Report of the Scientific Committee

The Committee met at the Kyoto International Conference Hall, Japan, under the Chairmanship of Dr P.S. Hammond, from 22 April-3 May 1993. A list of participants is given in Annex A.

1. CHAIRMAN'S WELCOME AND OPENING REMARKS

The Chairman welcomed participants to the meeting. The Committee paused in silence in memory of Dr Hideo Omura and Mr Michael Kozicki.

2. ADOPTION OF AGENDA

The adopted Agenda is given as Annex B. Statements concerning the Agenda are given in Annex S.

3. ARRANGEMENTS FOR MEETING

3.1 Appointment of Rapporteurs
Donovan was appointed Rapporteur, with various members of the Committee assisting as appropriate. Chairmen of sub-committees appointed rapporteurs for their meetings.

3.2 Meeting procedures and time schedules
The Committee agreed to a work schedule similar to that in previous years. This took into account comments, suggestions and procedures agreed to at earlier meetings (IWC, 1982; 1988a, p.59).

3.3 Establishment of sub-committees
The Chairman stressed that the main business at this year's meeting was the continuation of the Comprehensive Assessment programme and in particular the Revised Management Scheme (Items 7 and 8). The Commission had also asked for advice on the proposal from the Government of France for a sanctuary in the Southern Hemisphere (Item 12). Three sub-committees were established (management procedures; Southern Hemisphere baleen whales; and small cetaceans), their reports are given as Annexes D-F respectively. The report of the Working Group on North Pacific minke whale management trials that met from 19–21 April is given as Annex G. A number of Working Groups were established to examine specific subjects, including: population assessment models; maximum sustainable yield rates (MSYRs); IWC/IDCR Southern Hemisphere minke whale assessment cruises; whaling statistics; and research proposals. Their reports are given as Annexes or incorporated under relevant items.

3.4 Computing arrangements
Allison outlined the computing facilities available to the meeting. In addition to the link with the University of Cambridge computing system, 10 personal computers were in use by the Secretariat computing facility and four were available for use by Committee members.

4. REVIEW OF AVAILABLE DATA, DOCUMENTS AND REPORTS

4.1 Documents submitted
A list of documents submitted is given as Annex C. The revised guidelines for national progress reports are given in IWC (1989c). The progress reports received this year are listed in Annex C. The Committee reaffirmed its view of the importance of progress reports and again **recommends** that the Commission urges member nations to provide them following the approved guidelines.

4.2 Data collection, storage and manipulation
4.2.1 Catches and other statistical material from the previous season
The Secretariat had received data from the 1992 research permit catch by Norway and the 1992/93 Southern Hemisphere minke whale IDCR cruise. During the meeting, data on the 1992/93 Japanese research catch were received and also data from the 1992 North Pacific sightings cruise.

4.2.2 Progress on data coding projects
Allison reported that good progress had continued to be made on the data coding projects. Encoding and validation of available data from the Southern Hemisphere in the 1930s and 1940s is almost complete. In addition, data from the 1991/92 IDCR cruise in the Southern Hemisphere have been validated and sightings data collected by Japan since 1987/88 in transit to and from the IDCR cruise areas have been coded.

4.2.3 Progress on computing projects
Allison reported that management trials had been run as directed by the management steering group. These are discussed further under Item 7.

Last year, the Committee recommended the appointment of a database manager to the Secretariat to develop a database for sightings survey data and software for calculation of abundance estimates required by the CLA (as defined under Item 7) and, in addition, to analyse the annual IWC/IDCR Southern Hemisphere cruise data. After consultation with the Chairman and others, it had been decided that the most efficient and cost-effective way of achieving these aims was by outside contract. Accordingly, a contract has been set up with Buckland and

Borchers to perform this work over the next two years with the option of a third year if required.

Allison also reported that she has now received a new version of the HITTER/FITTER program and a separate population dynamics model (BALEEN II) from de la Mare with accompanying documentation. BALEEN II can be used by other programs implementing different estimation procedures, as had been recommended last year. These programs have not yet been validated.

4.3 Marking including photo-identification of natural markings

A Discovery mark had been recovered from a minke whale during the 1992/93 Japanese research programme (SC/45/ProgRep Japan). Analyses of Discovery mark data are included in a number of presented papers.

The following national progress reports contained information on natural markings: Australia, Brazil, Denmark, Germany, Ireland, Japan, New Zealand, Norway, Sweden, UK and USA. Natural marking data are discussed in a number of presented papers.

5. CO-OPERATION WITH OTHER ORGANISATIONS

5.1 ICES
The report of the IWC observer at the 80th Statutory Meeting of ICES (24 September-2 October 1992) was available as IWC/45/10C. At that meeting there was considerable discussion on North Atlantic pilot whales and the ICES Consultative Committee established a Working Group to conduct an evaluation of the status of long-finned pilot whales in the North Atlantic (i.e., population size and trends, population dynamics parameters), including the importance of behavioural factors and accounting for multispecies interactions, and to identify key information gaps and critical long-term information needs.

Other topics of interest to the IWC Scientific Committee included the study group report on Seals and Small Cetaceans in European Seas and the announcement of a joint NAFO/ICES symposium on the role of marine mammals in the ecosystem. The meeting thanked Bjørge for attending ICES on its behalf. He agreed to act as the IWC observer at next year's ICES meeting.

5.2 CCAMLR
The report of the IWC observer at the 1992 meetings of CCAMLR was available as IWC/45/10D. The major item of interest to the IWC Scientific Committee related to the Southern Ocean Sanctuary. CCAMLR's reply to a request for comments from the IWC is given in IWC/45/SAN9 and is discussed under Item 12. The Committee thanked de la Mare for attending the meetings on its behalf. Kock agreed to act as IWC observer at the forthcoming CCAMLR meetings.

5.3 CITES
CITES had requested comments on the status of the Irawaddy river dolphin, the rough-toothed dolphin, Risso's dolphin, the short-finned pilot whale and the dwarf sperm whale. This matter was considered by the sub-committee on small cetaceans (Annex F, Item 7.1) and under Item 17.3 of this report.

Ohsumi commented that in light of recent evidence to show that several populations of baleen whales are in a healthy state, he believed that the IWC should recommend that CITES should review its Appendices with a view to taking those species from Appendix 1.

5.4 CMS
The progress of the new Agreement on the Conservation of Small Cetaceans of the Baltic and North Seas (ASCOBANS) was discussed by the sub-committee on small cetaceans (Annex F, Item 7.2). ASCOBANS emphasises the need for research on the status and distribution of small cetaceans, for reporting and reduction of incidental takes and for ecosystem monitoring.

The Committee welcomes an exchange of data and information with ASCOBANS through the Interim Secretariat.

5.5 UNEP
Borobia reported on the main activities supported by UNEP during 1992 within the framework of the Marine Mammal Action Plan (MMAP) and in collaboration with the organisations of its Planning and Co-ordinating Committee (PCC). At the fifth PCC meeting, convened at UNEP, Nairobi, 16–18 February 1993, it was agreed that a revision of the MMAP should be undertaken as a matter of priority. UNEP encourages and welcomes a closer co-operation with the IWC Scientific Committee, particularly in view of the forthcoming revision of the MMAP.

The Committee recalled the role it had played in the development of the cetacean component of the first MMAP and **recommends** that it participates to the extent possible in the revision process. It notes that the next meeting is to be held in southern England and thus participation by the Chairman of the Scientific Committee and the Secretariat would have minimal financial implications.

5.6 NAMMCO
The reports of the IWC observer at the inaugural meeting of NAMMCO and the second meeting of the NAMMCO Council are given in IWC/45/10B. It was noted that a Scientific Committee of NAMMCO has been established. The Committee agreed that, where appropriate, close scientific co-operation with the NAMMCO Scientific Committee should be encouraged.

5.7 IATTC
Matters relating to IATTC are discussed under Item 17.2 and in Annex F. As yet no IWC observer has been appointed to attend the next IATTC meeting.

5.8 IUCN
The second five-year IUCN Action Plan for Cetacean Conservation is currently being finalised and the plan should soon become available.

5.9 Other organisations
The reports of IWC observers at the FAO Technical Consultation (IWC/45/10A) and the IOC assembly (IWC/45/10E) were also available to the Committee. The Committee noted the long history of co-operation with FAO and urged that this continue. Co-operation with IOC may become increasingly important in the light of discussions under Item 13.

6. RULES OF PROCEDURE AND TERMS OF REFERENCE

SC/45/O 1 provided information on recent discussions within the Commission with respect to the Rules of Procedure and terms of reference of its Committees, sub-committees and working groups. The Committee had no

comments on its terms of reference (Rules of Procedure, Rule M.1). SC/45/O 1 also contained a number of suggestions for modifications to the Committee's Rules of Procedure. The revisions agreed to by the Committee are given in Annex N1.

A matter relevant to the Committee's Rules of Procedure and the availability of papers (Rule E.7) arose during the meeting of the sub-committee on Southern Hemisphere baleen whales and was raised in plenary by Nomura. It concerned the inclusion of an Annex to SC/45/SHBa3 that referred to comments from the Commissioner of Japan (IWC/45/SAN8) and had been made available to the media. Nomura's statement on this matter is given in Annex N2. He concluded that the inclusion of Annex 1 in SC/45/SHBa3 was unacceptable and constituted a breach of Rule of Procedure E.7 with respect to confidentiality and wished the matter to be drawn to the attention of the Commission.

In response to an invitation by the Chairman to provide information on this matter, the author of SC/45/SHBa3 said that the document referred to (IWC/45/SAN8) was a Commission document already in the public domain. It had first been brought to his attention by media contacts in Tokyo and he had subsequently received a copy from Washington DC.

This matter led to a full discussion of the question of the availability of papers and reports of the Committee. The Committee agreed that it was important that its papers and reports should be freely available to foster scientific debate both within the Committee and in the wider scientific forum, although there was disagreement as to how this might best be achieved.

All members of the Committee agreed that:

(i) all reports and papers developed *during* the meetings of the Committee should be considered confidential before their distribution to the Commission (in the case of the Annual Meetings this means until the opening plenary of the Commission);
(ii) all primary papers and reports should be included in the archives of the Commission and thus be freely available; after the opening day of the Committee's meetings authors should not be permitted to withdraw their papers.

The divergence of opinion arose over whether primary papers should be considered freely available from the time of submission or whether they should remain confidential until the reports of the meetings to which they have been submitted have been distributed to the Commission. The Secretary described the current practice in this regard. He has taken the view that nearly all documentation submitted to the IWC is in the public domain. Thus, documents submitted to the Commission and its Committees, including the Scientific Committee, are circulated to members before meetings where this is possible. In particular, the Scientific Committee has recommended that members submit major papers to the Secretariat for circulation to the Committee at least 30 days before the Annual Meeting (IWC, 1988a, p.59). The domestic legislation of at least one member government means that any communication sent to it by the IWC is automatically in the public domain.

Nomura believed that the current practice was contrary to what many Japanese scientists and those concerned with the media had thought should be the practice under Rule E.7 which refers to 'Documents submitted to or developed at the Meeting .....'. He did not believe that Japan has ever

revealed such reports or papers to the public or press, prior to the opening session of the Commission Meeting. Should a country do so, it would face a strong objection from other governments, particularly should the document concern a position paper of one government, as is the case in his statement on SC/45/SHBa3. He believed many scientists would be discouraged from submitting valuable work if their names might be revealed to the media prior to the discussion of their work in the Scientific Committee. Therefore, he stated that what should be corrected is not the current Rule E.7, but rather the 'current practice' described.

The Committee draws the Commission's attention to this matter and in particular the two alternative views summarised below.

(1) The current rules of procedure on documents submitted are clear and should be retained. If papers are made available outside the Committee (particularly to the media) prior to meetings, this may hinder full and free discussion by the Committee.
(2) Papers should be considered available on submission. It is impractical to insist on confidentiality for a number of reasons, including: (i) it would preclude authors from circulating their papers to other than accredited scientists for comment before a meeting; (ii) it may lead to the incongruous position of a previously published paper being designated 'confidential' for the period of the meeting.

After this discussion, Walløe raised the question of Schweder's paper, SC/44/O 13 'Intransigence, incompetence or political expediency? Dutch scientists in the IWC in the 1950's: Injection of uncertainty', which was distributed last year. In the proofs of the Report of the Scientific Committee (p.92), the paper had been referred to as withdrawn from circulation although it had not been withdrawn by the author. In view of the discussion above and the view that all papers to the Scientific Committee should be fully available, at least after the opening plenary of the Commission, Walløe asked that the title of the paper should be included in the Report of the Scientific Committee from last year and the paper itself be included in the Commission's archives and thus be available in the usual way.

The Chairman informed the Committee that the paper had been withdrawn by the Secretary after consultations with the Chairman of the Commission, in the light of a notification of possible legal action for libel and defamation against the author of SC/44/O 13 and his superiors, and the Secretariat since it had distributed the document. The decision had been taken above the level of the Scientific Committee and therefore could not be changed by the Scientific Committee.

Walløe stated that the current 'Rules of Procedure of the Scientific Committee' provide no provision for the withdrawing of scientific papers by the Secretariat or by the Commission (see especially Rule E.7, first paragraph), and therefore repeated his request.

The Committee agreed that this matter should be referred to the Commission.

7. COMPREHENSIVE ASSESSMENT – REVISED MANAGEMENT SCHEME (also see Annex D)

The Committee notes that the RMP has been developed to replace the 'New Management Procedure' and that it does not require the classification of stocks.

There has been some confusion over the basic terminology used both within the Scientific Committee and the Commission. The Committee agreed to the definitions given below.

Catch Limit Algorithm (CLA). This is the process used to calculate a catch limit for a Management Area (as defined in Annex H).

