimates, there remained evidence of a decline in abundance estimates from CPII to CPIII, although it was not clear how this reflected any actual changes in minke abundance. This year, many contributions were

submitted suggesting refinements to these coarse quantifications (Annex G, Appendix 10), but it is premature to attempt an update of last year's computations, at least until the results of further work scheduled for the 2003 meeting could be reviewed.

Given the wide range of plausible hypotheses identified above, the Committee respectfully informs the Commission that it believes it is premature to comment on the equally wide range of potential management implications. The Committee **agreed** that the most appropriate time to fully address this issue will be after completing its work on reviewing the IDCR/SOWER abundance estimates.

10.2.5 Plans for completion of the Antarctic minke whale review

Annex G, Appendix 9 details the tasks identified by the Committee to further the review of Antarctic minke whale abundance estimates, together with an indication of priorities for the next year. Noting the need to explain why the estimates of abundance using the standard methods for CPIII are appreciably lower than for CPII, the Committee **strongly recommends** that substantial progress be made on all high priority tasks by next year's Scientific Committee meeting.

To successfully complete its review of the IDCR/SOWER abundance estimates and trends, and to address Resolution 2001-7, resources are required to complete the last two years of the IDCR/SOWER survey and to develop and test new analytical methods that result in less biased abundance estimates and trends. Financial details of the IDCR/SOWER cruises are discussed in Annex G, Appendix 2; and financial details of the method development and testing are discussed under Item 21.

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

10.3.1 Abundance estimation

An attempt had been made to improve the precision of detection functions for blue whale abundance estimates by using data for all circumpolar sets of cruises combined, instead of separately as at present (SC/54/IA27). The attempt was not successful, probably because small sample sizes do not contain sufficient information to distinguish the numerous factors affecting the shape of the fitted distributions. It was estimated that $g(0)$ is likely to be much closer to 1 for blue whales than for minke whales (SC/54/IA16), probably because of their large body size and blow.

The updated abundance estimates for blue whales from the IDCR/SOWER surveys from 1978/79 to 2000/01 using the methods of Branch and Butterworth (2001a) are given in Table 7. When comparable areas are considered, the point estimate of abundance in CPIII is appreciably higher than that in CPI and CPII; this difference is more marked when 'like-blue' sightings are also included in the comparable-area estimates. However, because of the high CVs associated with these abundance estimates, the CPII and CPIII estimates for comparable areas are not significantly different at the 5% level. These estimates refer to animals sighted south of 60°S, and are therefore likely to refer largely to 'true' blue whales. Given the results in SC/54/IA8 (see below) no more than 7% of such animals are likely to be pygmy blue whales.

Due to time constraints, the Committee did not complete its review of the abundance and trends of blue whales in the Antarctic.

10.3.2 Progress on sub-species differentiation

10.3.2.1 BEHAVIOUR AND MORPHOLOGY

A total of 362 video sequences of 28 hours 36 minutes and 146 photographs of 52 animals obtained mainly on SOWER circumpolar cruises in the period 1995/96-2000/01 had been examined to provide distinctive external morphological keys for sub-species discrimination of blue whales during shipboard surveys (SC/54/IA8). For comparison of morphological keys and surfacing behaviour between sub-species, in the absence of an appropriate genetic marker, the sampling location of blue whales in mid-summer was used, with animals north of 55°S identified provisionally as pygmy blue whales, and those south of 55°S as true blue whales. A statistically significant trend that putative pygmy blue whales submerge without showing the dorsal fin and keel was confirmed. A 'tadpole' shape typifies putative pygmy blue whales and a 'torpedo' shape putative true blue whales, while in putative pygmy blue whales the anterior tip of the central blowhole groove extends beyond the anterior tip of the nostrils. Furthermore, there were statistically significant differences in dorsal hump type between the two sub-species. Bayesian analyses indicated the reliability of the keys in combination for discriminating between the sub-species. The morphological analyses indicated that some animals identified as pygmy blue whales using the keys are found among true blue whales (south of 55°S). The proportion of such animals was calculated as 2.3% or 6.9%, depending on morphological key used. These values could be a measure of the mixing rate of pygmy blue whales south of 60°S.

Preliminary mtDNA analyses using biopsy samples collected earlier indicated statistically significant differences in haplotype frequency between the provisional sub-species,

Table 7

Point estimates of abundance, CV and 95% confidence interval (CI) for blue whales in the Antarctic, from the baseline analysis ('baseline'), when estimates from comparable areas are considered ('comparable areas') and when like-blue sightings are additionally included ('comparable + like blue').

Circum Set	Baseline			Comparable areas			Comparable + like blue		
	Abundance	CV	95% CI	Abundance	CV	95% CI	Abundance	CV	95% CI
I	400	0.41	200-940	500	0.41	250-1,200	500	0.41	250-1,200
II	500	0.48	230-1,300	700	0.51	270-1,700	700	0.51	260-1,700
III	1,700	0.42	760-3,700	1,900	0.42	860-4,200	2,300	0.38	1,100-4,600

although no specific haplotype peculiar to either sub-species was detected. Dizon and Brownell reported that new blue whale samples from the Southern Hemisphere had been received, thus significantly increasing the sample size. They will use these samples to expand their exploration of likelihood-based approaches using microsatellites to assign individuals to sub-species and report this to the Committee next year.

The Committee **recommends** the following:

(1) take still or video-photographs of the blowhole region in blue whales at every opportunity;
(2) conduct genetic (including microsatellite) analyses on the sample materials available from the IDCR/SOWER and JARPA cruises, taking account of information for each sampled whale on the three morphological criteria developed in SC/54/IA8 for sub-species differentiation.

10.3.2.2 ACOUSTICS

Clark reported that analysis of calls recorded so far on SOWER cruises indicated that all recordings made in high latitudes (from three areas over four years) were identical to themselves but differed from those made in mid-latitudes, i.e. from Madagascar, Chile and Western Australia, which were themselves different from each other. Calls recorded on the most recent (2001/02) cruise were identical to those recorded earlier in high latitudes, and are presumed to be made by males as part of a reproductive display. The results so far do not contradict the hypothesis that high latitude animals are different from those for which calls have been recorded in mid-latitudes. He noted however that so far only 75% of the tapes from earlier SOWER cruises have been made available.

Since 2000, the Committee has recommended that the acoustic data from the cruises be archived and examined. Clark reported that the archiving was almost complete.

For the past two years, the Committee has also recommended convening a workshop specifically on blue whale acoustics to: (1) review the sounds recorded on SOWER cruises in the context of known blue whale sounds; (2) reappraise the value of acoustics for distinguishing between the two sub-species; and (3) make recommendations for future acoustic work to address the sub-species issue. Participants invited will be people with experience in blue whale acoustics, including Clark (USA), Doherty (USA), Ljungblad (USA), McDonald (USA), McCauley (Australia), Shimada (Japan), Rankin (USA), Stafford (USA). Clark reported plans were underway to hold it during the 2002 summer, prior to the SOWER Planning Meeting.

Acoustic detections of baleen whales near the Antarctic Peninsula were recorded using passive acoustic recording packages (ARPs) (SC/54/O3). The aim was to provide information on seasonal occurrence, distribution and minimum population size for, *inter alia*, 'true' blue and fin whales. Preliminary analysis of data retrieved from seven out of eight ARPs deployed revealed numerous 'Antarctic-type' blue whale calls, detected year-round. Calls on the shelf-break were apparently louder than those detected on the shelf.

10.3.3 Other

Mikhalev presented information on a catch of pygmy blue whales obtained in a limited area south of Australia in late January 1965. The Soviet fleet *Sovietskaya Ukraina* took 177 animals in a small area centred on *ca* 39°S, 125°E, south of the Great Australian Bight, between 24 January and 1 February. Because animals were taken indiscriminately as encountered, their biological characteristics represent a random sample of stock structure prior to commercial whaling. Ninety-nine animals (55.9%) were male. Males ranged in length from 14.2-22.1m (mean length 19.7m). Forty-one of the 78 females were examined, ranging in length from 15.5-22.8m (mean 19.9m); 12 (29.3%) were immature, including one calf. Sexually mature females measured from 18.6m.

The Committee welcomed this important new information. In response to a request from the Committee, Mikhalev stated that he would attempt to obtain additional information on catches by the same fleet earlier in the season, for example east of Amsterdam/St Paul Islands in the Indian Ocean, for presentation at next year's meeting.

The Committee **recommends** that the Chilean and Japanese governments be urged to make available any data from the blue whale catches from the 1960s. An effort is needed to resolve the question of whether both sub-species were taken from Chilean land stations.

10.3.4 Work plan

The Committee noted that it was impossible to conduct the review on the IDCR/SOWER analysis methods and complete an in-depth assessment of blue whales. Therefore, the Committee **recommends** that the assessment of blue whales start in 2005, the year after the completion of the IDCR/SOWER review. To ensure the necessary materials are available by the time of the review, the sub-committee identified a number of important tasks. These are given in Annex G.

The Committee suggested that satellite-tagging be discussed next year. To ensure the success of this discussion it **recommends** that the appropriate tagging experts be invited to next year's meeting. The Committee requests the Secretariat to complete the coding of the historic catch data.

The Committee's final work plan is discussed under Item 19.

10.4 Southern Hemisphere humpback whales (Annex H)

10.4.1 New information on distribution, stock structure, abundance and trends

Surveys for humpback whales off the coast of Oman were conducted between 2000-2002 (SC/54/H3). This population appears to be resident in the Arabian Sea year-round and observations of song and of mother/calf pairs in February supports the suggestion by Mikhalev (1997) that this population is on a Northern Hemisphere breeding cycle. Photo-identification and genetic data were collected. There was a statistically significant difference between Omani samples and those collected from sites in the southwestern Indian Ocean. However, given the observations of year-round feeding off Oman, it is possible that animals that breed in the southwestern Indian Ocean cross the equator to feed in the Arabian Sea in the austral summer (boreal winter).

Humpback whale occurrence and distribution around Mayotte in the Mozambique Channel were investigated during the austral winters of 1995-2001 (SC/54/H18). There were sightings of 152 groups of humpback whales, of which 64% were mother/calf pairs. This is a much higher

percentage than has been reported for other breeding areas and suggests that Mayotte may represent an important nursing/calving area or resting point along the migration route.

Rosenbaum described the formation and activities of the Indo-South Atlantic Humpback Whale Network which exists to promote collaboration and to coordinate research among scientists working in the Indian and South Atlantic Oceans (primarily around Africa). The Network aims to make large-scale data comparisons to investigate migration links, population structure, trends in abundance and identification of critical habitats for humpback whales over a large proportion of their range around Africa and in the northern Indian Ocean. The Government of South Africa has contributed ship time for a whale research and training cruise which will be conducted in collaboration with dedicated shore-based surveys off Cape Vidal. The Committee expressed its appreciation to the Network and to the Government of South Africa for this important collaborative effort, and looked forward to seeing the results next year.

Research on humpback whales in the coastal waters of eastern Madagascar and off Gabon was summarised (SC/54/H20). The estimated abundance of humpback whales in Antongil Bay was 1,746 (CV = 0.19). This estimate is conservative, since 47.0% of the individuals are identified from dorsal fin photographs and were excluded from the analysis.

Carlson noted that surveys for humpback whales and other marine mammals off Kenya were being conducted (Weru, 2001), and would be coordinated with other members of the Indo-South Atlantic Humpback Whale Network. The Committee welcomed this work, and strongly supported research in this important and previously unstudied area.

A shore-based survey for humpback whales on the west coast of South Africa (Saldanha Bay) was conducted from July to December 2001 (SC/54/H21). Observations were made of 95 sightings of 233 humpback whales and 217 sightings of 354 right whales. Results seem to confirm the presence of a suspended migration in spring, as proposed by Best *et al*. (1995). Biopsies and fluke photographs were also collected. In addition to survey work, there was further investigation of whaling data. Catch per unit effort data from the Donkergat and Salamander whaling stations showed two peaks in humpback whale availability, one in July and the other in November/December. The size composition of the catch suggests that these peaks coincided with an influx of mature animals, representing peaks of migration.

Data from field notebooks kept by the late Dr William Dawbin including information on land-based sighting surveys for humpback whales in Fiji during the austral winters of 1956, 1957 and 1958 were presented. A preliminary analysis of these data (SC/54/H7) indicated that humpbacks were quite abundant in the area during this period although recent anecdotal reports indicate that humpbacks are much rarer in Fijian waters today. Clapham noted that, if details of Dawbin's field effort could be obtained from his notebooks, there would be an attempt to conduct replicate surveys in the area to better assess the present status of this population, which is presumably part of the depleted Area VI stock.

Activities of the South Pacific Whale Research Consortium (SPWRC) were summarised in SC/54/O14. This group includes researchers from areas of Oceania and the South Pacific as well as from adjacent regions of South America and the Antarctic. Matching within the regional catalogue of fluke photographs has revealed some degree of migratory interchange between adjacent areas of Oceania, South Pacific, but no interchange with South America or the Antarctic Peninsula. Non-systematic surveys and published capture-recapture estimates based on photo-identification indicate that the density of whales remains low throughout the wintering grounds of Oceania and the New Zealand migratory corridor.

The issue of animal ethics and experimental guidelines had arisen in the sub-committee on the Comprehensive Assessment of humpback whales (Annex H, item 6.1). A range of views was expressed during discussions but no agreement was reached on how this issue should be addressed. The Committee agreed that this was a complex issue that had some relevance to potential collaboration among scientists but did not pursue it further.

The abundance of humpback whales in New Caledonia was estimated from a catalogue of individuals identified by microsatellite genotyping ($n = 214$), by fluke photographs ($n = 217$) and by combined records of both (SC/54/H9). The estimate obtained from the genotype data (95% CI = 366-674) was larger and less precise than the photo-identification estimate (95% CI = 279-432). Overall, it is apparent that the population of humpback whales in New Caledonia is small. Although there were unresolved methodological issues with combined photo-identification and genotyping estimates of abundance, the Committee noted that this was a promising approach and encouraged further investigation into this issue. In this context, a collaborative discussion between the Indo-South Atlantic Humpback Whale Network, the South Pacific Whale Research Consortium, and researchers in the North Atlantic was recommended.

Occurrence of humpback whales in French Polynesia over the period 1988-2001 was summarised (SC/54/H14). From 1988-2001, more than a thousand observations of humpback whales were made near 25 islands in four of French Polynesia's five archipelagos. Analysis of skin samples showed few mtDNA haplotypes shared with other areas of the South Pacific. Given the high haplotype diversity within this region, this latter finding is not surprising.

SC/54/H5 reported on aerial surveys carried out off the coast of Brazil, between 12° and 20°S, with the objective of investigating distribution and abundance of humpback whales. Standard line transect sampling was used, and the resulting estimates were corrected for availability bias. The corrected estimated abundance was 2,291 individuals (CV = 0.45). Population estimates for humpback whales from Abrolhos Bank, Brazil over the period 1996 to 2000 ranged from 1,389-3,977 with an average CV of 0.27 (SC/54/H11). A maximum-likelihood estimate for the year 2000 was 3,871 individuals (95% CI = 2,795-5,542), with an estimated growth rate at 31%. In discussion, it was noted that this growth rate was clearly unreasonable (see Clapham *et al.*, 2001), and suggested the existence of some unknown methodological problems in sampling or in the estimation process. As a result, the estimate of abundance should be treated with considerable caution.

SC/54/H12 described research on humpbacks conducted off the western side of the Antarctic Peninsula. Photo-identification, biopsy sampling and vessel surveys were used to investigate the biology, distribution and density of cetaceans in the Antarctic Peninsula area. The authors encouraged the development of multidisciplinary habitat studies in the region to improve understanding of humpback whale ecology in the Antarctic.

The Committee regretted that a lack of funding had prevented the authors of the papers SC/54/H5, H11 and H12 from attending the meeting, and highlighted the need for the

IWC to support the attendance of researchers from developing countries.

A comparison of duplicate sighting rate for Southern Hemisphere humpback whales between the IDCR/SOWER CPII and CPIII was presented in SC/54/IA16. The duplicate sighting probability for school sizes greater than two was 1.6 times larger than for a single school. This confirms that duplicate sighting probability (and hence $g(0)$) is dependent on school size. The probability of duplicate sightings did not significantly differ between the second and third set of circumpolar surveys.

Sightings of humpback whales from the 2001/2002 JARPA survey were summarised in SC/54/O18. Total primary sightings of humpback whales were 1,219 schools/2,387 animals. This was the highest number recorded on any JARPA survey. Humpback whales and minke whales showed clear separation in most areas except for some areas near the ice-edge where both species were concentrated. The authors suggested that the increase in abundance of humpback whales may be leading to interspecific competition with minke whales because both species prefer the same prey and are generally distributed in similar areas while locally segregating from each other. In response, Clapham noted that simple overlaps in distribution were not sufficient to support claims of interspecific competition, which was a complex issue (Clapham and Brownell, 1996). Weinrich also noted that experience in the Gulf of Maine over 25 years has shown that patterns of prey abundance and distribution can cause medium-scale annual shifts in humpback distribution. Hence, dramatic local increases cannot be interpreted without similar effort throughout the stock's feeding range. In response, Ishikawa noted that JARPA surveys covered a large part of the Antarctic and had been conducted repeatedly over the last 15 years, and that therefore the results were reliable and showed that there had been an increase in humpback whales.

Results of aerial surveys of humpback whales migrating northward along the coast of Western Australia between 1976 and 1994 (Bannister and Hedley, 2001) were presented. These surveys demonstrated a rate of increase of approximately 10% per annum, at least between 1982 and 1991. The 1994 survey confirmed the rate of increase and provided an abundance estimate of 4-5,000. The most recent survey in 1999 was considerably affected by poor weather but applying a correction factor for animals missed yielded an estimate of absolute population size of 8,207-13,640.

Overall, in reviewing current studies in the Southern Hemisphere, the Committee commended all of the researchers working on humpback whales in Oman, Kenya, Madagascar, the Comoros, Mayotte, Gabon, Brazil, South Africa, Australia, Oceania and the Antarctic. The Committee was particularly pleased to see multi-area collaborations such as the Indo-South Atlantic Humpback Whale Network and the South Pacific Whale Research Consortium, and strongly encouraged the development of additional collaborative work of this nature.

10.4.2 Further population dynamics modelling

An assessment of the West and East Australian stocks of humpback whales was conducted using an age-aggregated production model that allows for mixing in the feeding grounds of Areas IV and V (SC/54/H17). These stocks were projected to reach pristine levels (assuming zero catches) in 10-15 years for the western stock and 15-20 years for the more depleted eastern breeding stock. The authors noted that their results were dependent upon absolute abundance estimates available for the two breeding stocks. A subsequent reanalysis using new estimates suggested that current abundance of the Western stock could be as high as 65% of the pristine level.

Baker commented that the total known catch over certain periods was greater than the total population estimated by the model for that period. Butterworth responded that the numbers caught reflected a combination of catches on the feeding and breeding grounds taken from both stocks. However, further concerns were raised about the assignment of previously unreported Soviet catches to Antarctic Areas, and it was agreed that this requires further discussion. Baker commented that genetic analysis in progress may allow the assignment of animals from the feeding grounds to the breeding grounds, and that this would assist future modelling efforts.

In response to a question, the authors responded that the growth rate estimated in the model approaches 12.6% when abundance was at its lowest, and that this rate declines as the population grows. Clapham noted that 12.6% was the maximum plausible rate of increase derived from knowledge of humpback whale biological parameters.

10.4.3 Antarctic humpback whale catalogue

Carlson reported on the status of IWC Research Contract 16, the Antarctic Humpback Whale Catalogue (SC/54/H13). The catalogue has received 448 images from 17 contributors during the contract period, bringing the total number of catalogued individuals to 1,405. Of particular note were thirteen matches, including between Southern Ocean Area V and Eastern Australia (one match), and the Antarctic Peninsula and Costa Rica (three matches). There was considerable discussion about the protocols for accessing these data. A Working Group was set up to discuss this issue; its report is given as Annex H, Appendix 4. The Committee was pleased to receive this information and **recommends** that this work continues to be supported with the new conditions laid out in Appendix 4 of Annex H.

10.4.4 Work required to complete assessment

Substantial progress has been made in recent years in improving the understanding of humpback whales in certain areas of the Southern Hemisphere. However, many major gaps in data remain. Time constraints meant that a comprehensive review of the current state of knowledge about Southern Hemisphere humpback whales was impossible to achieve during the meeting. To address this, an intersessional group under Bannister was established (see Annex S). The terms of reference of this group are to: (1) summarise current knowledge regarding Southern Hemisphere humpback whales, by population or management area; (2) identify major gaps in knowledge; and (3) establish priorities for research to fill these gaps. Current information under (1) would include abundance and trends, catches and incidental takes, population structure and stock identity, biological parameters, environmental concerns and assessment models. The intersessional group will use the North Atlantic humpback whale Comprehensive Assessment as a model in summarising information. After reviewing the group's report at next year's meeting, further consideration will be given to whether it is feasible to set a deadline for the completion of the Comprehensive Assessment.

The Committee **agreed** that the results of the most recent East Australia humpback whale survey (in 2000) were important to the assessment, and **strongly recommends** that they be made available soon.

10.4.5 Work plan

Considerable progress had been made in some areas of the work plan from last year; however many items still require further work. The proposed work plan of the sub-committee is given in Annex H. The Committee's work plan is discussed under Item 19.

10.5 North Atlantic humpback whales – completion of Comprehensive Assessment (Annex H)

10.5.1 Review of assessment model developments

Last year, the Committee had recommended further development to the assessment model (IWC, 2002h, p.239). The Commission had supported this work and an improved framework for the assessment of North Atlantic Humpback Whales was outlined in SC/54/H1. The population dynamics model underlying the assessment is density-dependent, age- and sex-structured, and allows for multiple feeding and breeding grounds, 'stock'- or feeding ground-specific values for the resilience parameter and survival rates, as well as depensation. The model is fitted to data on absolute abundance, trends in relative abundance, estimated rates of increase, and information about the proportion of animals from each breeding ground on the feeding grounds.

10.5.2 Review of catch data

Intersessional work attempting to improve estimates of historical removals of humpback whales had been completed. Searches of historical archives in Maine and in Provincetown, Massachusetts yielded a modest amount of new information (SC/54/H16). To refine estimates of catches from the West Indies and the Cape Verde Islands, whaling logbooks from an additional stratified sample were read and information analysed. The resulting figures generally corroborate previous work, but improve the accuracy of removal estimates and provide measures of precision that were lacking in earlier studies.

A struck and lost rate of 1.85 was applied to West Indies and Cape Verde non-mechanised shore fisheries up to 1957; this was derived from information given in Mitchell and Reeves (1983). A rate of 1.23 was used for catches after 1957; this was derived from data given in Price (1985), and reflects the fact that use of power boats to tow dead whales resulted in a decrease in the struck and lost rate.

The new data were added to existing records of removals; these are listed by year in Annex H, Appendix 2. These figures represent plausible best estimates, not minimum estimates, with the possible exception of a shore-based fishery in the Cape Verde Islands (searches for information on which have not been conducted). Current knowledge suggests that there are no substantial gaps in the catch history as presented. Additional discussion is given in Annex H (item 5.1.2).

10.5.3 Additional analysis and data collection

10.5.3.1 POPULATION STRUCTURE AND STOCK IDENTITY

Incidental observations of humpback whales given in the logbooks of 19th century American whalers showed humpback whales in locations where little or no survey effort has occurred in recent times (SC/54/H22). Sightings in summer (June and July) on, or to the west of, the Mid-Atlantic Ridge may represent animals in previously unknown mid-ocean feeding habitats. The Committee noted that singing is common on the Mid-Atlantic Ridge from November to March; no acoustic sampling had occurred there during June, July and August.

The Committee noted that one of three biopsy samples taken on a US research cruise in the eastern Caribbean had recently been matched (by microsatellite genotyping) to an individual sampled in the Barents Sea. This represents the first match (either photographic or genetic) between the eastern Caribbean and the northeastern North Atlantic.

The Committee was informed that photographs and tissue samples had been collected from animals taken in the St Vincent hunt, and that tissue samples would be analysed in collaboration with Japanese colleagues.

The Committee **strongly encourages** that photographs be submitted to the College of the Atlantic to allow comparisons with the North Atlantic humpback whale catalogue, including the YoNAH collection. It also strongly encouraged that tissue samples or results from their analysis be forwarded to Palsbøll at the University of California Berkeley for comparison with the YoNAH genetic database.

Pastene reported that tissue samples would be analysed using mtDNA control region sequencing and micro-satellite profiling at the ICR genetics laboratory, and that he would contact Palsbøll so that results could be compared with those for the entire North Atlantic.

Hester reported that a collaborative project among eastern Caribbean countries had been initiated to collect photo-identification data. The photographs will be submitted to the North Atlantic humpback catalogue at the College of the Atlantic.

The Committee welcomed these initiatives and looked forward to the early resolution of the question of population identity of humpbacks in the eastern Caribbean.

10.5.3.2 ABUNDANCE AND TRENDS

Information on humpback whales was presented for the Icelandic component of the NASS-95 survey (SC/54/H10), with a revised estimate of abundance of 13,900 (95% CI = 3,900-29,000). SC/54/H10 also presented estimates for each of the two survey vessels separately. One of these, 7,900 (CV = 0.22) for the vessel AFR was considered to be the most appropriate estimate for inclusion as input into the assessment model (see Item 10.5.4). Abundance for Icelandic nearshore waters from the NASS-2001 aerial survey (SC/54/H2) was estimated as 3,057 (95% CI = 1,727-5,410). However, this survey did not sample the entire area and the analysis did not account for availability bias; these are both sources of negative bias.

A trend of 11.4% (SE = 2.1%) annual increase was estimated from an analysis of sighting rates of humpback whales in four aerial surveys conducted in Icelandic coastal waters in the period 1986-2001 (SC/54/H6). The reported rate was similar to one of 11.6% reported from sightings of humpback whales recorded by whalers for the period 1970-1988. In discussion, it was noted that these figures should not necessarily be taken as population growth rates; they are close to the maximum plausible rates for humpback whales calculated from demographic parameters (Clapham *et al.*, 2001). Some members believed that this may reflect a combination of population growth and immigration into the survey area from other regions.

10.5.3.3 BIOLOGICAL PARAMETERS

An update to previously published data on reproductive parameters of Gulf of Maine humpback whales was presented in SC/54/H23. Details are given in Annex H (item 5.1.4). Mature females observed in five consecutive years produced an average of 0.43 calves per year during that time period. Mothers and calves were much more likely to occur

in a particular area in the Gulf of Maine, suggesting that studies of humpback whale reproductive rates in other populations may be subject to bias (notably negative bias) if sampling is not undertaken in all parts of the feeding range. This may have important implications for assessments of humpback whales in other feeding areas.

10.5.4 Assessment

The Committee **agreed** a series of assessment model runs to provide information on humpback whale populations in the North Atlantic. Results from the model runs are given in Annex H, Appendix 3. The main general features of all the results are: (1) poor fit; and (2) populations in all areas are predicted to have recovered to carrying capacity. This is not consistent with observed continuing increases in a number of areas. In addition, the observed fecundity rate (0.43, reported in SC/54/H23) is not consistent with the model's prediction of a lower rate.

Results of a simple exponential model, which assumed that catches and abundance data for each feeding ground were independent, to approximate the trend in each feeding ground, were reviewed. Details are given in Annex H (item 5.2.2). The results suggested that population sizes for the Gulf of Maine and Iceland were still very low during the period 1940 to the 1960s. This is not consistent with known catch data in at least Iceland, which were believed to be fairly accurate. Any additional (unrecorded) catches would therefore have to have been taken elsewhere. Gunnlaugsson noted that sightings by whalers of humpback whales off the western coast of Iceland were very rare in the 1950s.

The Committee **agreed** that possible explanations for the failure of the assessment model to fit the data include the five listed below.

(1) The model structure is wrong. It is possible that other structures, such as an inertia model (Witting, 2001), might provide a better approach to the assessment.
(2) The catch data contain major gaps. This is unlikely to be the case for the 20th century, for which the catch record is reasonably well documented, but it is possible that removals from earlier periods have been significantly underestimated.
(3) The recent estimates of abundance are wrong. These would have to be overestimates to explain the problems with model fitting; this was not considered likely.
(4) Carrying capacity may have fluctuated and increased in recent years, thus affecting the abundance of whales. It was acknowledged that the marine ecosystem has changed in many respects over the last century as a result of human exploitation and climatic variations.
(5) The existence of a largely unexploited population of humpback whales in some unknown area of the North Atlantic which has expanded and is now recolonising other habitats.

With regard to the last possibility, the Committee noted the incidental historical sightings around the Mid-Atlantic Ridge (see Item 10.5.3.1) as well as recent acoustic observations of humpback whales in the Norwegian Sea in winter (reported by Clark last year). It also noted that satellite tagging (in the North Pacific) has shown that humpback whales sometimes feed in remote offshore areas. Overall, the impression of the humpback whale as largely a coastal and shelf animal may well be erroneous.

In summary, as discussed above, the assessment model developed over the last two years did not provide good fits to the available data, nor were the results consistent with the observed data. In particular, all the best fits of the model under the range of options explored predicted that the populations in all areas have recovered to carrying capacity. As a result of this inconsistency, the Committee is unable to provide advice on the population level of North Atlantic humpback whales in relation to carrying capacity. This statement applies to past carrying capacity and to present carrying capacity.

In conclusion, the Committee **agreed** that it has greatly increased its knowledge of North Atlantic humpback whales as a result of its Comprehensive Assessment. In particular, populations are increasing in a number of areas in the North Atlantic (Gulf of Maine, Iceland, West Indies) and the rate of increase of the West Indies breeding population is estimated at 3% per annum between 1979 and 1992 (IWC, 2002h, p.236). This breeding population has an estimated population size of 10,752 in 1992 (IWC, 2002i, p.258).

The Committee agreed that its Comprehensive Assessment of North Atlantic humpback whales was now complete.

10.5.5 Future work

At last year's meeting, the Committee discussed future work that would lead to a better understanding of North Atlantic humpback whales (IWC, 2002h, pp.239-41). This year, catch data had been updated (Item 10.5.2), new information on abundance around Iceland had been received (Item 10.5.3.2), analysis of data on calves per mature female in the Gulf of Maine had been completed (Item 10.5.3.3), and work recommended on development of the assessment model, and supported by the Commission, had been completed (Item 10.5.1).

However, most of the areas of future work identified last year had not yet been progressed. The Committee identified a number of additional areas of future work arising from discussions this year; the following list includes previously and newly identified areas of future work that the Committee believes would increase knowledge of North Atlantic humpback whales.

Catches

(1) Review of historical data sources for land station catches in the Cape Verde Islands.
(2) Examination of eastern North Atlantic catch data by season.
(3) Review of additional historical data to allocate unidentified catches to species in the Faroe Islands and Iceland for the period approximately 1880-1930.
(4) Further examination of Bermuda Blue Books and other colonial records on the Bermuda shore fishery.
(5) Review of the Blue Books for Grenada, St Lucia and other West Indies Islands not previously covered.
(6) Examination of whaling station diaries from West Greenland.