Revised Management Procedure (RMP). This refers to Annex H of this report (this is the amended 'Draft Specification for the calculation of catch limits in a Revised Management Procedure for Baleen Whales' presented last year in IWC, 1993g).

Revised Management Scheme (RMS). This includes all scientific and non-scientific aspects of management, as covered in the Commission's resolution (IWC, 1993c).

7.1 Further development

7.1.1 Documentation of programs

Full documentation of the program implementing the CLA is given in Annex H and Annex I. Documentation of the control programs implementing the simulation trials is contained in reports of the Committee (IWC, 1990c; 1991c; 1992b; g; h; 1993j; SC/45/Mg7). The Committee agreed that this fulfilled the Commission's requirements on this matter as expressed in last year's Resolution (IWC, 1993c). In addition, the Committee believed that it may be of value to its work if a set of more detailed documentation be formulated. To this end, members of the Committee are requested to forward their suggestions and comments to the Secretariat by 1 December 1993. These comments will be considered by the management steering group when developing this more detailed documentation. Progress will be reported to the next Annual Meeting.

7.1.2 Minimum standards for data

SC/45/Mg11 compiled and summarised previous discussions within the Committee on this matter and highlighted some issues that remain to be addressed. Specific suggestions on some items were presented in SC/45/Mg6.

At last year's Annual Meeting (IWC, 1993f, pp.60–2) the Committee focussed on catch and abundance data. The Committee also addressed in more detail the question of data not directly required for the implementation of the RMP. It noted that it had not completed development of guidelines and minimum standards for absolute abundance data and corresponding estimates.

Subsequently, the Commission's Resolution on the Revised Management Scheme (IWC, 1993c) stated that one of the additional steps required to complete the RMS was agreement upon minimum data standards.

At this meeting, the Committee agreed to structure its discussions as in previous years i.e. initially focussing on minimum data requirements and standards for those data required to implement the CLA (catch data and estimates of absolute abundance). With respect to other data, the Committee agreed that these could be considered as those required for the RMS and those, although not required, that may be valuable to obtain from whaling operations where practical.

Data required as input to the CLA

CATCH DATA

The Committee agreed that the following information from whaling operations is required for all successfully caught and struck-but-lost animals:

(1) date of capture (or striking);
(2) species;
(3) sex (this may be unknown for struck-but-lost animals);
(4) position of capture (or striking) to nearest minute of latitude and longitude.

For those species/Management Areas to which the RMP is being applied, information on items 1–4 above (where known) is also required from all member countries for all other deaths not attributable to natural mortality (this does not include stranded animals) e.g. due to entanglement in fishing gear; collisions with vessels. The Commission should attempt to obtain this information from non-member countries.

In discussing the question of verification, the Committee recognised that such matters clearly overlap with Technical Committee deliberations. It was agreed that from the Scientific Committee's perspective, it is important:

(a) that the data specified are provided;
(b) that they are accurate; and
(c) that their timeliness ensures that catch limits (including taking the sex of catches into account) are not exceeded.

The precise practical details of how this is achieved are a matter for the Technical Committee (SC/45/Mg6 provides one example of how these aims might be achieved). The Committee noted that other aspects of supervision and control of whaling operations will be discussed by the Technical Committee. The suggestion from the Committee given below necessarily includes some options that are Technical Committee matters. These are shown in square brackets.

'The above data shall be verified [either from the catcher vessel or at the land station] by suitably trained [national inspectors and/or international observers] inspectors. The data shall be transmitted [daily/immediately/in a timely fashion] to the IWC Secretariat. The Secretariat shall monitor the accumulated data and, in a timely fashion, notify [member nations/operations] that the catch limit has been reached.
  After the end of each season, a set of verified records for that season shall be submitted to the Secretariat.'

ESTIMATES OF ABSOLUTE ABUNDANCE

Following discussions last year (IWC, 1993f), the Committee considered the results of trials to examine the behaviour of the CLA for abundance estimates with different levels of precision. The specifications of the trials, and a representative set of the results obtained are detailed in Annex D, Appendix 2.

Trials involving abundance estimates with high CVs indicated that, while high CVs *per se* do not lead to increased risk (although they do lead to reduced catches), problems can arise if the estimate of the CV is unreliable. Under these circumstances, an estimate whose true CV is high may be erroneously believed to have a low CV, which can mislead the CLA. The original trials indicated that increased risk can be caused when the estimate of the CV is based on one degree of freedom only (e.g. an inter-transect variance estimated from only two transects). These problems disappeared when the trials were modified so that each CV estimate was based on at least five degrees of freedom; the results of these modified trials (Annex D, Appendix 2) showed the desired properties of decreasing catch and decreasing risk as the precision of the abundance estimates drops, for the cases where these estimated CVs are unbiased.

The Committee considered that the method for dealing with zero estimates (Annex D, Appendix 3) that was used

in the trials with high CVs, was conservative in the sense that it ascribed greater weight to zero estimates than they would receive if all components of their variance were taken into account. It **recommends** that the method be used with the CLA until, and if, a superior alternative becomes available.

The Committee considered the question of observation and process errors in some detail (Annex D, Item 6.1.2). Observation error is the sampling error arising from survey methods and design. The level of observation error is inversely related to the amount of survey effort, provided that the survey is well designed. Process error reflects the extent to which abundance estimates from repeat surveys of the same area in successive years will vary more than would be expected on the basis of the observation error alone, for example due to variations in the numbers of whales moving into or out of the survey area.

The Committee **recommends** that the question of process error in abundance estimates with low estimated CVs should be considered further. In particular, the desirability or otherwise of including estimated process error in the variance estimates for use with the CLA should be examined. It further **recommends** that until this matter has been addressed, if an abundance estimate with a low estimated observation CV is obtained (e.g. with a CV<0.15), the estimated CV should be examined carefully with respect both to possible underestimation of observation error and to the probable level of process error, before being used as input to the CLA. The Committee agreed that the problem was not sufficiently serious to warrant postponing use of the CLA while the matter was investigated.

It was noted that process error is incorporated in the multi-stock trials in the sense that the movement from year to year of whales between Management Areas and, in some cases, the fraction of whales outside the survey area, are modelled explicitly in various ways. In order to examine the level of process error (in terms of a CV) implied by the models used in the multi-stock trials, the Southern Hemisphere minke whale implementation trials were re-run and the variability (over time) of the abundance in each half-Area was examined. The results showed that the extent of the movement of whales between Management Areas from year to year encompassed by the models used is reasonable (Annex D, Appendix 5).

As a result of the discussions on process error the Committee agreed to modify the 'Guidelines for conducting surveys and analysing data' (given as Annex J, see Item 7.1.3 below) and the specification of the RMP (given as Annex H, see Item 7.1.5 below).

Requirements with respect to future abundance estimates under the RMS are included in Section 2 of Annex J and are repeated here:

Notification and provisions for co-operation
Plans for survey design and proposed methods of analysis of the resulting data (including provisions for co-operation with Scientific Committee members, where appropriate) for use in the RMS shall be reviewed by the Committee in advance of their being carried out, although prior approval by the Committee is not a requirement.

The Secretariat shall be notified of such surveys at least 2 months prior to their start. The Secretariat shall inform the Scientific Committee at the time of notification.

Documentation of the survey
The following documentation shall be provided to the Secretariat no later than 6 months prior to the meeting of the Scientific Committee in which they are to be used:

Cruise planning report
Field instructions and example data sheets
Cruise summary report
Documentation of any experiments conducted, e.g. for $g(0)$ estimation
Documentation of methods used to estimate distances and angles to sighted groups
Specification of data accuracy verification procedures
Documentation of observations excluded for any reason

Data requirements
The data outlined in Appendix 1 of Annex J shall be provided to the Secretariat no later than 6 months prior to the meeting of the Scientific Committee in which they are to be used.

Data shall be provided to the Secretariat in fully documented computer readable data files. The Secretariat shall be consulted as to the most appropriate format.

Verification of the data should be carried out by those carrying out the survey. This verification will be audited by the Secretariat.

Analysis requirements
The analysis of the results shall be provided to the Secretariat and circulated to the Scientific Committee no later than 3 months prior to the meeting of the Scientific Committee in which they are to be used.

The Secretariat shall make available a suite of validated programs for analysing sightings survey data using 'standard' methods outlined in the Guidelines. These should normally be used to analyse data collected in the 'standard' manner. Where standard analyses have been carried out, those carrying out the survey shall document the relevant options chosen in these analyses. The Secretariat will investigate the implications of these choices for the resultant estimates.

If new methodologies are used, a full description and computer programs, including documentation to allow such programs to be validated, shall be provided to the Secretariat. The latter will be validated by the Secretariat in due course, on the instruction of the Scientific Committee.

OTHER REQUIREMENTS FOR DATA
As noted last year, the Committee has recognised that data currently not used directly in the RMP can play an important role in providing an independent check on the status of populations (IWC, 1993f, p. 61). In addition, biological data are used to reduce uncertainty in the identity of stocks; an important part of specifying and verifying Management Areas, and movements of whales among them.

There was considerable discussion as to whether data other than those required for the CLA could be considered as *minimum* data required for the RMS, or whether, although the Committee may still recommend that the Commission *requires* them to be collected, they are not considered as *minimum* requirements. Most members of the Committee agreed that the latter was the case, and was implicit in the development process over the years. Other members, noting the discussion in SC/45/Mg11, believed that data that may allow independent monitoring of the performance of the RMP and the status of the stocks should be considered as *minimum* requirements for the RMS.

In the plenary on the final afternoon, a working paper amplifying the latter view was presented to the Committee. After some discussion, it was agreed that this could become a minority statement (Annex O1). In order not to displace the balance in the report, it was also agreed that an Annex (Annex O2) could be prepared that expanded upon the rationale of most members of the Committee expressed above. Given the time available it was not possible for the wording of Annex O2 to be agreed by all members of the Committee who shared this view. The differences between these two views may require further discussion at next year's meeting.

Neither view precludes the Committee recommending that the Commission requires the collection of certain data should it so wish.

Last year, the Committee had proposed that an appropriate approach would be the introduction of an 'enabling' paragraph into the Schedule, stating that, in response to requests from the Scientific Committee, the Commission could require certain samples/data from whaling operations. The Committee reaffirmed this view and agreed that a review of the data and sampling requirements should occur on a regular basis. The Committee also recognised that mere collection of data or samples was not sufficient. Provision for archiving and timely analysis of the data and submission of results to the Scientific Committee must be included.

The Committee **recommends** that such an enabling paragraph be included in the Schedule (a suggested text is given below).

'Contracting Governments shall arrange for the collection, archiving and analysis of such biological samples, tissue samples, specimens and data from whaling operations as the Commission may from time to time decide on the advice of the Scientific Committee. The results of the analyses of these collections shall be reported to the Commission in a timely fashion.'

The Committee agreed that any additional requirements must be carefully justified. It stressed that non-inclusion of any items in 'requirements' here does not imply that they are not biologically valuable or that they should not be collected, but simply that the Committee does not consider them to be as important in the present management context as those items included below. It reiterates that items other than those included below may be added at future meetings. In addition, it does not preclude the Committee requiring other information under separate agenda items (e.g. Plenary Item 13). It noted that only one of its Recommendations below, that for tissue samples, was not currently included in some form in the current Schedule. Time had not permitted a complete review at this meeting. Only some of the potential data items identified in discussions are considered below. Data should be provided to the Secretariat in computer readable form, where applicable.

Length: The length of each animal is currently a requirement in the Schedule (Para. 24(b)). The Committee noted that such data can be easily collected. It recognised that, for example, major changes over time in the length distributions of catches by Small Area would warrant the attention of the Scientific Committee. It also noted that such information is valuable, perhaps essential, in interpreting the other data that are discussed below.

The Committee **recommends** that the length* of each animal caught be required. These data shall be reported to the Secretariat at the end of each season and included in the IWC database.

*Measured in a straight line parallel to the whale from the tip of the upper jaw to the notch of the flukes.

Foetus: The current Schedule requires that the length and sex of foetuses, if present, be recorded (Para. 24(b)). To ascertain whether small foetuses are present requires careful searching by trained personnel. Determining the sex of small foetuses is difficult and requires trained personnel. The Committee agreed that foetal data may help to interpret apparent pregnancy rate data and/or provide some information on stock identification.

The Committee **recommends** that, if sufficiently trained personnel are present, recording of the presence, length and sex of foetuses should be required. If it is not possible for such personnel to be present, these data should still be recorded where possible, and the Committee should be informed that the data were collected by untrained personnel. These data shall be forwarded to the Secretariat at the end of the season and included in the IWC database.

Age: At least one earplug from each whale caught is currently required under a 'where possible' clause in the Schedule (para 29(a)). They require collection by trained personnel. Processing of the samples is required in order to estimate the age of the animals. The issues of major changes over time and interpretation of other data are also applicable to age data. Unlike length data, technical problems in collecting earplugs may result in sampling bias.

The Committee **recommends** that the collection, where possible, of at least one earplug from each whale be required. In the case of Northern Hemisphere minke whales, bullae are an acceptable alternative to earplugs. The resultant age readings should be submitted to the Secretariat within *time*[1] of the close of the season and included in the IWC database.

Ovaries: both ovaries from each female caught are currently required under a 'where possible' clause in the Schedule (Para. 29(a)). They require collection by trained personnel, but the collection is not difficult. Processing of the samples is required in order to obtain corpora counts that provide information on the reproductive history of individual females and can be used to infer reproductive rates. The Committee agreed that, for example, major changes over time in apparent pregnancy rates would warrant the attention of the Scientific Committee. Information on both length and age is valuable in interpreting these data.

The Committee **recommends** that the collection, where possible, of both ovaries from each female caught be required. The resultant corpora counts shall be submitted to the Secretariat within *time*[1] of the close of the season and included in the IWC database.

Tissue: at present, there is no requirement for tissue samples to be collected. However, the value of genetic information which can be obtained from tissue samples for reducing uncertainty in stock identity is clear. Collection of samples requires trained personnel but is not difficult. Samples may be stored in 20% DMSO in saturated salt solution (Amos and Hoelzel, 1991). This is also sufficient for archiving purposes. Processing of samples requires trained personnel. While stock identity analyses may not require material from every animal, collection from each animal is not difficult and may be simpler than specifying a random sampling scheme. In addition, this would allow analyses on a fine scale (e.g. SC/45/SHBa13).

The Committee **recommends** that the collection of a suitable quantity of tissue* from each animal be required. A list of archived samples shall be forwarded to the IWC Secretariat at the end of the season.

*e.g. 5cm² of skin.

The Committee agreed that access to these samples should be obtained through the same procedure adopted last year (IWC, 1993f, p. 82) for biopsy samples collected during IDCR cruises, i.e. that researchers wishing to obtain samples should submit a research proposal that would be reviewed by the Committee at Annual Meetings.

Lactating animals: The Schedule forbids the taking of whales accompanied by calves. Traditionally, if a lactating female (Para. 1C) is taken this is regarded as an infraction and must be reported to the Commission.

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[1] An appropriate time needs to be determined, following discussion with those familiar with processing samples.

The Committee **recommends** that it be a requirement to record any lactating whale that is taken. This information shall be forwarded to the Secretariat at the end of the season and included in the IWC database.

Operational data: The Committee last examined the value of such data at the Comprehensive Assessment Workshop in 1987 (IWC, 1989a). The Committee agreed that operational data may be of value in monitoring. It is important if such data are to be used that they are obtained from the start of any whaling operation. Insufficient time was available at this meeting to review the most appropriate factors to record in this regard. It was noted that the Schedule (Para. 28 and Appendix A) currently requires detailed operational data to be collected (although some of these are only relevant to sperm whales). Technology now exists that would make recording of such data less onerous.

The Committee **recommends** that the requirements for collection of operational data included in the current Schedule be retained. The data shall be submitted to the IWC Secretariat within *time*[2] of the close of the season. The Committee draws the Commission's attention to the fact that future deliberations may result in the Committee reducing the number of such items required.

7.1.3 Guidelines for conducting surveys and analysing data

In its Resolution on the RMS last year, the Commission had stated that one of the additional steps required was agreement on guidelines for conducting surveys and analysing the results (IWC, 1993c). A suggestion for such guidelines was presented in SC/45/O 13. Specific proposals on certain items were given in SC/45/Mg6. The authors of SC/45/O 13 had identified certain topics that required further discussion, particularly on the questions related to minimum standards for data. These were considered under Item 7.1.2. It was noted that these Guidelines will require updating from time to time as new methodology and analytical techniques are developed.

The Committee **recommends** that the Guidelines for Conducting Surveys and Analysing Data within the Revised Management Scheme given as Annex J be adopted.

7.1.4 Mechanism for amendment of the RMP

The Committee distinguished between: (i) mechanisms for amendment of the RMP itself; and (ii) mechanisms for the amendment of case-specific implementations. The former involves amendment to the defining text of the RMP, while the latter involves changes to the designation or boundaries of Management Areas and the choice of catch-cascading and/or catch-capping options for particular implementations.

Amendment of the RMP

At last year's Annual Meeting, the Committee had outlined a suggestion for a three-step process for the evaluation of amendments to the RMP and had recommended that the matter be considered further (IWC, 1993f, p.58). It had also recognised that the protocol for amendment should in principle form part of the RMP specification.

As last year, the Committee emphasised the thorough and extensive testing process that had accompanied the

development of the RMP and that the question of amendments should not be approached in a casual manner. In particular it agreed that, for a proposal for an amendment to be considered, there needed to be some evidence, in the form of simulation trial results or otherwise, that the proposed amendment would result in improved performance in at least some respect. Following the suggestions from last year, the Committee **recommends** that the following protocol forms the basis for evaluating amendments to the RMP.

(i) Adequate notice shall be given to the Commission and the Scientific Committee of any proposal for amendment to the RMP.

(ii) Given the time it will take for the Committee to evaluate such proposals, suitable evidence shall be presented to indicate that the proposed amendment would indeed represent an improvement. In this context, an amended procedure that allowed higher catches or lower catch limit variability will only be considered an improvement by the Committee if it performs adequately on all risk-related performance statistics, and better than the current version of the RMP on at least some catch- or risk-related performance statistics. This evidence shall take the form of results from appropriate, fully specified and programmed simulation trials, a list of which needs to be developed by the Scientific Committee (based *inter alia* on Table 3 in IWC, 1993k). These trials shall have been carried out by the proposer.

(iii) The Committee may then specify further simulation trials and/or modification of trials already carried out along with criteria for the evaluation of the results. Advice to the Commission may then be given at its next Annual Meeting, subject to completion of the work specified.

It was understood that the above process would only need to be followed in the case of proposed changes to the substance of the RMP, such as changes to the structure or parameters of the CLA or the multi-stock rules, not with merely textual changes to the RMP specification aimed at clarifying ambiguities or overcoming practical problems of implementation.

With reference to the report of the Working Group on North Pacific minke whale trials (Annex G), the question was raised as to whether a catch limit could be set for a specific time of year. The Committee agreed that this matter required further discussion.

Amendment of case-specific implementations

The Committee recognised the need to distinguish between two types of 'assessment', as previously defined, that need to be conducted under the RMP. The first is the relatively simple and routine business of applying the CLA to existing Management Areas with the existing choice of catch-capping and/or catch-cascading options in order to calculate catch limits. For clarity, this is termed 'Catch Limit Calculation' (CLC). The second type is an 'Implementation' or 'Implementation Review' in the course of which, revisions to Management Area boundaries or designations (at the Small, Combination, Medium, or Large Area levels) could be considered, along with possible changes to the selection of catch-capping and/or catch-cascading options. The Committee agreed that the wording of the RMP specification (Annex H) should be modified to reflect this distinction (see Item 9.3.1).

The timetables for CLCs and Implementation (Review)s need not be linked. The Committee recognised that changes to Management Areas will need to be approved by the Commission before they take effect. Until then, CLCs would continue to be based on the existing Areas.

An Implementation Review would take account of new information on stock identity and related matters. If major changes to Management Area boundaries or other aspects of the implementation were indicated, then it may be necessary in some cases to perform further implementation trials, in which case the Implementation Review might not be completed in the course of a single meeting. Any CLCs that needed to be performed before the completion of the Implementation Review would continue to be based on the existing boundaries and options.

The Committee **recommends** that both Implementation (Review)s and CLCs be performed on a Regional basis. It also **recommends** that the maximum period of validity of CLCs remain at five years, as specified in the current text of the RMP. The Committee further **recommends** that a new Implementation Review for each species and Region be scheduled for not more than five years after the preceding Implementation (Review) for the species and region, but that it need not necessarily be completed within the five-year period. In contrast to the CLC, the results of an Implementation (Review) should not 'lapse' after a specific period. In order to plan its work, the Committee would normally need to request that relevant new data or analyses pertaining to stock identity or other matters relevant to case-specific implementation of the RMP be submitted or notified well in advance of the Implementation (Review).

The Committee emphasised that Implementation Reviews and CLCs can each be conducted before the end of the specified maximum periods when there are reasons for doing so. A new abundance estimate would normally constitute sufficient ground for carrying out a new CLC, but an Implementation Review would normally only be carried out before the scheduled time if substantial new information is available.

7.1.5 Revision of 'Draft Specification for the Calculation of Catch Limits in a Revised Management Procedure'
Detailed review of the draft specification of the RMP (IWC, 1993g) presented last year, has resulted in changes to some sections of the text. These changes do not change the form of the RMP but result in substantial improvements in clarity. The Committee **recommends** that the specification of the RMP given as Annex H be formally adopted by the Commission.

Revisions of terminology and text for internal consistency
In the light of discussions in SC/45/Mg9 and Mg12 and under various agenda items, the Committee agreed the revised text shown in Annex H. The Committee expressed its appreciation to Butterworth and Cooke for their careful review and redrafting of the text of Annex H during the past year and at this meeting for consideration by the Committee. Most of the changes are of a technical nature to remove minor inconsistencies and ambiguities. They also include modifications relating to the variances of estimates of abundance, arising from the discussions above. The two modifications of consequence concern the period pertaining to the catch phaseout rule and the definition of an 'Assessment'.

Number of years until phaseout rule invoked
At its previous meeting, the Scientific Committee had discussed arguments for and against two possible choices for the period after an 'Assessment' (as then defined) when catch limits are reduced in the absence of further surveys (IWC, 1993f, p.59). Both options (five and ten years) had been put forward to the Commission, but the Commission has yet to make a final decision on the matter. The Committee noted that the results of simulation trials of the RMP showed satisfactory performance for a ten year inter-survey interval. It also noted that the possible time-lag between a survey taking place, and an agreed estimate of abundance from that survey being available for input to the RMP, necessitated allowing for an eight year phaseout period even if surveys were taking place on a regular five-year basis. Taking note also of other sound reasons (not related to the results of the RMP simulation trials) advanced at the previous meeting for a phaseout period less than ten years (IWC, 1993f, p.59), the Committee **recommends** that the period specified in the phaseout rule be eight years. The Committee further **recommends** that the revised text (see Annex H, Section 3.2.2) include a specification that Management Areas to which the RMP's Catch Limit Algorithm is applied should normally be surveyed at intervals not exceeding six years.

7.1.6 Revision of the Schedule
The Committee referred to its views on this matter expressed last year (IWC, 1993f, p. 60). It notes that while the RMP as detailed in Annex H requires formal adoption by the Commission, the annotations should be considered as more dynamic and thus requiring endorsement rather than formal adoption. The Committee reaffirms that development of the RMP has been a long and difficult task, involving a wide range of scientific and technical issues and draws the Commission's attention to the protocol on amending the RMP it has recommended above. The Committee again **recommends** that the Commission exercises great caution before considering any changes to Annex H when developing possible Schedule amendments.

The Committee agreed that the Chairman and Rapporteur should produce a compilation of those parts of the report that are relevant to the Commission's Working Group on the Revision of the Schedule, to be considered together with the suggestions presented in SC/45/Mg1.

7.2 Preparations for implementation
In accordance with its view expressed last year (IWC, 1993f, p.62) the Committee agreed that, should the Commission wish to set catch limits according to the RMP during its forthcoming meeting, these should be calculated by the Secretariat, checked by the Chairman and then transmitted by him to the Commission.

7.2.1 North Atlantic minke whales
Discussions of SC/45/Mg2 and SC/45/Mg4 are given in Annex D, Item 11.1. The Committee agreed that it should concentrate on interpreting the results of the implementation trials for North Atlantic minke whales. These trials had originally been conducted during the last annual meeting in Glasgow. The trials had been repeated after the meeting following correction of certain minor errors. The corrected results are given in IWC (1993j, pp. 167-85).

Trial results were available for the following management options:

(i) application of the CLA to Small Areas without invoking any catch-capping or catch-cascading options;

(ii) catch-cascading over the Central and Eastern Medium Areas: (a) with catch-capping at Medium Area level; (b) without catch-capping;

(iii) catch-cascading over the Eastern Medium Area and over the CIC+CG+CM Combination Area, but treating the CIP Small Area separately.

Sub-options (ii) (a) and (b) are identical with respect to the trials and results because catch-capping has no effect on Small Area catch limits when catch-cascading is applied to the same combination of Small Areas. The two sub-options were therefore considered as one for the purpose of running the trials and interpreting the results.

Inspection of the results revealed that option (ii) consistently outperformed both other options in all trials in terms of the average catches obtained. The catch advantage of option (ii) over option (i) ranged from 8% to 20%. The catch advantage of option (ii) over option (iii) ranged from 1% to 5%. The risk-related performance of option (ii) was also satisfactory in almost all trials. Only in two trials was the lower 5%-ile of the final population sizes below the nominal protection level of 54%, and then only by a fairly small margin (to 50.1% in the worst case).

The Committee therefore **recommends** option (ii) for implementation of the RMP for North Atlantic minke whales. The boundaries of the Management Areas are specified in Annex K.

7.2.2 Southern Hemisphere minke whales
Northern boundary of Small Areas
SC/45/Mg9 proposed moving the northern boundary of the Small Areas for Southern Hemisphere minke whales from 60°S (with deviations to the north in some sectors to cover the extent of IDCR surveys) that had been agreed last year (IWC, 1993i) up to 55°S, because it is possible for certain 10° sectors to be completely covered by ice up to 60°S when surveyed early during these cruises in some years.

The question of which data to use for abundance estimates for the area between that surveyed on IDCR cruises and 55°S (for example Japanese scouting vessel data) and the best way of analysing them had been discussed elsewhere (IWC, 1993f, p. 107) There could also be a problem in taking the Small Area catch limits in some sectors in some years when there was extensive ice cover up to 60°S.

The Committee agreed to retain the current boundaries for the time being, but **recommends** that variations in the northerly extent of the boundaries should be considered by the Committee next year, taking into account geographical and other factors for each Small Area. The boundaries are specified in Annex K.

Review of implementation trial results
SC/45/Mg7 contained the results of the revised implementation trials for Southern Hemisphere minke whales. Certain minor corrections and modifications had been made to the trials performed during last year's meeting, and additional trials which had been specified at last year's meeting but not run (IWC, 1993j, pp. 154–5) had now been carried out.

The 'assessment' schedule simulated in the trials had been revised to ensure that 'assessments' were conducted on a regional basis at least every five years in conformity with the RMP specification.

A total of six different management options had been simulated in the trials: (1) application of the CLA to Small Areas only without catch-cascading; (2) catch-cascading at the half-Area level; (3) catch-cascading at the full Area level; (4–6) as 1–3 but with the addition of catch-capping to one of the Medium Areas.