Analysis and data collection

(1) Obtaining photographic and genetic samples from the Cape Verde Islands. The Commission has provided partial support for sample collection being undertaken in the Cape Verde Islands this year by Jann and colleagues. The Committee looked forward to the results of this work being presented at a future meeting and noted that further recommendations for additional work may be warranted in light of those results.
(2) Estimation of survival rates in areas other than the Gulf of Maine.

(3) Examination of the effect of heterogeneity of capture probabilities on abundance estimates.
(4) Further examination of patterns of migration and distribution using photo-identification data and historical records.
(5) Matching the YoNAH dataset to the North Atlantic Humpback Whale Catalogue. This work would greatly facilitate (3) and (4), above.
(6) Further elucidation of the relationship between animals in the Lesser Antilles (eastern Caribbean) and the rest of the West Indies; additional photographic and genetic samples are required. The Committee referred to its discussion under Item 10.5.3.1 with respect to this issue.
(7) Calculation of abundance estimates from NASS and NILS data that have not yet been analysed.
(8) Investigation of oceanic distribution through satellite tagging, offshore surveys or other means. In particular, the collection of acoustic data at the mid-Atlantic ridge during the summer months would be valuable.
(9) Additional photo-identification and biopsy-based surveys off the eastern coast of Iceland.
(10) Genetic approaches to determine the number and identity of animals using 'missing' breeding and/or feeding grounds, based on an analysis of microsatellites and/or haplotype frequencies.
(11) Continuation of assessment model development, including incorporation of the ability for carrying capacity to change, and exploring other types of models.

The Committee **agreed** that all of these areas of future work are valuable and **recommends** that they should be pursued if possible. It looked forward to receiving new information resulting from these studies at future meetings.

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

10.6.1 Small stocks of bowhead whales

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

Fisheries and Oceans Canada provided an update on these stocks. One aerial survey was performed, four satellite tags were deployed, and 48 biopsy samples were collected. The Committee appreciated the offer by Canada to provide information on the results of these studies at the next meeting.

The Committee was not advised of any bycatch or intentional removals from either bowhead whale stock.

Greenland Institute of Natural Resources reported to the Committee that about 10 bowhead whales out of a pod of about 30 were killed by a large, uncounted pod of killer whales near Qeqertarsuag in Disko Bay during four days in late April 2002. The Committee was grateful for this information and **requests** that the relevant authorities in Greenland provide more details on this incident to next year's Committee meeting.

10.6.1.2 OTHER STOCKS

The Committee received a report of a sightings survey performed by the All Russian Scientific Institute of Fisheries and Oceanography, in the Sea of Okhotsk in September and October 2001. A total of 48 bowhead whales were reported out of 1,065 cetaceans. Unfortunately, it was noted that poor weather conditions precluded an adequate survey of the Shelikhova Gulf and coastal areas near western Kamchatka.

10.6.2 North Atlantic right whales

Clapham reported on progress regarding recommendations from past IWC meetings and workshops concerning North Atlantic right whales (Annex F, Appendix 6).

Rosenbaum described ongoing work to compare historic specimens from the eastern North Atlantic (from the Bay of Biscay to Iceland) with genetic variation (historical and extant) in the western North Atlantic population. It is hoped that this work can be expanded to include eastern North Atlantic right whale specimens that are currently housed at European institutions. The Committee **recommends** that European institutions holding North Atlantic right whale specimens grant access to these samples for genetic analysis.

Biopsy sampling continues in the modern population, with some samples obtained from the calving grounds in the southeastern USA in 2002.

Two seasons of aerial photogrammetry work in the Bay of Fundy have been conducted by the US National Marine Fisheries Service, and have yielded a large sample of data on length of identified individual right whales; these data will be tied to information on sex, age and reproductive condition as obtained from sighting histories. An extensive study of the reproductive biology of this population has also been conducted in the last year.

Studies of previously satellite-tagged right whales have shown no apparent impact of the tags on these animals; observations of these individuals will continue over the next few years.

Right whales continue to die or become seriously injured by entanglements in fishing gear or ship collisions, and, in accord with the Committee's recommendations, this remains the highest priority in the US government's management of this species. Areas which are characterised by predictable concentrations of feeding right whales have been subject to seasonal area closures to fishing gear; other areas, in which right whales occur less predictably, are closed if sightings exceed a trigger density. Aerial surveys continue to be flown regularly in major shipping areas to warn mariners of the presence of right whales.

In recent years, (e.g. IWC, 2001c, p.34) the Committee has expressed grave concern over the status of this population. In particular it has noted that it is **a matter of absolute urgency** that every effort be made to reduce anthropogenic mortality in the population to zero. The Committee **reiterates** this recommendation.

10.6.3 Southern Hemisphere right whales

SC/54/BRG8 presented evidence of a summer right whale feeding ground on the west coast of South Africa. The current understanding of right whale seasonality on the South African coast is that it is normally distributed with a peak in September/October, and very low numbers over the period January-April. Most of the data in support of this come from the south coast of South Africa, between Cape Town and Port Elizabeth. However, when pelagic whalers from the USA and France first arrived on the South African coast in the late 18th century, they operated mainly between the months of November and May i.e. completely outside the currently 'understood' season. These vessels operated on the west coast, however, north of Cape Town, centred round St Helena Bay. Recent incidental observations in the St Helena Bay region resulted in 26 sightings of 54 right whales between February and April i.e. in summer. Four cow-calf pairs seen had been photo-identified about four months earlier on the south coast, and so had moved onto the west coast in summer. A total of 21 right whales were

satellite-tagged on the South African coast in September 2001. The results from this experiment will be reported fully next year. Such a summer feeding ground in coastal waters has not been recorded previously in the Southern Hemisphere, and provides unique opportunities for a study of southern right whale feeding behaviour.

SC/54/O18 described sightings of 22 southern right whales in Antarctic waters. Rosenbaum *et al*. (2001) described two sightings of right whales off the east coast of Madagascar. The Committee recognised the potential importance of these areas off Madagascar for the small population of southern right whales, and **strongly encourages** that these investigations continue.

10.6.4 Other small stocks of right whales

The Committee received only two reports of North Pacific right whale sightings over the past year: five animals seen in the southeastern Bering Sea from US aerial surveys; and three animals in the western North Pacific during JARPN II surveys.

The Committee recognises that these are among the world's most little known and critically endangered populations of whales. It **strongly recommends** that every effort be made to gather information about their status, and to take whatever measures are necessary to assist their recovery.

10.6.5 Western North Pacific stock of gray whales

The western gray whale population exists in small (< 100) numbers and is considered to be one of the world's most endangered populations of large whales (Weller *et al.*, 2002). Since 1995, joint USA-Russian ongoing studies of western gray whales off northeastern Sakhalin Island, Russia (the 'Piltun Feeding Ground') have resulted in a photographic dataset that can be used for mark-recapture survival estimation. In SC/54/BRG9, non-calf and calf survival were estimated as 0.941 (SE = 0.0194, 95% CI = 0.890-0.970) and 0.389 (SE = 0.1255, 95% CI = 0.185-0.642), respectively. Such estimates are essential for assessing the status of this population and determining appropriate protection and management measures.

A skeleton of a young gray whale was discovered on the eastern coast of Kyushu (Miyazaki Prefecture) in March 2002. This could be one of the 'missing' yearlings reported in SC/54/BRG9. The Committee **strongly recommends** that efforts be made to extract DNA from this skeleton and that microsatellites be compared to all 'missing' yearlings from the Piltun feeding ground. It also **recommends** that details of the stranding of the Miyazaki specimen be presented to the Committee next year.

Recent photo-identification data collected on the Piltun Feeding Ground indicate that most reproductive females follow a three-year inter-birth interval (SC/54/BRG12) rather than the normal two-year interval for some other whales. This longer interval may reflect nutritional stress and might be compounded by ongoing anthropogenic disturbance while on the feeding ground (see below).

SC/54/BRG14 presented evidence of behavioural disturbance from seismic surveys on the Piltun Feeding Ground. During summer 2001, high-intensity seismic surveys were carried out over a six-week period. The whales appear to have moved away from the region where seismic surveys were conducted, reoccupying the region from which they had been displaced once the surveys ceased. This endangered population depends on the Piltun Feeding Ground for most of its annual food intake. Such disruption of feeding could have major negative effects on individual whales and the population as a whole, especially those observed to be 'skinny'. Half of the adult females with calves have been recorded as 'skinny' over the past three years. Borodin referred the Committee to the results of a Russian sighting survey in the Sea of Okhotsk that corresponded with the post-seismic period of the SC/54/BRG14 study. Forty-one gray whales were observed off the northeast coast of Sakhalin Island.

Last year, the Committee had strongly recommended that no seismic work be conducted while whales are present on their feeding ground (IWC, 2002d, p.47). As a result of this and Resolution 2001-3 (IWC, 2002c), the Russian government was able to get the seismic work stopped last summer, and the Committee commends this action. SC/54/BRG14 provides strong empirical evidence in support of the Committee's concerns last year that seismic activities can have a major impact on gray whales (IWC, 2002f, p.182). Last year, the Committee also recommended acoustic monitoring and behavioural observations be conducted to examine noise-related disturbance of these whales; it **reiterates** that this recommendation should be implemented.

The Committee is concerned to hear that additional seismic work is planned for 2002, 2003 and the future. It again **strongly recommends** that no seismic work be conducted on or near the Piltun Feeding Ground while whales are present because: (1) gray whales in this area have shown strong avoidance responses to seismic survey activities during which they were displaced from important feeding habitat; (2) this region is the only known feeding ground for the population and is therefore critical to its continued survival; (3) 'skinny' whales, including many reproductive females with calves, have been observed in the area between 1999 and 2001 and require maximum food intake during the summer feeding season; (4) the cumulative impacts of seismic operations on the health and survival of these whales, especially 'skinny' animals, are unknown and of great concern.

During summer 2001, the oil and gas industry conducted a number of research activities related to these whales and the Committee **strongly urges** that these studies and associated findings be presented to the Scientific Committee for review at the earliest possible date. Furthermore, the Committee **recommends** that all future monitoring and mitigation plans for seismic surveys and other activities (e.g. planned construction of piers and pipelines bisecting the feeding ground and migratory corridor) related to Sakhalin oil and gas development be reviewed by an independent panel of outside experts that are not directly funded by the operators working in the area.

Two sightings surveys are scheduled within the range of the western gray whale during 2002, one along the eastern side of the Korean Peninsula in May (SC/54/RMP21) and one along the eastern coast of Sakhalin Island in August-September 2002 (SC/54/RMP9). The Committee **strongly recommends** that every effort be made to photograph any gray whales sighted during the aforementioned surveys in 2002, following protocols outlined in SC/54/BRG13.

As in previous years, the Committee **strongly recommends** that the ongoing (1995-2001) USA-Russian western gray whale research and monitoring programme, and national programmes, be continued and expanded into the future; this research is currently the only means for assessing the status of this critically endangered population. The research methods used in this programme to monitor the

population (vessel-based photo-identification work, shore-based distribution and behavioural observations, and biopsy sampling) must be continued annually. Photo-identification is an excellent way to monitor the status of this population. Genetic sampling needs to be continued in order to validate long-term individual identifications, determine sex and examine the relatedness of individuals, whilst a portion of skin from biopsy samples might be used to analyse for CYP1A induction as a biomarker to assess oil-related contamination. Additional actions are needed to ensure: (1) adequate and stable funding for the continuation of the current research and monitoring programme; (2) establishment of more effective range-wide monitoring and protection measures; (3) increased cooperation between science, industry and government.

The Committee also **recommends** the following additional research items: (1) benthic sampling and prey resource assessment (i.e. prey base evaluation) in known foraging locations and in areas outside of the feeding ground; (2) simultaneous theodolite-based behavioural observations and acoustic monitoring of industry-related noise to examine possible disturbance; (3) satellite and radio telemetry work to determine movements on the feeding ground, migration pathway(s) and location of the wintering grounds (tag design and attachment protocols, however, should first be assessed on eastern gray whales to evaluate safety and effectiveness); and (4) obtain DNA and photos to match to existing catalogues of such materials of any stranded or living animals.

As in previous years, the Committee **strongly recommends** that the Commission facilitates a workshop comprising interested scientists, including those from range states. The purpose of the workshop should be to:

(1) assess the current status of the population;
(2) develop the foundation for range-wide research;
(3) update the 10-year research and monitoring programme presented to the Committee in 1999.

The Committee **strongly endorses** the proposal for such a workshop given in Annex F. Unfortunately, there was insufficient time to develop the funding requirements and include them in discussion under Item 21. The Committee therefore **strongly recommends** that at a minimum, the Commission endorses the proposed workshop and cooperates in its organisation. A Steering Group was established comprising Brownell (Chair), Borodin, Kim and Ohsumi.

Research in Chinese coastal waters is of particular importance, as this is suspected to be the location of the calving and breeding grounds. Such knowledge is critical to the survival and recovery of the population. The Committee **recommends** that ground searches in combination with local knowledge interviews be used to determine gray whale locations within the wintering grounds and that photo-identification and biopsy sampling be implemented where possible. Research protocols and methods should follow those developed during the USA-Russian programme. Comparisons of photographs and DNA collected from China and elsewhere to similar materials already catalogued from Sakhalin Island will provide important new information on the population. Ohsumi suggested the possibility of holding an international meeting to plan research on the wintering grounds.

The Committee also **recommends** continuation and further development of comparative studies between the western and eastern gray whales to better understand the health of individual whales in both populations.

In conclusion, the Committee **strongly reiterates** (IWC, 2002d, pp.46-47) that it is a matter of **absolute urgency** that every effort be made to reduce anthropogenic mortality (including direct catches) and disturbance to zero to save western North Pacific gray whales from extinction.

10.6.6 Work plan

The work plan agreed by the sub-committee is given in Annex F. The Committee's discussion of its overall work plan is given under Item 19.

10.7 Other

10.7.1 Fin whales in the North Atlantic

The Committee received a standard line transect analysis of the Icelandic and Faroese vessel data from the NASS-2001 survey (SC/54/O9). An estimate of 25,352 (CV = 0.13) fin whales was calculated for the survey area. The CV is considered to be under-representative due to possible movement of animals over the survey period and irregularities in the realised effort. The sightings rate was generally higher than in earlier NASS surveys (1995, 1989 and 1987) and sightings were more evenly distributed, particularly in the Iceland-Greenland area. The 2001 estimate does not include areas farther to the south, as was covered in 1989. The estimates for comparable areas have been steadily increasing at a rate that is by an order of magnitude higher than expected due to the cessation of whaling in the area. Methodological improvements are considered unlikely to explain the whole difference. Immigration from stocks recovering elsewhere in the North Atlantic is suggested among other things that need further consideration.

The Committee did not have time to discuss this paper in detail.

10.7.2 Sperm whales

10.7.2.1 NORTH ATLANTIC

A novel protocol used to estimate sperm whale abundance from the NASS 2001 survey was presented (SC/54/O8). Sperm whales were tracked to determine the point of deep dive (fluking). Deep dives recorded before the animal was expected to come abeam of the vessel were used for a cue count estimate, while the animals on the surface abeam gave a traditional line transect estimate of the number of animals on the surface at any one moment and thus needs to be scaled up by dividing by the average proportion of time on the surface. The total weighted average estimate for the whole area was 9,477 (CV = 0.34). The corrected line transect surface estimate was significantly higher than the cue count estimate and is 1.41 times higher than a conventional uncorrected line transect estimate.

The Committee commended the authors of this paper for attempting to estimate $g(0)$ for sperm whales but regretted there was insufficient time to explore this method in detail.

10.7.2.2 WORLDWIDE

A global review of sperm whale estimates and a historical abundance trajectory for sperm whales worldwide was presented (SC/54/O6). Published population estimates were obtained from the literature, and a correction factor of $g(0) = 0.87$ was applied for animals missed on the trackline.

Scaling to habitat areas was used to produce a global estimate and a population model was used to estimate pre-whaling numbers and the status of the population in 1880 and 1999.

The Committee discussed several assumptions used by the author that may not be globally valid. These included: $g(0) = 0.87$; maximum rate of increase = 1.1% (range 0.7% to 1.5%); habitat definitions for extrapolating density estimates to unsurveyed areas; inadequately addressing uncertainties about 20th century catches by the Soviet Union. Since catches usually preferentially targeted males, a sex-specific model was suggested.

Given the uncertainties identified for this analysis, the Committee **agreed** that substantial further development is required before estimates using such an approach can be considered reliable.

Given that commercial sperm whaling ceased 14 years ago, the Committee **endorses** the idea of planning for an in-depth assessment of sperm whales. It **agreed** that it would be possible to get the available information organised and reviewed in the next few years and so conduct the assessment some time after that. A Steering Group, convened by Smith, was established and will include Best, Childerhouse, Gunnlaugsson, Leaper, Reeves, Rogan and Tynan. Scientists who do not normally attend Committee meetings will also be needed, including Barlow, Dawson and Whitehead. Subject to discussions under Item 19, the Committee **agreed** that planning for an assessment should start in 2003.

10.7.3 Status of abundance estimates

To help clarify the different statuses of the many and various estimates of abundance considered by the Committee (e.g. acceptable for RMP, acceptable for use in RMP trials, acceptable for inclusion on the IWC website, noted without any detailed review, etc.), the Committee requests that Donovan prepares a proposal for consideration at next year's meeting, suggesting categories that could be used to classify abundance estimates submitted to the Committee.

11. STOCK DEFINITION (ANNEX I)

11.1 Further review of terminology

Unit-to-conserve

This year, the Committee has had extensive general discussions about RMP *Implementations* and *Implementation Reviews* (see Item 6.2). These discussions were prompted by the unanticipated and prodigious duration of the North Pacific common minke whale *Implementation* process, but have general relevance. One of the conclusions was that a lack of clarity over the unit-to-conserve has been partly responsible for the difficulties and delays. This is particularly significant for the North Pacific case because of the operational objective of maintaining a coastal fishery on a more-widespread population, but unit-to-conserve is an extremely important issue elsewhere too: not just for RMP, but also for AWMP, and for management of mortalities of other cetaceans and other species whether inside or outside the IWC. This year, the Stock Definition Working Group was asked to develop a list of potential definitions of 'unit-to-conserve', and to clarify the implications that different choices would have for management.

The Commission has agreed management objectives for commercial whaling: avoidance of risk of undue depletion of stocks, and making possible stable high yields[12]. However, there is no consensus within or outside the Committee on the meaning of the word 'stock'[13], and the Committee **agreed** that further attempts at 'stock definition' are not likely to be very useful.

Defining 'unit-to-conserve' is a different task than defining 'stock'. It is also, perhaps, more useful, since it is more directly linked to management. Of course, many of the detailed issues are the same, but the change of emphasis is significant because it clarifies the need to think not just about biology, but also about explicit operational issues in the context of management. There is more room for case-by-case flexibility than with definitions of stock, and there is no need to try to develop a single all-embracing formulation. When considering possible options for unit-to-conserve and what the implications of each option would be for management, it is not the remit of the Committee to propose a single option; instead, the Committee can develop a list of possible options and associated comments, for consideration by the Commission. These shifts in emphasis may help the Committee to provide something of greater value to management. It was agreed that the Stock Definition Working Group should henceforth direct its attention towards 'unit-to-conserve' rather than 'stock', but that the Group should nevertheless retain its old name for pragmatic reasons.

There was no opportunity to have a full discussion of unit-to-conserve during this meeting, although preliminary discussions ranged over a number of points (see Annex I). As a way of making progress on this issue, the Committee encourages the submission of papers for next year's meeting on unit-to-conserve in the context of RMP-based management. Specifically, any paper proposing definitions of unit-to-conserve, should discuss (1) how and whether it is possible to implement the RMP in such a way as to get both satisfactory yields and satisfactory protection at the level of that unit-to-conserve; and (2) under what harvesting scenarios (i.e. the general aspects of when and where whaling is proposed) this would be possible. Discussion should be in terms of the two main 'adjustable' components of RMP-based management. The first of these is how the overall catch is to be spread out in space and time (*Small Areas* etc., and also the harvesting scenario). The second concerns what data are available or required on abundance, distribution, stock structure and movement[14]. Papers proposing definitions should include examples to demonstrate relevance to some plausible whale population structure and harvesting scenario. More detailed notes and suggestions for authors are given in Annex I.

[12] The exact words, as given in IWC (1988, p.36), are:

(a) stability of catch limits, which would be desirable for the orderly development of the whaling industry; acceptable risk that a stock not be depleted (at a certain level of probability) below some chosen level (e.g. some fraction of its carrying capacity), so that the risk of extinction of the stock is not seriously increased by exploitation; making possible the highest continuing yield from the stock.

[13] At least when 'stock' is used on its own; there is more consensus over combined terms such as 'breeding stock'.

[14] The *Catch Limit Algorithm* only uses information on total abundance (and catch history). However, each specific Implementation of the RMP requires information on population structure. Further, the allocation of catches in space and time may make use of other information besides total abundance.

The Committee noted that the choice of unit-to-conserve, the harvesting scenario, and the quality of available information can all affect how easy it is to arrive at an RMP Implementation that delivers effective conservation and stable high yields.

Of course, this should not be interpreted as implying that ease of implementation and compatibility with harvesting should be the sole, or even the primary, factors that determine any future Commission decisions about the appropriate unit-to-conserve in particular cases. Ultimately, though, choices about conservation and harvesting do need to take account of practicality, and the task of the Committee is to spell out as clearly as possible what the implications of different choices would be.

Archetypes

This year, the sub-committee on the RMP also recommended drawing up a list of archetypes for consideration in Implementations (see item 6.2.2 of Annex D). The point of this is to provide a checklist of conceptual models of what whales do, so that when considering a new population, the Committee will be obliged to give some (possibly very brief) consideration of the plausibility of the various different stock structures that are known to exist for other species and populations. It is important to include real examples (preferably cetacean) in discussions about unit-to-conserve, both to ensure that any list of options for unit-to-conserve is somehow related to the real world, and also to start the task of drawing up a list of archetypes.

Summary

The Committee emphasised that time for discussion on all aspects of 'stock definition' had been very limited this year, that the issues involved were complex, and that discussions so far were inevitably of a preliminary nature. These issues will need to be revisited in depth next year.

11.2 Review of historical responses of cetacean sub-stocks to severe depletion

In 2000, the Committee reviewed instances of (sub)stocks of large baleen whales that had been severely depleted, and had either been extirpated or had failed to recover after intense harvesting stopped (Clapham and Hatch, 2000). That review highlighted several important factors: (1) abundances had been reduced to no more than a few hundred animals; (2) in most cases, neighbouring (sub)stocks had also undergone heavy harvesting; and (3) in some cases, low-level human-induced mortality had continued after the end of the main harvest. The Committee had noted that it would also be useful to review instances where heavily depleted (sub)stocks *had* subsequently recovered.

As a starting point for identifying cases that might be informative, Smith summarised the information on 44 baleen whale stocks given in Best (1993). Many of those stocks were thought to have been reduced to below 10% of their original abundance. Of those 44 stocks, significant rates of increase had been demonstrated for 10, and at least 10 others were believed to be increasing. It was noted, though, that if the 1993 study was repeated today, the stocks chosen might be different, because of new information on stock structure.

The Committee recognised that it is by no means straightforward to interpret, or in some cases even to identify, instances of recovery from severe depletion, especially in the context of population structure. Lack of abundance data, and complications over the depletion of and immigration from neighbouring aggregations, were singled out as particular difficulties. It was also pointed out that, in some cases where recoveries are observed, the local recovery rate may be a positively biased indicator of population recovery rates if increases in local abundance are driven more by social attraction/migration from other areas, than by intrinsic population growth.

The Committee noted that recovery and genetic analysis of bones and other material from historic whaling areas and prospective studies of slowly recovering stocks, might provide improved information on historical distribution, population structure and range. It **strongly encourages** the continuation of this work. A prospective approach could also be informative in areas with extreme variation in recovery; samples collected now could be useful for comparisons to future samples on decadal or generational time periods. Initial proposals for species and areas are presented in Annex I, Appendix 2.

11.3 Statistical and genetic issues pertaining to stock definition

SC/54/SD3 noted wide variations in life history and population structure between baleen whales, and cautioned against drawing general conclusions about the stock structure of all baleen whales based on the structure of one particular species in one region. The authors suggested that evidence of slight genetic heterogeneity based on very limited data does not provide a sound basis for concluding that more than one stock must exist in a region, for instance in the case of the putative O-W stocks of North Pacific minke whales. Differences between humpback whales and North Pacific minke whales were highlighted. For example, humpback whale calves appear to learn their migration patterns from their mother during the long lactation periods, whereas minke whales have a much shorter lactation period and in the North Pacific, the young-of-the-year are weaned before reaching the feeding grounds. The Committee **agreed** that data from both feeding and breeding grounds are needed to understand stock structure, migratory behaviour and site fidelity in North Pacific minke whales. It is important to consider how best to collect data to answer basic questions, such as how juveniles learn their adult feeding grounds. It was noted that various types of information (genetic data, biological markers and tagging) could shed light on this, and that genetic data could feasibly be obtained from breeding grounds in the near future.

SC/54/SD4 proposed methods for estimating dispersion or mixing rates from genetic data on kinship between pairs of animals. The author suggested ways to compensate for family fidelity, uncertainties arising from the nature of genetic data, uneven spatial sampling and differing dispersion rates by sex. Unlike some other genetic analyses, no assumptions about long-term history are required. The approach might be applicable to the determination of appropriate scales for management units. The Committee **encouraged** further development of this promising approach. Simulation testing will be required, particularly to investigate its applicability to more complex population structures. The advent of new genetic methods to obtain many loci from few individuals might prove useful for pedigree-based analyses such as in SC/54/SD4. Population genetics modelling for multi-locus genotyping is a rapidly developing area of current research, and the Committee **agreed** to seek participation of additional experts in this field to progress its work.

Cui *et al.* (2002) outlines a Bayesian approach for comparing single with multiple stock hypotheses. Bayesian methods should be preferable to classical methods for

hypothesis testing. One variant of the approach performs well in simulations where two stocks differ substantially in haplotype frequency, and/or when sample sizes are large. Answers inevitably depend on the priors chosen, and with the current version it is difficult to assess whether a given prior is biologically reasonable. The Committee **encourages** the authors in their ongoing work to address this.

The method in Cui *et al.* (2002) requires an *a priori* choice of postulated boundary between stocks; if there is real stock structure but the *a priori* choice is inappropriate, the power of the method, and of classical hypothesis tests, will be reduced. By contrast, the Boundary Rank (BR) method (see Martien and Taylor, 2001; Cui *et al.*, 2002; SC/54/SD5 and discussion in SC/54/Rep1) uses the data to propose a number of possible stock boundaries. A permutation test has now been developed to allow the use of BR for a general hypothesis test of one versus two or more stocks (although not of the particular boundary selected), without relying on a particular *a priori* boundary. The boundaries suggested by BR, and the power of the statistical test, will still depend on the basic population structure assumptions (i.e. what is the maximum number of stocks and what patterns of movement are realistic), and to a lesser extent on how samples are initially grouped; some grouping is necessary in order to keep sample sizes high enough to adequately characterise gene frequencies. Tests for North Pacific minke whale data resulted in the rejection of a single stock hypothesis at a 5% significance level for two out of six different population structure assumptions. However, the power of the tests was shown to be low, because of limited information content.

Based on the new work presented and on discussions held during this year's meeting, the Committee **endorses** the value of BR for use in *RMP Implementations* and *Implementation Reviews*, and **encourages** further development of the method. Some members noted, though, that there had been limited time available for in-depth consideration, and that the discussion had proceeded very rapidly, particularly given the language difficulties.

The Committee noted that it is of considerable importance to make a determination on the applicability of BR in a timely fashion, because of issues arising in the North Pacific minke whale Implementation. If, after further consideration, any specific concerns do arise, then the Committee **urges** that they be promptly communicated to the BR developers so that they can be addressed intersessionally.

Hypothesis tests are another tool often used to investigate issues of stock structure. The Committee **reiterates** its concerns about the value of conclusions based solely on the results of hypothesis tests, expressed in IWC (2001f, p.236). In brief: it is often not clear *a priori* what hypotheses should be tested; multiple hypothesis tests are a poor way of doing exploratory data analysis; stock definition analyses should begin with exploratory data analysis and proceed, where possible, to estimation (e.g. of dispersal rates between areas) rather than to hypothesis testing.

In summary, the Committee noted that it is important, in any application of stock structure methods, to examine the sensitivity of conclusions to different *a priori* decisions about the definition of initial units, and about which population structure hypotheses to examine.

11.4 Simulation testing

SC/54/SD6 discussed some issues to address when designing performance tests of methods for analysing population structure. Performance criteria should be based on how well the management units defined by a technique would meet specific objectives if they were to be managed under (for example) the RMP or AWMP. The paper also discussed the use of formal decision analyses in which specific costs are assigned to different stock structure scenarios and different types of stock definition errors. For instance, the errors of defining too few or too many stocks can be assigned equal cost or, if a precautionary approach is taken, a higher cost can be assigned to the definition of too few stocks. These different cost structures can have a substantial impact on the relative performances of different methods.

The Committee noted the useful points identified in SC/54/SD6. The process of spatial structure simulation (i.e. testing different techniques for identifying spatial stock structure, and for translating results into management units), is a crucial step in validating the applicability of current and future methods for analysing population structure. An intersessional Working Group on the Testing of Spatial Structure Models (TOSSM) had been established last year to progress this issue, but pressure of work had prevented any substantive progress in the intervening period.

The Committee reaffirmed the importance of the simulation work, and decided to continue TOSSM under the Terms of Reference agreed last year (IWC, 2002k, p.412). Further consideration in TOSSM will be required to devise appropriate performance criteria. Substantial efforts will also be required to develop the operating model that governs the 'real' population structure and the 'real' management rule; it is important to strike an appropriate balance between 'too much realism' (excessive complexity, and problems in extrapolating conclusions to other situations) and 'too much simplicity' (conclusions irrelevant to practical management situations in the IWC).

Setting up extensive simulation trials is complex, and the Committee **agreed** that an intersessional workshop is essential in order to make reasonable progress on spatial structure simulation. Apart from those interested in actually developing methods, this meeting would ideally require two other types of participant: first, one or more Scientific Committee members with extensive experience in setting up large simulation trials, particularly in an RMP or AWMP context; and second, experts from outside the usual IWC circles who can provide input on appropriate genetic, statistical and ecological considerations to be used in developing the simulations. Further details on the proposed workshop can be found in Annex I, Appendix 3.

There is significant divergence between the terminology of the IWC and of other scientific arenas, e.g. conservation biology. To avoid confusion among workshop participants and authors of papers, especially those outside IWC circles, a glossary of terms relevant to the management framework of the RMP and AWMP should be developed for distribution, along the lines of the glossary that already exists for the AWMP. The new glossary should include some indication of what harvesting scenarios are likely to be contemplated. Donovan agreed to do this in conjunction with Hammond.

11.5 Work plan

The Committee has already given attention to the issue of archetypes of population structure (IWC, 2001f, p.236), and expects to be able to develop at least a preliminary list during next year's meeting.

The Working Group's proposed work plan is given in Annex I and the Committee's discussion of its overall work plan is given under Item 19.

12. ENVIRONMENTAL CONCERNS (ANNEX J)

12.1 Cooperative research in the Antarctic

12.1.1 Results from SOWER 2000 cruise (cooperation with CCAMLR)

There were no specific papers that pertained to results from SOWER 2000. However, SC/54/IA7 was discussed since it highlighted the importance of management information being tailored to the regional specificity of the Antarctic climate (e.g. the observed trends of warming and loss of ice are greatest in the Bellingshausen Sea, Amundsen Sea and part of the Ross Sea).

The Committee **agreed** that the Ecosystem Working Group of CCAMLR should be approached concerning further collaborative support of the GLOBEC cruises and data previously collected by CCAMLR in the parts of the GLOBEC study region held in the CCAMLR database. DeMaster **agreed** to coordinate this.

12.1.2 Progress on development of joint research programme with SO-GLOBEC

In 2001, a multi-year series of collaborative research cruises began with Southern Ocean GLOBEC (SO-GLOBEC). The US SO-GLOBEC cruises are multidisciplinary and comprise standard mooring cruises, line transect surveys over a constant grid, and process studies at selected locations, all within the Western Antarctic Peninsula study region around Marguerite Bay. A preliminary report on the first three cruises in this series was provided last year (Thiele *et al.*, 2001). SC/54/E12 presented preliminary results from the IWC collaborative studies conducted on the 2001 winter survey and the 2002 late summer mooring cruise with the US SO-GLOBEC programme. It provided a summary of research and preliminary results for the cetacean visual, biopsy and sonobuoy studies conducted on the two cruises since the last report (Thiele *et al.*, 2001). Results from the ARP (acoustic recording package) year-long deployments were reported in SC/54/O3. The full colour version of SC/54/E12 and reports of all the IWC SO-GLOBEC collaborative cruises can be found at: http://www.ccpo.odu.edu:80/Research/globec/iwc_collab/menu.html

The *Nathaniel B Palmer* (NBP) (US SO-GLOBEC) survey cruise was conducted 23 July to 1 September 2001 and the *Laurence M Gould* (LMG) mooring cruise was repeated in February 2002. Sea-ice cover was significantly more extensive earlier in the season in 2002. Only minke whales were observed in the study region in winter 2001, although humpback whale concentrations were seen as late as the end of May. Concentrations of humpback whales were seen in Marguerite Bay and east of Adelaide Island up until late May in 2001, and at the ice edge in southern Marguerite Bay and the passages to the north in February 2002. Although geographic locations of humpback concentrations are different between years, habitat remained consistent. Baleen whale calls detected on sonobuoys included blue, minke and possible fin whales. Autumn and winter multidisciplinary research cruises conducted last year under this programme will be repeated this year, and will include both passive acoustic and IWC visual/biopsy teams. Currently, there are IWC visual, biopsy and collaborating sonobuoy teams on the US SO-GLOBEC LMG and NBP cruises (April-May 2002).

In September/October 2002 a small workshop will take place in the USA to assist with data integration analyses prior to the second International GLOBEC Open Science Meeting in China in October. Final submissions for a special issue of *Deep Sea Research* are due in November. Proposals from the group will be submitted to the NSF for funding under the synthesis and analysis phase of US SO-GLOBEC (2002/2004).

Regarding future plans for collaborative work between SO-GLOBEC, CCAMLR and the IWC, the following activity was endorsed by the SWG on Environmental Concerns (Annex J): one dedicated multidisciplinary survey per season for at least the next five years consisting of visual survey, biopsy sampling and fine scale ecological studies, including passive acoustics work. It was noted that a contribution of £25,000 per year would be a minimum amount of support to continue the partnership of the IWC with SO-GLOBEC and CCAMLR. This request for support is considered under Item 21.

Committee members from Japan expressed their reservation regarding the competence of the IWC in a programme such as SO-GLOBEC.

Finally, the SWG on Environmental Concerns recognised the need for the development of a standardised data collection protocol for sea-ice observations. An *ad hoc* Working Group chaired by Thiele was established which will report back to the Committee next year concerning progress related to the process described in Annex J, Appendix 3.

12.2 Steering Group report on POLLUTION 2000+

Details of POLLUTION 2000+ research completed in the last 12 months are summarised in Annex J, Appendix 4. Activities conducted under the bottlenose dolphin sub-project of POLLUTION 2000+, which seeks to evaluate potential biomarkers of exposure to organochlorine contaminants, included: (1) analyses of samples collected in Sarasota Bay, Florida; and (2) comparison of PCB-concentrations in blubber samples from the three study sites (the Bahamas Islands and Charlotte Harbor, Florida, representing sites with 'low' pollution, and Sarasota Bay, a site with 'moderate' pollution). The sub-project also included a feasibility study to collect biopsy samples from the Mediterranean, where dolphins are likely to carry high levels of polychlorinated biphenyls (PCBs).

The second sub-project involves the calibration of post-mortem time effect on changes of biomarkers and pollutants in harbour porpoises. This analysis will enable the utilisation of bycaught animals throughout the North Atlantic. In the summer of 2001, samples were collected in the Bay of Fundy for this purpose. Most of the samples were collected using the detailed field protocol previously designed, and the successful collection of these critical samples was very much due to the work of Read and colleagues.

In addition to completion of analyses currently in progress, the 2002-2003 work plan for POLLUTION 2000+ will include an intersessional meeting to synthesise results among the laboratories involved, and an intersessional meeting of the Steering Group to finalise Phase 1 of this programme and to determine activities to be conducted under Phase 2. Within this work plan, the highest priority projects are the collection of samples and PCB analyses under the bottlenose dolphin sub-project, and completion of the harbour porpoise post-mortem calibration project. The budget to complete the entire 2002-2003 work plan will require £140,500, of which the majority will be sought

through external direct or 'inkind' funding. To complete the highest priority projects mentioned above, a request for £54,410 from the IWC was proposed. The Committee agreed to consider this request for support under Item 21.

Phase 1 of POLLUTION 2000+ is approximately 80% complete. Finalising the harbour porpoise post-mortem calibration sub-project and the bottlenose dolphin sub-project was considered to be of high importance to many Committee members. The value of the results from the completion of the post-mortem calibration sub-project include: (1) ability to improve the utilisation of existing stranding data; and (2) enhanced value of information from stranded and bycaught animals to the field of ecotoxicology. The value of the results from the bottlenose dolphin sub-project include: (1) reporting on the health consequences of a wide range of pollution levels on bottlenose dolphin; and (2) contributing to the establishment of cause and effect relationships between levels of pollutants and physiological responses in cetaceans. Finally, many members believed that the completion of POLLUTION 2000+ will lead to the development of a valuable model concept for ecotoxicological research on cetaceans and other animal species.

Committee members from Japan expressed concern that this project is not consistent with the objectives of the IWC since the species dealt with by the current POLLUTION 2000+ are limited to small cetaceans. It was noted that since its inception, it was **agreed** to initially concentrate on these species and areas for which it was most likely to obtain successful results. The ultimate aim is to provide a predictive model that, with caution, can be applied to all cetacean species (Reijnders *et al.*, 1999).

12.3 Habitat related issues

12.3.1 State of Cetacean Environment Report (SOCER)

During the intersessional period, a Steering Group from the SWG on Environmental Concerns was charged with making recommendations for the development of a mechanism for the compilation, review process, style, structure and frequency of this type of report. The Steering Group had considered a wide range of proposals for the future style and content of SOCER, and these were presented and discussed within the SWG. The proposal recommended by the Steering Group and endorsed by the SWG involved taking a regional approach for each annual report (i.e. the six regions used in the original form of SOCER (Mediterranean and Black Seas, Indian, Pacific, Arctic, Southern and Atlantic Oceans) along with a seventh 'global' category). Each region would be covered on a rolling basis every 3-5 years, with scope for the inclusion of significant events on a global scale, or repeat events from particular regions to be updated on an annual basis. This would ensure the timely receipt of recent significant 'events' from any region, and those occurring on a global scale, for the consideration of the Commission.

A clear set of criteria identifying an appropriate scale and scope for material for SOCER and a submission procedure that is easy to follow were developed by the SWG (Annex J, Appendix 5). The aim of implementing such a process is to encourage submissions to SOCER from a wide range of sources, including member governments, individual scientists and a range of agencies and organisations. The Committee recognised that invitations to make submissions to the SOCER need to cover a broad scale of sources and it extended its appreciation to the SWG for agreeing to develop a covering letter to facilitate this.

Finally, it was noted that a Working Group within the SWG would aim to produce a draft SOCER for next year's meeting. This report would be distributed as a Committee document in the spring of 2003. It is intended to be a preliminary attempt at a form of the report that will be developed over the years into an objective product and an easily followed submission process. Productive comments and suggestions on the draft SOCER will be welcomed and incorporated wherever possible.

Some members of the Scientific Committee recommended that the SOCER should be: (1) consistent with the competence of the IWC; (2) conducted in an objective manner; (3) cost-effective; and (4) reviewed by the SWG before sending to the Committee for finalisation. It was further recommended that the usefulness of the SOCER and the efficiency of how it is prepared should be evaluated by the SWG and the Committee. After some discussion, the Committee accepted all of these recommendations.

12.3.2 Review results from workshop on habitat degradation

At the first meeting of the parties to ACCOBAMS (The Agreement for the Conservation of Cetaceans of the Black and Mediterranean Seas), the importance of developing work on habitat degradation in the region was recognised. The Meeting of Parties had established a list of priorities for the next three years and this included the Habitat Degradation Workshop proposed by the IWC. The issue of funding for the IWC workshop has yet to be resolved, but there is still considerable interest, and it is hoped that funding from outside sources might be found to at least contribute towards the meeting.

Some Committee members noted that this workshop had been proposed and given priority in the budget for some years now (e.g. IWC, 2002d, p.73). It was agreed that the workshop was still a priority for the Committee, and although it appears unlikely that funds can be allocated this year, it is hoped that this proposal would receive high priority for funding next year.

12.3.3 Review information regarding whalewatching activities and noise impacts

A summary of this discussion is reported in Annex L and under Item 14.2.

12.3.4 Interactions between cetaceans and fisheries

IWC Resolution 2001-9 encouraged the Scientific Committee to plan and convene a methodological/modelling workshop to examine interactions between whales and fish stocks. To this end, a Steering Group (Northridge, Walløe, Tamura, Friday and Donovan) was established to organise such a workshop to be held intersessionally. The Government of St Lucia generously offered to host the Workshop (IWC, 2002d, pp.55-6).

As noted in a circular to the Committee in November, it was not possible for a sufficient number of the experts identified by the Steering Group to attend in February and the new dates were narrowed to the period mid-late June. The precise new dates were agreed by the Steering Group in December. In April, the Government of St Lucia informed the Secretariat that it was unable to host the meeting. A request was then sent out to Contracting Governments to find an alternative venue at this late stage. The only reply received was the offer from the USA to host the meeting in La Jolla, which was thus gratefully accepted for the dates agreed by the Steering Group.

The agenda for the meeting is provided in Annex J, Appendix 6. The meeting has been planned to include an introductory overview on the modelling approaches currently being used to address related issues, followed by a discussion on aspects of data availability and reliability. Specialists have been invited to present their modelling work covering a range of approaches (e.g. food web models, mass balance models and minimum realistic models). The workshop will determine how best these approaches can be taken forward by the Committee. The report of the workshop will be available at next year's meeting. The £10,000 funding allocated last year is still available and thus the Steering Group has not requested additional funding to support the workshop. However, several members noted that one of the advantages of a venue in St Lucia was to encourage the participation of scientists from developing countries. The Committee **draws this to the attention** of the Commission this year so that it can consider providing additional funding to support travel of scientists from developing countries to the specialist workshop in La Jolla.

During the plenary session discussion of this item, Komatsu noted that the proposed changes in venue and timing for the workshop were problematic. He expressed the view that the workshop should be held in either Japan or Norway since these countries have large amounts of relevant data. Further, he noted that the proposed dates conflict with other obligations for Japanese scientists. He concluded that these matters should be decided by the Commission since the original decision was made by the Commission.

The Chair responded that this was a short specialist workshop, primarily intended to address methodological modelling concerns. Therefore, hosting the workshop where there are considerable data holdings is not important to the success of the workshop. She also noted that the change in dates had been approved by the workshop's Steering Group in December. The IWC Secretariat had been forced to request an alternative venue as late as 22 April and the only response received was from La Jolla (California, USA).

During review of the report, Smith, who had been absent during plenary discussions of this item, queried if Komatsu's comments above meant that Japanese scientists would not be allowed to participate in the meeting.

He expressed his disappointment at Komatsu's response that they would not participate. He also expressed his disappointment that one reason given was that the dates were not acceptable, even though Tamura had represented Japan in the Steering Group that agreed those dates as long ago as November 2002. Smith noted his appreciation of Walløe's statement that even though these dates were not ideal for Norwegian scientists, they planned to participate nonetheless. He then expressed his regret that Japanese scientists would not be allowed to participate, because in his view the workshop had been set up to address issues arising out of discussion of JARPN research whaling. Japan's withdrawal will negatively affect the work of the Committee.

12.3.5 Mitigation of incidental capture of large cetaceans in fishing gear

IWC Resolution 2001-4 requested that the Committee provide the Commission with a summary of recent work on the most feasible methods to mitigate the incidental capture of large cetaceans in fishing gear and ways in which entangled large cetaceans may be removed from fishing gear with minimal risk to rescuers.

In response to the Resolution, an intersessional Working Group was formed. Its report is given as SC/54/BC2 and is summarised in Annex J, Appendix 7. The Committee expressed its appreciation to the Working Group, and its Chair (Clapham) for their efforts.

The report provides advice on the handling of large whale entanglements, developed from the experience of personnel involved in long-term disentanglement programmes, particularly from the east coast of the USA. Examples of entanglement rates for some species of large whale have been calculated for this region e.g. 71% of humpbacks and 62% of North Atlantic right whales had been entangled at some stage in their lives, with an annual rate of entanglement of 10-31% for humpbacks and 10-28% for right whales.

There have been few studies to quantitatively measure the survival of disentangled large whales. However, it appears that such releases may be successful in many instances. The likelihood of a successful release of an animal that has been entangled and stranded for a significant period of time is low (as it is for otherwise healthy animals that have been beachcast for long periods). Disentangling procedures for entangled southern right whale calves in South Africa appear to have been successful. In these cases the calves had been entangled for less than 24 hours, and their mothers appeared to wait offshore. The Committee **recommends** that photographs of the scarring patterns on entangled animals be recorded as a matter of course, to assist with the assessment of survival. It was also noted that small whales, such as minke whales, are more likely to die quickly if entangled in nets, while larger whales can carry off even heavy gear, which may eventually cause immobilisation, infection and/or death.

Disentanglement programmes exist in a number of regions, including Oman, South Africa, eastern Canada, Gulf of Maine and the western Mediterranean. Based on the information reported in Annex J, Appendix 7, it is clear that disentanglement is a dangerous task, with great potential for serious injury or death of persons involved. The Committee **strongly recommends** that disentanglement should only be attempted by experienced personnel. It was noted that the Center for Coastal Studies has extensive experience in disentangling large whales and has held training/advisory workshops in the past (contact David Mattila, *dmattila@coastalstudies.org*).

During the intersessional period, a number of Scientific Committee members with expertise in cetacean bycatch issues attended a meeting (convened by World Wildlife Fund) in Annapolis, Maryland (USA), January 2002. The objective of the meeting was to produce a strategy to eliminate unsustainable bycatches of cetaceans and, over the long term, ensure that cetacean populations are restored to, or maintained as, functional components of their ecosystems. The strategy was developed in recognition of bycatch as a major threat to whales, dolphins and porpoises and is summarised in SC/54/BC6. It was noted that a final report would be available in the near future.

Finally, the Committee recognised that many countries are currently making particular effort towards developing effective marine mammal conservation measures and many member countries and individual scientists are likely to benefit from the information contained in SC/54/BC2 and BC6. The Committee **agreed** that the authors of these reports should ensure widespread distribution of the recommendations to appropriate government agencies.

12.4 Other

The following issues are briefly discussed in Annex J (Item 8): (1) current status of the ozone layer; (2) distribution of Vitamin A (retinoids) in tissues of common dolphin; (3) effects of acoustic harassment devices on killer whales; (4) results of JARPN II feasibility study on pollutants in the western North Pacific Ocean; (5) categorisation of South African cetaceans according to the 2001 IUCN Red List; (6) effects of a major tourist development (called Nautical Steps) in Baja California, Mexico, on cetaceans; and (7) effects of seismic noise on the western North Pacific population of gray whale.

After some discussion, the Committee **recommends** that: (1) the Commission requests information from the Government of Mexico on the specific locations and types of construction that comprise the development, referred to as Nautical Steps; (2) the Commission requests that the Government of Mexico take steps to ensure the maintenance of habitat important to cetaceans; and (3) scientific experts on the western gray whale and oil and gas industry experts hold one or more workshops to identify specific potential risks to gray whales from oil and gas exploration off Sakhalin Island, and identify alternative methodologies to mitigate any potentially harmful effects.

Finally, IWC Resolution 1999-4 expressed concern over human health effects related to the consumption of cetacean products. Considerable uncertainty exists as to how the World Heath Organisation (WHO) would like concentrations of contaminants in cetaceans reported. A new manual exists that provides details of the requirements for data to be submitted to the Global Environment Monitoring System (GEMS). This is summarised in SC/54/E2. Although data could be formatted manually, it would be more efficient for laboratories to automate the procedures if large quantities of data need to be submitted. Thus, if the IWC would like to have cetacean contaminant data submitted on a large scale or regular basis to the WHO/GEMS database, it should provide funds for creation of a spreadsheet or database to automatically convert chemical contaminant data for cetaceans into a format that would be acceptable for WHO.

12.5 Work plan

The work plan agreed by the SWG on Environmental Concerns is given in Annex J. The Committee's discussion of its overall work plan is given under Item 19. Funding implications are discussed under Item 21.

13. SMALL CETACEANS (ANNEX K)

13.1 Status of humpback dolphins

13.1.1 Review of information

In the past, the Committee has expressed concern regarding the status of humpback dolphins (genus *Sousa*). This concern has arisen from the existence of potentially unsustainable bycatches in fisheries, shark control nets, high levels of contaminants, and extensive habitat degradation in many areas of its range (e.g. IWC, 1999b, pp.213-214). This year the Committee examined the status of this genus throughout its range.

Humpback dolphins occur in coastal waters of the eastern Atlantic, Indian and western Pacific Oceans (see Annex K). Current knowledge regarding the distribution of this genus is derived from sightings or stranding records. Gaps in the known distribution should be interpreted with caution, as they may represent real distribution gaps or gaps in current knowledge due to a lack of research effort.

The taxonomy of humpback dolphins is confused. Recent reports have suggested the existence of from one to five species within the genus. The classification proposed by Rice (1998) identifies three species: *S. teuszii*, *S. plumbea* and *S. chinensis* in the Atlantic, Indian and Indo-Pacific Oceans, respectively. In contrast, the IWC currently recognises only two species: *S. teuszii*, the Atlantic humpback dolphin and *S. chinensis*, the Indo-Pacific humpback dolphin (IWC, 2001k).

The Committee reviewed the results of new research on the taxonomy of *Sousa* using cranial morphometric (SC/54/SM8) and molecular (SC/54/SM34) analysis. In the analysis of skull characters, a Principal Components Analysis of skull characters revealed that specimens from west Africa were distinct from those from the western Indian Ocean, but showed strong overlap with those from the eastern Indian and western Pacific Oceans. This finding is in contrast to geographical variation in gross external morphology and colouration. Humpback dolphins from west Africa and the western Indian Ocean exhibit a prominent dorsal hump and are uniformly grey in colour, while those from the eastern Indian Ocean and western Pacific lack the dorsal hump and are light grey to white as adults, often with prominent darker spots.

A molecular analysis of geographical variation in sequences from the mitochondrial (mt) DNA control region and cytochrome *b* gene showed significant variance among groups from southeast Asia, northern Indian Ocean and the southern Indian Ocean. Preliminary phylogenetic analysis suggested three principal clades among the sampled populations of humpback dolphins: a monophyletic clade containing all humpback dolphins from the Pacific (southeast Asia); a clade containing only humpback dolphins from Oman; and a clade containing humpback dolphins from Madagascar, South Africa and a single lineage with two individuals from Oman. The results from population genetic analyses suggest that strong population structuring occurs in this genus, both within and across ocean basins.

The Committee **agreed** that it is premature to draw any firm conclusions concerning the systematics of humpback dolphins from these preliminary analyses. Therefore, it **recommends** that the current IWC classification of two species be maintained for the time being, but recognises that this classification may require future revision. The Committee also **recommends** the use of the common name 'humpback' instead of 'hump-backed' for dolphins of this genus.

There is little information on the life history of this genus and existing data come almost exclusively from South Africa and Hong Kong (SC/54/SM22; Jefferson, 2000). Gestation lasts for approximately 12 months and calves are born at lengths of between 90-115cm. In South Africa, age at sexual maturation was estimated to be approximately 10 years in females and 13-14 years in males; limited observations suggest a similar range for humpback dolphins in Hong Kong. The oldest animals aged to date were 34 years of age in Hong Kong and 46 years in South Africa. The calving interval in South Africa was estimated to be three years. Reproduction is diffusely seasonal in both areas, with a peak of births occurring during spring and summer.

There are few estimates of the abundance of humpback dolphins in any parts of their range and trend data exist at only one site, Hong Kong. The few existing estimates

derived from line transect surveys or photographic capture-recapture methods are presented in table 1 of Annex K. The Committee noted, however, that in comparison with many other small cetaceans, humpback dolphins are not very abundant in any part of their range.

Humpback dolphins are essentially coastal animals, inhabiting estuaries, river mouths and nearshore waters where mangroves, sandbars, rocky outcroppings or reefs harbour prey (Jefferson and Karczmarski, 2001). Most sightings have been made in water depths less than 25m, although the existence of populations in adjacent areas separated by deep water suggests that individual dolphins may traverse deeper waters on occasion. Data on feeding ecology are also limited, but most prey items are small estuarine or reef fish and some prey species are also commercially important.

There are few areas within the known range of humpback dolphins where anthropogenic alteration to habitat has not occurred. Humpback dolphins in Hong Kong live in a highly altered habitat, in which a 1,200-hectare airport was constructed in 1998, most of which was built on reclaimed land. In this area, therefore, habitat of humpback dolphins was both degraded and lost entirely. Unfortunately, there is no baseline data on habitat use patterns of humpback dolphins prior to construction of this airport. The Committee reviewed an analysis of humpback dolphin habitat use in Hong Kong (SC/54/SM36). The sightings data have not yet been standardised for effort, but a preliminary analysis suggests that dolphins are found most frequently near Lantau Island, in an area influenced by freshwater input from the Pearl River. Although humpback dolphins appear able to survive in the face of heavy shipping traffic, dredging, land reclamation and coastal development, the Committee noted that the continued presence of humpback dolphins in highly degraded habitats, such as the waters around Hong Kong, does not rule out adverse effects of habitat degradation. There are no long-term time series of relative abundance for this genus in any area of its range with which the effect of such environmental degradation could be measured.

With the exception of Madagascar, there is little evidence for intensive direct exploitation of humpback dolphins. In some areas, however, it is difficult to differentiate direct from incidental takes and, in other areas, directed takes are illegal and estimation of their magnitude is difficult to quantify. The Committee was particularly concerned about the magnitude and effect of directed takes of humpback dolphins in Madagascar (SC/54/SM33). Interviews and surveys at fishing camps made in 1999 in southern Madagascar revealed that humpback dolphins are hunted by harpoons and taken directly in gillnets. The magnitude of this fishery is unknown and there is insufficient information to evaluate the impact of these directed takes on affected stocks. Small numbers of humpback dolphins are also hunted in the Arabian Sea and Red Sea (SC/54/SM6). There are also recent reports of live captures of humpback dolphins from the Gulf of Thailand for the oceanarium trade, although the effects of these removals have not been evaluated.

Incidental takes have been recorded from almost all areas of the range of this genus. With the exception of some shark control programmes, there have been no observer programmes from which bycatch estimates could be generated. Consequently, it is difficult to evaluate the magnitude of this threat in most areas. Most evidence for bycatch comes from observations of strandings, interviews with fishermen and personal observations. Humpback dolphins are taken as bycatch in shark control nets in South Africa (SC/54/SM37). Current mitigation measures in this area include the use of acoustic alarms and reduced fishing effort. Humpback dolphins are also taken in fisheries in northern Mozambique (SC/54/SM28), Madagascar (SC/54/SM34), Kenya, Oman (SC/54/O4) and Hong Kong (Jefferson, 2000). In Australia, bycatches of humpback dolphins occur in inshore gillnets in the Gulf of Carpentaria and Queensland, and in shark control nets in Queensland (Gribble *et al.*, 1998), where the response of humpback dolphins to acoustic alarms is currently being evaluated.

Studies of humpback dolphins in the Pearl River estuary in Hong Kong (SC/54/SM5) have noted high levels of organochlorine concentrations in the tissues of these animals. Half of the stranded animals examined in Hong Kong had PCB levels above which toxic effects might be expected (Jefferson, 2000), and 44% had PCB levels above which increased levels of infectious disease were reported in UK cetaceans (Jepson *et al.*, 1998). An area of particular concern is the effect of organochlorines transferred to humpback dolphin calves from their mothers' milk. A high proportion of stranded cetaceans in Hong Kong are neonatal animals and it has been suggested that this may be linked to organochlorine contamination via lactation. The Committee concluded that elevated concentrations of pollutants observed in tissues of humpback dolphins from Hong Kong indicate that pollution may pose a risk to the health of dolphins in this area and, by virtue of similar contamination in other habitats, possibly to *Sousa* populations in other regions.

13.1.2 Conclusions

Humpback dolphins are listed as *Data Deficient* by the World Conservation Union (IUCN) and are listed in Appendix 1 of the Convention on International Trade of Endangered Species (CITES) (Anon., 1979; Baillie and Groombridge, 1996). The taxonomy of humpback dolphins remains unresolved and information on this genus is fragmentary throughout almost all of its range. Humpback dolphins are long-lived, but nowhere have research programmes on these animals been in place for longer than 10 years, a small fraction of their lifespan. Baseline data on abundance, population structure, rate of increase, recruitment and mortality levels are lacking.

The primary threats to humpback dolphins are incidental mortality in fisheries, including shark control nets, habitat degradation and, in a few areas (such as Madagascar), directed catches. Levels of contaminants in tissues of humpback dolphins are very high in some areas, raising concern over the effects of these pollutants. The Committee recognised the existence of these threats, but was not able to evaluate them with current information. Therefore, the Committee **concluded** that the status of humpback dolphins is unknown, but recognises that this genus is adversely impacted by anthropogenic changes throughout its known range.

With respect to humpback dolphins, the Committee **recommends** the following:

(1) wide collaboration among researchers to allow resolution of systematics and population structure within the genus;
(2) expanded morphological and molecular sampling throughout the range of the genus;
(3) representative sampling of humpback dolphins from areas in which samples have not yet been included in molecular analyses, such as Australia, India, Malaysia, Mozambique, Tanzania, the Persian Gulf, Gulf of Aden, Red Sea and West Africa;

(4) studies over long time scales to obtain estimates of abundance, and rates of fecundity and mortality;
(5) surveys, and photo-identification and genetic sampling in areas where the distribution of humpback dolphins is patchy, to allow for more detailed information on distribution, ranging patterns, discontinuity or population fragmentation and stock structure;
(6) studies of the life history, behaviour and ecology of this genus, to better understand its conservation status, ecological requirements and social structure;
(7) further quantitative studies of habitat use, and of the degradation of habitat, especially where habitat modification has occurred;
(8) independent observer monitoring programmes to estimate incidental mortality from bycatch and to monitor the effects of mitigation measures when they have been introduced;
(9) evaluation of the magnitude and effects of the directed fishery for humpback dolphins in Madagascar.

13.2 Progress on previous recommendations

The Committee noted IWC Resolution 2001-13, which directs it to continue to review progress on recommendations and resolutions relating to critically endangered stocks of small cetaceans on a regular basis. This year, the Committee reviewed progress on several of these stocks.

13.2.1 Status of the baiji

The baiji is the most endangered cetacean. Its range is restricted to the Yangtze River and its population size is probably only a few tens of animals (IWC, 2001i, p.275). Recent sightings have confirmed the continued existence of this species in the Yangtze River. Given its critically endangered status, the Commission has (IWC, 2001b; 2002c) requested the Government of China to report progress on the conservation of this species to the Scientific Committee on an annual basis. Unfortunately, for the second consecutive year, no new information has been received from China. The Committee expressed its extreme concern for the survival of this species in the near future and stressed the immediate need to eliminate all sources of anthropogenic mortality, including bycatch. The Committee **reiterates** its request for updated information on the status of this critically endangered species and on management efforts intended to conserve it.

13.2.2 Status of the vaquita

The Committee has followed progress on conservation efforts directed towards the highly endangered vaquita with great interest and this year reviewed three papers on this topic. Acoustic surveys of the distribution of the vaquita in the northern Gulf of California indicated that porpoises continue to inhabit a core area between Rocas Consag and San Felipe Bay (SC/54/SM17), a region of intense fishing operations. The northern Gulf of California is a Biosphere Reserve, but also an important fishing ground for shrimp (*Penaeus* spp). A study on the distribution of vaquitas and shrimp trawlers obtained during 1997 (SC/54/SM19) revealed a positive relationship between the occurrence of trawlers and the level of aggregation of vaquita. Whether this result is a direct consequence of the presence of trawlers is as yet unknown, but these findings raise concerns that such spatial aggregations of vaquita might be vulnerable to a single large mortality event.

The Committee reviewed progress on the conservation of vaquita in Mexico (SC/54/SM18). The main recent event has been the establishment of a Working Group whose mandate is to develop a general strategy for the recovery of the vaquita. This strategy consists of four elements: conservation, socio-economic considerations, education and establishment of a legal framework. The Scientific Committee **commends** the joint efforts of WWF, CIRVA, Conservation International and the Government of Mexico for their development of this strategy, and looks forward to receiving information regarding its implementation at its next meeting.

13.2.3 Harbour porpoise

The harbour porpoise has experienced major declines in parts of its range, perhaps most notably in the Baltic Sea. Previous surveys in the Baltic have not included Polish coastal waters, where porpoise bycatches are known to occur, and where it has been suggested that an unknown but significant part of the Baltic population might occur. To address this possibility, an acoustic and visual survey for porpoises was conducted in Polish waters during August and September 2001 and the results were reported in SC/54/SM3. Only two independent porpoise detections were made, both in the extreme western part of the survey area. This study confirms that harbour porpoises do occur in the Polish sector of the Baltic Sea but only in low numbers.

At the request of the Agreement on the Conservation of Small Cetaceans in the Baltic and North Seas (ASCOBANS), the Committee then considered a draft version of the ASCOBANS recovery plan for harbour porpoises in the Baltic Sea (the 'Jastarnia Plan'). The draft recovery plan contains the following elements: (1) reduction of fishing effort in fisheries known to have high bycatch rates of porpoises; (2) changes in fishing methods from those with high bycatches to alternative gear that is less harmful; (3) compilation of standardised data on fishing effort; and (4) implementation of a pinger programme on a short-term basis.