Last year the Committee had agreed that implementation of the RMP was possible for Southern Hemisphere minke whales on a Small Area basis, and that it was not necessary to specify any further implementation simulation trials (IWC, 1993f, pp. 66–7). The only task of the Committee this year was to examine the results of the trials conducted in order to determine whether use of catch-cascading and/or catch-capping options could be recommended in preference to implementation on a Small Area basis.

After consideration of SC/45/Mg8, that included trials with catch-cascading in only some half-Areas, the Committee agreed to restrict its discussions to the results from the trials specified at last year's meeting, as had been agreed at that time (IWC, 1993f, pp. 66–7).

The key features of the trial results given in SC/45/Mg7 (information on total catches and lower 5%-iles of the initial, lowest and final depletions of the 'most depleted' stock, for each option) are given in Annex D, Appendix 6. The results with catch-capping are not included because they were virtually indistinguishable from the results without catch-capping.

The Committee agreed that it should not recommend catch-cascading at the full Area level because of the greater degree of depletion below the nominal protection level of 54% predicted under this option and the fact that the additional catch benefits relative to half-Area catch-cascading were not great.

The Committee had more difficulty choosing between catch-cascading at the half-Area level and implementation without catch-cascading (the 'Small Areas option' in Appendix 6) because the balance of advantage was less clear. On the one hand, the Committee felt obliged to take into account the Commission's expressed desire that stocks not be depleted to below 54% of their unexploited level, and that stocks initially below this level be permitted to recover. On the other hand, half-Area catch-cascading yielded about 60% more than the Small Areas option in terms of total catch, which was also an important criterion to be taken into account, because it had been one of the main criteria used in the development of the RMP and related directly to one of the Commission's expressed objectives.

Several members expressed concern that the 5%-ile statistics showed that the catch-cascading options appeared not to allow an initially depleted stock to recover. Although some aspects of the interpretation of the catch-cascading results had not been resolved, the trial results were sufficient to enable the Committee to recommend implementation of the RMP on a Small Area basis. They emphasised the importance of moving forward on the basis of the trial results to hand.

There was considerable support for this proposal. The Committee therefore **recommends** the selection of the Small Areas option (without catch-cascading) for the implementation of the RMP for Southern Hemisphere minke whales.

Komatsu raised the point that 15° rather than 10° sectors might be more appropriate for Small Areas. The Committee noted that provision for an Implementation Review is made in Annex H and discussed under Item

7.1.4. It was noted that normally an Implementation Review would only be carried out before the scheduled time 'if substantial new information was available'. It agreed to put the matter on the Agenda for next year when the Committee could decide whether such an Implementation Review was warranted.

7.2.3 North Pacific minke whales
Report of Working Group meeting
The Working Group on North Pacific minke whale management trials had met for three days immediately prior to the meeting of the Scientific Committee to specify implementation trials for the application of the RMP to minke whales in the western North Pacific. Its report is given in Annex G.

The Working Group had separated the process of specification into two phases:

(1) to construct a set of operating models, based on the available data, reflecting the plausible hypotheses for how aggregations of minke whales appear to move around the northwest Pacific area in time and space, and to use this model to develop an initial range of simple options for the application of the RMP;
(2) to use the results of (1) to determine, probably over several iterations, the final range of options to be tested by trials for implementation.

At this year's meeting it was possible to address the first phase only. The Working Group had produced a draft specification by amending an early draft for the operating model developed prior to the meeting (SC/45/Mg5). The Working Group's specification is the first attempt at addressing the complexities arising from the seasonal migrations of whales through areas of past and potential future whaling operations.

During the meeting, Punt undertook initial simulations using the specification to determine whether the operating model could be set up such that its behaviour conformed to the various hypotheses used in its specification. After several slight modifications, the Committee agreed that the specification, as finalised in Appendix 3, Annex G, was satisfactory for the first phase of the implementation process.

It was noted that, in the absence of abundance estimates for minke whales in the Sea of Japan, Yellow Sea and East China Sea, that the initial setting up of the operating model assumed that the sub-stocks in these areas were depleted to 30% of their initial abundance. This figure was roughly derived from the analysis of CPUE data from the South Korean fishery (Gong and Hwang, 1984; Rørvik *et al.*, 1984). It was agreed that the depletion, including its CV, used for these sub-stocks would be refined using a HITTER-FITTER analysis of the CPUE data. It was also noted that some of the sub-stocks in the Sea of Japan, Yellow Sea and East China Sea were very small in some trials. The Committee agreed that lower bounds of the proportion of each sub-stock in the total stock of 5% and 15% should be tried and that a lower limit of depletion of 5% on the sub-stocks should be used.

The Committee noted that the proposed mixing matrices led to considerable numbers of whales from the putative Western stock appearing in Japanese coastal sub-areas. It was agreed that the trials should examine the sensitivity of the results to a range of assumed mixing rates.

The Committee also noted the desirability of obtaining improved data from the populations in addition to those from the 1992 sightings survey, particularly stock abundance estimates for the Sea of Japan, Yellow Sea and East China Sea, and additional information on stock identity and the migration pattern. Such data would lead to improvements in the operating model, and reduce the range of plausible hypotheses that need to be considered.

The Committee agreed on the initial sets of Small Areas to be tried in the first phase of implementation trials specified in Annex D, Appendix 7. It was emphasised that these sets of Small Areas were only a first attempt at definitions, and that flexibility was required to refine them when the results of initial implementation trials became available. On a similar basis, the Committee agreed to the initial set of management options set out in Appendix 8 of Annex D.

Intersessional work
The Committee agreed that a Steering Group was required to carry out the work of refining the implementation trials and management options during the intersessional period. Hammond agreed to convene this group, the composition of which will be finalised after the meeting.

It was noted that data from a sightings cruise conducted in 1992 would become available soon, and that further new relevant data which could be used to improve the operating model could also become available in the coming year. The Committee stressed that any other data which may become available should be brought to the attention of the Steering Group as early as possible so that any re-running of trials using new data can be minimised.

The Committee discussed the timetable for completing the implementation trials. Given the considerable amount of work which had been identified, it was suggested that the implementation trials may not be completed and final recommendations on management options made until the 1995 meeting of the Scientific Committee. If the Commission requires this advice at its 1994 meeting, the Committee agreed that a Special Meeting of the Scientific Committee of about one week would be needed. The Committee agreed that the Commission should be advised of these two options.

7.3 Other considerations relating to RMP implementations
In its Resolution of last year (IWC, 1993c), the Commission had stated that one of the additional steps required to complete the RMS is agreement on arrangements to ensure that total catches taken did not exceed RMP catch limits over time. Some aspects of the question, such as supervision and control, fell within the competence of the Technical Committee rather than the Scientific Committee. However, there may be some scientific aspects on which some advice could be given.

Some members suggested that the use of the catch-capping option provided for in the RMP (either alone or in combination with catch-cascading) would go some way towards meeting the Commission's concerns. They believed that it may provide a mechanism for accounting for, at the Medium or Large Area level, catches taken in Residual Areas, and/or catches taken in Small Areas in excess of RMP catch limits.

Other members believed that the catch-capping option could not provide a mechanism for ensuring that total catches taken did not exceed catch limits calculated by the RMP.

The general question of how and when to make use of the catch-capping option was also raised. Some members noted that the process of development of the RMP, including all of the robustness trials, had concentrated on

the case where the 'core' CLA is applied to a single biological stock in a single area. Because Medium Areas are defined as representing the 'known or suspected range of a biological stock', catch-capping at Medium Area level ensures that the total catch limit for a suspected biological stock does not exceed the amount that would be obtained by applying the core procedure, whose robustness has been demonstrated, to the stock. These members suggested that catch-capping is likely to be most important when a stock is exploited in more than one part of its migratory range: in such cases RMP catches could be taken from the same stock twice over in the absence of catch-capping. The implementation trials completed to date had all assumed that future catches would be restricted to one part of the migratory range and hence did not throw much light on the question of whether and when catch-capping would be necessary. These members suggested that in cases where the implementation trials indicated that Medium Area catch-capping would engender little or no penalty (in terms of catches obtained or other aspects of performance), catch-capping might be applied on a routine basis.

Other members stated that if the situation were to arise in which a stock is exploited in different parts of its range, then new implementation trials for that species in the region would need to be conducted to determine on a case-by-case basis whether modification of management options is required. For example, the implementation trials for North Pacific minke whales had been specifically formulated to take account of this (Annex G).

8. COMPREHENSIVE ASSESSMENT – SOUTHERN HEMISPHERE BALEEN WHALES
(also see Annex E)

8.1 Methodology for estimating abundance

Last year the Committee recommended the development of a general linear model framework to permit evaluation of alternative models of spatial and temporal distribution and a working group had been established to work intersessionally (IWC, 1993f, p.63).

Two related problems had been identified last year involving the need to explore:

(1) the application of interpolation methods to provide abundance estimates for areas and times not covered by the IDCR cruises;
(2) methods to combine IDCR data and sightings survey data from other sources.

A preliminary investigation of generalised linear models to accomplish (1) was contained in SC/45/SHBa23. It used Japanese scouting vessel (JSV) data for 1978/79 to 1987/88. Data were aggregated over years and on a 2° latitude/30° longitude basis, with fits to data over longitude ranges 60–70°S and 58–72°S. A statistically significant declining trend northwards in density was readily apparent but the data were unable to support significant estimates of longitudinal effects at the 30° level. Significant results were obtained from a Fourier series analysis, apparently correlated with the northward extent of the ice-edge, but there were some indications of model mis-specification. The results implied that natural fluctuations may be too large for reliable interpretation using generalised linear models, although use of distance north of the ice-edge rather than latitude might give better results.

The Committee makes the following **recommendations** with regard to future work on this matter.

(1) Future analyses should be based on the disaggregated daily JSV data (only aggregated data were available to the authors of SC/45/SHBa23). The disaggregated data have now been made available to the IWC Secretariat and are available to accredited members of the Scientific Committee.
(2) The JSV data should be incorporated into the sightings data base being developed by Buckland and Borchers (see Item 4.2.3) for the IWC.
(3) If it can be obtained, historical information on the position of the ice edge should be incorporated into the analyses of the JSV data. Reilly agreed to contact the Joint Ice Center to determine the extent and availability of the historical data they hold.
(4) It would also be useful to include historical information on the position of the Antarctic Convergence in the modelling framework being developed. Although its position varies during the year, the mean January position could be used. The need for this information is of lower priority than that on ice edge position.
(5) Analyses of JSV data should continue intersessionally.

SC/45/O 26 proposed a new analytical technique for estimating mean school size. The Committee believes that this may represent an improvement on the standard method used (IWC, 1988b) and that it should be further examined on a subset of IDCR data. If successful, the method should be applied to all past IDCR cruises, probably after completion of the planned IWC sightings data base.

8.2 Humpback whales

8.2.1 Stock identification

Genetic data indicate two major stocks in the Australian region (Baker *et al.*, 1993c) confirming earlier hypotheses that whales feeding in Antarctic Areas IV and V come from separate breeding stocks, to the east and west of Australia. Considerable uncertainty still exists concerning stock structure for South Atlantic humpback whales, causing problems in assigning historic catches to specific stocks.

The Committee agreed the following **recommendations** in relation to humpback stock identity.

(1) The Committee should actively solicit research proposals for specific projects that address its interests. In this regard it should develop a list of investigators and laboratories that may be qualified to undertake genetic analysis of biopsy samples collected under the auspices of IWC sponsored research. The range of genetic analyses that may be carried out on biopsy samples developed at the Workshop held in 1989 (IWC, 1991e) should be reviewed and updated where necessary. Ideally arrangements for analyses (perhaps by contract) should be made before biopsy samples are collected.
(2) Biopsy samples should be obtained from humpback whales in the South Atlantic.
(3) The Secretariat should continue to try to contact investigators holding photographic collections of Southern Hemisphere humpback whales and compile a listing of the areas and dates where the photographs were obtained. A directory of these listings should be maintained and updated by the Secretariat to facilitate the exchange and comparison of photographs among investigators.
(4) An analysis of the relevant Discovery mark data should be carried out (and see Item 18).

8.2.2 Estimates of abundance

Estimates of abundance of humpback whales have been obtained from the data collected during the 13 IWC/IDCR Southern Hemisphere minke whale assessment cruises, for most of the area south of 60°S during January and February. The best estimate of abundance, from the second, more complete, circumpolar survey (which covered 80% of the area south of 60°S) is 5,559 (CV 0.281). This estimate relates only to part of the population as it does not cover the more northerly latitudes where humpback whales are known to occur. An approximate estimate of 15,000 (CV 0.4) whales for the area south of 30°S was obtained using data from Japanese scouting vessels to supplement IDCR data (Annex E, Appendix 5).

A shore-based study at Cape Vidal off the east coast of South Africa was reported in SC/45/SHBa16 and 17. The estimate for the northern migration in 1990, which was the only survey covering the entire duration of the migration, was 1,711 (CV 0.71); it is biased downward, but probably by a small amount, because some animals pass unseen offshore. It compares with an estimate of 1,954 animals (CV 0.38) for an area off central and southern Mozambique reported last year (SC/44/SHB5).

Two studies were available of population size and increase rate of humpback whales off eastern Australia. In SC/45/SHBa18, an estimate of 1,900 (95% CI 1,650–2,150) was obtained from observations off North Stradbroke Island. An increase rate of 11.5% (95% CI 9.6–13.8%) was estimated from the average number seen per 10 hour period for the four weeks of the peak of the northward migration in each year from 1984 to 1992. A similar study from the same area in May/August 1991 gave a minimum abundance estimate of 1,404 with an increase rate between 1981 and 1991 of 13.8% (SC/45/SHBa19). The Committee regarded these studies as interesting and informative but noted some difficulties in interpreting the results (Annex E, Item 7.2.3).