The Committee commended ASCOBANS for a valuable draft recovery plan that provides guidance for action to conserve harbour porpoises in the Baltic Sea. It **strongly endorses** the plan and concurs with its recommendations. With respect to the implementation of a pinger programme on a short-term basis (i.e. two to three years), the Committee **recommends** the following actions.

(1) Before introducing pingers to the Baltic environment, a simple modelling exercise should be conducted to confirm that their acoustic properties there will be similar to those in other, less brackish environments. Sound propagation measurements from a series of selected sites and water depths in the Baltic would be needed for this.
(2) Cost-effectiveness and efficiency will be best served if pinger implementation is targeted on those areas/times considered most likely to have overlap between 'high' porpoise densities and intensive driftnet and/or bottom-set gillnet fishing (hotspots). A few of these can be identified based on available information on bycatches and fishing effort, and short-term implementation in these areas should move ahead now.
(3) To identify other hotspots will require that the recommended compilations of data on fishing effort, the timing and location of porpoise bycatches (both historical and recent) and porpoise distribution (sightings, strandings etc.) be undertaken immediately.
(4) As noted in the draft recovery plan, it is essential that any pinger implementation must be accompanied by an

observer programme to verify that pingers are being used properly at sea.

(5) Despite the associated difficulties with high fishing effort and low bycatch rates, bycatch monitoring should be made an integral part of any pinger implementation programme, especially in the hotspots identified above.

(6) The concern expressed in the draft recovery plan that pingers might exclude porpoises from large areas of critical habitat should be addressed before pinger use becomes widespread in the Baltic.

(7) The draft recovery plan recommended that implementation of pingers be short-term and therefore any such implementation should be reconsidered within three years, with the expectation that pinger use will be replaced by longer-term mitigation measures at that time.

(8) The requirement in the draft recovery plan for rapid development of medium- and long-term approaches to mitigation (e.g. reduced fishing effort in 'high-risk' areas, conversion to fishing gear and practices that are much less likely to result in porpoise bycatch) is crucial and should not be compromised.

In view of the critical status of harbour porpoises in the Baltic, it is important to review the progress of the recovery plan at frequent intervals and to incorporate new information. The first review should occur within three years of the implementation of the plan. On behalf of ASCOBANS, Reijnders thanked the Committee for its careful and constructive review of this plan.

In some respects, for example their small population size, the conservation status of harbour porpoises in the Baltic Sea is similar to that of the vaquita in the Gulf of California, and the Committee recalled that it had recommended against the use of pingers to reduce bycatches of vaquitas at its meeting in Grenada (IWC, 2000e, pp.242-3). Nevertheless, the Committee concluded that the two situations were indeed different and, therefore, distinct conservation approaches were called for.

The Committee also received updated estimates of harbour porpoise bycatches in Danish North Sea bottom-set gillnet fisheries from 1987-2001 (SC/54/SM31). One estimation method resulted in an estimated annual bycatch of from 2,867-7,566 harbour porpoises. A second, newer method produced estimates that ranged from 3,887-7,366 porpoises per year. Both methods suggest that bycatches have been reduced in recent years due to decreases in both effort and landings, although the new method suggests a smaller reduction. Neither estimate accounted for the use of pingers in the wreck net fishery for cod, which may have reduced the bycatch in that fishery to near zero (SC/54/SM32).

13.2.4 Survey methodology for freshwater cetaceans

At its meeting in 2000, the Committee recommended that scientists with appropriate analytical skills be directly involved in the design and implementation of surveys for freshwater cetaceans, so that these surveys might result in statistically robust estimates of abundance. This year, the Committee reviewed the results of work that had been conducted in response to this recommendation. Line-transect, strip transect and photo-identification surveys of boto and tucuxi were conducted in the Colombian Amazon involving field collaboration among quantitative analysts and field researchers. The study was carried out in March and April, 2002 and presentation of results is expected next year. The Committee **recommends** the continued development of these techniques.

13.2.5 Bycatch mitigation

The Committee reviewed the results of a study to test whether gillnets made from high density monofilament (impregnated with iron oxide) would catch fewer harbour porpoises (SC/54/SM30). These modified nets were designed to be more detectable to an echolocating odontocete. The trial was conducted in the Danish North Sea bottom-set gillnet fishery in 2000 and recorded a 20% reduction in cod catch relative to nets made from conventional materials. Eight porpoises were caught in control nets and none were taken in high-density nets, a significant reduction in bycatch. Surprisingly, acoustic testing indicated that there were no significant differences in the acoustic target strength of modified and control nets, suggesting that the reduction in bycatch was not caused by an increase in acoustic reflectivity. Instead it is more likely that the modified nets caught fewer porpoises (and cod) because they were stiffer than conventional nets. If this is true, modification of net stiffness offers the potential for an inexpensive means of reducing bycatch. The Committee welcomed the results of this research and encouraged further developing and testing of these modified nets.

Use of pingers became mandatory in Danish North Sea wreck cod gillnet fisheries in August 2000. SC/54/SM32 outlined the results of an independent observer programme monitoring harbour porpoise bycatch in this fishery before and after implementation of pingers (1993-2001). Before the introduction of pingers, porpoises were observed taken in 19 of 873 sets, while after their introduction, no porpoises were observed in 129 sets in nets equipped with pingers. Thus, the introduction of pingers significantly reduced the bycatch rate in this fishery. The Committee welcomed these encouraging results and **recommends** continued monitoring of this fishery, including pinger use and bycatch rates.

A growing number of studies have demonstrated the ability of pingers to reduce harbour porpoise bycatch in fishing nets, but concerns remain regarding their use. The research outlined in SC/54/SM2 was conducted to investigate two of these concerns: (1) that the devices might exclude porpoises from preferred habitat; and (2) that porpoises might attempt to swim through nets where malfunctioning pingers create an acoustic window. The presence and behaviour of porpoises were monitored around a simulated net, equipped with functioning and non-functioning pingers, off the coast of western Scotland. The results of this work suggest that pingers may exclude porpoises from a larger area than was previously believed and that it is possible that porpoises may occasionally become entangled in nets with malfunctioning or missing pingers.

13.2.6 Dall's porpoises

IWC Resolution 2001-12 directed the Committee to complete a full assessment of the status of exploited Dall's porpoise stocks as soon as sufficient information becomes available. In its review of the subject last year, the Committee was unable to complete this assessment, because information on takes in the Japanese hand harpoon fishery was not made available. The hand harpoon fishery for Dall's porpoises continues, but members of the Japanese delegation did not participate in the work of the standing sub-committee on small cetaceans this year and no new information was

made available to the Committee on this topic. Therefore, the Committee was unable to complete its assessment of the status of Dall's porpoise stocks.

Komatsu noted that new information on Dall's porpoises will be made available outside IWC meetings to those requesting such information. He explained the Government of Japan's position on this matter, that the management of small cetaceans is the sovereign right of states and outside the terms of reference of the IWC. Komatsu further noted that as long as the Scientific Committee continued to involve itself in issues related to these species, the Government of Japan will not participate in the work of the sub-committee on small cetaceans or provide data on these species.

In conclusion, the Committee referred to the great value of the information provided by the Government of Japan on the status of small cetaceans in previous years; it was disappointed that members of the Japanese delegation were unable to contribute to its work on small cetaceans again this year. The Committee respectfully **requests** that the Government of Japan reconsider its position on this matter and resume the valuable contribution of Japanese scientists to its work on small cetaceans.

Komatsu responded that the Government of Japan would not change its position on this matter.

The Committee thanks the Government of the Republic of Korea for including observations of incidental takes of Dall's porpoises in its progress report (SC/54/ProgRep Korea). The Committee **reiterates** its request that the Government of the Russian Federation report bycatches of Dall's porpoises (and other small cetaceans) in its National Progress Report, together with estimates of the magnitude of bycatches in other fisheries. Borodin noted that the Russian Federation believes that matters pertaining to small cetaceans are outside the competency of the IWC.

13.2.7 Other recommendations

The Committee reviewed a monitoring project and boat-based observer scheme to investigate the takes of small cetaceans in coastal fisheries in Peru (SC/54/SM10) Three Burmeister's porpoises were taken in 10 overnight sets in artisanal bottom gillnets. In addition, evidence for a minimum of 471 small cetacean captures was documented from 1999-2001. Most striking was a continuation in the reduction of the relative proportion of dusky dolphins taken in fisheries along the central coast (Van Waerebeek, 1994). The Committee **requests** that the Government of Peru submit catch statistics of small cetaceans in their next progress report to the Commission.

Brownell informed the Committee that a permit for catch quotas of white and killer whales had been issued recently by the Russian Central Committee of Fisheries. The quotas included 1,000 white whales (for aboriginal harvest) and 10 killer whales (for live capture). In its last review of the status of white whales in 1999 (IWC, 2000e, pp.243-250), the Committee noted that some of the stocks from which these harvests were planned, particularly those in the Okhotsk Sea, were depleted or of unknown status. The Committee also recalled IWC Resolution 1998-9 which expressed concern that some directed takes of white whales may not be sustainable. As in the past (IWC, 1992; IWC, 2001i, p.278) the Committee expressed concern over such takes of small cetaceans when there is insufficient information to adequately assess the impact on the target populations. The Committee **recommends** that these planned takes of white and killer whales be preceded by an assessment of the size of affected populations and of the impact of these removals.

13.3 Takes of small cetaceans

The Committee was not able to review its table of recent catches of small cetaceans (Annex K, Appendix 2) at this year's meeting. Nevertheless, the Committee **agreed** that it is highly likely that this table would be incomplete, as it has been in previous years. The Committee recalled Resolution 1997-8, which requested member governments to provide data on the directed and incidental takes of small cetaceans. The Committee noted that the following countries have not contributed these data over the past six years and asked that the Secretariat request data on directed and incidental takes of small cetaceans from these governments, preferably on a stock-by-stock basis: Antigua & Barbuda, Chile, People's Republic of China, Costa Rica, Denmark, Grenada, India, Kenya, Norway, Peru, the Russian Federation, St Vincent and the Grenadines, Senegal, Solomon Islands and Venezuela.

13.4 Work plan

The standing sub-committee's discussion of its future work is given in Annex K. The Committee's overall work plan is discussed under Item 19.

14. WHALEWATCHING (ANNEX L)

The Committee had identified three priority topics for discussion this year:

(1) review the work of the Intersessional Correspondence Groups (Data Collection Correspondence Group and Whalewatching Management Correspondence Group);
(2) review information on the significance of noise production from vessels and aircraft in a joint session with the Standing Working Group on Environmental Concerns; and
(3) review the research on the effectiveness of and compliance with national whalewatching guidelines and regulations.

Additional work would be to review new information on: (1) dolphin feeding programmes; (2) 'swim-with' whale and dolphin programmes; and (3) national guidelines and regulations.

A representative of Japan drew attention to the following statement:

> It is the Government of Japan's position that whalewatching is outside the competence of the IWC. Japan does not deny that studying the effects of whalewatching on whale stocks is beneficial in order to obtain better understanding of the stocks. However, the IWC has limited financial and human resources and should be focusing its efforts on important matters such as stock assessment.

In response, one member noted that, in many locations, whalewatching has provided a platform for data collection that has proved of importance to the assessment and understanding of local cetacean populations. Such studies have resulted in many publications in international journals. Consequently, to state that the IWC should ignore whalewatching and instead concentrate its scarce resources on 'assessments' ignores the considerable contribution to the latter that can be made by whalewatching data.

14.1 Reports of the intersessional working groups

14.1.1 Data Collection Correspondence Group

SC/54/WW2 reported on the further development of the 'Data Recording System' (DRS), including preliminary instructions and recommendations for its use in the field. A prototype computer program has been developed to assist would-be researchers in producing simple data-collection

forms based on the DRS. The Committee **agreed** to form an intersessional group to continue the work as described in Annex L, Appendix 2.

The Committee also **agreed** that Carlson should collate data forms from whalewatching operations and research groups around the world, as well as the scientific question(s) the forms attempt to address, and present a report to next year's meeting.

14.1.2 Whalewatching Management Intersessional Correspondence Group

Oosthuizen presented the report of the Whalewatching Management Intersessional Correspondence Group regarding a workshop on the development of scientifically-based whale- and dolphin-watching management. He noted that the rationale and need for such a workshop were discussed in detail at the Scientific Committee last year (IWC, 2002l, pp.345-346).

Noting the ongoing proliferation of whalewatching activities worldwide, and concerns about possible impacts of whalewatching activities on cetacean populations, the Committee **agreed** that an intersessional workshop will benefit future whalewatching management. Details of the workshop are given in Annex L (item 5.2). As this will not be an official IWC workshop, funds will not be sought from the IWC, but from member nations and other potential sponsors. The workshop will be scheduled before next year's meeting.

The Committee **recommends** that:

(1) an Intersessional Advisory Group be established to advise Oosthuizen on the scientific parameters which would be discussed during the proposed workshop; and
(2) that the Commission endorses the Workshop and encourages participation by members of the Scientific Committee and IWC member states.

14.2 Whalewatching activities and noise impacts

This was initially discussed in a joint session with the sub-committee on whalewatching and the standing working group on environmental concerns.

SC/54/E7 reviewed recent knowledge concerning noise pollution and its implications for cetaceans, with particular reference to vessel noise. The paper considered: developments in the theoretical framework (including recent recommendations that seismic surveys avoid areas where densities of marine mammals are known to be high, that initial surveys for marine mammals should be conducted in the vicinity of deployment, and the recent use of computer models to estimate noise impacts); technological mitigation; vessel design; and information on avoidance behaviour as well as changes in behaviour and habitat use by cetaceans as a result of vessel traffic.

M. Simmonds concluded that, despite increasing concerns about noise pollution, it still receives little attention from policy makers. The need for the regulation of boat traffic, when in the vicinity of cetaceans, including in particular (but not limited to) whalewatching vessels, is also indicated.

There was a brief discussion on the mass stranding of beaked whales in the Bahamas in March 2000 (IWC, 2001g, p.255). Few to no *Ziphius* were sighted in the summer of 2000, but some *Ziphius* were sighted the following year. Sighting rates are apparently still lower than before.

Some members commented on the increase in high-speed ferries, whalewatching vessels and other ships and the potential for serious threats to cetaceans that do not show avoidance to their noises. It was noted that within the next few decades, freighters and super tankers would have the capability of travelling at 60mph. An increase in average low frequency ambient noise of 10dB off the central California coast in the last two decades was reported. This increase could significantly lower a whale's communication range. It was noted that further research is needed to determine whether making vessels quiet necessarily confers a net benefit to whale populations.

SC/54/E8 reported on an investigation of the relevance of international law to marine noise. The Chair of the SWG on environmental concerns pointed out that legal opinions need to come from appropriate authorities. The author of SC/54/E8 noted that there was a growing recognition of disturbance in international law, especially relating to cetaceans, and recommended that scientifically supported definitions of what constitutes unacceptable or dangerous noise pollution, disturbance or harassment would help to inform the development and interpretation of existing and future law.

One member commented on the difficulty of defining unacceptable noise levels, as it would have to be species- and frequency-specific. C. Clark noted that one approach on potential impacts from anthropogenic noise separates impacts into physical harm and behavioural responses. Physical harm, often due to chronic exposure to noise, is evident as a permanent threshold shift (PTS) in hearing ability caused by damage to inner ear sensory receptors, while temporary threshold shift (TTS) is a modification of these receptors that, although not damaging, does serve as an indicator that further exposure is likely to lead to PTS. He further noted that important progress has been made in the ability to estimate levels of noise exposure for individual animals or populations of animals and that this might provide a way forward to better evaluate the potential for noise impacts.

Williams *et al.* (2002) reported results from a shore-based experimental study of behavioural responses of killer whales to a vessel operating in western Canadian waters at two operating speeds. Killer whales responded to high-speed experimental approach by adopting paths that were significantly less predictable than those observed during preceding no-boat conditions. The tendency for whales to swim further along a circuitous route may carry energetic costs to whales. He suggested that the boat would need to be 700m away for the whales' received noise level to equal the noise level received by the same boat operating at slow speed at 100m from the whale. One member commented that studies such as these are valuable as they demonstrate that noise level can be used to determine biologically relevant approach distances for vessels watching whales.

Bain (2002) attempts to model the cumulative effects of such short-term energetic costs. This study considered the increased energy expenditure due to avoidance responses and reduced energy acquisition due to acoustic impairment of foraging efficiency. The models suggest that population-level effects are negligible for killer whale populations well below carrying capacity. Hence population growth in the presence of disturbance cannot be used to conclude that disturbance will not affect the population at other densities as it approaches carrying capacity. The models suggested that missed prey due to noise was a more prominent mechanism than excess energy expenditure.

It was noted that the study demonstrates how physical acoustic and biological information can be merged and serves as an excellent model of how to integrate the two fields.

14.3 Review of research on effectiveness of and compliance with whalewatching guidelines and regulations

SC/54/WW1 reported on short-term impacts on Indo-Pacific bottlenose dolphins in Menai Bay, Zanzibar. Observations were made from tourist boats and from a research boat in order to evaluate the impact of violating guidelines. The results showed that the dolphins were more likely to change their group activity when guidelines were violated during boat approaches compared to when guidelines were followed. Further stress-related behaviours in dolphin groups were significantly more frequent when guidelines were violated and indicate that the behaviour of the Indo-Pacific bottlenose dolphins in Menai Bay is significantly affected by dolphin tourism in its present form. In the Menai Bay area, local scientists and operators meet to discuss research results in relation to guidelines and how the dolphin watching is conducted. The intent is to develop dolphin-watching activities that are conducted in a sustainable manner with a minimal impact on dolphins. The adoption, implementation and enforcement of suggested guidelines could be an important step towards the sustainable development of dolphin tourism in Menai Bay.

The Committee welcomed the type of research in SC/54/WW1 and **agreed** that such research should be encouraged.

14.4 New information on previously discussed topics

14.4.1 Dolphin feeding programmes

Corkeron presented an update on the feeding programme at Tin Can Bay, southeast Queensland, Australia, focusing on Indo-Pacific humpback dolphins. Details are discussed in SC/54/SM27. To date, no management programme, such as those in place in Monkey Mia or Tangalooma, has been established.

14.4.2 'Swim-with' whale and dolphin programmes

Rose presented information on three 'swim-with-whale' programmes. The number of commercial operations promoting swimming with large whales (e.g. humpback and minke whales) appears to be increasing. Rose suggested that a thorough review of these proliferating programmes be conducted, for discussion next year. Some members expressed concern with the swim-with programmes, particularly those that are not regulated, allow free swimming and encourage swimming with mothers with small calves.

The Committee **agreed** that research on the impacts of swim-with-whale programmes should be encouraged and **recommends** that a review of these programmes be a priority for next year, along with ongoing work on swim-with-dolphin programmes.

14.4.3 National guidelines and regulations

SC/54/WW3 reviewed whalewatching guidelines from six areas in Japan. The paper detailed target species, safety zones, minimal approach distances, and general codes of conduct for each area. There are no laws or ordinances in Japan that directly regulate whalewatching activities; however, there are several areas where voluntary codes of conduct have been established by operators, scientists or associations. One member noted that the situation in Japan is ideal for studying and comparing whale behaviour in whalewatching areas with and without written codes of conduct.

There was a brief discussion on the development of national whalewatching regulations. Some members felt that it would be difficult to standardise regulations due to several variable factors. Therefore, rules should be overarching with specifics tailored to suit target species, area use (i.e. feeding, breeding, resting and migrating areas) and vessel and operation types. One member noted that a co-management system in South Africa, with dialogue between government and operators, has been effective in improving whalewatching management.

The compendium on whalewatching guidelines and regulations around the world is now on the IWC website. Carlson requested that any new or changed guidelines or regulations be sent to her so that the site can be updated.

M. Simmonds suggested consideration might be given to the meaning of the term 'harassment' and/or what constitutes unacceptable disturbance. Some members were of the opinion that this was an extremely difficult task as there are several confounding variables that may affect whale behaviour. In addition, the term 'harassment' has legal implications and the discussion should be science-based. The Committee concluded that:

(1) persistent changes in cetacean behaviour associated with the presence of whalewatching platforms may indicate a negative effect;
(2) further research on the topic of disturbance is encouraged.

14.4.4 Other

Morton and Symonds (2002) provided results of a natural experiment on the deliberate introduction of high-amplitude noise (Acoustic Harassment Devices/AHDs) into a portion of the core habitat of resident and transient killer whales in British Columbia, Canada. Killer whale usage of the ensonified area declined while AHDs were in use, and returned to baseline levels when the devices were turned off. In the adjacent (control) area, killer whale presence remained stable across the 15-year study. Careful consideration of alternative explanations for the findings, including changes in prey distribution, led the authors to conclude that acoustic harassment must have displaced killer whales from one part of their range, while usage of the habitat immediately adjacent remained consistent.

SC/54/WW4 discussed behavioural responses of wintering humpback whales to vessels in Ecuador. The study aimed to identify components of whale behaviour that changed consistently when boats approached, to provide concrete signs that boat operators could look for to determine when they might be too close, or staying around whales too long. The land-based study compared whale behaviour when no boats were present to the behaviour of the same group as vessels approached, and found that whales increased swim speed significantly. Park managers were advised to caution boat operators that if they had to increase their boat speed to keep up with whales, that this might be a sign that they should end their whalewatch encounter.

Heckel *et al.* (2001) studied the influence of whalewatching on the behaviour of migrating gray whales in Todos Santos Bay on the northwest coast of the Baja California Peninsula. The study shows that during the southbound migration of gray whales, there were no significant differences in swimming direction between whale groups with and without whalewatching boats. By contrast, during the northbound migration, the differences were statistically significant. An additional suggestion was made to prevent such disturbances.

The Committee welcomed the above papers and noted that the whalewatching management-related research presented represents the type of studies necessary for the development of science-based regulation.

14.5 Other

SC/54/O7 described a novel DNA-based method for identifying krill species present in the faeces of baleen whales (see Annex J, item 7.4 for further details). It was noted that whalewatching vessels offer a platform of opportunity for the collection of cetacean faecal samples, and broad collaboration with researchers working in targeted parts of this industry is sought. Several researchers expressed interest in collaboration, and discussions were to continue outside the meeting.

A workshop was held on Philip Island, Australia in 2001, during which several papers on the issues of whale watching, scientific studies of measuring impacts from tourist activities and dolphin feeding programmes were presented. These papers will appear in a proceedings on the conference. Gales undertook to encourage the authors to present these papers for information at the next IWC meeting.

14.6 Work plan

The work plan developed by the sub-committee on whalewatching is given in Annex L. The Committee's overall discussions on its work plan are given under Item 19.

15. DNA TESTING

This item is discussed in response to Commission Resolution 1999-8 (IWC, 2000a, p.55).

15.1 Progress on genetic methods for species, stock, individual identification

SC/54/SD2 reported on the implementation of DNA Surveillance (*http://www.dna-surveillance.auckland.ac.nz*) as a web-based program for molecular genetic identification of cetaceans and cetacean products derived from strandings, fisheries bycatch, regulated exploitation and illegal hunting. It aligns a user-submitted DNA sequence with a validated and curated reference dataset of pre-aligned sequences and returns a phylogenetic tree (with bootstrap values if desired) showing with which species the submitted sequence clusters. It also returns a table summarising the evolutionary distances between the submitted sequence and each of the members in the reference dataset.

DNA Surveillance and the reference database were developed specifically for taxonomic identification. This approach differs from a standard BLAST search of GenBank. GenBank entries are not curated and can suffer from species or population misidentification, missing information and inconsistent terminology. This is a particular problem for cetacean species, as the morphological identification of a number of species is very difficult, and the sequences are usually not associated with identifiable reference material (e.g. from skin biopsies).

The initial reference sets comprise sequences (~500 bp) from the 5' end of the mitochondrial (mt) DNA control region (D-loop). Technical details regarding the sequencing of this region are available at the DNA Surveillance Web site. The mtDNA control region is highly variable and has proven to be an effective tool for the species identification of test specimens and for differentiating intra- and interspecific relationships (e.g. Baker *et al.*, 1996; Henshaw *et al.*, 1997; Dalebout *et al.*, 1998; SC/54/SD1). The reference sets provide coverage of the taxonomic and geographic diversity of cetaceans and comprise 121 sequences from 67 species in 10 families. Sequences were derived from tissue samples analysed at the Laboratory of Molecular Ecology and Evolution, University of Auckland, or retrieved from GenBank. Each sequence was included only if the specimen from which it was obtained had been examined by an expert in cetacean morphology, and diagnostic skeletal material or photographic records were collected (Dizon *et al.*, 2000). In some cases, sequences were derived from DNA extracted from teeth and bones of museum holotypes. Each sequence is annotated with information on its provenance. Reference sets of cetacean cytochrome *b* sequences and sequences from other taxa are under development.

In response to a question about quality control, Baker noted that a workshop may be convened to develop quality-control criteria for the sequences in the register. He also noted that at this point only mtDNA control-region sequences are included in the register and that the methodology for developing these is well-established and available on various websites. A discussion ensued about the plans to expand the register and identification service to assignments below the species level. Concern was expressed about the difficulty of accomplishing this for most groups without very large reference datasets. It was suggested that a tree be provided placing the unknown specimen among the specimens represented in the register, rather than an assignment to a sub-specific taxon or population, but members believed that even this could result in users believing that the results were more reliable than they actually were. Baker agreed that this is a problem, especially for some groups such as the delphinine odontocetes and some others, and noted that the feedback to the user will include appropriate warnings in such cases. He also noted that one motivation for creating the system is to encourage contribution of sequences from others, to build the necessary large datasets needed for reliable population assignment.

15.2 Progress on collection and archiving of samples from catches and bycatches

In Norway, samples have been collected and archived from 2,676 minke whales (of a total of 2,758 taken by Norway, 1997-2001). No information on collection and archiving of samples in Japan was available to the Committee.

15.3 Reference databases and standards for a diagnostic register of DNA profiles

The Norwegian register, while not fully diagnostic, includes sequences for over 97% of the whales taken. The register is not yet fully operational and technical audits and other necessary steps to this end are in progress.

15.4 Work plan

The terms of reference for the working group for next year's meeting will remain the same, unless the Commission requests other information in the interim. The Committee's overall work plan is discussed under Item 19.

16. SCIENTIFIC PERMITS

16.1 Advice on effects of scientific permit catches

Further to its discussions of last year (IWC, 2002d, p.64), there had been no further work on this general issue during the intersessional period. It was noted that in terms of the Southern Hemisphere, the Committee was still working to obtain agreed abundance estimates (see discussion under Item 10.2). The Committee also noted that there had been no

progress by the intersessional group that had been established to generate a list of approaches potentially useful for quantifying the scientific benefit of research catches and the features of a proposal needed for such analyses (IWC, 2002d, p.65).

16.2 Suggestions for improving review procedures

The Committee had established an intersessional group to consider improvements to the way that the Committee reviews scientific permit results and proposals. Although that group did not submit an agreed report at this meeting, it was noted that the approach used this year to review the new North Pacific JARPN II proposal had proved successful i.e. first discussing the proposals in a Working Group. Given this, the Committee agreed that it would establish a Standing Working Group on Scientific Permit Proposals under Bjørge. It was noted that the workload of this SWG would vary depending on whether new proposals were being presented or whether major reviews of existing long-term proposals were scheduled. It was also noted that the existing Commission guidelines had developed over a number of years and included some duplication and overlap within the broad headings used. It was suggested that it might be possible intersessionally to attempt to streamline these (whilst retaining the references to the origins of the guidelines) for discussion next year with a view to presenting a suggested revised version for the Commission to consider.

16.3 Review of results from existing permits

16.3.1 Japan – Southern Hemisphere minke whales

SC/54/O18 summarised the 15th field season of the JARPA programme. Research was conducted in Area IV and the eastern part of Area III (Area IIIE) from 29 November 2001 to 9 March 2002. One sighting vessel (SV), three sighting and sampling vessels (SSVs) and one research base ship were engaged in the research. The searching distance of the SV was 5,970.2 n.miles and 745 primary sightings (1,751 individuals) of Antarctic minke whales were made. The three SSVs searched a total of 13,797.2 n.miles and made 1,122 (2,623 individuals) primary sightings of that species. The Antarctic minke whale was the most commonly seen species, followed by the humpback whale. The Antarctic minke whale occurred in extremely high densities in the east-south stratum and Prydz Bay in Area IV. Sightings of humpback whales were much higher than those of Antarctic minke whales in the north strata and the west-south stratum in Area IV. The distribution of humpback and minke whales did not overlap except in some areas near the ice-edge where both species were highly concentrated. The number of sightings of Antarctic minke whales equalled the highest number observed in the previous research in Areas IIIE and IV. The number of sightings for both humpback and fin whales was higher than the past JARPA survey records. The authors hypothesised that the recent increase of humpback whales may result in interspecies competition with Antarctic minke whales (although see the discussion under Item 10.4.1). A total of 493 Antarctic minke whales was targeted for sampling resulting in the catch of 440 individuals (110 from Area IIIE and 330 from Area IV). A total of 52 biopsy samples was obtained from humpback, blue, fin and right whales by the SV and SSVs. The SV conducted an oceanographic survey using a passive acoustic system, Electric Particle Counting and Sizing System (EPCS), CTD and XCTD. One of the SSVs also conducted an oceanographic survey using EPCS.

Studies using JARPA information (including papers SC/54/IA9, 14, 25 and SC/54/O18, 19) were presented in the relevant sub-committees and working groups.

16.3.2 Review of results from existing permit for feasibility study

The text below (Item 16.3.2.1) summarises the results of the JARPN II feasibility study under special permit reported by Japan (SC/54/O17) and presented to the Scientific Committee by Fujise. The Committee acknowledged Fujise for his informative presentation. Comments from the Scientific Committee are given under Item 16.3.2.2.

16.3.2.1 RESULTS REPORTED BY JAPAN

INTRODUCTION

The JARPN II feasibility study was designed to respond to issues arising in the 2000 JARPN Review Meeting (IWC, 2001l) in order to better address the issue of competition between cetaceans and fisheries with the overall goal of contributing to the conservation and sustainable use of marine living resources, including whales, in the western North Pacific, especially within Japan's EEZ (Government of Japan, 2000). The priority for the research was feeding ecology and ecosystem studies. Other objectives were related to continuing studies on the stock structure and monitoring environmental pollutants.

JARPN II began as a two-year feasibility study in order to evaluate, among others, the practicability and performance of concurrent whale and prey surveys for estimation of prey preference. The 'feasibility' also applied to the addition of Bryde's and sperm whales to the research. The research area was off the coast of Tohoku and southern Hokkaido, (sub-areas 7, 8 and 9) which are Japan's richest fishing grounds and therefore provides a suitable area to study the interactions between cetaceans and fisheries. A total of 140 minke whales, 93 Bryde's whales and 13 sperm whales were sampled. The first feasibility survey of JARPN II was conducted from 1 August to 16 September 2000. The second year survey was conducted from 14 May to 3 August in 2001.

With regard to feeding ecology and ecosystem studies, the feasibility studies addressed questions such as: (1) whether information on the diet composition and daily and seasonal consumption can be obtained with adequate precision through the examination of stomach contents of the whales; (2) whether the weights of the stomach contents can be measured for large whales such as Bryde's and sperm whales as is the case for minke whales; (3) whether the first concurrent whale and prey surveys with six research vessels involved are practicable; and (4) whether these provide data to assess prey preferences. This latter point is important since it is a key parameter for most ecosystem models.

Regarding the stock structure of the common minke whale, following the discussions and conclusions of the JARPN review meeting, the objective focused only on investigating whether or not the W stock exists in sub-area 9, and if so, to investigate the spatial and temporal extent of its occurrence. Another objective of the two-year feasibility study was to investigate the pattern of mixing between the O- and J-stocks in sub-area 7[15]. Since there were no genetic samples for Bryde's whales in the research area, one of the objectives of the feasibility study was to determine whether

[15] The stock structure of the North Pacific common minke whale is discussed under Item 6 and in SC/54/Rep1 and a map of the sub-areas can be found there.

samples for stock structure studies could be collected from this area, and whether the analysis of such samples could provide additional information on the stock structure.

The research plan also included the monitoring of PCBs, DDTs and other pollutants in whales and their prey as well as in their environment.

PREY CONSUMPTION BY CETACEANS

Prey species of minke whales varied both geographically and temporally (similar to the results obtained during JARPN). During August and September, Japanese anchovy was the most important prey species. Walleye pollock was an important prey species in sub-area 7. On the other hand, Pacific saury was consumed in low proportion compared to the results obtained during JARPN. This may be due to the low abundance of Pacific saury in recent years. There is evidence of competition between minke whales and commercial fisheries (SC/54/O17). For example, dip-net fishermen have complained about interference by minke whales more frequently in recent years. This topic needs to be addressed with further research. Estimates of the daily prey consumption were 1.4-8.2% of body weight. More precise daily consumption rates can be calculated with more data such as the caloric value of prey species on an area, seasonal and annual basis.

One of the objectives of the feasibility study was to check how to sample and measure Bryde's whale prey. Sampling cow/calf pairs did not produce useful results. Prey species of Bryde's whales varied temporally within the research area. The major prey species were krill and Japanese anchovy. They fed on different sizes of the same prey species (Japanese anchovy) compared to minke whales, which occurred in nearly overlapping areas. More data are needed to better understand the geographical and temporal changes of prey species. Most of the Bryde's whale sightings occurred close to the fishing grounds of skipjack tuna. On these grounds, both Bryde's whales and skipjack tuna feed mainly on Japanese anchovy. Therefore, further research is necessary to understand the nature of this competition. Estimates of the daily prey consumption were 3.3-8.2% of body weight.

Another of the important objectives of the feasibility study was to examine methods for sampling and examination of stomach contents of sperm whales. Sperm whales could be sampled at random except for the large bulls. Results from the JARPN II feasibility study (SC/54/O17) clearly showed that sperm whales did not eat only deep-sea squid but also squid occurring in the pelagic ecosystem. In addition, they were feeding on some fish species. The species of squid and fish were identified by examining beaks and otoliths, respectively. The body length and weight of the main prey species could be estimated using regression equations to the otolith length or lower rostral beak length. Sperm whales seem to feed on prey during the daytime in the meso- and epipelagic layers. As the sample size is small (13 animals), no conclusion can be drawn on the role and contribution of this species to the surface ecosystem, and further sampling is required.

PREY PREFERENCE OF CETACEANS

The most important objective in the feasibility study was to evaluate the practicability and performance of concurrent whale and prey surveys. Such concurrent surveys were conducted for the first time in the North Pacific and involved many research vessels operating at the same time (Government of Japan, 2000). Several small blocks were set in the research area and both surveys were conducted concurrently in each small block. Stomach contents were examined and compared to the biomass of each prey in the sea, which was estimated with an acoustic device and mid-water trawl net.

There were no serious practical problems in the conduct of the concurrent surveys. Close cooperation between the two surveys is indispensable for good performance. Preliminary analyses showed evidence of prey preference of cetaceans. For example, the preference of minke and Bryde's whales for lantern fishes is judged as zero. Minke whales prefer Japanese anchovy to krill (SC/54/O17). Bryde's whales may prefer larger fish among small-sized anchovy. The prey preference of cetaceans can be estimated if the concurrent whale and prey surveys continue.

ECOSYSTEM MODELLING

Some initial analyses were conducted using the ecosystem models Ecopath and Ecosim. These analyses were conducted to assess the potential effectiveness of these models in relation to the goals of JARPN II. Ecopath and Ecosim models indicated possible competition between cetaceans and fisheries and that the ecosystem of the western North Pacific may be affected on a large scale by trophic interactions and changes of fishing. The results of many tests suggested the utility of the Ecopath and Ecosim models to study the western North Pacific ecosystem. Cetaceans, especially minke and sperm whales, are probably important key species in the western North Pacific pelagic ecosystem because removals of these species brought fluctuations in the biomasses of direct and indirect prey species (SC/54/O17). Long-term information on diet composition is needed to clarify the characteristics of the ecosystem. More precise estimates of other biological parameters are also necessary, particularly temporal and spatial migration and prey preference of cetaceans.

STOCK STRUCTURE

MtDNA analysis detected slight genetic heterogeneity among the minke whale samples collected from the western part of sub-area 9 in some years. These results suggest that putative W stock individuals, if they exist, enter sub-area 9 only every few years. However, analyses of nuclear DNA (microsatellite) and other biological data do not show any evidence of heterogeneity among samples collected from sub-areas 7, 8 and 9. Therefore, conclusions about the putative W stock in the east side of the western North Pacific are still pending.

Using the same maximum-likelihood method used to estimate the mixing rate of whales from the minke whale stock in the Yellow Sea, East China Sea and Sea of Japan (J-stock) and from the minke whale stock nearest the Pacific coast of Japan (O stock) in sub-area 11 (Pastene *et al.*, 1998), the J-stock proportion in sub-area 7 was estimated at 0.08 (SE = 0.08) and 0.07 (SE = 0.04) for the 2000 and 2001 JARPN II surveys, respectively. These rates are much smaller than those estimated for some months in sub-area 11, indicating that very few J-stock animals migrate into sub-area 7.

JARPN II in 2000 and 2001 sampled Bryde's whales in regions within sub-area 1 not covered previously. Even by adding samples obtained from JARPN II from regions in sub-area 1 not previously covered, no strong evidence of additional stock structure within this sub-area was found (SC/54/O17).

Analysis of mtDNA control region sequences and microsatellite DNA indicated that these genetic markers were variable enough to explore stock structure of North Pacific sperm whales (SC/54/O17).

POLLUTANT MONITORING

Information on the accumulation levels of contaminants in minke whales has been obtained. These data will be examined in relation to biological information such as sex, body length, age, gestation and lactation. For the concentration levels of organochlorines such as PCBs, DDTs and HCHs, some contaminants in seawater and air samples in the research area showed a decreasing pattern relative to past levels. However, no conclusive results were obtained due to the small sample size. With regard to the usefulness of skin samples for pollution studies, some parameters of toxic elements could be monitored using skin biopsy samples from minke whales. However, no conclusive results were obtained for these metals as the results of the present study do not coincide with those from the Antarctic whales.

16.3.2.2 COMMENTS AND DISCUSSION BY THE SCIENTIFIC COMMITTEE

Some members raised questions about the relationship of the objectives of the feasibility study as proposed and the results of the feasibility study as presented here, and the relationship of that to the proposal to be discussed. They noted that the feasibility questions addressed in SC/54/O17 did not appear directly in the original proposal for the feasibility study (Government of Japan, 2000). Further, the questions to which answers are reported on page 18 of SC/54/O17, are in fact for the most part simple, such as can weights of stomachs of whales be measured. They were answered in equally simple yes and no statements, answers that could have been given before the feasibility study was undertaken based on past experience of Japanese whaling and research capability. More importantly, however, the questions reported were primarily related to mechanical aspects of sampling. They were disappointed that the feasibility study did not address critical aspects of overall design of the programme, including the relationships between sampling methodologies, the data analysis methodologies and ecosystem modelling methodologies. The proponents noted that performance criteria for the JARPN II feasibility study were implicit in the research proposal submitted to the Committee in 2000. The performance was evaluated directly through analysis of data obtained. Thus, if the feasibility study provides results and data to support continuation of the study, it has performed well. Further, the proponents stated that this is the case for the 2000-2001 research carried out under the JARPN II feasibility study as shown in SC/54/O17. These aspects are further elaborated in the discussion of the new proposal below.

The authors of SC/54/O26 reported that performance criteria are not implicit but must be explicitly stated in measurable terms. They also noted that the idea of a feasibility study performing well because it had provided results to support the study's conclusion was a circular argument.

16.4 Review of new or revised proposals

16.4.1 JARPA

SC/54/O1 outlined the JARPA survey plan for the 2002/2003 field season. The objectives, survey items and methods are the same as last year. The survey for the coming season will cover Area V and the western half of Area VI. The objectives of the programme have been elucidated previously and include the better determination of stock structure and the collection of samples suitable for catch-at-age analyses. The expansion to Area VI was to allow for the testing of new hypotheses on stock identity (Government of Japan, 1996).

The schedule for the 2002/2003 JARPA survey is as follows:

(1) research vessels will leave Japan at the beginning of November and return in the middle of April 2003;
(2) the sample size is 300 Antarctic minke whales in Area V and 100 Antarctic minke whales in Area VI with 10% allowances;
(3) the type and number of vessels are the same as in the previous years – one research base vessel, three sighting and sampling vessels and one dedicated sightings vessel.

In addition, examination of the extent of the yearly variation of stock distribution patterns using other available sources of information (i.e. environmental correlates) is planned. Therefore, data will also be collected on prey species availability and on the nutritional condition of sampled whales.

COMMENTS AND DISCUSSION

It was noted that this is a continuation (14th year) of a long-term (16-year) research programme. The Committee held a major review of this programme in 1997 (IWC, 1998b), and the Committee draws the attention of the Commission to its previous considerations on this matter (IWC, 1999a, pp.45-46; IWC, 2000b, pp.54-56; IWC, 2001c, pp.57-58, 64-65).

Attention was drawn to the fact that in the coming season, there is overlap in the research areas between JARPA and the SOWER circumpolar surveys. The issue of avoiding any spatio-temporal overlap between the two programmes will be placed on the agenda of the SOWER planning meeting (see Item 10.1.2.2).

Tynan expressed concern that the JARPA research would be carried out in the Ross Sea, an area exhibiting some of the largest calving of the ice shelf, which has unknown and potentially serious ecological consequences for the ecosystem, including whales. In response it was noted that the JARPA vessels will be able to provide good information on this phenomenon, by monitoring the ice-edge information obtained from NIC as well as information from its own vessels where the southern stratum is 45 miles from the ice-edge. Oceanographic information is also collected.

Childerhouse referred to the comment that estimation of biological parameters should be carried out for known stocks and questioned whether the sample size is now sufficient to address the stock issue.

Pastene responded that with respect to the sample size for the stock structure issue in the expanded area, because the level of genetic difference between stocks of Antarctic minke whales is small, large sample sizes are generally required for genetic analysis (n = 150-200). However, for heterogeneity tests, samples must be divided into smaller groups depending on certain spatial and temporal factors. In fact, a sample size of 150-200 is required for each of the small groups.

Hatanaka explained further that the first objective of JARPA is to estimate the biological parameters to improve the stock management of the Southern Hemisphere minke whale. The sample size of JARPA in Areas IV and V was designed primarily to achieve this objective.

16.4.2 JARPN II

In the text below, summaries of the plans for further research under special permit (based on document SC/54/O2 and an oral presentation to the Scientific Committee by Kawahara) are listed first, followed by comments from the Scientific Committee. The Committee acknowledged Kawahara for his informative presentation.

The text is structured according to Guidelines for the Review of Scientific Permit Proposals (Donovan, 2001) and previous Committee reviews of special permit proposals. In addition to the report of the feasibility study (SC/54/O17) and the proposal (SC/54/O2), the Committee also received a critique of the proposal (SC/54/O26) and a number of other documents. One was written in response to SC/54/O26 by Hatanaka, Kato, Nishiwaki, Hakamada, Kanda, Yasunaga, Murase, Zenitani, Kawahara, Miyashita, Okamura, Fujise, Goto, Tamura, Matsuoka and Goodman. Other documents used were prepared by Haug, Schweder and Walløe, by Gales, by Tynan, by Tamura and by Víkingsson and Gunnlaugsson. The points raised in these have been integrated into the following summary of the Committee discussions.

A. The Proposal

The relevant guidelines are as follows.

1. A statement as to whether the permit proposal adequately specifies the four sets of information required under paragraph 30 of the Schedule (*Rep. int. Whal. Commn* 36:133).

2. Objective of the research (Schedule Paragraph 30).

3. Number, sex, size and stock of the animals to be taken (Schedule Paragraph 30).

Proposal (summary of SC/54/O2)

The overall aim of JARPN II is to contribute to improved understanding of trophic interactions in the marine ecosystem, and thereby contribute to the development of a holistic ecological management approach for the conservation and sustainable use of marine living resources in the western North Pacific, in particular within Japan's EEZ. JARPN II responds to FAO requests for development of ecosystem approaches to the management of marine living resources (FAO, 1999), and for studies on the interactions between fisheries and marine mammals in accordance with Paragraph 39 of the 2001 COFI meeting (FAO, 2002). JARPN II is consistent with IWC Resolution 2001-9 in which the Commission unanimously decided to make the study of interactions between whales and fish stocks a matter of priority (SC/54/O2). Other important objectives are: (1) monitoring of concentrations of environmental pollutants in cetaceans and their prey species; and (2) further elucidation of cetacean stock structure.

The proposed research has a broader scope than cetacean research, and therefore also addresses other research needs than those required for the completion of the Comprehensive Assessment (IWC, 1987; 1988). However, for the activities associated with sampling of cetaceans under special permit, the proposal outlines the four sets of information required in IWC Schedule Paragraph 30 (a: objective of the research; b: number, sex and stock of the animals to be taken; c: opportunities for international participation in the research; d: effects of the take on the stock).

The proposed sample sizes for baleen whales are set to provide necessary sample sizes for estimating the prey consumption with good precision (CV = 0.2) following the procedures applied in the Norwegian research programme (Norway, 1990). The sample sizes were estimated as: 150 minke whales from the O Stock and the putative W-Stock (100 whales from sub-areas 7, 8, 9, 12 and 13, and 50 whales from inshore areas of sub-area 7); 50 Bryde's whales from the western North Pacific Stock; and 50 sei whales from the Asian Stock.

With regard to sperm whales, the continuation of a sample of 10 whales from the Western Division, is based on the reason outlined in the proposal for the JARPN II feasibility study.

The sampling of baleen whales will not be selective with regard to size and sex. For Bryde's whales, female/calf pairs will not be sampled, and larger males of sperm whales will be avoided due to technical problems in handling the large animals.

The proposal noted that fluctuations including 'species replacement' have been observed in the research area over the past 100 years (Wada, 1997). These fluctuations are repetitive with periods of 10-20 years. To monitor these processes, the programme will be continued without specifying the duration of the research. However, the research will be comprehensively reviewed every six years by the IWC Scientific Committee and/or other organisations. A report of each cruise will be submitted to the annual meetings of the Committee and to other relevant organisations. A report on the feasibility parts of the research (inshore take of 50 minke whales and take of sperm whales) as well as a recalculation of the required sample size for sei whales will be presented following the completion of two years of the research.

Comments and discussion by the Scientific Committee

Authors of a critique (SC/54/O26) of the JARPN II proposal stated that the experimental design was poor, that the proposal did not give sufficient detail in several areas and that it failed to give either specific hypotheses to be tested or performance measures for evaluating its success. They felt that these general issues were such that the proposal would not be acceptable for review by major national and international scientific funding agencies (for example, the European Commission or the US National Science Foundation).

Further, and important for proposal review, the authors of SC/54/O26 noted that publication of research results in international peer reviewed journals was often an important criteria used in proposal reviews, and JARPA and JARPN had led to relatively few peer reviewed publications.

Pastene noted that many international journals have a policy not to publish papers based on data or samples obtained by lethal sampling of cetaceans, and he asserted that the number of publications resulting from special permit catches in peer reviewed journals may be due to this fact. A small number of publications does not therefore mean a lack of, or shortage of scientific results of high quality from research under special permit.

Rather than scientific research in the original sense of 'scientific' whaling as adopted by the IWC, the authors of SC/54/O26 felt that JARPN II appears to be a long-term whaling operation without an end point. They felt that this research-whaling proposal constitutes a significant change in form over previous use of the provision of research under the Article VIII in not specifying an end point. Further, this research, along with other recent Japanese whaling under special permit, continues what is a significant change in

magnitude over earlier years. Since 1987/88 over 6,000 whales have been taken under special permits, 2.8 times more than all catches under special permits between 1949 and 1987.

The proponents responded that they did not agree that the design was poor, and noted that the performance had been evaluated in the two year feasibility study (see above review). When a feasibility study provides results and data to support continuation of the study, it has performed well. They noted that hypotheses are specified on page 12 of SC/54/O2. They also argued that the proposal fits within the terms of Article VIII of the International Convention for the Regulation of Whaling (ICRW). The research plans have a wide ecological scope, but with regard to the cetacean research part, the proposal has sufficient detail and transparency for an evaluation of objectives, research design, sample sizes, methodology and anticipated results. The sample sizes have been determined by scientific necessity.

The proposal (SC/54/O2) made a clear distinction between its primary objective (feeding ecology and ecosystem studies) and two additional objectives (monitoring of environmental pollutants and elucidating stock structure). Each of these is meant to contribute to the overall goal of the programme, that is to contribute to the conservation and sustainable use of marine living resources, including whales, especially within Japan's EEZ. Some members felt that the proposed annual catch is specified adequately, although the size and sex of the animals cannot be pre-determined due to a random sampling scheme. The question of possible effects of the takes on the whale stocks is addressed, and the possibility for participation by foreign scientists is mentioned. Thus, they felt, the proposal does adequately specify the four sets of information required under paragraph 30 of the Schedule.

Haug, Schweder and Walløe welcomed the proposed research and underlined that this comprehensive research will contribute to understanding the feeding ecology of cetaceans both in the western North Pacific, and in general. They further argued that feeding ecology and the spatial-temporal distribution of cetaceans are linked at three spatial-temporal scales: at the *macro scale* cetaceans migrate seasonally between feeding and breeding grounds; at the *meso scale* cetaceans move over days and weeks in search of preferred local abundance of food; and at the *micro scale*, whales dive and search for food within localised areas. Some members noted that JARPN II is focused on the micro scale; while in their experience to be useful for management it is necessary to understand feeding behaviour at the meso scale. It is also necessary to understand the behaviour of prey species at the meso scale. Thus, they and others felt that the research could be made more useful for management purposes if its focus were changed to some degree.

Walters congratulated Japan on the presentation of its research and proposal to continue this very valuable work, the primary objectives of which are feeding ecology and ecosystem studies. He also made reference to the decision of the FAO Committee on Fisheries (COFI) to endorse work of this type and concurred with the written comments by Víkingsson and Gunnlaugsson. Walters said that this work being undertaken by Japan is of major interest to the small island states in the Eastern Caribbean, which depend primarily on the living resources of the sea to feed their people. As such, he encouraged Japan not to be deterred by criticism whether constructive or otherwise to continue this research, which in time will give a very good understanding of the interactions between cetaceans and fisheries.

Conclusions

Concerns were expressed over the research design and that this research-whaling proposal constitutes a significant change in form over previous use of the provision of research under the Article VIII in not specifying an end point. Other members welcomed the research initiative of JARPN II, noting that it addressed important issues for the western North Pacific as well as in other areas.

In relation to the guidelines 1 through 3, the Committee **agreed** that the proposal contains the four sets of information required under paragraph 30 of the Schedule.

B. Objectives

The relevant guidelines are as follows:

1. Comments on the objectives of the research to be carried out under the proposed scientific permit, including in particular how they might relate to research needs identified by the Scientific Committee (*Rep. int. Whal. Commn* 36:133);
2. The proposed research is intended and structured accordingly to contribute information essential for rational management of the stock (*Rep. int. Whal. Commn* 37:25);
3. Is required for the purposes of management of the species or stock being researched (Resolution 1999-2);
4. The research addresses a question or questions that should be answered in order to conduct the comprehensive assessment or to meet other critically important research needs (*Rep. int. Whal. Commn* 38:27-28);
5. The number, age and sex of whales to be taken are necessary to complete the research and will facilitate the conduct of the comprehensive assessment (*Rep. int. Whal. Commn* 37:25).

Proposal (summary of SC/54/O2)

The overall goal is to contribute to the conservation and sustainable use of marine living resources including whales in the western North Pacific, especially within Japan's EEZ. To meet this goal, three specific objectives were defined:

(1) studies of cetacean feeding ecology and ecosystems;
(2) monitoring of environmental pollutants in cetaceans and in the marine ecosystem;
(3) further elucidation of cetacean population structure.

STUDIES OF CETACEAN FEEDING ECOLOGY AND ECOSYSTEMS

Important research needs to be addressed were to improve the understanding of energy flow through the larger components (estimated as tons biomass) of the higher trophic levels in the ecosystem. Therefore, minke (164 ktons), Bryde's (408 ktons), sei whales (477 ktons) and sperm (1,889 ktons) whales were chosen for the study (SC/54/O2). These four species constitute close to 90% of the total cetacean biomass in the western North Pacific, and JARPN II aims to study the prey preference and prey consumption of these cetaceans.

The final goal of JARPN II is to provide data for building quantitative ecosystem models for the area. Therefore, information on distribution in space and time, biomass and biological information (including migration pattern, age, growth and feeding) of prey species will be needed. Most of the information on the fisheries resources is collected by the National Fisheries Research Institute.

MONITORING OF ENVIRONMENTAL POLLUTANTS IN CETACEANS AND THE ECOSYSTEM

There is concern related to the effects of environmental pollutants on marine resources, especially whale stocks. One important research need for maintaining a healthy marine environment is to monitor levels and trends of environmental pollutants and study exposure and biological effects in predatory organisms within the ecosystem.

FURTHER ELUCIDATION OF CETACEAN POPULATION STRUCTURE

Knowledge of population structure and stock identity is an important need for rational management of whale stocks. Unresolved problems in the research area are the putative existence of a W-stock of minke whales in sub-area 9, the occurrence of J-stock minke whales in sub-area 7, and the identity of minke whales in sub-areas 12 and 13. For Bryde's whales, areas not yet covered should be investigated, such as regions west of 180°.

Comments and discussion by the Scientific Committee

Some members noted that the proposal's three objectives addressed important areas for management and for Committee priorities. The feeding ecology objective addressed the IWC priority of studying the interaction between cetaceans and fisheries (IWC, 2002c), as has been urged by international organisations (i.e. FAO, ICES, NAFO, NAMMCO and IOTC). The pollution related objective was designed to complement the work in POLLUTION 2000+. The population structure objectives for minke and Bryde's whales relate to the development of RMP *Implementations.*

Relative to the feeding ecology objective, some members noted that the management of whales by the IWC under the RMP does not currently employ an ecosystem-based approach; whether it should do so had not been discussed to date. Further, they felt that the difficulties of sampling and modelling the myriad variable and complex trophic relationships involved in the marine ecosystem make it unlikely that the programme (certainly as currently designed) will yield results that would permit the development of a reliable predictive framework for use in any type of management system.

The proponents noted that there is no requirement that research under special permits should be focused on questions related to management using the RMP. Rather, they suggested that the results of JARPN II would be useful to improve management of all marine resources in the North Pacific. Further, they considered the 'myriad of variables and complex trophic relationships' to be a challenge, but not a reason to dismiss the need for research. Rather, the complexity makes the need for JARPN II all the more important as a start to understanding ecosystem relationships. Furthermore, they believed that the proposal used the widely accepted approach of using models to deal with complexity.

While the proposal suggests that cetaceans may be negatively affecting fisheries, some members noted that in addition to the direct effects of whale predation, in the complexity of ecosystems there are several ecological pathways through which whales could benefit fisheries. They noted examples from the eastern North Pacific, (California Current, Gulf of Alaska and the Bering Sea). One was the possible role of cetaceans in feeding on zooplankton allowing higher phytoplankton densities, which studies by Lasker (1975) and many others have shown are critical for larval fish first feeding and survival. Another was the possible role of cetaceans in feeding on larger fish, thereby reducing the effect of both their cannibalism and predation on younger fish. A further role of cetaceans is recyclers of carbon and nutrients within the ecosystem, contributing to the phytoplankton production and the microbial loop. Such trophic linkages illustrate the complex 'bottom-up' and 'top-down' influence of top predators, such as whales, on the structure and function of ecosystems. The assumption implicit within the JARPN II proposal that the removal of whales will enhance fisheries production does not begin to address the complexities of the complete role of whales and other top predators in the structure, function and productivity of ecosystems. Unless such complexity is addressed within models, their function as a management tool for fisheries is misapplied.

The proponents replied that Lasker's critical period theory (Lasker, 1975) has been shown not to be the case in the western North Pacific (the research area of JARPN II) by studies of Watanabe *et al.,* (1995) documenting that the recruitment of pelagic fishes such as Japanese pilchard is determined after fish reach the juvenile stage. The proponents also stressed that the predation of cetaceans will affect both recruitment of fish and natural mortality after recruited. Therefore the effect of cetacean predation is more direct. The phenomenon that fish are cannibalistic on their own eggs may be unique in the up-welling waters off California and Peru as referred to. In the western North Pacific, fish predation is concentrated on copepods (for Japanese anchovy) and on krill (for Pacific saury).

Others, while agreeing that the relationships are complex, gave further examples of ecological pathways where the effects of cetaceans may be different, noting that all pathways in the system must be considered because it works as a whole. Another example was given, that of walleye pollock in the western North Pacific, where high adult biomass was known to reduce recruitment, suggesting that cetacean predation on the adult of this species could benefit not hinder fisheries productivity.

The proponents replied that studies of complicated marine ecosystems are being conducted in the western North Pacific. One approach is the 'bottom-up' type ecosystem approach (mostly project type), which starts from oceanographic condition, phytoplankton, zooplankton and fish. These studies are appropriate to examine long-term environmental changes such as the 'Regime Shift' in the North Pacific, but answers concerning competition between cetaceans and fisheries could not be derived from these studies. The proponents stressed that 'top-down' approaches are required to elucidate the latter problems. JARPN II is a 'top-down' type ecosystem study. Some members argued that JARPN II is pursuing direct competition between cetacean and fishery resources disregarding that: (1) much information has already been collected; (2) much of the prey of cetaceans is not consumed by humans; (3) fish, not whales, are the major predators of other fish; and (4) human overfishing (rather than whales) is largely responsible for the depletion of fish stocks in the North Pacific and elsewhere (Pitcher, 2001).

The proponents of the proposal replied that: (1) much of the existing data is only qualitative and insufficient for modelling purposes; (2) feasibility results show that much of the prey consumed by whales is comprised of species targeted by fisheries for human consumption (walleye pollock, Pacific saury, common squids); (3) that because fish prey on fish it is important to understand not only direct relationships between cetaceans and fisheries resources, but also prey-predator relationships of other species in order to develop ecosystem models; and (4) the fact that overfishing is the primary cause of depletion of fish stocks is not an argument against the conduct of the research since it implies the need for better fisheries management.

The authors of SC/54/O26 replied that this response missed the major point of their argument. The major premise of the JARPN II programme is that cetaceans are the main cause of fishery problems. The points they made above (fish being the major predators of fish, and human over-exploitation of fish stocks being the major reason for

their decline) *invalidate* this premise. They continued that no one would dispute that better fisheries management is required; however, this should not be management that ignores the real causes of fish stock declines and is based instead upon the culling of cetaceans. The proponents responded that this was an inaccurate characterisation of both the premise of the JARPN II programme and the proponents' views concerning the need for improved fisheries management.

Some members noted that while the sample sizes for minke, Bryde's and sei whales appear appropriate, given the at least six-year timeframe, the sample size for sperm whales is lower than can be expected to give statistically significant results. Some members also noted that there was no mention of using historic data, market samples and bycatch samples to resolve questions of seasonality of presence of the J-stock of minke whales. Proponents noted that historical samples have been used previously (Goto *et al.*, 2000), although sample sizes are small in many cases. Market samples cannot be used because localities and dates of catches are unknown. The proponents argued that bycaught whales are not useful to study feeding habits because their stomach contents represent the fish caught by the net.

Further specifications were requested to examine how the sample sizes were calculated and established to adequately answer the questions identified for the completion of the research. The proponents responded that for JARPN II, required sample size of common minke whales, Bryde's whales and sei whales in sub-areas 7, 8 and 9 were re-examined based on the results of JARPN between 1994 and 1999 as well as the feasibility study of JARPN II in 2000 and 2001. In addition, the data of past commercial whaling was used for calculation of the sample size of sei whales. The method used was the same as that applied in North Atlantic minke whales (Norway, 1990). The purpose of these statistical examinations is to estimate the prey consumption by minke, Bryde's and sei whales with appropriate accuracy (CV = 0.2) in the period of the year in which the survey is conducted.

Conclusions

In relation to the guidelines 1-4, some members argued that the feeding ecology objective is both relevant to the interests of the IWC, and that it addresses other critically important research needs. Others argued that the assumptions inherent in the proposal about that objective were too simple, and unduly emphasised direct negative effects of cetacean predation over the balance of the several potentially negative and positive effects of fishery resources and cetaceans on each other. Therefore, they concluded that the objective as structured and proposed is not relevant to the interests of the IWC.

Some members pointed out that while the Committee has identified pollution as a priority issue, the pollution-related objective does not relate to the specific goals of the POLLUTION 2000+ project. The proponents argued that the proposal aims to address wider goals than that, including long term monitoring of levels. The Committee **agreed** that this objective is relevant to the interests of the IWC.

The stock structure objective addresses those species for which an RMP *Implementation* is under development. The Committee **agreed** that this objective is relevant to the interests of the IWC. However, some members contended that, because of sampling design, the JARPN II programme would not yield results that would adequately meet this objective, and disagreed that lethal sampling was required. Other members disagreed with these statements.

C. Methodology

The relevant guidelines are as follows:

1. Comments on the methodology of the proposed research and an evaluation of the likelihood that the methodology will lead to achievement of the scientific objectives. These comments may also include evaluation of the methodology in terms of current scientific knowledge (*Rep. int. Whal. Commn* 36:133);
2. The objectives of the research are not practically and scientifically feasible through non-lethal research techniques (*Rep. int. Whal. Commn* 37:25);
3. … whether the information sought could be obtained by non-lethal means (Resolution 1999-2);
4. The research addresses a question or questions that cannot be answered by analysis of existing data and/or use of non-lethal research techniques (*Rep. int. Whal. Commn* 38:27-28);
5. Whales will be killed in a manner consistent with the provisions of Section III of the Schedule, due regard being had to whether there are compelling scientific reasons to the contrary (*Rep. int. Whal. Commn* 37:25);
6. The research is likely to yield results leading to reliable answers to the questions being addressed (*Rep. int. Whal. Commn* 38:27-28).