A preliminary photo-based mark-recapture study off northwestern Australia (SC/45/SHBa26) based mainly on southward migrating animals gave an estimate of 3,878 (95% CI 1,319–14,108) for the pair of years 1991–1992. The Committee noted that the low number of resightings resulted in the large variance and that the estimate may be negatively biased if animals tend to have consistent migration routes between years. If, as in right whales, there are inter-annual cycles in return to the study area, the results could be misleading, but those closely familiar with the biology of those populations thought that was unlikely.

An increase rate in humpbacks off Western Australia between 1977 and 1991 of 10.9 ±3.0% was reported in SC/44/SHB15 (revised). Comparison of the 1991 sighting rate with a population estimate in 1963 gave an estimate of at least 3,000 animals in 1991, similar to the photo-based estimate in SC/45/SHBa26.

The Committee commended these shore-based, aerial and photo-based studies. It **recommends** that they be continued and similar ones be initiated to allow further monitoring of trends in Southern Hemisphere humpback whale populations.

Future work

The Committee considered short and long term activities needed for the assessment of the status and identity of depleted Southern Hemisphere humpback whales (Annex E, Item 7.2.3). The following short term activities were identified that would allow further assessment at the 1994 meeting;

(1) completion of the coding of BIWS catch and marking data;
(2) development of an inventory of biopsy samples with priority being given to Australian, New Zealand and African coast humpback whales;
(3) identification of sources of photo-identification material and development of a central catalogue for the Southern Hemisphere.

8.3 Other species

The Committee reviewed SC/45/SHBa27, a proposal for a plan of research to help determine the reasons for the low abundance estimates for blue whales, and their apparent lack of recovery from commercial exploitation. The proposal related to the 'true' blue whale, as opposed to the 'pygmy' blue whale subspecies. It includes proposed sighting surveys before and after the IWC/IDCR Southern Hemisphere minke whale cruises, together with ecological and behavioural studies in the breeding areas.

The Committee supported the proposal in principle but some reservations were expressed, particularly because low densities would make some aspects of the proposal infeasible and because of the lack of information on the location of breeding grounds. Some members believed that the objectives of the proposal should be reconsidered, for example, by expanding them to include other species such as the humpback whale, by focussing on possible competition among whale species in Antarctic feeding areas, or by examining ecological factors in the breeding areas.

Some members commented that their general support for a research programme on blue whales did not imply that they accepted the premises for it outlined in the proposal, i.e. that there has been no increase in numbers of blue whales since they were protected and that such presumed failure to begin to recover was related to the abundance of other baleen whale species.

The Committee agreed that the proposal had merit and discussed material directly relevant to the work of the Commission. However, without additional information on specific objectives and methodology, its priority relative to other research activities related to the Commission's work could not be determined.

The Committee identified three possible objectives for such a research programme:

(1) to refine estimates of abundance in feeding areas;
(2) to evaluate the potential for competition for krill between blue whales, other baleen whales and other high-level predators;
(3) to determine the distribution of breeding areas and whether animals that utilise a particular low-latitude breeding area utilise particular feeding areas in the Southern Ocean.

It was recognised that experience gained on the IWC/IDCR Southern Hemisphere minke whale cruises would be important in the development of an experimental design for objective (1) and that information and advice from CCAMLR would be important in developing a research proposal concerning objective (2). It was further recognised that work on the Comprehensive Assessment of Southern Hemisphere baleen whales would be important in identifying research needs and in evaluating the importance of research on blue whales relative to research on other species. Finally, it was noted that the likelihood of obtaining useful abundance estimates for other baleen species from data collected during surveys designed

primarily to estimate the abundance of Southern Hemisphere blue whales must be considered when evaluating the proposal's overall merit.

The Committee noted that the proposal requested supplementary IWC funding. It **recommends** that a steering group under Bannister work intersessionally to identify a set of objectives for research on Southern Hemisphere blue whales. The group should also identify individuals who could contribute to the development of a research proposal at next year's meeting. At that meeting, a working group could be convened to develop a revised research programme proposal, including an outline of objectives, methodology, the chances of success, and short- and longer-term financial implications. Should the Commission approve the revised proposal in principle and be willing to make funds available, a detailed programme should be developed at a subsequent meeting.

The Committee recognised that, while the primary focus of the initial proposal would be Southern Hemisphere blue whales, the final proposal may not necessarily be limited to this. The proposal should include a wide range of research elements, including (1) biopsy sampling; (2) satellite tagging; and (3) photo-identification and behavioural studies on the breeding grounds.

The possibility of work being conducted on IDCR pre- and post-cruises was explored. It was agreed that this should be referred to the group planning the 1993/94 sightings cruise. In addition, the potential relationship of the work to the proposed workshop with CCAMLR on feeding ecology needs to be clarified.

8.4 Food and feeding habits of Southern Hemisphere baleen whales

Last year the Committee agreed that a comprehensive review of the food and feeding habits of Southern Hemisphere baleen whales should be undertaken.

SC/45/SHBa8 reviewed published and un-published data collected since 1946. For all baleen whales apart from sei whales, *Euphausia superba* was found to be the primary prey species. Krill size classes observed in stomach contents were found to increase in a clockwise pattern around the Antarctic Ocean; the largest krill were in Areas II and III, the smallest in Areas VI and I. No clear evidence was found for intra– or interspecific competition among whales for krill.

Comments from individual Committee members on various aspects of the study, including the question of competition between minke and blue whales, are reported in Annex E, Item 10.

8.5 Definition of minke whale

The Committee **recommends** the inclusion of the dwarf or diminutive form of minke whale in the Schedule, so that catch limits for Antarctic minke whales recognise the distinction between the two forms.

9. COMPREHENSIVE ASSESSMENT – OTHER STOCKS

9.1 North Pacific Bryde's whales

Last year the Committee had noted that Japan would provide an updated status report on the available data for North Pacific Bryde's whales. Four papers were available at this year's meeting.

SC/45/O 8 examined the available information on biological parameters for the western North Pacific and, in particular, possible variation in estimated parameters by area and/or time. The authors concluded that the information they examined provided no evidence for stock differentiation in the area. Differences in parameters appeared to be related to the nature of the operations (factory ship versus land station) rather than the geographical location of the catches, probably due to the differential size limits in force.

SC/45/O 9 reported on the results of 21 cetacean sighting surveys carried out in the August – September period from 1988–91. A preliminary estimate of the abundance of the western North Pacific Bryde's whales in the research area was presented (11,386; CV=0.16) and a number of points for further examination identified. The authors believed that the sightings distribution allowed identification of the northern and western boundaries for this stock.

SC/45/O 10 examined the available Discovery mark data for Bryde's whales in the western North Pacific. A total of 531 whales had been marked and 48 recaptured. The authors concluded that the data suggested that there was a single Bryde's whale stock west of 160°W and north of the equator.

SC/45/O 11 reviewed the published information on North Pacific Bryde's whales. It covered taxonomy, morphology, distribution, migration, stock identity, life history, abundance, catches and management.

Although time did not permit detailed discussion of these papers, the Committee welcomed them as a valuable contribution to the Comprehensive Assessment process.

The Committee had agreed (IWC, 1991b) that the Comprehensive Assessment should encompass the whole North Pacific. Last year the Committee had recommended that available information in Russia and the USA be provided, but no papers had been presented to this year's meeting. The Committee noted that experience had revealed that a Comprehensive Assessment of a species/ region required careful planning. A steering group (convened by Brownell) was established that would meet initially at this year's meeting, correspond intersessionally and meet at next year's meeting to plan for an assessment to be carried out at the 1995 meeting. The report of the initial meeting of the steering group is given in Annex P.

SC/45/O 27 had reported on continuing catches of Bryde's whales by a non-member nation, the Philippines. A whale fishery has operated from Pamilacan Island from at least the turn of the century and it appears that Bryde's whales are the main species involved. The catch for the period 1985–91 was estimated at 92 whales. The Committee **recommends** that the Secretariat be asked to contact that Government in order to obtain further information on the operation, and in particular the historical catch data. Recognising the importance of questions of stock identity to the future Comprehensive Assessment, the Committee stresses the value in obtaining tissue samples from that fishery.

9.2 Northeastern Atlantic minke whales

Two papers were presented concerning analysis of CPUE data for Northeastern Atlantic minke whales. These were briefly discussed by the Committee. SC/45/NA5 investigated possible biases in CPUE series based on the NCD method, by examining the degree of patchiness in spatial whale distribution. The average size of patches is inferred from the lengths of catch periods and the density of patches from the lengths of no-catch periods. This is carried out for the data organised in boat periods of presumed constant catch efficiency. The patchiness for minke whales in the Barents Sea shows limited variability

from 1952 to 1983. From simulations, the authors concluded that the NCD method was inferior to the other methods they had examined if there was large variability in patchiness. For less variability, the ACD method (Schweder *et al.*, 1991) performed best. The authors thus used the ACD method to examine relative abundance. Using this approach the estimated abundance of Barents Sea minke whales in 1983 was 70% of that in 1952, with a 95% confidence interval of 52% – 94%.

Commenting on SC/45/NA5, Cooke noted that the average area of patches, as measured by the length of catch periods, showed no trend and little variation over the period in question (1951–83). He did not consider that the time between catch periods gave a reliable indication of the density of patches, because it depended on how often the vessels had to return to port. He believed that the bias of the NCD method reported in SC/45/NA5 was a function of the distribution of daily catches, which did not conform to a Poisson distribution as assumed in SC/45/NA5. Above a certain level of overdispersion, the NCD index is less biased than the catch period index.

SC/45/NA7 presented a consolidation of previous analyses of the Barents Sea minke whale CPUE data contained in working papers to previous meetings, together with new analyses of the cyclic patterns in the time series. A significant cyclic oscillation with a period of 6.8 (±0.2) yr, together with an 'overtone' with a period of 3.4 (±0.04) yr was identified. Accounting for the cyclic variation had very little effect on the estimated trend which was – 1.6% p.a., but it did explain about 70% of the residual process error. Use of the CPUE series in a HITTER/FITTER analysis yielded an estimate of the status of the mature female stock to be depleted to 45% of its initial level, and estimates of the MSY rate (mature) of 0.7% or 0.9% according to whether or not the cyclic terms were fitted.

The question was raised as to whether these analyses meet the criterion indicated by some members of the CPUE workshop (IWC, 1989a) that CPUE was only suitable as a primary means of assessing stocks where a precise relationship between changes in CPUE and changes in abundance had been identified. Cooke responded that he believed SC/45/NA7, together with previous analyses he and his co-authors had contributed on the issue (e.g. Cooke, 1985; Beddington *et al.*, 1984) reflected substantial progress towards this goal in this instance.

Commenting on SC/45/NA7, Schweder believed that the main problems with the analyses presented are: (i) that CPUE is measured by the NCD method which might lead to bias, and (ii) that bias due to trends in catch efficiency might not be completely removed. With respect to (ii), he noted that the yearly decline in whale density within patches estimated by the NCD method was found to be 1.73% in SC/45/NA7, and, using the same method, 1.42% in SC/45/NA5. Although interesting, he believed that the more elaborate methods of frequency analysis and estimation of process error in SC/45/NA7 do not help in solving the basic measurement problem at hand. Furthermore, he believed that the MSYR estimate of 0.72%, which seems low for minke whales, is likely to be negatively biased because the CPUE series used (in view of the analysis in SC/45/NA5) is likely to exaggerate the decline in abundance. A more thorough analysis integrating all relevant information (CPUE, catches, demographic parameters, segregation etc.) is required, both for estimating MSYR and for other purposes. This

could be done in a Bayesian analysis (cf. SC/45/AS1) or by a non-Bayesian method. He believed that CPUE methods may be valuable for monitoring stocks, contrary to the pessimism expressed in the CPUE workshop report (IWC, 1989a). He believed it appropriate that CPUE methods are given more attention, as reflected in both SC/45/NA5 and SC/45/NA7.

Butterworth concurred with Schweder's general views about the utility of CPUE data, and suggested that the MSYR estimate that follows from the analysis of SC/45/NA5 should be reported, as well as that from SC/45/NA7, because the extent to which the former estimate was larger than the latter would be of interest.

10. COMPREHENSIVE ASSESSMENT – METHODOLOGY

10.1 Population assessment models (see also Annex L)

Evaluation of assessment methods

Highest priority was given to the evaluation of the methods proposed for use next year in evaluating the status of bowhead whales. Givens presented the basic methods used in SC/45/AS1, noting that the Bayesian synthesis approach used provides a method of incorporating additional sources of information and uncertainty, a need that had been identified by the Committee as being particularly important for bowhead whales (IWC, 1992c, p.64).

The approach consists of establishing a joint probability distribution (pre-model distribution) for the several input and output parameters of the BALEEN II population dynamics model. Simulations with the population dynamics model constrain the pre-model distribution to what is termed a post-model distribution of the parameters. The post-model distribution includes the total amount of information consistent with the model structure, and can be used to construct probability statements. In particular, it can be used as a basis for setting confidence intervals on quantities such as replacement yield which might be used as a basis for setting catch limits.

The Committee noted that the methodological problem addressed in SC/45/AS1 (and SC/44/O 31) is of great general interest. When different data sources are relevant to a given phenomena (such as assessing the status of a stock of whales), the basic problem is to integrate the information extracted from the various sources. In complex situations a model is needed and a statistical methodology must be developed to allow the different sources of data to flow together according to the structure of the model. Such methodology is in development along various routes, and the work by Givens, Raftery, and Zeh seems to be pioneering these attempts within the Bayesian paradigm.