Proposal (summary of SC/54/O2)

Research methods, including the establishment of survey tracklines, follow those of the two-year feasibility study of JARPN II conducted in 2000 and 2001 (Fujise *et al.*, 2001; SC/54/O16; SC/54/O17). A zigzag survey track line was established to take into consideration the need: (1) to randomly cover the survey area; (2) to obtain a wide area of coverage; (3) whale migration patterns; and (4) vessel logistics including cost. Major changes in the full-scale research are: (1) the addition of 50 minke whales taken by small-type whaling catcher boats; (2) the inclusion of 50 sei whales; (3) an eastward extension; and (4) stratification of the research area for the feeding ecology and ecosystem studies (see fig. 2 of SC/54/O2).

No selection will be made as to sex and size in the sampling except for bull sperm whales that are too heavy to lift onto the *Nisshin Maru* (over 10m of body length) and the Bryde's whale cow/calf pairs that will not be sampled. The sampled whales are measured in the same way as in JARPN.

Whales sampled under special permit will be killed in a quick and effective manner by means of explosive harpoons consistent with the provisions of Section III of the Schedule. When whales are not killed instantaneously by the primary killing method, an appropriate secondary method will be chosen according to the species and condition. For minke whales, a large calibre rifle will be used; for Bryde's, sei and sperm whales a large calibre rifle or a second explosive harpoon will be used if necessary.

All sampled whales will be processed in accordance with Article VIII (2) of the ICRW. Tissues will be taken and DNA data be registered for individual identification and market control.

FEEDING ECOLOGY AND ECOSYSTEM STUDIES

Stomach contents of sampled whales will be examined for number, weight and body size by prey species (Haug *et al.*, 1995). For fully digested prey, hard tissues (otoliths and squid beaks) will be used for species identification and body size estimations.

Concurrent prey species studies will be conducted by acoustic recording of prey species abundance and horizontal and vertical distribution. Echo recordings will be verified using mid-water trawl, drift nets and hand jigs. The catches will be sorted by species and weighed. At each operation, about 100 individuals of the main species will be selected at

random and measured to the nearest cm, while 10 individuals will be collected for further biological measurements including stomach contents.

Prey consumption by cetaceans will be estimated using two methods: (1) based on energy content of prey and standard metabolism (e.g. Lockyer, 1981; Folkow *et al.*, 2000; Watanabe *et al.*, 2000); and (2) based on temporal changes of the weight of stomach contents in a day (Bushuev, 1986; Tamura *et al.*, 1997; Tamura and Fujise, 2000). Seasonal consumption of each prey species by whales will be estimated from consumption per day, composition of prey species and the number of whales in the area.

Cetacean prey preference will be estimated by comparing the prey composition in stomachs of whales and prey abundance in the environment based on the concurrent whale and prey surveys in a narrow area (Lindstrøm and Haug, 2001). Two indices will be used to express the prey preference: the relative frequency of occurrence by number, and the individual number index (Lindstrøm *et al.*, 1998).

MONITORING OF ENVIRONMENTAL POLLUTANTS IN CETACEANS AND THE ECOSYSTEM

Samples of blubber, liver, kidney, muscle, other tissues and blood from each sampled whale, and some prey species from stomach contents and trawl surveys will be collected and analysed for pollutants. Concentrations of contaminants in organisms at lower trophic levels, sea water and air will also be analysed. Chemicals to be analysed include the heavy metals, organochlorines (PCBs, DDTs, HCHs, HCB and CHLs) and dioxin related compounds (PCDDs, PCDFs and coplanar PCBs) (Honda *et al.*, 1982; Iwata *et al.*, 1993; Tanabe *et al.*, 1994; Aono *et al.*, 1997; Kang *et al.*, 1997; Tanabe, 1998). Sex hormones, P450, AH receptor and other 'biomarkers' will be analysed (e.g. Saito *et al.*, 1986; Subramanian *et al.*, 1987).

STOCK STRUCTURE

Studies of stock structure will follow the methods outlined for JARPA. Samples from all sampled whales and biopsy samples will be analysed for genetic variations using allozymes, mtDNA sequencing of control region and microsatellites (Wada and Numachi, 1991; Goto and Pastene, 2000; Goto *et al.*, 2001).

To address O-stock versus W-stock issues data will be analysed following the recommendation from the Scientific Committee that all J-stock whales should be removed for all comparisons (IWC, 2002d, p.98). Mixing rate between O- and J-stocks in sub-area 7 will be estimated by two methods: (1) the maximum-likelihood method (Kishino *et al.*, 1994; Pastene *et al.*, 1998) based on allele/haplotype frequencies obtained from the genetic markers; and (2) individual assignment using mtDNA sequencing profiles complemented with other independent biological and ecological markers. If the putative W stock is confirmed in offshore areas, the mixing rate between O- and W-stocks will also be examined using genetic markers.

Comments and discussion by the Scientific Committee

FEEDING ECOLOGY AND ECOSYSTEM STUDIES

Some members felt that the ecological methodology proposed to be used was sound and that the methods proposed are those most likely to meet the objective. They argued that direct examination of stomach contents from lethal samples is preferable to biochemical analysis of tissue samples, such as fatty acid and isotope analyses. The latter methods cannot provide as detailed a picture of the diet (including individual species identification, segment of prey, or seasonal and regional variation). Further, stomach samples allow the simultaneous comparison with fishery survey results.

Other members noted that if this objective is to be pursued, the methods proposed to be used are not the best ones. Some noted that there were promising non-lethal methods that would yield more reliable results. They felt, for example, that stable isotope analysis of biopsy tissue would provide a long-term signal of diet, and its variation in time. This was more useful than stomach analysis, which provides only a snapshot view of recently consumed prey that can be a misleading indicator of overall diet, especially for species like minke whales with a large variation in prey species over space and time.

The proponents pointed out that as noted, the advantage of stable isotope and fatty acid analysis is to provide a long-term signal of diet, but that this method can only elucidate the trophic level of prey on average. However, it cannot identify species nor which segments of the populations are being consumed. Further, these methods cannot provide any resolution in space and time. This is important since there is seasonal and geographical change of prey of minke whales and Bryde's whales in the research area. This means that Japanese anchovy, and Pacific saury and lantern fish would be treated as one group. This is the most important reason to use stomach content analysis that will provide long-term information on the variation of prey.

Based on Norwegian experience with minke whale feeding ecology, the stomach evacuation method was problematic. For this method to be used successfully, the rate of emptying the forestomach, where samples are proposed to be collected in order to minimise the variability in results due to the variable rates of digestion, must be determined. Gales noted that several factors affect the rates of digestion, which begins in the forestomach and continues throughout the complex gastrointestinal tract. Some factors relate to variations in the behaviour of the cetacean itself (e.g. level of activity, meal size, method of passing indigestible parts). Other factors relate to the nature of the prey (e.g. taxa, size, energy content, relative digestibility, presence of relatively indigestible hard parts). These factors result in various biases in calculations based on prey remains in stomachs. Some members felt that the proposal did not adequately address how these methodological issues would be addressed, thus making the utility of the results uncertain. However, Tamura responded that the research method will be forestomach samples, where digestion begins, and that this will allow quantitative reconstruction of prey species composition.

The second statistical method of estimating prey consumption used in the Norwegian studies of minke whales, involving scaling prey species composition from stomach contents according to the energy requirements of the animal, was regarded as more useful. Gales noted, however, that current estimates of metabolic rates of other baleen whales are extrapolations, based on volume to surface area ratios and on food intake. These estimates must be regarded as indicative only. The risk of inaccuracy is high, and they fail to completely consider the effects of season and diurnal activity patterns.

Tamura stated that it is possible to raise the reliability of predation rate estimates by combining methods of stomach evacuation and field metabolism.

Víkingsson believed that the calculations in appendix 2 of SC/54/O2, which divides the total consumption into prey composition by species, are premature at present but that the proposed research is likely to strengthen the basis for such

calculations. He agreed that there are many problems of interpretation associated with the stomach content analysis. Some of these can be accounted for by taking into account different digestibility of prey and by comparison with a sub-sample containing only fresh prey. Problems associated with digestibility increase when sampling is conducted further along the digestive tract. It is generally recognised that analysis of diet based on scats is less precise than that of stomach contents. On top of that, sampling of faeces in the sea creates various additional problems associated with representativeness of the samples, for example due to limited knowledge of defecation behaviour of whales and of different sinking rates of particles in the sea.

It was also pointed out that one difficulty with analysis of stomach contents, both directly and biochemically, is distinguishing which items are actually from the stomachs of the animals directly preyed upon, that is prey of prey.

Tamura noted that the prey of prey cannot be detected from other methods either e.g. faeces samples (see below). Tynan stated that in studies of smaller organisms such as plankton species, oceanographers had developed sophisticated opening and closing nets.

New methods were described that have been (fatty acid and stable isotope) and are being developed (genetic analysis) to determine prey composition that can be applied not only to non-lethal tissue samples but also to faecal samples. These methods vary in their degree of specificity, with some allowing only general trophic level or general prey taxa, while one new genetic method (SC/54/O7) allows identification of the krill component of diet. Developers of that method feel that it is likely to soon be capable of species level identification of all components of the diet. Kato noted that while faeces can be collected for some species, this is very difficult for sei, Bryde's and minke whales.

The proponents noted that non-lethal methods are problematic. Problems include the inability to identify prey of prey species, and that daily prey consumption cannot be calculated. Further, there may be problems with some of these methods for detecting very small otoliths from prey species such as Japanese anchovy. Some members noted that the advantages and disadvantages of various methods for determining the diet composition of marine mammals have already been discussed and summarised at a NAMMCO workshop held in Norway in September, 2001. They also noted that methods of stable isotopes and fatty acids will be used in conjunction with stomach sampling in JARPN II.

Cooke noted that estimation of prey consumption using the stomach evacuation method required diurnally distributed sampling in order to reliably determine how long food remained in the forestomach, but this was not envisaged for JARPN II. The alternative method, of scaling up relative diet composition to an estimate of absolute food consumption based on total energy requirement, was problematic when using data from only a limited season. Because whales can store energy, their average total energy requirements are a poor guide to the amount of energy assimilated over a limited season.

Relative to the diurnal issue, the proponents plan to conduct laboratory studies to estimate digestion rates of stomach contents. Further, they responded that there are no data on night feeding of either minke or Bryde's whales. Relative to the seasonal issue, they agreed that the seasonal limitations of the proposed research make determining annual rates difficult, but noted that their purpose is to estimate the prey consumption during the research period. The research period will be extended to early spring and late autumn to cover most of the feeding season.

Some members noted that the method of determining prey preferences was problematic. The method essentially involves comparison of prey observed in stomach content samples to the existence of potential prey, determined by echolocation and trawl samples in the region of feeding whales. The inference to be drawn here is indirect at best, and assumes that other factors such as patchiness of prey density do not affect what a whale chooses to prey on at that particular time. Uncertainties in prey preference are a critical component in understanding the overall feeding patterns of whales.

The proponents stated that preference at an individual level is important in feeding ecology, but in JARPN II, the focus is put on the prey preference of cetaceans for the group as an input parameter to the ecosystem models (SC/54/O17). In most of the ecosystem models, the population models for each fish and marine mammal are integrated with the prey and predator interactions. Prey and predator interactions are defined with several factors: abundance of predators, days staying in the area, daily rations and diet compositions. Diet compositions could be estimated directly from the stomach contents. Diet compositions would be affected by the biomass of each prey, distributional overlaps with predator and prey, and prey preference of predator. Therefore prey preference in the ecosystem model should be an effective parameter to adjust for the difference between diet composition in the stomach and prey composition in the sea, with reflecting the distributional overlap. As the target area is stratified in most of the ecosystem models to express the distribution pattern and migration, distributional overlap will be considered on a stratum basis. Thus, the concurrent whale and prey surveys conducted in JARPN II are at an adequate spatio-temporal scale to estimate prey preference for the ecosystem model.

Some members noted that the sei whale is known to primarily prey on copepods, and that the proposal fails to cite the work of Nemoto and Kawamura (1977) who analysed over 21,000 sei whale stomachs. Those authors showed that only 3.4% of those stomachs included fish while 82% included copepods. The new samples would add little to that wealth of information.

The proponents noted that Nemoto and Kawamura (1977) examined samples collected between 1952 and 1971 between latitude 33º and 55º N, and that the conclusions there about copepod consumption pertained to the Bering Sea and near the Aleutian Islands. This research area is totally different from the JARPN II research area, and the 50 whales proposed will add significant new information. Those authors also reported that sei whales in the southern western Pacific Ocean and those from around Japan eat mainly fish, not copepods. This latter conclusion was also supported by earlier work by Mizue (1951) and Kawamura (1973), who noted that sei whales consumed anchovies, Japanese sardines, mackerel, Pacific saury and common squid in that region. Thus the diet of this species varies regionally. In addition, those studies were more than 30 years old and therefore difficult to incorporate into ecosystem models, as many aspects of the ecosystem are likely to have changed over that period.

Some members noted that it is widely recognised that sperm whales feed on deep-water squid, as the proposal acknowledges, and that this is based on examination of a large number of the stomachs of the more than 400,000 taken in the Southern Hemisphere in the 20th century. The proponents noted that the feasibility study demonstrated that sperm whales also take pelagic zone squid as well as fish, as described in appendix 3 of SC/54/O17. However, Best raised

a question about the interpretation of those results. He said that those results indicated that the pelagic species listed as the most important was only found in one whale, and although this species comprised 95% of the stomach contents by weight, it was likely represented by as few as six individuals. Thus he concluded that there is little evidence for sperm whales consuming other than deep-water squid. The proponents noted that other species listed in appendix 3 of SC/47/O17 indicated with a * and ** symbols were also pelagic. Best raised the possibility that these may be prey of prey. Tamura responded that they did not use separated beaks and thus the results do not include the prey of prey.

Some members noted that the ability of Ecopath and Ecosim to take account of biological interactions is dependent on the accuracy of the input data for all species in the ecosystem as well as the validity of the assumptions of modelling technique. Although JARPN II proposes to use an ecosystem framework to examine these biological interactions, little or no information is given in the proposal on the input data beyond cetacean species. Only limited information is presented on the concurrent prey and no information is presented on phytoplankton, zooplankton (beyond krill), benthic species, detritus and fish/squid species not covered by the prey surveys (such as deep water species). Although sensitivity analyses may determine that certain species are less important for exploring specific questions, such analyses have not been presented here, and these lacuna are fatal to this proposal's credibility.

The proponents responded that historical data on the catch statistics and resource surveys are available. For example, a drift net survey targeting flying squid has been conducted for more than 10 years along the longitudinal line 155°E. These data can be used to estimate 'vulnerability'. On the other hand, the concurrent prey survey in JARPN II is specifically designed to acquire local prey abundance to estimate the prey preference of cetaceans. National fisheries research institutes have conducted extensive fishery resource surveys covering a wide area to estimate the stock abundance. Both resource survey and JARPN II data will be used in the model. Sensitivity analyses and other work are being conducted for Ecopath with Ecosim using data from JARPN II. Certainly some species are less important in the model. However, they are still included because the results are preliminary ones and additional data are being collected.

Some concerns were expressed concerning the absence of specifying a time step for the models, the need for winter sampling to meet the usual annual averaging approach used in Ecopath/Ecosim applications, how to apply this model to systems with migratory species, and lack of information of residence time of the migratory species. Further, the proposal fails to provide details of how fisheries in the region, the recent decline of fish stocks, and the implied lack of mass-balance are to be handled in the modelling process.

The proponents stated that one of the weak points of Ecopath with Ecosim may be using a yearly time step. It is desirable to conduct winter sampling but data from spring/summer/autumn have higher priority at present. The same can be said regarding the treatment of migration. Ecopath with Ecosim is being spatially extended as Ecospace now. Also the information on migration and residence time is incorporated in the Multspec model, while it makes the input data enormous. The merits of both Ecopath and Multspec models are being explored and an integrated model will be built in the future. Information on fisheries is incorporated in both Ecopath with Ecosim and Multspec models in different ways. Since Japan has the necessary data and is the biggest fishing country in the western North Pacific and since catch and bycatch data are also collected in other countries such as Russia, Korea and China, there is no serious problem on this point.

Norwegian scientists noted that based on their experience, stomach evacuation methods are difficult to use for minke whales, and possibly for other cetacean species. In contrast, the metabolic rates of minke whales are well understood. Using this approach, however, requires large scale (macro to meso scale) information about the resource base, abundance as well as spatio-temporal distribution throughout the year. The proposal does not identify the degree to which this information is available in Japanese waters. Other members agreed that stomach sampling provides only micro-scale information, whereas the energetic requirements approach requires sampling over the entire feeding season while the proposed sampling covers only a portion of that period.

It was noted that one approach to obtain better spatial and temporal coverage was using satellite tagging. The results of a large scale tagging experiment (with parallel biopsy sampling) would be a highly valuable non-lethal component of the research programme. Tynan agreed, and suggested that combining these approaches with telemetric measurements of dive patterns would be valuable.

The proponents noted that three National Fisheries Research Institutes are responsible for resource monitoring and stock assessment for seven fishery resources, including saury, walleye Pollock and common squid. A large amount of data and information including historical aspects are provided to the JARPN II programme. The proponents are making an effort to develop satellite tagging methods. They also described changes in Japanese fisheries management.

Some members noted that models such as Ecopath, Ecosim and Multspec have not yet been used for management (Aydin and Friday, 2001). They noted that although the culling of cetaceans may free biomass for use by other species, the ability of such models to accurately predict which species in the ecosystem will benefit from this freed biomass, and the magnitude of any increase in commercial fish biomass, is unknown. Further, preliminary studies of simplified food-web models indicate that there is considerable uncertainty in the response even when climate variability is ignored. One major uncertainty that determines much of this behaviour is the required 'vulnerability' parameter, which controls the degree to which trophic relationships are bottom-up or top-down controlled.

Norwegian scientists noted that contrary to what is asserted above, the original version of Multspec, which addressed only fish-to-fish interactions, has been used in the process of fisheries management of cod, herring and capelin in the Barents Sea. They explained that the catch limit for capelin is computed by first using Multspec to estimate the expected mortality of capelin due to cod predation in the presence of herring and other food items for cod. If that mortality leaves capelin above a threshold level otherwise determined, the difference is allowed as a fishery harvest. The capelin-cod interaction is modelled through the use of empirically determined spatial-temporal distributions and the diet preferences and consumption rates for cod. They noted that the fishery resource survey requirements for determining these inputs are substantial.

The likely ability of research programmes such as that proposed and the earlier study by Norway to meet their objectives was suggested to be a function of the proportion of the mortality due to all top predators that is caused by cetaceans. In a model with cod, herring, capelin and minke whales, with mortality of fish due to harp seals and other

predators left as residual mortality, the abundance of minke whales was found to significantly influence the continuing catch of cod (more whales, less cod caught) indicating that minke whales contribute a large proportion of the total mortality (Schweder *et al.*, 2000). Haug suggested that the consumption by minke whales was about half that of harp seals.

Kawahara referred to historical variations in fish abundance, and suggested that the effect of cetacean predation may vary with the variation in relative abundance of the respective fish species. Okamura reported verbally on some preliminary Ecopath simulation studies that considered a much larger number of both cetaceans (six species) and fish (five species) top predators. Pinnipeds were regarded not important in the study area. Okamura further noted that given the many assumptions involved, total mortality due to cetaceans exceeded that due to other species by two to one. The authors of SC/54/O26 noted that the cetacean consumption estimates have not been reviewed, and questioned the validity of these statements.

MONITORING OF ENVIRONMENTAL POLLUTANTS IN CETACEANS AND THE ECOSYSTEM

The argument was raised that a range of the questions of relevance to the pollution objective could be addressed by non-lethal sampling. Other members were concerned that biopsy samples are restricted to skin and outermost part of the blubber, and that the limited control over the sampling site would compromise the utility of samples collected in that manner. Further, lethal samples allow collection of supplementary information, although there was no consensus on the requirement of such lethal sampling.

STOCK STRUCTURE

The most serious criticisms from some members were raised regarding stock structure objectives for minke and Bryde's whales. It was noted that only 16 and 29 samples were taken to address the O/W stock question, which remains a major source of uncertainty in *Implementation Simulation Trials*. This sample size is completely inadequate to make progress on reducing this uncertainty. Proponents replied that JARPN II is not designed to optimally determine stock structure, and therefore gives only low priority to this objective. However in these two surveys 1,190.6 n. miles and 5,776.9 n.miles of searching effort were covered in sub-area 9, and bad weather prevented the collection of more samples. Samples are obtained through systematic surveys.

It was further noted that the proposal made no mention of designing experiments to avoid further takes of J-stock animals, although the stock status remains unknown and incidental bycatch mortalities remain high. Further, no mention is made that with respect to obtaining further data on the mixing rate of J-stock into sub-areas 7 and 11, there are substantial historical samples and samples from current bycatch that should be analysed and published before further catches are allowed. The proponents responded that there is no plan to sample minke whales in sub-area 11. Regarding sub-area 7, the observed mixing rate of J-stock animals is low in this area and changes by month. The Seattle Workshop (SC/54/Rep1) agreed that the data to be used to condition the simulations would be based on a mixed stock analysis of the data for sub-area 7, pooled over both month and sex. It was agreed that the *Implementation Simulation Trials* include a value for mixing rate of J-stock of 2.8% for this sub-area (SC/54/Rep1). Therefore they estimate the take of J-stock animals will be only less than 3% on average.

Historical samples of minke whales in sub-areas 7 and 11 have been already examined by mtDNA and microsatellite (Goto *et al.*, 2000). Bycatch samples have been and will be analysed for stock identification, but these samples cannot be directly used for mixing rate calculations because of the lack of representativeness.

The authors of SC/54/O26 noted that the proposal identified 'weak genetic differences' for Bryde's whales, but it does not give any details. SC/54/O17, appendix 10, table 4 compares JARPN II ($n = 84$) to samples from the coastal waters off Ogasawara ($n = 103$), and shows a χ^2 p-value of 0.02. This is not 'weak' evidence. Other comparisons to the central North Pacific ($n = 95$) showed non-significant differences, but no statistical power calculations are given and the sample sizes are low compared to those for minke whales. Further, concerns were raised that Ogasawara was proposed as a future site for scientific whaling despite the uncertainties about stock structure and considering the past heavy commercial harvest that occurred several times in this region.

The proponents noted that the expression 'weak genetic differences' should be interpreted in a wider context because examination of genetic heterogeneity among localities was made using different genetic markers and different statistical methods. Only one of a large number of comparisons was significant. Further, the data being compared were collected about 20 years apart and any differences could be temporal rather than spatial. The proponents stated that there is no plan to sample around Ogasawara Island.

The proponents also noted that methods for appropriate statistical power calculations are still under discussion. Further, the other biological and mark-recapture studies are consistent with the genetic results, as they provide no evidence for the occurrence of additional stock structure in the western North Pacific. They also noted that Bryde's whales do not remain in this area year-round and that the Committee's Comprehensive Assessment did not agree that there is an independent stock around Ogasawara Island (IWC, 1996).

In addition to these specific points, several general points were raised. Some members noted that samples for genetic analysis of stock structure should be obtained from biopsy tissue samples (not lethal sampling); such sampling is routinely conducted elsewhere in the world. The proponents responded that such sampling would require a large sampling effort, and that lethal random sampling as planned in this programme has the advantage of combining genetic and non-genetic methods.

The authors of SC/54/O26 also pointed out as a general criticism that in every case where population structure has been found, genetic data alone were sufficient to make the case. In cases where major uncertainties remained, such as for pelagic North Pacific minke whales, JARPN II will not resolve those uncertainties because it is not designed to optimally determine stock structure for use in RMP *Implementations*. Specifically, there are no plans to sample on the breeding grounds (as is recommended every year) or the wider feeding grounds, but rather sampling will continue on migration or in only small parts of the feeding grounds.

The proponents argued that the above criticism does not take account of priorities among the research objectives. JARPN II places lower priority on stock structure studies and therefore is not intended to be optimally designed for this purpose. Further, they felt that stock structure should be studied in the migration corridor as well as on the breeding and feeding grounds, even if interpretation is difficult, because mixing among stocks in this area is very important.

They also noted that they have conducted non-lethal research in the low latitude areas to clarify breeding grounds for large cetaceans and that the results have been inconclusive for minke whales.

Finally, the authors of SC/54/O26 noted that extensive samples are available from historical commercial catches and no mention is made of mapping where remaining samples come from, or analysing those samples to allow for a more modern assessment of population structure prior to further whaling. The proponents responded that most of the historical samples had been analysed for the assessment of stock structure. However, further scientific permit sampling is needed mainly for the objective of feeding ecology and ecosystem modelling.

Conclusions

In summary, several members argued that a range of questions of relevance to all identified research objectives could be addressed by non-lethal sampling techniques, e.g. for pollutant monitoring (biopsy sampling for fatty acid and stable isotope analysis), for stock structure (photo identification, biopsy sampling and faecal sampling), and for feeding ecology (faecal sampling).

The proponents argued that lethal sampling was necessary to meet the research objectives, especially for feeding ecology and pollution. Quantitative data on prey are required for modelling purposes. At present, non-lethal sampling techniques are inadequate for this purpose. Others noted that they did not agree that the feeding ecology objective was appropriate, and therefore did not feel that lethal sampling was required. For the stock structure objective, they argued, non-lethal biopsy sampling would allow much larger sample sizes and hence allow greater statistical power.

The proponents argued that the performance of the RMP depends on the accuracy of the reproduction curve, and lethal sampling allows data on biological parameters that are difficult to obtain without lethal methods. Further, data on morphology, and external and internal parasites are essential for stock identification. Further, stock structure work is mainly focused on minke whales, where biopsy sampling is difficult in the open sea. Finally, highest priority is given for feeding ecology studies, where lethal sampling to obtain stomach and other samples is required. However, non-lethal sampling techniques (biopsy sampling for fatty acid and stable isotope analysis) will also be used.

It was asserted that it was not the case that the performance of the RMP depends on the accuracy of the 'reproduction curve'.

Relative to guidelines (1) and (6), some members felt that the experimental design and methods to be used were inadequate to meet the proposal's objectives. Others felt that the proposed research would allow the highest priority objective, feeding ecology, to be addressed adequately.

Relative to guidelines (2)-(4), some members felt that non-lethal means could be used for all aspects of the proposed research. Others felt that this was true for parts of the lower priority objectives of pollution and stock structure, but not for the first priority objective.

Relative to guideline (5) the Scientific Committee noted that should whales be killed under this proposal, the proposal describes methods for killing in a manner consistent with the provision of Section III of the Schedule.

D. Effect of catches on the 'stock'

The relevant guidelines are:

(1) A review of the most recent information on the stock or stocks concerned, including information on any exploitation, stock analysis and recommendations by the Scientific Committee to date (including, where appropriate, alternative analyses and conclusions and point of controversy) (*Rep. int. Whal. Commn* 36:p.133);

(2) An evaluation of the specification in the permit proposal of 'possible effect on conservation of the stock'. As appropriate, the Scientific Committee may carry out its own analysis of the possible effects (*Rep. int. Whal. Commn* 36:133);

(3) The research can be conducted without adversely affecting the overall status and trends of the stock in question or the success of the comprehensive assessment of such stocks (*Rep. int. Whal. Commn* 37:27-28).

Proposal (summary of SC/54/O2)

A total of 150 minke whales will be sampled annually, assuming 90 from sub-areas 7 and 30 from each of the sub-areas 8 and 9. Incidental catches (IWC, 2001c) are taken into account when the effects of stock are estimated using HITTER simulations. Two scenarios are used for the O-stock: (1) all whales from sub-areas 7, 8, 9, 11 and 12 are from the O-stock; (2) all whales from sub-areas 7, 8, and 11 are from the O-stock; in sub-areas 9 and 12 the percentages of O-stock are 70% and 81.3%, respectively; the other whales are assumed to be W-stock, see Pastene *et al.* (2002) for explanation. A male sex ratio of 79.2% (based on results from JARPN II, 2000-2001) was assumed for the sampled whales. Incidental takes by sex in sub-areas 2, 7, and 11 are taken into account. The best estimates of total 1+ abundance for the O-stock are 25,591 (5% lower limit 16,894) used in scenario 1, and 20,872 (5% lower limit 13,907) in scenario 2. These estimates are based on specifications of the North Pacific minke whale trials (IWC, 2001e).

HITTER runs were conducted for the two scenarios (using both the best estimate of abundance and the lower 5% limit) and MSYR of 1-5%. All cases examined show that the proposed catches allow the population of mature females to increase over a 30-year period (2002-2032).

For Bryde's whales two scenarios are considered (1: all whales from sub-areas are from one stock; 2: all whales in sub-area 1 are from one stock). Abundance estimates for 1992 (Shimada and Miyashita, 1997) of 21,403 (5% lower limit 15,856) in 1992 is used in scenario 1, and 19,301 (5% lower limit 13,913) for scenario 2. In the HITTER simulations MSYR of 1-6% are used, and the simulations show that the proposed catches allow the population of mature females to increase over a 30-year period (2002-2032) for all cases simulated.

For sei whales, an abundance estimate of 28,369 (CV = 0.405) for 1999 is applied (appendix I of SC/54/O2). A sex ratio of 1:1 is assumed. The HITTER runs show that the proposed catches allow the population of mature females to increase over a 30-year period (2002-2032) for all cases studied.

No calculations were made for the sperm whales. However, an annual take of 10 whales from the Western Division stock was assumed to be below the critical level to affect the stock given the large size of this population.

Comments and discussion by the Scientific Committee

Some members noted that analyses of possible effects based on the HITTER population model reported in appendix 6 of SC/54/O2 for western North Pacific stocks of minke, Bryde's and sei whales, even under the most conservative assumptions considered, showed continued growth of these stocks over the next 30 years under the proposed sample sizes. The results for each species were discussed separately.

MINKE WHALES

Some members referred to the preliminary results of minke whale *Implementation Simulation Trials* presented to the Committee at its last meeting (Allison, 2002, pp.124-5). They judged from those results that the proposed minke whales sample sizes may adversely affect the stock defined for the *Implementation Trials* as that nearest the Pacific coast of Japan (herein referred to as the O-stock). In two example trials that resulted in acceptable levels of final depletion, the average allowed catches were 2.4 and 18.4 animals annually, with even the upper 96th percentiles (17.6 and 34.4) being far lower than the 50 minke whales proposed to be taken.

The proposal proponents responded that the RMP is designed to provide a long-term sustainable harvest quota for commercial operations, and further that the *Implementation* process has not in any case been completed. Also, they noted that another example *Implementation Trial* (C7F) gave higher average annual catch limits (52.9) with 96% percentile of 98.7 animals in sub-area 7 (excluding incidental catch). Further, they argued that research under Special Permit as specified in Article VIII of the Convention has no relation to the RMP. The fundamental principle is that the research catch should not pose a threat to the stock, and they felt that the calculated effect of the research takes given in the proposal has confirmed that this would be the case.

Some members also raised concern about the effect of this whaling operation on the J-stock and the compounding of the level of possible unintentional removals of this stock with the substantial present bycatch, which itself exceeds the example *Implementation* results noted above. These members contended that the status of this J-stock is poor, and they felt strongly that this research under Special Permit could pose a threat to this stock, especially because of the unlimited duration of the study.

They noted that the proposal acknowledges this potential problem by partially mitigating it by restricting the JARPN II sampling in some months in sub-area 11 (April and July). However, 22% and 35% of the minke whales in this area are J-stock animals in June and August respectively. In addition, the mitigation does not include sub-area 7, where 13 and 22% of minke whales are J-stock females in May and August, respectively, and 13% are J-stock in September. They felt that further season-area restrictions are required to avoid a negative impact on the status of J-stock animals.

The proponents pointed out that there is no plan to enter sub-area 11, and noted that the mixing rate of J-stock animals is low and changes by month and year, and therefore the Seattle Workshop agreed (SC/54/Rep1) that the *Implementation Trial* structure includes a value for catch mixing rate of J-stock of 2.8% for sub-area 7, pooled over both month and sex. They conclude that the estimated take of J-stock animals will be less than 3% of the sampled animals, on average, and they feel that this is a negligible effect.

Several members requested that an evaluation of the effect of the research under Special Permit on the J-stock be reported next year if this research is conducted.

BRYDE'S WHALES

Some members thought that, although the HITTER calculations suggest that proposed catches of the Bryde's whale stock should not adversely affect the overall status of the stock, there is strong evidence ($p < 0.02$) for stock differences between Ogasawara and the coast of Japan, as discussed above. This observation is contrary to the suggestion that Ogasawara should be a preferred site for lethal sampling in JARPN II (SC/54/O2). These members felt that targeting whaling around Ogasawara is particularly undesirable because of heavy commercial exploitation in this area during the past and consequently the unknown status of Bryde's whales in that area. The proponents responded that several statistical methods were used in genetic analyses to compare localities in the North Pacific and only one resulted in significant heterogeneity between Ogasawara and JARPN II samples. They stated that there is no plan to sample Bryde's whales around Ogasawara Island.

SEI WHALES

Concerns were raised by some members with the estimate of sei whales of 28,400 used in the model. This figure appears to be based on an unreviewed estimate of 4,909 derived from JARPN 1997 and JARPN II 2001 surveys, with subsequent extrapolation using Japanese Scouting Vessel (JSV) data. They noted that the Committee had previously concluded that estimates of abundance using these types of surveys (e.g. fig. 3, SC/54/O16) does not lead to estimates that are comparable to estimates from dedicated surveys (SC/54/Rep1). They also noted that the Committee has not endorsed abundance estimates based on extrapolations using JSV data. Further, they noted that only selected surveys were used for the 4,909 estimate, specifically those that had the highest encounter rates. Finally, they queried why data from other dedicated vessel surveys that have been used to condition *Implementation Trials* for other species (minke whale) were not also used.

Given these uncertainties and questions, they judged that the estimate of 28,400 is unreliable and unacceptable for use in determining the likely effect of whaling under special permit on the sei whale stock. They concluded that the proposed catches are higher than the coastal catches taken during each of the last three years of the commercial fishery, and that such a high catch level should not have been proposed without new reliable information on which to base an assessment, such as stock structure.

The proponents replied that, in fact, the minke whale abundance estimate for sub-area 9 based on the sighting data from JARPN (Miyashita and Fujise, 1997) is used for the *Implementation Simulation Trials* (SC/54/Rep1). Systematic sighting surveys were conducted in the JARPN research. Furthermore, the program DISTANCE version 3.5 was used to obtain the present abundance estimate in the research area. The characteristics of the JSV data are the consistency in recording of sightings over a long period since the 1960s and the wide area coverage. While it cannot be used for direct abundance estimation because it has no sighting distance data (e.g. radial distance, angle), it is useful as a relative abundance index (Miyashita *et al.*, 1994). Therefore if there is no direct estimate, extrapolation using JSV from the directly estimated area is appropriate. In other words, JSV data can be used for extrapolation. For these reasons the abundance estimate in the survey area is reliable.

Further, the proponents stated that JARPN covered 40-90 days during May to September every year. Sei whales in the JARPN research area were widely distributed in June and July, as is indicated by the World Wide Map of the Cetaceans (Miyashita *et al.*, 1995). Because there was not enough sighting effort in these months except for the years 1997 and 2001, the data for those particular seasons were used for the analysis. The main distribution area of sei whales in summer is the colder waters north of the Arctic convergence. The area was very partially surveyed by the dedicated sighting survey in 1990, which was used in Buckland *et al*. (1992) for minke whales. Furthermore the main survey area in 1990 was the Sea of Okhotsk where sei

whales are rare. Therefore, a reasonable abundance estimate for sei whales was derived from the past dedicated sighting survey.

Noting the concern raised that the HITTER simulation runs were carried out with only a point estimate of abundance for this species, the proponents also provided a summary of some additional HITTER runs based on the lower end of the confidence interval (14,747-54,575) using a newly calculated bootstrap variance of the extrapolated estimate of 28,400 (SC/54/O2, appendix I). These calculations indicated replacement yields in 2002 that varied from 152-720 as MSYR varied from 1-6% (Table 8).

Table 8

The effect on the stock of western Pacific sei whales of taking 50 animals (25 males and 25 females) from 2002 to 2031. Depletion is given for mature female component.

Hit 1999 total (1+) population of 14,747 (5% lower limit)

	MSYR (1+) (%)					
Statistic	1	2	3	4	5	6
K (1+)	49,486	43,433	38,963	35,435	32,508	30,234
Depletion – 1976	17.9%	13.0%	8.7%	5.4%	2.8%	1.5%
Depletion – 2002	27.9%	29.9%	31.4%	32.6%	33.7%	34.8%
Depletion – 2012	30.6%	37.1%	43.8%	50.5%	56.9%	63.0%
Depletion – 2022	33.7%	45.9%	58.7%	70.3%	79.7%	86.2%
Depletion – 2032	37.2%	55.6%	73.2%	85.4%	91.9%	95.0%
RY – 2002	152	297	430	548	646	720
MSY (+1)	297	521	701	850	975	1,088

From these calculations, the proponents concluded that the population would continue to increase under the proposed sample size (assuming equal proportions of males and females in the catches). Based on these calculations and observations of an increasing encounter rate over eight years of surveys, they argued that the stock has recovered and that the proposed sample sizes would not jeopardise the conservation of the stock.

SPERM WHALES

Although no attempt was made to systematically evaluate the possible effects of the take of 10 sperm whales annually, the animals were noted to be a very small proportion of the most recent abundance estimate of 102,112 (Kato and Miyashita, 1998). Some members argued that the abundance estimate given in the proposal is unreliable and likely heavily positively biased because a correction factor used was developed in a study in the Antarctic where the sex and group composition is very different. They felt that this factor, which would increase the abundance estimate, was entirely inappropriate for the study area, where most sightings are of groups of females and young whose surfacing patterns make them much more available for sighting.

The proponents replied that while it is true that the group size and composition is different in the study area, the correction used is appropriate because very frequently the first sighting is a singleton, but during confirmation the other school members aggregate. In addition, additional downward biases of this estimate include lack of sighting effort in the Bering Sea and around the Aleutian Islands, mean school size was based only on primary sightings, and recent recovery in density in coastal waters suggested by the frequent strandings was not reflected in the estimation.

It was also pointed out that Japanese sperm whale catch data was falsified and represents underestimates of the true catch, further adding to the uncertainty of the status of the population. Proponents argued that nonetheless, the proposed catches are a small fraction of the abundance estimate of 102,112, and the sampling of only 10 whales would have a negligible effect on the population.

The authors of SC/54/O26 commented that the annual increase of 11% in the encounter rate given in appendix 1 of SC/54/O2 has not been subject to review, and that it probably does not reflect population growth rate since this rate of growth is biologically impossible for sperm whales. Further, they referred to research by Whitehead *et al*. (1997) suggesting that sperm whale growth rates are actually extremely low in response to catches of mature males and the consequent lack of 'acceptable' mates for females. The proponents replied that increase of the encounter rate by 11% per year was observed based on the dedicated sighting data from 1983-1996 off the northern Pacific coast of Japan where the most important past whaling grounds were located. In the 1980s, the encounter rate in this area was very low, perhaps because of the effect of past whaling. However, in the 1990s, after the introduction of the moratorium on commercial whaling, the encounter rate increased. The most plausible explanation of this increase seems to be that sperm whales expanded their habitat to the coastal area and returned to their original niche as a result of population recovery. This is supported by the recent frequent strandings and sightings by the general public.

Some members noted that the proposal did not mention that two stocks have been described in coastal Japanese waters (Kasuya and Miyashita, 1988), one of which is likely depleted, and that these waters may include nursery schools. Further, the proposal did not mention the possibility of using frozen historical material for stock structure. This material should be used before additional samples are collected.

The proponents replied that stored samples cover only a small portion (eastern side) of sub-area 9, but not sub-areas 7 and 8 where JARPN II surveys are proposed. The two stock hypothesis referred to has not been examined by DNA methods, and additional data including the historical samples will enable testing of the two stock hypothesis. More importantly, the justification for additional catches of sperm whales is not stock structure, but rather the ecosystem component of the research programme.

Conclusions

It was noted that no information was provided on struck but lost whales in the JARPN II feasibility study, and the Scientific Committee advised that this information should be provided for the continued JARPN II research under Special Permit.

In relation to guidelines (1)-(3), some members judged that based on the information in the proposal there was substantial risk of stock depletion from the proposed sample sizes for both the O-stock and the J-stock of common minke whales, as well as for Bryde's whales should they be taken around Ogasawara Island. These members also judged there was no basis for evaluating the effect of catches on sei whales because the sole abundance estimate involves selective use of surveys as well as extrapolations using JSV data, and the lack of information about stock structure made it uncertain how to evaluate the effect of coastal catches relative to an abundance estimate from the western North

Pacific. A similar concern was expressed regarding sperm whales because of an inappropriate dive-time correction of the abundance estimate.

Other members judged that the proposed research samples would not pose a threat to the O- and the J-stocks, and that the perceived risks for minke whales are being overemphasised. Further, there is no risk for Bryde's whales in the Ogasawara area because this species is not resident and not planned to be taken here. Selective use of survey did not occur in the abundance estimation of sei whales. Rather, based on the distribution of the species in June and July, the survey data in 1997 and 2001 were chosen for calculation of an abundance estimate, which was extrapolated with JSV data. As the research area of JARPN II extends from the coastal area to the offshore area, with the latter being especially important for sei whales, the effect of coastal catches is limited. They believed that the abundance estimates for sei and sperm whales are reliable.

E. Research cooperation

The relevant guideline is:

1. Comments on the adequacy and implications of specified arrangements for participation by scientists of other nations (*Rep. int. Whal. Commn* 36:133).

Proposal (summary of SC/54/O2)

Participation of foreign scientists, especially those from neighbouring countries, is welcome, as long as their qualifications meet the requirements set by the Government of Japan.

Comments and discussion and conclusion

Kim understood that the JARPN II programme is intended to contribute to the overall improvement in knowledge and methodology necessary for the management of fisheries resources as well as whales in the western North Pacific. As the research approach to be used in the programme is new and important in this regard, it would be helpful that the programme be introduced to fisheries science societies within the range states in order to encourage and assist in their participation.

In relation to the guideline, the Scientific Committee **agreed** that adequate provisions for participation by scientists from other nations have been made.

17. WHALE SANCTUARIES (ANNEX N)

17.1 Review of the Indian Ocean Sanctuary

At last year's Committee meeting it was noted that the Commission was expecting thorough reviews of the Indian Ocean Sanctuary (IOS) in 2002 and Southern Ocean Sanctuary (SOS) in 2004 (IWC, 2002d, p.67). In addition, it was noted that the Committee has received two proposals for new sanctuaries in recent years. At that time, the Commission had provided limited guidance as to what it expected from the Committee's reviews of sanctuaries, and an intersessional Steering Group was appointed to develop:

(1) a process by which the Committee would complete a review; and
(2) evaluation criteria for the reviews, taking into account the Commission's previous comments and any further advice that might be offered by the Commission.

The review process and evaluation criteria were intended to be used on a trial basis by the Scientific Committee to review the Indian Ocean Sanctuary this year, and if necessary, would be modified and improved in order to review the Southern Ocean Sanctuary (SOS) in 2004.

During the subsequent Commission meeting, a set of 'Instructions from the Commission to the Scientific Committee to Review Sanctuaries and Sanctuary Proposals' was developed (IWC, 2002a). The intersessional Steering Group on Sanctuary Reviews developed a proposed framework to evaluate the effectiveness of the IOS taking the Commission's Instructions into consideration and additional criteria it considered useful during the review process. These latter criteria focused on the evaluation of: (1) whether the objectives of the IOS have been met; and (2) research in the IOS Sanctuary and its relevance to the Comprehensive Assessment of Whale Stocks.

This year, a Working Group was established to review the IOS and its report is given as Annex N. The Working Group was instructed to limit its Terms of Reference to large whales, but some members thought the review should include small cetaceans.

The IOS was established in 1979 but no scientific objectives were stated in the original proposal. In 1987, scientific aspects of the Sanctuary were reviewed and a list of objectives was prepared based on previous discussions of the proposal and the role of the IOS by the Commission and the Committee (Leatherwood and Donovan, 1991). In reviewing these objectives, the Committee **agreed** that whales were protected from commercial whaling in the Indian Ocean since the Sanctuary was established. There was some discussion of whether other listed objectives had been achieved. Some members indicated that the IOS serves no scientific and conservation purposes because it has been made redundant by the moratorium, and by the RMP if the moratorium was lifted. Others noted that neither the moratorium nor the RMP negate the value of sanctuaries as management tools. They also felt that it is becoming apparent that the time required to evaluate the effectiveness of a sanctuary is much longer than might have been anticipated. Some members noted that lack of research in certain areas prevented the IOS from playing a role as a control region relative to areas where whaling has taken place.

In regard to the information available for large whale stocks in the IOS, the Committee **agreed** that:

(1) Progress has been made on some stocks of large whales, namely right whales and humpback whales off South Africa and western Australia, but that this is insufficient for a comprehensive assessment of stocks in the entire IOS.
(2) Studies are underway on some of the other stocks (e.g. Bryde's whales, pygmy blue whales and humpback whales in the Northern Indian Ocean, pygmy blue whales in Australia and in the western Indian Ocean).
(3) Some species, especially Bryde's whales, are hardly studied.
(4) Not all of the research that has occurred in the IOS can be definitively attributed to the formation of the IOS; some felt that there was a strong link between the formation of the IOS and their own research, while others asserted that their own research would have occurred regardless of the formation of the IOS.

In reviewing the effectiveness of the IOS with respect to the Instructions provided by the Commission, it became clear that there was a broad range of views among members. It was noted that lack of consensus in earlier discussions suggested that there may be insufficient time to complete the full agenda unless an alternative mechanism for arriving at

detailed statements incorporating all viewpoints was established. Given the general tenor of previous discussions, three small groups were established that broadly encompassed the range of views expressed. Their terms of reference were to:

(1) evaluate the effectiveness of the IOS according to the Commission's Instructions (Annex N, Appendix 3);
(2) make recommendations to any aspect of the IOS the sub-group thought might be appropriate to improve it (Annex N, Appendix 3); and
(3) develop recommendations for the Commission's Instructions for Reviews of Sanctuaries and Sanctuary Proposals (Annex N, item 6).

Each sub-group was assigned a Convenor and was named in the order in which the rapporteurs received their reports (sub-groups A, B and C).

After producing their reports, the Working Group reconvened and attempted to assess whether there was consensus among the sub-groups for each Instruction. The following section contains a compilation of the views expressed by these three sub-groups. Items below are listed according to the Commission's Instructions in Annex N (Appendix 3). Full sub-group reports A-C are given as Annex N, Appendices 4-6 respectively.

(1) Give attention to assessing how well the scientific aspects of the agreed objectives of the sanctuary have been met, and how well they might be met if the sanctuary continues.

SUB-GROUP A

There are no agreed objectives for the IOS so it is difficult to respond directly to the question. However, it can be noted that the IOS serves no scientific or conservation purpose primarily for the following reasons: (1) it has been made redundant by the moratorium; (2) research in the IOS has not provided sufficient information to assess stocks of large whales; (3) even if the moratorium is lifted, the RMP provides more than adequate conservation measures; and (4) its boundaries are ecologically inappropriate. Continuation of the sanctuary will not resolve these issues. For these reasons the sanctuary should be abolished.

SUB-GROUP B

The IOS effectively provides direct protection from commercial whaling to the breeding stocks of all large whales in the Indian Ocean although the precise locations of some of these breeding areas are still unknown. Much of the research in the IOS is aimed at the identification and assessment of other threats. A difficulty in evaluating the Sanctuary is determining which of the research and other activities in the IOS have taken place as a direct or indirect consequence of the sanctuary designation, and which may have occurred anyway. It is also becoming increasingly apparent that the time period required to reach an adequate assessment of something such as the effectiveness of a sanctuary is likely to be much longer than might have been anticipated.

SUB-GROUP C

The objectives have been met in part, but not to any great extent. The major contributions have been continuation of South African right whale and West Australian humpback and right whale surveys, although these would probably have continued with or without the IOS. Some work on humpback and blue whales in the western Indian Ocean has taken place. However, there has been an absence of the major pelagic surveys necessary if the IOS was to have played its intended role as a control region. In particular, there is no such work on pelagic Bryde's whales, the primary concern of the IOS when motivated. More resources need to be committed if the IOS is to play this intended control role. The IOS may, however, serve to assist to promote some fundraising efforts for research, although this should not be a function of a sanctuary.

COMMITTEE EVALUATION

There was no consensus among the three sub-groups on how well the scientific aspects of the agreed objectives of the IOS have been met, or on how well they might be met if the sanctuary continues. Details regarding areas where opinions differed are presented in the sub-groups' full reports in Annex N, Appendices 4-6. Similarly, there was no consensus within the Committee.

(2) Provide advice on the status and trends of whale stocks in the sanctuary in so far as these are known.

SUB-GROUP A

Meaningful advice cannot be provided on the status and trends of whale stocks in the sanctuary because neither systematic sighting surveys (except for some work on humpback and right whales) nor commercial whaling have been conducted in the sanctuary since its establishment.

SUB-GROUP B

The status of stocks in the sanctuary is summarised in Annex N, table 1. The sanctuary contains examples of: (1) populations which are depleted but known to be recovering; (2) populations which are depleted where the current trend is unknown; (3) populations such as minke whales, which are probably not depleted, but the current trend is under assessment by the Scientific Committee; and (4) populations which are probably not depleted but whose current trend is unknown.

SUB-GROUP C

See Annex N, Appendix 6.

COMMITTEE EVALUATION

The Committee **agreed** that sufficient information exists to review the status and trends of humpback and right whale stocks in western Australia and southern Africa. There is insufficient information available to review the status and trends of other large whale stocks in the IOS.

(3) Assess whether the sanctuary distinguishes between species and stocks that are depleted and apparently slow to recover, those that are increasing rapidly, and those that are abundant and not threatened.

SUB-GROUP A

The IOS does not distinguish between species and stocks. The prohibition on commercial whaling applies to all species and stocks irrespective of the status of stocks. This is one of the major arguments against the IOS in that it provides protection for stocks even when scientific advice demonstrates that such protection is not required for conservation reasons.

SUB-GROUP B

The IOS gives complete protection from commercial whaling to populations in all of the four categories listed above, but distinction between the categories can still be made for research and conservation purposes.

SUB-GROUP C

The IOS does not distinguish between such species and stocks.

COMMITTEE EVALUATION

The Committee **agreed** that the IOS provision does not distinguish between species and stocks that are depleted and apparently slow to recover, those that are increasing rapidly, and those that are abundant and not threatened; the IOS contains populations in each of these categories.

(4) Assess the present and potential threats to whale stocks and their habitats in the area of the sanctuary and how the sanctuary addresses these. Such factors may include inter alia: whaling, fishing, oil and gas exploitation, including seismic surveys, shipping, whalewatching, climate change, other environmental factors.

SUB-GROUP A

No information is available to assess the threats to whale stocks and their habitats. The IOS addresses only commercial whaling. Commercial whaling is not a potential threat because any resumption of whaling would only occur under the risk-averse RMP. The IOS does not address aboriginal subsistence whaling, fishing, oil and gas exploration, whalewatching, climate change or other environmental factors.

SUB-GROUP B

Although the IOS currently only provides direct protection to whales from commercial whaling, much of the research in the IOS is aimed at the identification and assessment of other threats. The results of the research have importance for the development of national protective measures and for the development of future regional and international measures.

SUB-GROUP C

There is at present an aboriginal sperm whale fishery in Indonesia. Potential for unregulated whaling is always present. Known fisheries considerations include: drift and gillnet entanglements off Oman (humpback, Bryde's), Zanzibar, and in shark nets off South Africa (humpbacks, right whales); pot line entanglements off Australia; and potential ship strikes in all areas. The group was not aware of any areas where diminished prey due to fishing was affecting whale populations. Oil and gas explorations are taking place and may have detrimental effects near South Africa, Mozambique, Oman, the straits of Hormuz and Arabian Gulf, and Australia. Whalewatching should be covered by domestic regulations as for example in Australia and South Africa. There is, however, no such coverage in some areas, for example Madagascar. Northern IOS stocks may be vulnerable to climate change as they are without the option to move to polar grounds. Coastal habitat degradation and shipping, for example, may be concerns around Arabia.

COMMITTEE EVALUATION

The Committee **agreed** that currently the IOS protects whales from commercial whaling. It also **agreed** that additional threats may be occurring, which have to be rigorously assessed in the future.

(5) Consider relationship of the sanctuary with other existing whale protection measures from anthropogenic and environmental factors.

SUB-GROUP A

The IOS does not improve protection of whales. It simply duplicates the unnecessary protection afforded by the moratorium on commercial whaling. Neither does it improve the conservation of breeding sites, migratory routes and/or feeding grounds. The IOS does not complement either the Commission's current management regime (the moratorium) nor will it complement the proposed regime of the RMP/RMS, because safe quotas will only be adopted for abundant stocks to ensure whaling is sustainable.

SUB-GROUP B

The Commission's RMS is still under development but it is envisaged that the RMS and sanctuaries would represent mutually complementary management measures.

SUB-GROUP C

See Group C's comment on Items 6.1-6.3 below.

COMMITTEE EVALUATION

There was no consensus on the relationship of the IOS with other existing whale protection measures from anthropogenic and environmental factors.

(6) Assess the anticipated effects of the proposed sanctuary in terms of: (6.1) improving protection of whales, in breeding areas, feeding grounds and/or migratory routes; (6.2) improving the conservation of breeding sites, migratory routes and/or feeding ground; and (6.3) complementing existing or potential protection including the Commission's management regime and regional and international agreements concerning biodiversity and conservation of nature.

SUB-GROUP A

(6.1) The IOS does not improve protection of whales. It simply duplicates the unnecessary protection afforded by the moratorium on commercial whaling.

(6.2) Neither does it improve the conservation of breeding sites, migratory routes and/or feeding grounds.

(6.3) The IOS does not complement either the Commission's current management regime (the moratorium) nor will it complement the proposed regime of the RMP/RMS, because safe quotas will only be adopted for abundant stocks to ensure whaling is sustainable.

SUB-GROUP B

(6.1) The IOS provides protection for the breeding stocks of all Indian Ocean baleen whales. The boundary at 55°S confers protection to feeding grounds of Bryde's and sei whales, the main feeding grounds for southern right whales, and part of the feeding grounds of Southern Hemisphere fin whales. Southern Hemisphere blue and humpback whales and Antarctic minke whales migrate outside the Indian Ocean Sanctuary. Female and juvenile sperm whales are protected throughout their range.

(6.2) The issues of habitat protection have only recently been considered by the IWC and to date no international measures have been taken. Whale habitat is specifically included in some national marine protected areas in the Indian Ocean.

(6.3) CCAMLR requires that the fisheries management take into account the needs of dependent species. The IOS provides protection to those dependent species during the part of the year for which they are outside the CCAMLR area.

SUB-GROUP C

(6.1) The IOS offers no such further protection given the moratorium. Furthermore, were the moratorium lifted, species migrating beyond its borders would not enjoy full protection.

(6.2) The IOS does not improve the conservation of any of these.

(6.3) The IOS could provide a control area, should the RMP be applied globally. However, it may be more appropriate to consider different areas within the Southern Hemisphere for different species.

COMMITTEE EVALUATION

There was no consensus on the role of the IOS in terms of: improving protection of whales in breeding areas, feeding grounds and/or migratory routes; improving the conservation of breeding sites, migratory routes and/or feeding ground; or complementing existing or potential protection including the Commission's management regime and regional and international agreements concerning biodiversity and conservation of nature.

(7) Provide advice on whether the boundaries of the sanctuary are ecologically appropriate.

SUB-GROUP A

Boundaries of the IOS were established simply to cover as wide an area as possible without regard to ecological principles or specific conservation needs for whale stocks. The boundaries of the IOS neither cover the entire range of large whale stocks that migrate through or into the area, nor are they limited to critical habitats for the species. For this reason, the IOS boundaries are not ecologically appropriate and are not consistent with the common concept of a sanctuary.

SUB-GROUP B

The current boundaries are simply defined in terms of latitude and longitude and include an ecologically coherent area with land boundaries forming the majority of the eastern, western and northern boundaries. Most previous discussions regarding the boundary largely concentrated on the southern boundary. The original proposal was to cover the entire Indian Ocean including the Southern Ocean sector, but for operational reasons this was revised to 55ºS while recognising that this had only limited ecological significance. The current sanctuary boundaries provide opportunities for comparison of the potentially unique (in terms of genetics, behaviour and physiology) northern Indian Ocean whale stocks with southern Indian Ocean stocks across the same ocean basin.

SUB-GROUP C

For many species, the boundaries do not encompass their full distributional range, and so are not appropriate. Other options considered to be superior to the IOS include: (1) extending the IOS southward to the ice-edge, together with possible east-west broadening to encompass the assessed range of biological stocks, (2) limiting the IOS to a northern part of the area, given the unique situation there of whales precluded from polar migration and (3) selecting a longitudinal slice of the Southern Hemisphere to serve as a control region, with the choice based upon simulation studies to assess optimality. This choice may be species-specific.

COMMITTEE EVALUATION

There was no consensus on whether the boundaries of the sanctuary are ecologically appropriate.

(8) Provide advice on whether the sanctuary addresses the issue of critical habitat and non-critical whale habitat.

SUB-GROUP A

The sanctuary does not address any habitat issues. It is simply a blanket prohibition on commercial whaling in the area. The issue of critical habitat is, however, addressed by the RMP, which does not provide quotas in breeding areas.

SUB-GROUP B

Since the competence of the IWC to include habitat protection measures in its Schedule has not yet been established, the sanctuary provision *per se* contains no measures for habitat protection. However, the Sanctuary is of sufficient size to encompass the complete habitat for some populations.

SUB-GROUP C

Not in general, but a sanctuary restricted to the northern part of the area could more defensibly be argued to do so.

COMMITTEE EVALUATION

The Committee **agreed** that the sanctuary does not specifically address the issue of known and unknown critical and non-critical whale habitat; this issue needs to be addressed in the future.

(9) Evaluate whether the sanctuary may contribute to or impede the conduct of scientific research useful for meeting the IWC objectives and facilitate coordinated and integrated research and monitoring programmes

SUB-GROUP A

While initially, the establishment of the sanctuary is reported to have resulted in an increase in research funding from NGOs and some research on sperm whales reported to be useful for meeting the IWC objectives, it also resulted in a decrease in national research funding in the area, except for Sri Lanka. Although a number of long-term research projects have been suggested, very few such projects have been initiated. The IOS has therefore impeded the conduct of scientific research useful for meeting the IWC objectives. This is confirmed by the absence of any recent reports of such research in the list of bibliographic references prepared for the IWC Sanctuary Review Steering Group.

SUB-GROUP B

An important consideration when considering the level of research in the IOS is that the coastal states are predominantly developing countries. The increase in research effort since 1992 is partly a reflection of the increase in cetacean research worldwide, but some projects have been initiated in response to the sanctuary designation. One of the difficulties in evaluating the IOS is knowing which activities are a direct result of the IOS and which would have happened without it. In the case of research, the sub-group mainly relied on whether the reports of the

research indicated that the existence of the IOS had been of benefit. Indirect benefits that were referred to included: a focus on regional initiatives and cooperation; a greater awareness of cetaceans in coastal states; facilitation of the initial phase of integrated research between Indian Ocean and Southern Ocean; additional sources of funding.

SUB-GROUP C

The current combination of the IOS and SOS impedes research, as the associated inability to compare stocks both under exploitation and unexploited in a control area detracts from capabilities to estimate demographic parameters relevant to the IWC objective of sound management on a scientific basis. Species-specific sanctuaries in parts of the Southern Hemisphere could, however, play some useful role towards that end.

COMMITTEE EVALUATION

There was no consensus on whether the IOS contributes to or impedes conduct of scientific research useful for meeting IWC objectives or facilitating coordinated and integrated research and monitoring programmes.

(10) Provide advice on whether the sanctuary is consistent with the precautionary approach.

SUB-GROUP A

No widely accepted or pragmatic definition of the precautionary approach provides for the implementation of measures for the total protection of whales irrespective of their conservation status. Further, no such definition recommends unnecessary or duplicative measures such as the Indian Ocean Sanctuary. By contrast, although the RMP is unnecessarily precautionary and wasteful of resources, its implementation would be consistent with broadly accepted definitions of the precautionary approach.

SUB-GROUP B

The central tenet of the precautionary approach is that lack of information shall not delay potentially necessary conservation measures. The adoption of the IOS in 1979 at a time when relatively little was known about the whale populations in the region, was a precautionary measure adopted by the IWC. While the RMP is designed to be more precautionary than its predecessors, the establishment of an appropriately designed system of sanctuaries can be regarded as a precautionary safeguard to mitigate the effects of possible failure of the RMP to adequately protect whale stocks after the current moratorium ends.

SUB-GROUP C

Superficially, a positive answer would seem obvious. However, the precautionary approach, taken to extremes, implies no utilisation of any natural resources. A pragmatic and balanced interpretation is necessary, taking account of the precautionary nature of the RMP, and the fact that the data contrast provided by limited exploitation is a necessary component of input to the development of a sound scientific basis for management. In this context, the precautionary approach should be seen as consistent with a set of species-specific sanctuaries of limited scope only.

COMMITTEE EVALUATION

There was no consensus on whether the IOS is consistent with the precautionary approach.

CONCLUSION

Lack of consensus in evaluating the scientific aspects of the IOS is not surprising considering that the sanctuary's original proposal did not clearly state its scientific objectives. The Committee recognised that the review process would benefit from explicitly stated objectives in Sanctuary proposals. In addition, there was some difficulty in interpreting some of the evaluation criteria and some of the Instructions from the Commission. While there was little consensus in evaluating the IOS, nevertheless, a considerable amount of substantive advice in response to the questions in the Commission's Instructions was provided by the working group.