Discussion focused on methods for defining marginal pre-model distributions on model input and output parameters, and on methods for interpreting the post-model distributions. It was noted, for example, that some of the pre-model distributions were based on information which had allowed only ranges to be established, and that uniform distributions were adopted in the absence of additional data. In such situations it was suggested that the selection of a uniform prior required care in interpreting the results. Specifically, in such cases, certain kinds of probability statements based on the post-model distributions could be misleading if not interpreted with care. Reliance on simple summary statistics, such as the mean and variance of prior distributions, in formulating probability statements could also be misleading.

Several approaches were identified as being useful in interpreting the results of this analysis. To apply the methods in SC/45/AS1 it is necessary to select a joint pre-model distribution and it was noted that this is not something with which the Committee has had extensive experience, at least in a true Bayesian sense. The authors noted that they had used three approaches to setting pre-model distributions: data (e.g. sampling distributions of abundance estimates), previous consensus within the Committee (e.g. mortality rates) and the authors' experience (e.g. age at transition to adult mortality). Committee members thought that these approaches were acceptable, but noted especially the difficulty in the case where little information was available.

SC/45/O 5 describes a method facilitating rapid analyses using different pre-model distributions. The procedure involves creating a database using the approach of SC/45/AS1 but with a maximally diffuse pre-model distribution. Those results are then resampled using the 'sampling, importance resampling' (SIR) algorithm under varying (less diffuse) pre-model distributions. These post-model distributions do not depend on the initial maximally diffuse pre-model distributions.

The value of the approach is that the effect of alternative pre-model distributions can be rapidly evaluated, in the context either of estimation or sensitivity analysis. It was noted that when actually conducting an assessment, the results would be numerically reliable only for pre-model distributions which were not more diffuse than the maximally diffuse distributions initially assumed. Further, given the computational requirements of the methods, alternate maximally diffuse distributions could not be incorporated rapidly. Thus it is important that the initial diffuse priors be sufficiently wide.

The Committee agreed that this approach provided a substantial improvement in assessment methodology, and **recommends** its use for the planned bowhead whale assessment. However, the Committee agreed that the above caveats regarding the interpretation of probability statements should be investigated further in each case where the methods may be applied.

Development of approaches to multispecies population models

Some results of work which might be relevant to determining the desirable scope of multispecies population assessment models were reviewed. A proposal for integrating multiple data sets relevant to cetaceans and other large marine predators (SC/45/Mg10) was presented as an example of the possible value of such work for developing approaches to multispecies population models. It was pointed out that new data collection and analysis may be of value in developing an approach to multispecies modelling; research programmes in Norway and Japan were noted.

There was little discussion under this item. It was recognised that further consideration of the objectives to be addressed by multispecies models was required. It was suggested that the task of developing such models is very broad relative to the resources of the Committee and that progress might be facilitated by cooperation with other international organisations; for example the ICES Multi-Species Working Group. The Committee agreed that for it to make progress on this subject, additional information was needed on the specifics of work being conducted in such organisations. Stokes agreed to work with other interested individuals to compile such information in a

working paper for the 1994 Annual Meeting. It is hoped that review of such a compilation will provide a better basis for determining the future direction of the Committee in this area.

Validation of computer programs

The population dynamics component of the HITTER/FITTER estimation method previously validated (termed Bill-1 in last year's report) had been extracted and recast as a subroutine by de la Mare, in consultation with Allison, Punt and Butterworth. Documentation and code for this subroutine, named BALEEN II, have been provided to the Secretariat for validation. The Committee **recommends** that first priority for validation be given to BALEEN II because it is used by all population estimation procedures currently being considered.

Three estimation procedures utilising the BALEEN II subroutine are candidates for validation, one by de la Mare (Bill-2), one by Punt and Butterworth (Andre-1), and one by Givens, Raftery and Zeh (SC/45/AS1 and SC/45/O 5, termed here Geof-1). The Committee **recommends** that second priority should be given to Geof-1, and third priority to Andre-1 and Bill-2. However, it was agreed that the output from the latter two programs should be compared, facilitated by the Secretariat, noting that this would be a relatively easy step towards their eventual validation.

One approach to completing this validation would be to use contract work. There was some discussion of the efficiency of this approach. It was noted a contractor would not necessarily need to be familiar with the work of the Committee, given adequate documentation. However, supervising such contracts becomes a larger task if the contractor is unfamiliar with the work of the Committee. It was noted that the scope of the validation task would be further reduced following the example of the development of a common subprogram for the BALEEN II subroutine and agreed that this should be carried out

The Committee agreed that validation of all these models should be given high priority overall, as discussed under Item 18.

Priorities for future work

Several aspects of density dependent changes in vital rates were noted as being of potential importance to the work of the Committee. However, the Working Group report (Annex L) included no specific suggestions for consideration next year.

Potential topics for the Population Assessment Models Working Group to consider had been formulated in 1991 (IWC, 1992e). Several of these have now been addressed (see also IWC, 1993e) and the Committee discussed whether the Working Group should continue. It was noted that it had been useful in assisting in the coordinated development of assessment methods. Many members believed, however, that the approach taken this year of separating out one specific issue (i.e. MSYR) into a separate Working Group was not generally desirable.

The Committee agreed that the Working Group should continue under its original terms of reference, but, it recognised that the Working Group would not necessarily have substantial work to do at every meeting. In such cases, it should meet only to develop and review plans.

Several specific items for future work were suggested, including: the form of density dependence relationships, issues arising from the MSYR Working Group (Annex M; multispecies population assessment methods; more

modern computing environments, density dependent habitat selection – e.g. Ginzberg, 1986); implications of the form of density– and growth rate-dependence in models involving predator and prey dynamics; and methods for setting prior probability distributions. It was agreed that the Working Group would not require a significant amount of time during the next meeting.

10.2 Maximum sustainable yield rates (see also Annex M)

The Committee recognised that evaluation of estimates of maximum sustainable yield rates (MSYR) cannot be divorced from discussions of maximum sustained yield levels (MSYL) and the shape of the production function. It was also noted that estimates of MSYR can refer either to the size of the total population or to one of any number of identifiable recruited populations. The Committee noted that in any discussion of actual estimates of production parameters, the portion of the population to which the estimates pertain must be clearly identified.

Two approaches were identified for estimating rates of population increase from observations on recruitment rates. These were:

(1) population dynamics models using either (a) program FITTER and a time series of population estimates (SC/44/O 23) or (b) a Bayesian synthesis approach to incorporate data from various sources (SC/45/AS1, SC/45/O 5); and

(2) estimating a lower bound for the MSYR from an estimate of the rate of increase and the assumption that the recruitment function is convex over the range of population sizes which encompasses MSYL and the size of the population at which the rate of increase was obtained.

Within the context of estimating a lower bound for the MSYR from an estimate of the rate of increase and the assumption that the *per capita* production function is always convex, the Committee discussed SC/44/O 23 and SC/F92/Mg3 (revised). These two papers both presented direct estimates of net recruitment [and MSYR(1+)] for several depleted whale stocks based on published results. They used estimates of net recruitment to provide estimated lower bounds to MSYR ranging from 2.6% to 6.9% for seven stocks based on the assumption of a convex *per capita* production function.

A need for caution was expressed regarding estimated rates extracted from the literature when they are used to compare or to draw general conclusions about population dynamics. There is often a wide range of quality and reliability in different published estimates; in addition, published estimates of the standard errors may not be an adequate indicator of relative quality. Each estimate should be reviewed critically. At the very least, any comparisons should be based on consideration of the confidence intervals and not merely the point estimates. Further, there was disagreement within the Committee about whether available information supported the hypothesis that *per capita* production functions are always convex.

SC/45/O 24 and SC/45/O 25 present examples in which estimates of annual rates of population increase or bounds for this rate are estimated from empirically derived estimates of demographic parameters. In SC/45/O 24, a rate of 7.1% (SE=0.6%) was estimated for right whales observed off Peninsula Valdes, Argentina based on resighting data from individually identified animals. In

SC/45/O 25, an upper bound for the net recruitment rate of 1.6% was estimated for minke whales in Antarctic Area IV. The latter bound was obtained by constraining the mortality rates to be non-negative. The rates estimated for right whales in SC/45/O 24 were similar to rates observed for right whales in South Africa.

With respect to the analyses in SC/45/O 25, it was pointed out that the results are dependent upon the age structured data obtained from the Japanese catches under the special permit programme and that the analyses require the assumption that the age structure estimates are unbiassed estimates for the population. It was suggested that while the data from the catches under the special permit programme are likely to be less biassed than those obtained from commercial whaling, concerns still exist about whether the samples are unbiassed given the apparent latitudinal segregation of animals by age and the fact that sampling did not occur north of 55°S. The authors of SC/45/O 25 noted that sightings data (SC/45/SHBa4) indicate that the number of minke whales north of 55°S in Area IV was small and thus that the lack of sampling in lower latitudes could not be a large factor.

A new estimation procedure using the same underlying population model contained in the HITTER-FITTER procedure but based on a Bayesian approach was reported in SC/45/AS1. The authors of SC/45/AS1 pointed out that an advantage of this approach is that it allowed for all available information to be taken into account in the estimation procedure and produced a probability distribution for MSYR that is determined by the available empirical estimates (including the uncertainty associated with these estimates) of both the input and output model parameters. This approach was applied to the available data for bowhead whales.

Some members of the Committee believed that the estimation procedure in SC/45/AS1 represented a substantial improvement over previous methods for estimating MSYR based on population models. However, there was no general agreement on whether this application of the Bayesian approach was the best approach. The Committee **recommends** that, where possible, estimation methods based on integrated approaches (but not necessarily limited to Bayesian methods) should be used.

Several potential sources were identified as possibly contributing to the difference in the bowhead whale estimates for MSYR given in SC/45/AS1 and SC/44/O 23. These centred around the explicit accounting for uncertainty in the estimates for the biological parameters (SC/45/AS1), problems of maximisation when the likelihood surface was complex (SC/44/O 23), and the inclusion of age structure information (in the form of proportion of mature and immature animals) in SC/45/AS1. Use of the reweighting methodology described in SC/45/O 5 indicated that the latter was probably not a primary cause of the difference. Concerns were expressed about the sensitivity of the final estimates in SC/45/AS1 to the assumed prior distributions. It was noted that SC/45/O5 provided an easily used tool for assessing the extent of this sensitivity. Discussion on the methodology used in SC/45/AS1 was referred to the Working Group on Population Assessment Models (Item 10.1 and Annex L).

The Committee noted that estimates of production parameters from interspecific comparisons had been discussed extensively in previous meetings of the Scientific Committee concerned with estimating MSYR and MSYL (IWC, 1990b). Discussion during this meeting was

focussed primarily on more recent analyses (i.e., SC/45/O 6 and SC/44/O 30 (revised)).

SC/45/O 6 examined data for five large mammal populations with respect to whether the shape of the net reproductive function was convex. For all five of the cases, the second derivative was found to be negative when a second order polynomial was fitted to the data, although the second-order term was not significant in several examples. A non-parametric test was used to suggest that these results were unlikely unless the second derivatives are generally negative. SC/45/O 6 also examined results for the relationship between demographic parameter estimates and population size for four additional populations and found a convex relationship in all cases. The results from these analyses were consistent with results from previous analyses reported by the same author.

SC/44/O 30 (revised) also examined data for five large mammal populations with respect to the question of the shape of the production function by fitting the Pella-Tomlinson net recruitment function to these data. Four of the populations were the same as those examined in SC/45/O 6. The author found positive second derivatives in four of the five examples examined and concluded that the evidence does not support the hypothesis that the second derivative is always negative in the range of population densities from zero to K (carrying capacity).

Concerns were raised about the way the functions were fitted and the choice of data used in the two different analyses (SC/45/O 6 and SC/44/O 30 (revised)). Time did not allow the Committee to examine and compare the details of the analyses in these two papers. No agreement was reached within the Committee on which set of analyses was more appropriate and whether the results from either or both of these two papers supported the hypothesis that the net reproduction curve is always convex. Results reported in SC/45/SM10 and Taylor and DeMaster (1993) indicated that (1) it is possible for population models with linear density dependence (and even a few simulations where at least one density dependent parameter was related to density in a non-linear fashion) to have their maximum net production level below 0.5K; and (2) no consistent pattern exists to relate the net production of the overall population to changes in specific life history parameters.

SC/45/O 14 considered two hypotheses for sustainable yield as a function of population size and explored the implication of these two hypotheses for the situation when a population growth rate estimate is available for a population at low level. In this particular case, data from the South African right whale were used where the growth rate was estimated to be 6.8% per year. The two hypotheses are (1) that the *per capita* production function is convex and (2) that MSYR is 2/3%. If the first hypothesis is correct, then a lower bound for MSYR (1+) of 3.4% can be derived from the estimated growth rate. If the second hypothesis is correct then the largest proportion of the density dependent response must occur at a population level well below MSYL, unless the MSYL is much less than 0.5K. There was general agreement that these two hypotheses are incompatible. Some members of the Committee believed the former was more likely true than the latter. Others suggested that the two hypotheses are not the only possible alternatives for the *per capita* production function and that other parameterisations of the production function are possible.

The results of the use of a 'basin' model to explore some of the possible shapes that a population production function could have, as a result of density dependent habitat selection and utilisation, were reported in SC/45/O 20. The results indicate that even if the habitat is such that the *per capita* production function is everywhere convex for the local habitat, the overall *per capita* production function for the population need not be convex. In the model results presented in SC/45/O 20, the global population *per capita* production function was not convex and the MSYL was in the range of 41% to 50%, while the local *per capita* production functions were everywhere convex with an MSYL of 80% of the local maximum density. It was also noted that the overall population MSYR/R_o rate (R_o = the maximum rate of increase) was considerably lower than the maximum rate in the best habitat (i.e., $0.30 - 0.51$ compared to 0.92).

Considerable discussion took place on the relevance of such basin models to inferences about the shape of the production function for large whales. The question of the extent of site fidelity and movement of animals both within and between seasons as well as the shape of any basin and steepness of the habitat gradients is critical in determining the resultant population production function as the result of density dependent habitat selection. It was suggested that one indication of whether density dependent habitat selection is important is whether range contraction and expansion are observed as populations decrease and increase.

It was noted that recent satellite tagging of right and pilot whales suggest rather extensive searching of the habitat during a given feeding season (e.g., movements of several hundred miles within a two week period) which might suggest that animals are integrating over a wide range of potential habitat gradients.

The Committee concluded that the results from the theoretical modelling of the effects of the density dependent habitat selection are insufficient to determine whether the overall *per capita* production function for any given whale stock is likely to be concave or convex. Both concave and convex functions are possible within the framework of such models. Without considerable additional detailed and quantitative information on the behaviour of whales and the spatial/temporal distribution and dynamics of the density of limiting resources, it is not possible to predict what the shape of the production function would be based on these types of models.

Based on these and previous discussions, the Committee agreed that the range of 1% to 7% of the mature population for MSYR values used in the management trials was adequate for that purpose. However, consensus was not achieved concerning MSYR values that span the range that actual stocks of whales may exhibit.

In view of the related nature of the work of the Working Group on Population Assessment Models and MSYR, it was agreed that additional meetings of the Working Group on MSYR were not necessary. Further consideration of related items should be the responsibility of the Working Group on Population Assessment Models. In addition, some of the implications of MSYR values could be referred to the sub-committee on management procedures.

11. COMPREHENSIVE ASSESSMENT – FUTURE WORK

11.1 Priority work
The Committee agreed that its highest priorities for the coming year were: the ongoing Comprehensive Assessment of Southern Hemisphere baleen whales; in

particular, Southern Hemisphere humpback whales; reassessment of the status of the Bering-Chukchi-Beaufort Seas stock of bowhead whales and the eastern stock of North Pacific gray whales; further work relating to the Revised Management Scheme, in particular, relating to preparations for implementation of the RMP for North Pacific minke whales; preparations for a Comprehensive Assessment of North Pacific Bryde's whales.

As last year, there was insufficient time to discuss priorities for further Comprehensive Assessments.

11.2 Intersessional Working Groups and meetings
The Committee did not identify the need for an intersessional meeting, but noted that if the Commission required advice at the 1994 meeting on implementing the RMP for North Pacific minke whales, a Special Meeting of the Scientific Committee would be needed (Item 7.2.3).

11.3 Work plan for 1993/94
The Committee agreed to establish sub-committees on management procedures (Convenor-Hammond), Southern Hemisphere baleen whales (Convenor-Bannister) and aboriginal subsistence whaling (Convenor-Reilly), in addition to the standing sub-committee on small cetaceans (Convenor-Bjørge).

The Committee had also established steering groups on management procedures (Convenor-Hammond, see Item 7), North Pacific Bryde's whales (Convenor-Brownell, see Item 9.1) and Southern Hemisphere blue whales (Convenor-Bannister, see Item 8.3), to work intersessionally.

Data processing and computing work to be done by the Secretariat during the intersessional period is described under Item 18.

12. SANCTUARY IN THE SOUTHERN HEMISPHERE

Last year, the Commission adopted a resolution (IWC, 1993d) that invited member governments to submit questions and comments on the proposal by France for a Southern Ocean whale sanctuary south of 40°S (IWC, 1993d, Annex), and requested the Scientific Committee to review these at this meeting.

The review had first been attempted by the sub-committee on Southern Hemisphere baleen whales (Annex E, Item 8). That sub-committee had found itself unable, given the time available and the unstructured nature of the set of comments and questions posed (IWC, 1993d, Annex; IWC/45/SAN1–11), to respond to all of these; it had agreed to restrict itself to questions only, after considering one comment.

In introducing the item in plenary, the Chairman of the Committee made the following observations.

(1) In originally discussing the question of the sanctuary, the Commission had considered the possibility of a mechanism to review and structure the comments and questions made by member governments, before they were forwarded to the Committee. Unfortunately, this had not been established. It was apparent from Annex E that this contributed to the problems encountered by the Committee. It was not possible to address fully the scientific aspects of the large number of comments and questions that had been submitted, even though considerable time had been allocated to this item.

(2) In light of the Commission's discussions of this item last year, he did not believe it would be helpful to the Commission for the Committee's report merely to comprise a compilation of individual viewpoints. If consensus could not be achieved, a brief summary of the main views expressed should be presented, with a reference to the discussions in Annex E.

The Committee concurred with these views.

The Committee noted that the sanctuary proposal constituted a replacement for the RMP in the Southern Ocean. The current view of the Committee is that advice about management options should be based on a systematic evaluation, including computer simulation trials where appropriate. Given that some evaluation of management options is necessary, one question to be decided is whether this should be done on a species-by-species, regional or global basis.

One view held is that the proposal has no scientific elements to justify its implementation. The RMP has been thoroughly tested for the purpose of conservation and sound management of baleen whales on their feeding grounds, to accommodate all likely, and some unlikely eventualities, and can be implemented safely. Therefore the sanctuary is not necessary.

Another view is that, while the sanctuary proposal would constitute a replacement for the RMP within the Southern Ocean, it needs also to be considered in the context of a broader scheme for the management of whaling and the conservation of whales both in the Southern Hemisphere and globally. In this global context the proposed sanctuary would limit the impacts of unforeseen problems in the RMP to the other regions where it was applied. Certain aspects of the adoption of the proposal for a Southern Ocean sanctuary could be evaluated by appropriate computer simulation trials. However, those holding this view believe that there is a limit to the matters which can be realistically tested by simulation.

Some members believed that this implied that if the RMP proves to be unsound, it will be in circumstances which have not been anticipated. Therefore, a sanctuary could be a prudent complement to the RMS until experience proved the RMP to be satisfactory.

Other members believed that within the context of considering the sanctuary as a mechanism to limit the impact of unforeseen problems, there are other approaches to increasing the safety of the RMP that should be compared to the sanctuary approach.

With respect to conducting simulation trials, it was noted that some trials have been conducted to evaluate certain aspects of the effect of the sanctuary proposal on minke whales, assuming a duration of 50 years (SC/45/SHBa24). Further trials could be conducted to investigate a number of other aspects, including an evaluation of the longitudinal extent that might be required to achieve the proposer's objective of protecting at least one population of each southern species throughout its migratory range.

The Committee **recommends** that, should the Commission require further advice, development of a set of trials for this purpose would be necessary. This would require more than one meeting of the Scientific Committee before further advice can be given.

The Committee noted that the establishment of a sanctuary may theoretically have an effect on already protected species or at least on the possibility of estimating and monitoring population parameters for these stocks. Attempts to deal with these questions appear in SC/45/O 21.

In addition, already protected species may be affected, in that interactions with minke whales will be different

compared to a situation where minke whales are harvested under the RMS. However, it is difficult to indicate what such changes in interactions might be because:

(1) the information on interactions between different whale species is very limited;

(2) even if interactions such as, for example, competition for krill are strong, the likely level of catch limits for minke whales under the RMS will be such that possible differences in the recovery of seriously depleted species (e.g. the blue whale) under the two management regimes, will be relatively small;

(3) it is unclear whether these small differences will be positive or negative for the depleted species.

13. IMPACT OF ENVIRONMENTAL CHANGES ON WHALE STOCKS

At last year's meeting, the Commission decided that the Scientific Committee should establish a regular agenda item to address the impact of environmental changes on whale stocks, that it should initiate the exchange of information on this topic with relevant organisations, and that it should develop practical means to address the questions raised by these exchanges (IWC, 1993b). The Secretary has contacted CCAMLR and SCAR during the intersessional period, but no replies have yet been received.

Some members believed that this topic should be more appropriately addressed by other organisations.

SC/45/SHBa21 was provided in response to the request to develop a practical means for considering the potential effects of environmental change on whale stocks. The author noted that the assessment of any potential effects would require, at minimum, the identification of biological parameters most likely to reflect direct and indirect (e.g. food chain) responses to environmental change, and assessment of the temporal and spatial scales over which responses are most likely to occur. He noted that a preliminary approach would be to undertake modelling studies to identify and assess parameters likely to provide useful information on baleen whale responses to environmental changes. Detecting any responses to environmental change in whale stocks will require, at minimum, information on population size and changes in particular life history parameters sufficient to discern trends.

In discussion, the Committee recognised the broad nature of the topic. It clearly is of relevance to the long term management and conservation of whales. It noted that at this meeting it would only be possible to identify some preliminary areas for discussion in the future. A number of points emerged.

(1) Although the title of the Commission's Resolution referred to the Antarctic region, it is important that this matter be addressed for all areas.

(2) The subject matter can be divided into two general types of environmental changes: those arising from climate changes, where studies of the changes themselves, let alone their impact on whale stocks, are at a relatively early stage (in the short term at least, the effects of these are more likely to be detected in primary producers than in long lived animals such as whales); and those, such as pollution, indirect effects of fishing mortality, habitat loss as a result of development and disturbance from shipping, where

some studies of their effects on marine mammals are established.

(3) Given the broad nature of the topic, it might be appropriate to focus, at least initially, on 'local' rather than 'global' aspects of the problem.

(4) It is important that a theoretical framework be established to focus on and interact with data collection (e.g. see SC/45/O 21). In particular, simulation modelling can help to provide information on likely parameters to consider in attempting to measure the response of whales to changes and the levels of precision needed to detect such responses.

(5) Addressing this topic will require expertise not presently found within the Scientific Committee. The Committee draws this to the attention of the Commission and notes that governments may wish to take this into account when deciding on their nominations to the Committee. The Committee noted that it was important to limit the scope of its work in this area so as not to duplicate the work of other organisations with primary expertise in the relevant subject areas. The Commission has already identified the need to co-operate with CCAMLR and SCAR. The Committee **recommends** that the Secretariat also be asked to contact other relevant international organisations e.g. WMO, IOC, ICES, UNEP to obtain information on programmes they may be carrying out relevant to this subject. Consideration will need to be given to the most appropriate ways to foster co-operation, identify areas of common interest and facilitate the exchange of information.

14. ABORIGINAL SUBSISTENCE WHALING

Last year the Committee agreed that it could profitably start considering the scientific problems inherent in the present aboriginal subsistence whaling scheme, and that this item should be given priority on the agenda for this year's meeting, if specific advice were received from the Commission regarding objectives and other advice that could be used in the development of a new aboriginal subsistence whaling scheme (IWC, 1993f, p.74).

The Commission's Aboriginal Subsistence Whaling Sub-committee recommended that the Commission request the Scientific Committee to conduct initial work on this topic and proposed that the development of new objectives be considered. However, the Commission was not in a position to give advice to the Scientific Committee at last year's meeting (IWC, 1993a, p.19).

The Committee reiterates its request of earlier years that the Commission consider the question of objectives and provide the Committee with advice that could be used in the development of a new aboriginal subsistence whaling scheme.

14.1 Humpback whales off St. Vincent and The Grenadines
The Committee last considered this item at its meeting in 1990 (IWC, 1991b, p.69). It noted the mark-recapture estimate obtained for the western North Atlantic from photo-identification studies of 5,505 (95% CI 2,888–8,122) for the years 1979–86 (Katona and Beard, 1990) and the estimate of annual rate of increase of 9.4% but with extremely wide confidence limits. Although the relationship between animals from the Bequia-St. Vincent breeding area and other humpback whales is unknown, the Committee agreed that a catch of up to three animals was unlikely to harm the stock. It further went on to

recommend that if whales are taken, every attempt should be made to collect as much information as possible from them.

At the meeting of the Commission in 1992, St. Vincent and The Grenadines reported that one female humpback whale (35 feet, not lactating) was caught in 1992 and that one large male was struck-and-lost (IWC, 1993a).

The Scientific Committee this year received information that two humpback whales were caught in 1993, but no further details were available.

The Committee had received no further information this year which would cause it to change its advice of three years ago.

The Committee reiterates its **recommendation** that if whales are taken, every attempt should be made to collect as much information as possible from them. In particular, photographs should be taken of the ventral surface of the flukes to allow comparison with the North Atlantic humpback whale catalogue, and samples should be collected for genetic analysis. The Committee noted that such information had not been received from the earlier catch.

The Committee noted that animals are struck-but-lost in this fishery.

14.2 Bering-Chukchi-Beaufort Seas stock of bowhead whales
The Population Assessment Models Working Group considered the assessment methods presented in SC/44/O 31, SC/45/AS1 and SC/45/O 5 (see Item 10.1 and Annex L). The Committee agreed that these approaches provide a substantial improvement in assessment methodology and **recommends** their use for the planned bowhead whale assessment next year.

The Committee noted that during the 1992 Alaskan subsistence hunt, 43 strikes resulted in 34 whales landed (SC/45/AS2). The Committee also noted that a full scale combined visual and acoustic census was attempted last year, but due to severe ice conditions this was not successful. Another full scale combined visual and acoustic census is underway this year, the results of which, if available, can be incorporated into next year's assessment. It was noted, however, that no funding was available this year for the aerial survey expected.

This stock was most recently assessed by the Committee in 1991 (IWC, 1992d). As was the situation last year, the Committee had received no new information this year which would cause it to change its advice of 1991 and it reiterates the recommendations given then.

14.3 Eastern stock of North Pacific gray whales
SC/45/AS3 presented results of aerial surveys conducted for 10 days in January 1993 in cooperation with shore counts of migrating gray whales. Further, a summary of the shore counts for gray whales migrating southward during the winter of 1992/1993 is presented in the SC/45/ProgRep USA. A new estimate of abundance based on the shore counts and aerial survey data will be available in September 1993 and will be presented at next year's meeting. DeMaster noted that a survey will be undertaken in the winter of 1993/1994.