17.2 Other

IWC/54/16 introduced a proposal for a South Pacific whale sanctuary submitted by Australia and New Zealand and noted that the content was the same as the previous year, but that it had been reformatted in accordance with the Instructions from the Commission although not all instructions were addressed. A record of the discussion of this document is given in IWC (2002d, p.67) and hence there was no need for further discussion.

It was noted that a proposal for a South Atlantic Sanctuary would be resubmitted to the Commission this year and that its supporting document remains the same as that presented to the Committee in 2001.

SC/54/O11 reported on the declaration of a whale sanctuary by the Government of the Cook Islands. The Cook Islands Whale Sanctuary (CIWS) was declared on 19th September 2001. It covers an area of approximately one million n.miles^2.

The Committee was notified that the Tristan da Cunha Island Council officially adopted the Tristan da Cunha Whale Sanctuary in November 2000. It includes the 12 n.miles territorial waters of the Islands of Tristan, Inaccessible, Nightingale and Gough. The sanctuary is designed to protect all cetacean species inhabiting or using these waters and is in place for an indefinite period of time.

17.3 Suggestions for improving the review process

As requested by the Commission, the Scientific Committee has provided some advice on the Instructions from the Commission and the evaluation criteria (Annex N, item 6). The Committee recognised that the review process could be further developed and **agreed** that it should try to develop suggestions for evaluation criteria to make them more precise and operational. This work will be initiated intersessionally by the Steering Group to review sanctuaries and sanctuary proposals. A proposal for a more precise set of review criteria will be presented to the Commission next year.

The Committee noted that, for future work, some mechanisms by which sanctuary proposals and the review process would benefit should be developed, including: (1) reviewing IWC sanctuaries in combination when biologically relevant; and (2) introducing Marine Protected Area (MPA) scientific concepts into sanctuaries and sanctuary proposals. The Committee also noted that a mechanism through which the Commission could assist member countries in developing sanctuary proposals should be discussed. This mechanism should include, in particular, identifying the objectives of the sanctuary and establishing a scientific monitoring programme that allows evaluation of

these objectives. These mechanisms will be developed by the intersessional Steering Group to review sanctuaries and sanctuary proposals.

The Committee **agreed** that priority should be given to further developing the evaluation criteria given the review of the SOS in 2004. It also **agreed** that the review process of this sanctuary will benefit if the review is initiated next year by collating the information required to follow the Commission's Instructions for Sanctuary Reviews.

18. RESEARCH AND WORKSHOP PROPOSALS AND RESULTS

18.1 Review results from previously funded research proposals

Results from previously funded research were reviewed in the appropriate sub-committees and working groups. Details are included in Annex E (satellite tagging and tracking of two fin whales off West Greenland), Annex G (progress with data entry and analysis options in DESS), Annex H (Antarctic Humpback Whale Catalogue) and Annex K (research on common dolphins in coastal waters of Pacific South America).

18.2 Review proposals for 2002/2003

No proposals were received.

18.3 Workshop on Methods for Whale Research

This workshop had originally been proposed by the Commissioners of the USA and Japan, not the Committee itself (IWC, 2002d, p.69) and had not been funded out of the Committee's research budget (IWC, 2002d, p.72). The invitation to host the meeting in Tokyo was for the period 4-8 February 2002, but it had not been possible to find outside experts available at that time. Subsequent efforts by Read, Chair of the Steering Group, had failed to find a period when the necessary experts had been available. Indeed, he reported a lack of enthusiasm for the workshop from the people he approached. Many members shared the view that the Committee had discussed and will continue to discuss these matters frequently and they expressed doubts that such a workshop would advance the work of the Committee. Others believed that if it had occurred before the review of JARPN II it might have provided useful input to the review process (Item 16.4.2). Hatanaka and Smith thanked Read for his efforts. They regretted that the workshop could not be advanced. The Committee **agreed** that a workshop on research methods would not be fruitful without outside experts and that it would be a low priority for research funding, compared to other workshops it had proposed (see Item 21).

19. COMMITTEE PRIORITIES AND INITIAL AGENDA FOR THE 2003 MEETING

As in recent years and with the Committee's agreement, the Convenors met after the close of the meeting and drew up the following as the basis of an initial agenda for the 2003 meeting. They took into account:

(a) the priority items agreed by the Committee last year and endorsed by the Commission and, within them, the highest priority items agreed by the Committee on the basis of sub-committee discussions;
(b) general discussions in the plenary session and in particular the need to reduce the workload of the Committee and, as far as possible streamline the sub-committee system to avoid conflicts in the need for personnel;
(c) discussions over the budget in the full Committee.

The Committee recognised that priorities may be revised in the light of the Commission's decisions. Following the Commission meeting, the Chairman will circulate to the Committee a summary of the Commission's conclusions as they affect next year's work, along with a preliminary draft agenda. This will also provide a framework for determining invited participants to the 2003 meeting.

The Committee **reiterates** that suggestions for future in-depth or pre-implementation assessments must be accompanied by thorough written reviews of the available information and an outline of the work that would need to be undertaken to complete an assessment.

The Standing Working Groups and Standing Sub-Committees must, of course, meet. Otherwise, the sub-committee structure is flexible and should be seen as a way to most efficiently address the Committee's priority items. With this in mind, it was agreed to have the following sub-committees, noting that should other specific issues arise, then the option to appoint *ad hoc* Working Groups remains. The number of sessions allocated to each group will be strictly limited and similar to the number indicated below. Items of lower priority will only be discussed if time allows. It is again stressed that papers considering anything other than priority topics may not be addressed.

RMP (14)

As last year, this sub-committee will concentrate on two areas:

(a) General issues

Priority topics will be:

(1) adjustment of the convergence criteria for the CATCHLIMIT program;
(2) consider results from the Intersessional Working Group on Abundance Estimation;
(3) consider implications of choice of component of population to which MSYR, MSYL and density dependence apply in RMP trials.
(4) define levels of information required for *Pre-Implementation Assessments* and for proceeding to an *Implementation*.
(5) spatio-temporal considerations in the context of the RMP.

(b) Preparations for Implementation

The priority topics will be:

(1) completion of North Pacific minke whale *Implementation* (including review results of intersessional meeting);
(2) North Atlantic minke whale *Implementation Review*. It is proposed that discussion of this begins two days prior to the Annual Meeting.

Bycatches and other anthropogenic removals (BC − 7)

This year the Working Group will (in the context of the RMP) concentrate on the estimation of bycatch only.

The priority topics will be:

(1) bycatch based on fisheries data and observer programmes;

(2) bycatch based on genetic data;
  (a) proposal for a workshop
  (b) analytical tests for assignment to stocks and/or areas
  (c) use of capture-recapture methods for estimation of bycatch from market data.

AWMP (9)
This Standing Working Group will continue the development process and will have had an intersessional workshop in Seattle. Priority topics will be:

(1) selection of an *SLA* for Eastern North Pacific gray whales;
(2) review of results from Greenlandic Research Programme and revise programme;
(3) progress on development of potential *SLA*s for Greenland fisheries;
(4) annual review of catch data and management advice for minke and fin whales off Greenland;
(5) annual review of catch data and management advice for humpback whales off St Vincent and The Grenadines.

Southern Hemisphere whales other than Antarctic minke whales (SH − 6)
Priority topics will be:

(1) review progress on the Comprehensive Assessments of Southern Hemisphere humpback and blue whales and determine timetable and work plan.

Bowhead, right and gray whales (BRG − 4)
Priority topics will be:

(1) new and/or conflicting biological information on bowhead, right and gray whales;
(2) revised new abundance estimate for BCB bowhead whales;
(3) review progress on previous recommendations.

In-Depth assessments (IA – 14)
Priority topics will be:

(1) issues relating to the abundance estimation of Southern Hemisphere minke whales;
(2) review results of most recent SOWER circumpolar cruise and plan for the next.

Stock definition (SD – 7)
This Working Group will also hold an intersessional Workshop. Priority topics will be:

(1) statistical and genetic issues (Testing of Spatial Stock Models);
(2) options for units to conserve including management implications;
(3) development of stock and harvesting archetypes suitable for consideration in whaling management;
(4) review of new information on responses of cetacean sub-stocks to severe depletion.

Environmental concerns (E − 8)
Priority topics will be:

(1) review results from workshop on marine mammal-fisheries interactions (2-3);
(2) high latitude climate change (2-3).

It will also devote limited (2-3) time to:

(a) Steering Group report on POLLUTION 2000+ ;
(b) progress report on SO-GLOBEC/CCAMLR;
(c) review of results from the workshop on habitat degradation (if held);
(d) Arctic issues;
(e) progress on State of the Cetacean Environment Report (SOCER).

DNA (2)
This Working Group will provide the annual progress report to the Commission required by Resolution 1999-8.
Priority topics will be:

(a) genetic methods for species, stock and individual identification;
(b) collection and archiving of tissue samples from catches and bycatches;
(c) reference databases and standards for diagnostic DNA registries.

Small cetaceans (SM − 10)
Priority topics will be:

(1) review of the status of small cetaceans in the Black Sea;
(2) review of the existence of directed and incidental takes of small cetaceans in member countries, with a view to requesting data in the future;
(3) review of progress on previous recommendations.

Whalewatching (WW − 5)
Priority topics will be:

(1) review the reports of Intersessional Working Groups;
  (a) data collection;
  (b) whalewatching management;
  (c) compendium of data forms used on whalewatching platforms;
  (d) directory of relevant researchers
(2) review of research on the effectiveness of national whalewatching guidelines and regulations;
(3) review of new information on whale and dolphin swim-with programmes.

Sanctuaries (S – 2)
Priority topics will be:

(1) review work of intersessional Steering Group;
(2) preparation for review of Southern Ocean Sanctuary.

Scientific permits (P –2)
Priority topics will be:

(1) proposals to facilitate the review process;
(2) review results of existing permits;
(3) review plans for new and continuing permit proposals.

20. DATA PROCESSING AND COMPUTING NEEDS FOR 2002/2003

The Committee identified the requests for intersessional work by the Secretariat given in Table 9. Allison noted that it should be possible to complete all the items listed before next year's Scientific Committee meeting, unless much additional work arose from the Intersessional Meeting on North Pacific minke whales. The Committee recognised that a final decision on priorities would need to be made after the Commission meeting to take into account Commission deliberations. The Committee **agreed** that Allison will liase with the Chair of the Scientific Committee and the

Table 9

Computing tasks/needs for 2002/03

Task	Estimated time
AWMP	
Amend control program to implement modifications to GE trials including the inertia model and changes to be specified, condition trials and circulate to developers.	1-2 months
Create input files for and condition GR trials, produce population trajectories.	1-2 months
Run GE trials for candidate SLAs and prepare comparison plots and tables for Intersessional meeting.	2 weeks
Work resulting from Intersessional meeting.	??
RMP	
Investigate the conditioning output for the North Pacific minke whale *Implementation Simulation Trials*, to resolve any inconsistencies, in collaboration with the NP conditioning steering group (see Agenda Item 6.4.1).	3 + months
Conduct the final set of *IST*s as specified at the Intersessional Meeting.	1 month
Undertake simulation trials to assist the Committee in understanding the implications of the choices of modelling density dependence and defining MSYL in the *Implementation Simulation Trials* (see Agenda Item 5.2).	1 month
Adjust the convergence criteria in the new CATCHLIMIT program to be robust when less precise integration is used.	2 weeks
Other	
Validation of the 2001/02 and 2002/03 SOWER cruise data and incorporation into the sightings database.	6 months
Completion of validation of the 1999/2000 joint IWC/CCAMLR cruise data (being undertaken by Hedley).	?
Validation of the 2000/01 joint IWC/SO GLOBEC cruise data.	?
Encode the basic individual records from the revised Soviet catch data and document inconsistencies in the data. The earliest data will be coded first. (The detailed biological data will not be encoded in this first phase.)	1-2years

Convenors of the relevant sub-committees to decide if priorities need to be changed in the light of Commission decisions and to review progress during the year.

21. FUNDING REQUIREMENTS FOR 2002/2003

Table 10 summarises the complete list of recommendations for funding made by the Committee. The total required to meet its preferred budget is £376,235. The Committee **recommends** all of these proposed expenditures to the Commission. However, it understood that the projected amount available for funding is £275,261, of which £96,045 is committed funds. It therefore reviewed the full list, taking into account its work plan, priorities and the possibility that some of the work requiring funding could be postponed to a future year while other items represented unique opportunities that would not be available again. Should the Commission be unable to fund the full list of items in Table

Table 10

Scientific Committee recommendations for research finding in 2002/3 (amounts in £ sterling).

Item	For	Reference	Preferred budget	Reduced budget
AWMP*				
Intersessional workshop	Invited Participants	Item 8.7 and Annex E	12,000	9,000
Greenland Research programme*	Satellite tagging	Item 8.4.1, 9.1.3 and Annex E	18,000	18,000
Developer's fund*	Development of SLAs	Item 8.7 and Annex E	8,400	8,400
RMP				
Intersessional meeting	Invited Participants	Item 6.1.4 and Annex D	10,000	7,000
IA				
SOWER circumpolar cruise	Scientists, equipment, planning meeting	Item 10.1.2.2 and Annex G	94,440	80,000
Further minke whale abundance estimates:	Developmental support	Item 10.2.3.1 and Annex G	5,000	5,000
	Develop/apply BBM model/spatial models	Item 10.2.3.1 and Annex G	8,000	8,000
	Develop/apply Hazard model	Item 10.2.3.1 and Annex G	1,040	0
	Evaluate standard methods/other analyses	Item 10.2.3.1 and Annex G	3,000	3,000
E				
SO-GLOBEC related research	Planning meeting, cruise support, analysis	Item 12.1.2 and Annex J	25,000	21,500
POLLUTION 2000+	Complete Phase I	Item 12.2 and Annex J	54,410	15,000
Habitat degradation workshop	Invited Participants	Item 12.3.2 and Annex J	15,500	0
Preparation of SOCER	Editorial work	Item 12.3.1 and Annex J	3,000	0
H				
Antarctic humpback whale catalogue*	Towards improving catalogue	Item 10.4.3 and Annex H	5,100	5,100
BRG				
Joint USA-Russian western gray whale research*	Continuation of programme	Item 10.6.5 and Annex F	34,245	34,245
SD				
Intersessional workshop	Invited participants	Item 11.4 and Annex I	17,500	7,000
SC				
Invited participants	Invited participants	Item 21	27,900	27,900
DESS *	Analysis and support	Item 10.1.1 and Annex G	32,000	32,000
Sundries (bank charges etc.)*			1,700	1,700
Total			**376,235**	**282,845**

*Committed items

10, the Committee **agreed** that the final column given in the table represents a budget that will allow progress to be made by its major sub-committees and working groups. Progress will not be possible in some important areas, as outlined below and the Committee **requests** that the Commission or individual member governments provide additional funding in these areas. The Committee **strongly recommends** that at a minimum, the Commission accepts its reduced budget of £282,845, although it recognises that this is about £7,500 over the projected amount available.

A summary of each of the items is given below, by sub-committee or working group. Full details can be found under the relevant Agenda Items and Annexes as given in Table 10.

(a) Items recommended for funding under the reduced budget

Aboriginal Whaling Management Procedure

(1) AWMP INTERSESSIONAL WORKSHOP

The Commission has agreed that development of the AWMP is a high priority item. Without intersessional workshops, it would have taken at least three more years to develop the *Bowhead SLA*. Work to complete a similar exercise for gray whales and make progress on the Greenland fisheries case requires a similar strategy. With such a workshop it may be possible to recommend a gray whale *SLA* at next year's meeting; without one it will certainly not. The Committee therefore strongly recommends that a four-day intersessional workshop be held, probably in December. Although £12,000 was originally budgeted, if the meeting is held in conjunction with one of the other workshops (RMP or SD), it may be possible to reduce the costs to around £9,000. The workshop will concentrate on reviewing the first results of *Evaluation* and *Robustness Trials* for gray whales and initiating the major review of the Greenland Research Programme. The US NMFS National Marine Mammal Laboratory has again offered to host the workshop, so the only cost to the Commission is for invited participants.

(2) AWMP DEVELOPERS FUND

The developers fund has been invaluable in ensuring fast completion of AWMP trials and other essential tasks of the Standing Working Group. The Committee noted that this is included as a separate item of expenditure in the Commission's provisional budget.

(3) GREENLAND RESEARCH PROGRAMME

The Committee is unable to provide advice on these stocks. The Committee stresses that obtaining adequate information for management should be seen as of very high priority by both the national authorities and the Commission. Without this information, the Committee will not be able to provide safe management advice in accord with the Commission's management objectives, or develop a reliable *SLA* for many years, with potentially serious consequences for the status of the stocks involved. The Committee noted that the present money for satellite tagging to address issues of stock structure and movement is carried over from last year.

Revised Management Procedure

(4) RMP INTERSESSIONAL MEETING

The Committee is concerned about the length of time taken to complete the *Implementation* for North Pacific minke whales. The Committee recognises that substantial intersessional work is still required if final *Implementation Trial* results are to be available at next year's meeting. It is impractical to complete most of the substantial work required via e-mail; an intersessional workshop is essential. Although £10,000 was originally budgeted, if the meeting is held in conjunction with one of the other workshops (AWMP or SD), it may be possible to reduce the costs to around £9,000.

In-depth Assessments

(5) SOWER CIRCUMPOLAR CRUISE

Completion of this set is essential to the work of the Committee in response to the Commission's resolution, in particular with respect to Antarctic minke whales but also blue whales and other species. The Government of Japan has kindly offered the use of two research ships in 2002/2003 and the preferred budget in Table 10 reflects the remaining costs of the cruise (Appendix 2 of Annex G). The reduced budget in Table 10 is the minimum required if the cruise is to take place. This requires cuts in the equipment budget and elsewhere.

(6) FURTHERING ESTIMATION OF ANTARCTIC MINKE WHALE ABUNDANCE

The Commission has given high priority to obtaining new abundance estimates and trends in Antarctic minke whales. Although a better understanding of the issues has been reached at this meeting, little progress can be made if most of these development projects are not funded. A considerable amount of in-kind support is included with these projects.

Environment

(7) SO-GLOBEC RELATED RESEARCH – SOWER 2000

Item 12.1.2 describes the Committee's collaboration with SO-GLOBEC. Support for this activity was considered a preferred priority, as it complements the enormous in-kind support the IWC receives for the SOWER 2000 cruises. The reduced budget will cover only the minimum number of IWC-funded observers (two per cruise) required for IWC participation in SO-GLOBEC, as well as providing partial support for the coordinator. The field studies to be supported represent a unique opportunity in the coming year to conduct research on Southern Ocean whales and their ecosystem as mandated by IWC Resolutions 1998-3 and 1998-6.

(8) POLLUTION 2000+ RESEARCH ON BIOLOGICAL EFFECTS OF CONTAMINANTS IN CETACEANS

The POLLUTION 2000+ programme is an important and fundamental research programme that has been given high priority in the past by both the Committee and the Commission (e.g. Resolution 2000-7, IWC, 2001b, pp.56-57). In addition to completion of analyses currently in progress, the 2002-2003 work plan for POLLUTION 2000+ includes an intersessional meeting to synthesise results among the laboratories involved, and an intersessional meeting of the Steering Group to finalise Phase 1 of this programme and to determine activities to be conducted under Phase 2. Within this work plan, the highest priority projects are the collection of samples and PCB analyses under the bottlenose dolphin sub-project, and completion of the harbour porpoise post-mortem calibration project. The budget to complete the entire 2002-2003 work plan will require £140,500, of which the majority will be sought through external direct or 'in kind' funding. To complete the highest priority projects mentioned above, £54,410 from the IWC is required. The reduced budget amount will only allow analysis of a portion of the existing samples, thereby considerably delaying completion of Phase 1. Interested member governments are urged to consider providing additional funds.

Humpback whales

(9) ANTARCTIC HUMPBACK WHALE CATALOGUE

The Committee is already committed to funding this project, which represents only a partial cost of running the catalogue and is of great benefit to its in-depth assessment of Southern Hemisphere humpback whales. The work required to *inter alia* make the IWC IDCR/SOWER photographs more accessible is described in Annex H, Appendix 4.

Bowhead, right and gray

(10) JOINT USA-RUSSIAN WESTERN GRAY WHALE RESEARCH

The importance of this work to the conservation of the critically endangered western gray whale is stressed under Item 10.6.5. The funding has kindly been donated by the USA.

Stock definition

(11) INTERSESSIONAL WORKSHOP

Consideration of the appropriate 'unit-to-conserve' is fundamental to the successful implementation of the RMP and is critical to the conservation and management of all cetacean species. The Committee reaffirmed the importance of the simulation work. Setting up extensive simulation trials is complex, and the Committee **agreed** that an intersessional workshop is essential in order to make reasonable progress on spatial structure simulation. Apart from those interested in actually developing methods, this meeting would ideally require two other types of participant: first, one or more Scientific Committee members with extensive experience in setting up large simulation trials, particularly in an RMP or AWMP context; and second, experts from outside the usual IWC circles who can provide input on appropriate genetic, statistical, and ecological considerations to be used in developing the simulations. Further details on the proposed workshop can be found in Annex I, Appendix 3. Although £17,500 was originally budgeted, if the meeting is held in conjunction with one of the other workshops (AWMP or RMP) without meeting room costs, it may be possible to reduce the costs to around £7,000.

Scientific Committee

(12) INVITED PARTICIPANTS FUND

The Committee draws attention to the valuable contribution made to its work by the funded Invited Participants. They are essential to the work of the Committee and represent excellent value as they receive only travel and subsistence costs and thus donate their time.

(13) DESS

The IWC's DESS (Database Estimation Software System) is vital to the Committee's work on abundance estimation, particularly with respect to future work on the abundance of Antarctic minke whales and the *Implementation Review* of North Atlantic minke whales. This is the third year of a three-year contract.

(b) Items not recommended for funding under the reduced budget

Environment

(1) HABITAT DEGRADATION WORKSHOP

The Commission (Resolution 2000-7) has encouraged work in this area. Progress on the conceptual framework that the workshop would consider was made at an intersessional meeting (Simmonds *et al.*, 2002a) and a new workshop proposal was subsequently produced (Simmonds *et al.*, 2002b). ACCOBAMS has endorsed the workshop plans. ICRAM in Italy has offered to host the meeting, so the item in the Committee's preferred budget is needed only for invited participants.

(2) PREPARATION OF SOCER

The Commission (Resolution 2000-7) has encouraged work in this area. A working group within the SWG will aim to produce a draft SOCER (State of the Cetacean Environment Report) for next year's meeting. This report will be distributed as a Committee document in the spring of 2003. It is intended to be a preliminary attempt at a form of the report that will be developed over the years into an objective product and an easily followed submission process. It is aimed at providing a non-technical summary of the positive and negative events and developments in the marine environment relevant to cetaceans.

22. WORKING METHODS OF THE COMMITTEE

22.1 Increasing participation of scientists from developing countries

The Committee reviewed the proposed addition of rule A.6 (i) to its Rules of Procedure considered last year (Pinto de Lima and Palazzo, 2002). It **agreed** the proposed wording, noting the importance of a number of features: (1) the Chair retains the right of selection as indicated in the rule; (2) Invited Participants proposed for conversion to national delegate status under the rule are permitted to decline; (3) use of the rule was appropriate only by developing countries.

Zeh noted that no responses to her circular communication requesting suggestions regarding research priorities in developing countries had been received before the meeting. There was not adequate time to consider this matter further during the meeting, or to follow up on additional ideas for helping scientists from developing countries gain the necessary expertise to address conservation and management issues in their own countries (see IWC, 2002d, p.74). The Committee **agreed** that it would discuss these topics further next year.

22.2 Participation by member nations in the Committee's work

Near the close of the meeting, Smith expressed disappointment concerning the reduced participation by Japan in some aspects of the Committee's work in recent years. His remarks, the remarks of Walløe and a response from Komatsu are given in Annex P.

22.3 General methods of improving the Committee's efficiency and effectiveness

Several suggestions were made regarding working methods of the Committee. Some of these are given below and others were taken directly into account in the Convenors' discussions of Initial Agenda and Work plan (see item 19.).

22.3.1 Late arrivals

Childerhouse expressed his concern at the trend in recent years for some scientists to arrive only for plenary discussions. In particular, this can result in a considerable waste of time spent revisiting sub-committee discussions in plenary. Whilst agreeing that it was appropriate for the final consideration of sub-committee and working group reports to occur in plenary, many members noted that this was in large part intended to reflect the fact that concurrent sessions meant that it was not possible to attend each sub-committee;

they thus shared the concerns of Childerhouse of the disruption this practice can have on the Committee's proceedings. It was emphasised that these comments do not apply to cases where countries do not have adequate resources to send a scientist for the whole period, but rather to countries that had other delegates already attending the full meeting.

22.3.2 Citation and restrictions on citation of documents and working papers

The review (including further analysis if required) of scientific papers is critical to the work of the Scientific Committee and the transparency of its management advice to the Commission. Some concern arose at the meeting that this may be compromised by either authored working papers or documents being submitted to the Committee with the heading along the lines of 'Not to be cited (or used) without the permission of the author(s)'. The general policy of the Scientific Committee is relevant to this issue.

WORKING PAPERS

These are intended to expedite resolution of disagreements or stimulate debate within the meeting. They officially disappear at the end of the meeting (unless appended to the Committee or sub-committee reports with the author's permission). They have no status once the meeting is closed and thus cannot be cited in authored documents or manuscripts for publications.

However, if they are to assist in the work of the Committee it does not seem appropriate to include any restriction of citation *in the context of the meeting at which they are submitted*. Certainly, unless appended or incorporated into the text of the report, they cannot be used in the provision of management advice. In conjunction with the policy in the paragraph above, the Committee therefore **agreed** that working papers should not be submitted with such restrictions.

SCIENTIFIC COMMITTEE PAPERS

Authored documents submitted to the Committee reside in the Secretariat, are publicly available on request and are considered part of the public domain. The policy of the *Journal of Cetacean Research and Management* on citation of authored documents is consistent with the Committee's policy: authored documents are publicly available and can be cited as such – the citation style makes clear that these are unpublished manuscripts[16].

The policy of the Journal is that if authors specify on the title page that the paper should not be cited without the permission of the author, that must be respected. Although not all authors make such a specification, it is in any case good practice (as well as courteous) to inform authors of unpublished papers that one intends to cite them and make use of the data therein. This is important as, for example, by the time of citation the document may have been submitted/accepted for publication (or already published), in which case it is more appropriate to cite the (to be) published version. It was noted that in the case of JCRM, the Journal could consider undertaking notification of authors in this regard.

[16] Editorial policies on the form of citation of SC authored documents differs from journal to journal. Some journals consider these documents as 'gray literature' and restrict citations to footnotes or to reference as 'personal communication'. To avoid these restrictions, authors submitting manuscripts to peer-reviewed journals may wish to inform the editors of the policy of the JCRM and the format for citation therein.

In general, it does not seem unreasonable to include such a citation provision on a paper that has perhaps been written at the last minute in order to stimulate discussion or present the results of a preliminary analysis which subsequently the author feels (or is told) is flawed.

However, if a paper is to form the major basis for a recommendation by the Committee, it is not acceptable for such a strong restriction on citation to be placed. The Committee **agreed** that it is appropriate for the Chair of the Committee or relevant sub-committee to ask that such a restriction either: (1) be removed; or (2) be replaced by one that makes it clear that the restriction excludes citation in the context of Scientific Committee meetings and documents. This latter option gives protection to the authors of *inter alia* first publication rights.

22.3.3 Reducing the amount of wasted papers

Donovan briefly outlined a proposal to reduce the number of papers copied for, but then thrown away by, participants. The current practice is that all Committee members receive every paper submitted to the meeting. The Secretariat will use the website to allow members to sign up for certain categories of papers in advance of the meeting. On arrival, Committee members will therefore receive only a subset of the total papers submitted. They will be able to request additional papers (either electronically or on paper) from the complete list of documents later. The Committee welcomed this initiative and **agreed** that it should be tried out for the coming meeting. It also welcomed the increased use of the website for Committee business, and Donovan noted that it would become an increasingly useful tool to the Committee's work in the coming year.

22.3.4 Observers on surveys

Late in the meeting, the issue of adequate attention to field methods used in abundance surveys and the role of independent observers was raised. The Committee noted that it has discussed aspects of this issue in the past. It did not have time to discuss the matter this year and **agreed** to include it on next year's agenda.

23. ELECTION OF OFFICERS

The three-year terms of Zeh as Chair and DeMaster as Vice-Chair end at the end of IWC 54. The heads of delegations therefore met to agree a process for conducting the election. Considerations regarding the election process and proposed changes to the Committee's Rules of Procedure to reflect their decisions are given in Annex Q. The Committee **agreed** to the modified rules as given in Annex Q. Although the modified rules cannot officially take effect until a subsequent election, they were followed by the heads of delegations for the election. The head of the Icelandic delegation protested the denial of his right to vote.

The Committee was delighted to welcome DeMaster as the new Chair and Bjørge as the new Vice-Chair.

24. PUBLICATIONS

The year 2001 was an extremely productive year with respect to the IWC's scientific publications. The third volume of *The Journal of Cetacean Research and Management* was completed, comprising three issues published in May, September and December. Publication of some 34 papers (328pp.), covering a wide range of topics and with authors from 20 countries, illustrates its increasing

contribution to the field of cetacean research. In addition, the 453 page supplement to the fourth volume of the Journal, containing the 2002 Report of the Scientific Committee was published in April 2002. Also published since the last meeting was the second Special Issue in the Journal series (Right Whales: worldwide status – edited by P.B. Best, J.L. Bannister, R.L. Brownell Jr and G.P. Donovan). This hard-backed volume of over 300 pages contains the Reports of the Cape Town and Boston Right Whale Workshops, and 28 peer-reviewed papers reporting the current status of right whale stocks.

For reasons well known to the Committee, publication of the long-awaited gray whale special issue has been consistently delayed. It has finally been decided that those papers that have been completed shall be included in dedicated but regular issues of the Journal. The first of these will be the Spring 2002 issue.

Finally, Donovan reiterated the importance of Committee members urging their respective institutes and colleagues to subscribe to the Journal and to submit high quality papers to it. Now that it has been in existence for three years, it will be included in the Science Citation Index.

The Committee congratulated Donovan and his team for the quantity and quality of the publications produced since the last meeting, and recognised the important contribution the Journal made to the work of the Committee and to the wider issues of the management and conservation of whales. They also congratulated him on finally realising that despite his eternal optimism, some people never change when it comes to the gray whale special issue!

25. OTHER BUSINESS

The Committee congratulated two of its members, Parsons and Rose, who had met at a previous Committee meeting, on their engagement.

Appreciation was expressed to the Government of Japan and the people of Shimonoseki for the exceptional level of support and hospitality provided to the Committee during the meeting. The Secretariat staff was thanked for its huge contributions to the smooth progress of the Committee's work. The Committee gave Zeh a standing ovation for her outstanding service as Chair of the Committee. She carried our her duties with diligence, fairness, good humour and kindness to all members. Zeh thanked all the members for the help they had given her during her term of office and congratulated the newly elected officers.

26. ADOPTION OF REPORT

The report was adopted at 18:00 on 9 May 2002.

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