The catch from this stock in 1991 was 169 whales. No whales were taken in 1992.

This stock was most recently assessed at the Comprehensive Assessment Special Meeting on Gray Whales in 1990 (IWC/42/4A). For the last two years the Committee has repeated its advice of 1990 (IWC, 1991a, p.29).

The Committee had received no new information this year which would cause it to change this advice.

The Committee reiterates the following three recommendations from the Special Meeting:

(1) a northbound cow-calf census of animals should be undertaken, if necessary having priority over a southbound census;
(2) a reanalysis of Soviet pregnancy data should be carried out, stratified by month, year and area;
(3) further photo-identification studies should be undertaken at the breeding grounds, particularly to provide information on changes in pregnancy rates.

The Committee encouraged further work and discussions to take place before next year's meeting.

14.4 Future work
The Committee noted that the Commission would require advice on all stocks subject to aboriginal subsistence whaling at next year's meeting. It therefore agreed to establish a sub-committee on stocks subject to aboriginal subsistence whaling, to be convened by Reilly.

15. SCIENTIFIC PERMITS

15.1 Review of results from existing Scientific Permits
15.1.1 Japan
Fujise briefly introduced the results of the work carried out on Southern Hemisphere minke whales during the 1992/93 season in Area V. The research was divided into two surveys, one for the entire research area and one for a special monitoring zone where seasonal fluctuations in distribution were examined. Methods had been modified to improve representative sampling in the catch and one vessel had been allocated exclusively to sightings to improve abundance estimation. A total of 933 primary sightings (3,049 animals) and 395 secondary (952 animals) sightings was made during 13,492 n.miles of searching. A total of 327 (167 males and 160 females) ordinary and 3 (all female) dwarf form minke whales were taken. Further details are given in SC/45/SHBa12. Results from the overall programme were presented in a series of papers to the meeting. These are summarised briefly below. It was also noted that the results from studies relating minke whale abundance with krill abundance will be presented next year.

SC/45/SHBa13 addressed the question of temporal variation in mtDNA haplotype composition in minke whales in Area IV based on 306 samples from 1989/90 and 165 from 1991/92. The study emphasised the importance of considering temporal factors in describing the population structure of Southern Hemisphere minke whales.

SC/45/SHBa14 described genetic differences between ordinary and dwarf form minke whales, supporting the view that they should at least be considered subspecies. This is discussed further in Annex E and under Item 8.5.

SC/45/SHBa15 presented a preliminary analysis of the relationship between minke whale distribution and oceanographic data. This work will be continued. SC/45/SHBa11 summarised the work of the Institute of Cetacean Research, particularly with respect to the scientific permit programme.

Comments and discussion
Insufficient time was available to discuss the results in any detail, although several members commented on the high quality of certain aspects of the work. Specific comments are referred to under Item 15.2.1.

15.1.2 Norway
Haug introduced results from the first year of the programme that had been designed to address questions concerning seasonal and geographical variation in feeding and condition of the Northeastern Atlantic minke whale, and had been initiated by Norway in 1992. Field activities were restricted to the summer period (4 July – 17 August), and SC/45/NA2 gives an account of the general logistics involved. A random sampling procedure was applied, and six chartered small-type whaling vessels searched for whales along predetermined transects within five selected sub-areas. Very poor weather resulted in considerable deviations from the predetermined tracks in some areas. Biological samples were obtained from 92 animals; another three were struck (and killed) but lost. Data and samples necessary for the study of condition and diet (measurements, weighings, stomach contents) were given the highest priority, but sampling was carried out also for a number of other studies, including reproduction, population identity and pollution. Concurrent with the sampling of minke whales, estimates of potential prey abundance were carried out using acoustic and trawl equipment. Sightings of whales were also recorded by observers on these vessels.

Preliminary results from the 1992 diet and food availability studies are given in SC/45/NA3. Analyses of forestomach contents indicate a minke whale diet almost completely dominated by fish, although there was considerable heterogeneity in species composition between the sub-areas studied. Capelin dominated diets in the two northernmost study areas (Spitsbergen and Bear Island). Further south, in coastal areas off North Norway and Russia, herring was the most important food item, but was accompanied by significant amounts of sandeel, cod, haddock and saithe. Resource surveys in the two northern areas revealed a particularly high abundance of 0-group cod (which was not found in whale stomachs), while concentrations of capelin were recorded only sporadically. Along the coast of northern Norway and Russia, there appeared to be a large degree of similarity between prey abundance and minke whale diet. Herring was found to be very abundant both in the resource surveys and in the whale stomach analyses. The similarity in distribution was particularly conspicuous for 0-group herring.

Comments and discussion
Ichii and Ohsumi expressed appreciation that the study focussed on the position of minke whales in the ecosystem. Several members commented that the programme had been intended to provide information for the multi-species model MULTSPEC, but that no information had been provided on how the first year's results were to be used in that regard. Schweder noted that the data had not been fully analysed but that information would be provided next year. MULTSPEC is an ambitious long-term programme and its development will be an iterative process taking into account the data obtained from this and other studies.

Lankester commented on the observation in SC/45/NA2 that the commercial catch had often been of whales seeking the vessel. This may have implications for the sampling procedure and for abundance estimation. Walløe explained that the method used in sampling whales under special permit was different from that in the commercial catch operations. Under special permit, the catcher boat steamed at higher speed on predetermined transects. When a whale was sighted, attempts were made to catch that whale. If the whale was not caught, the vessel returned to the transect. The commercial catch method did not rely on chasing animals at high speeds, such as those used by sighting vessels. However, he noted that behavioural observations are being collected that will allow the question of ship-seeking behaviour to be addressed further.

15.2 Review of new or revised Scientific Permit proposals
15.2.1 Japan
The Committee noted that the proposal (SC/45/SHBa10) was a continuation of the programme it has discussed extensively in the past (e.g. IWC, 1989b; 1990a; 1991b; 1992c; 1993f). It draws the Commission's attention to those discussions which are not repeated here. It further notes that the population estimate in Area IV is 76,692 (CV=0.257). The planned sample size is 300 ±10%. The plan follows that enacted the previous year that had incorporated comments and suggestions from the Committee.

Comments and discussion
In response to a question about whether the sample size for the programme would take into account catch limits that may be set under the RMS, Komatsu noted that it would be unchanged. This is in accordance with Article VIII of the Convention. Ohsumi clarified that although, as stated last year, the immediate focus of the programme had switched to estimation of the average natural mortality rate, the long-term aim was still to estimate age-specific natural mortality. To this end a committee to address and develop theoretical aspects of the plan had been established. Schweder commented on the valuable theoretical work already undertaken and reported to the Committee.

In discussion, Polacheck expressed support for the continued emphasis on the sighting component of the programme. He suggested that further consideration might be given to the design of this component of the programme to ensure that the maximum amount of information is obtained from it, including factors which might reduce the variance or result in estimates of $g(0)$. One factor to consider is whether the same vessel should be used for the dedicated sightings vessel throughout the work rather than rotating this responsibility among vessels. This could be valuable in terms of reducing the variance in the abundance estimates.

Smith also noted the value of the sightings component. He suggested that further investigation of the reasons for the different density estimates obtained for the sampling and dedicated sighting vessels, would be useful, particularly in the light of the question of the reaction of minke whales to vessels (e.g. SC/45/NA8 and SC/45/O 19). Further, he noted with appreciation the fine scale of the examination of both genetic and spatial heterogeneity. Any implications these might have for management need to be considered.

Komatsu noted with appreciation that the authors of SC/45/O 25 had used data from the Japanese programme in a management context. As they had previously argued that the programme would not provide data essential to management (IWC, 1989b) he enquired if their view had changed. De la Mare responded on behalf of the authors

that use of the data in this manner did not imply that they were essential to management and their views had not changed.

15.2.2 Norway
The Committee noted that the proposal (SC/45/NA4) was a continuation of the programme presented last year. The sampling strategy had been modified in the light of the first year's experience to take into account the likelihood of poor weather and variability in whale abundance. The Committee had discussed the proposal extensively last year (IWC, 1993f, pp.76-81) and it draws the Commission's attention to those discussions.

16. SECOND INTERNATIONAL DECADE OF CETACEAN RESEARCH

16.1 Review of new results from previous work

(a) IWC/IDCR Southern Hemisphere minke whale assessment cruises
An assessment of minke whale abundance in Area V from the 1991/92 sightings survey was available in SC/45/SHBa20 (revised). The number of animals in the survey area, approximately 55% of Area V, was estimated as 92,709 (CV 0.20). An estimate for the whole area south of 60°S, obtained by projection, was 207,833 (CV 0.21).

Previous surveys in Area V had been carried out in 1980/81 and 1985/86. The former is not directly comparable with the others; the 1985/86 estimate of 294,610 (CV 0.14) and the projected 1991/92 estimate now available are not significantly different.

The report of the 1992/93 cruise is given as SC/45/SHBa5.

(b) Humpback whales off northwestern Australia
A report on this work is given in SC/45/SHBa26.

(c) Genetic variability and stock identity of humpback whales
Results from this work are used in Baker, 1993; Baker *et al.*, 1993a; b; c.

16.2 Review of Southern Hemisphere minke whale cruises
The Committee reviewed its role in planning and organisation of IDCR cruises, based on recent experience, particularly during the 1992/93 cruise. It recognised that its role in the cruises had diminished in recent years.

Three main areas of concern were recognised:

(i) logistical and administrative, particularly at the early planning stages;
(ii) scientific, particularly in the specific details of cruise tracks and methodology;
(iii) acceptance of responsibility, particularly the extent of the Scientific Committee's involvement in abundance surveys in the context of the RMS.

The Committee recognised that implementation of the RMS will result in the need for monitoring surveys, requiring closer Committee involvement in their scientific aspects. This will require in practice, more time devoted to the subject at annual meetings, and/or increased Committee involvement in intersessional meetings.

The Committee noted that it should itself set the scientific priorities for such surveys. Its involvement would be beneficial in two ways, by enlarging the scientific

expertise applied in planning, and by increasing external confidence in the cruise results.

The Committee received the report of the Working Group established to consider the 1993/94 survey (Annex Q). It endorsed the recommendations in that report. In particular it re-emphasises the importance of an expanded planning meeting and an increased logistical and administrative role for the Secretariat, and recognises the increased budgetary implications of this. The Committee agreed: that Area I should be surveyed; that the cruise should begin later than usual if this proves practical; and that the size of the survey area should be decided at the planning meeting for the reasons described in Annex Q.

16.3 Review proposals for 1993/94
The Committee reviewed six research proposals submitted to the meeting (SC/45/RP1-6). Each was considered on the basis of its relevance to the Commission's work, the scientific quality of the project, its chances of success, the scientific competence of the proposers, the feasibility of the work schedule and the reasonableness of the budget.

After careful consideration of the proposals, reviewers' comments and responses by the proposers, the Committee concluded that all six proposals fully met or exceeded the criteria listed above. The proposals reviewed were:

(i) Structure of fin whale populations of the Gulf of St. Lawrence and West Greenland through photo-identification and genetics (SC/45/RP1). Amount requested: £9,500.
(ii) Parameters of the southern migration of humpback whales on the west coast of South Africa (SC/45/RP2). Amount requested: £6,740.
(iii) Project YoNAH (Years of the North Atlantic Humpback): Analysis of individual-identification photographs from an intensive, ocean-wide study (SC/45/RP3). Amount requested: £13,500.
(iv) Molecular genetic identification of sex and identity among humpback whales of the southern oceans (SC/45/RP4). Amounts requested: £12,240 (primary); £9,000 (supplemental).
(v) Collection of tissue samples from Russian white whales for genetic discrimination of stocks (SC/45/RP5). Amount requested: £7,500.
(vi) Years of the North Atlantic Humpback (YoNAH): West Indies and Gulf of Maine support (SC/45/RP6). Amount requested: £35,500.

The Commission has received a grant from the US Government to fund SC/45/RP6. Details in SC/45/RP3 indicated that the work proposed therein would logically follow the work to be conducted under SC/45/RP6. The Committee strongly endorsed SC/45/RP3 and **recommends** funding in principle, but advised that the proposal be resubmitted for consideration next year.

The Committee agreed that those proposals focusing on Southern Hemisphere humpback whales (SC/45/RP2 and SC/45/RP4) were of high priority because of their relevance to the Comprehensive Assessment of Southern Hemisphere humpback whales currently in progress (Item 8.2). SC/45/RP2 addresses abundance and trends in one stock of humpback whales, and SC/45/RP4 proposes to conduct genetic analyses of all Southern Hemisphere humpback stocks. Results from both proposals will be invaluable for the Comprehensive Assessment. The Committee therefore **recommends** that both be funded.

Proposals SC/45/RP1 and SC/45/RP5 both address questions previously identified by the Committee as

important. SC/45/RP1 addresses stock identification questions important to effective management for fin whales in the North Atlantic (IWC, 1992a). SC/45/RP5 proposes to obtain and analyse genetic samples from white whales in Russia. This species is exploited in parts of its range and its stock structure is poorly known (IWC, 1993h). The Committee **recommends** funding of both these proposals.

17. SMALL CETACEANS

17.1 Review of abundance and exploitation of small cetaceans in inshore waters of southeast Asia, Indo-Malay region

17.1.1 Irrawaddy dolphin, Orcaella brevirostris, *in Laos and Cambodia*

There may be two main areas in Laos inhabited by the Irrawaddy dolphin: the Mekong River in the Champasak province and the Sekong River with some of its larger tributaries in the provinces of Sekong and Attapeu. Dolphins from these areas may concentrate in the deeper riverine waters near the convergence of the Mekong, Sekong and Sesan rivers in Cambodia during the dry season from December to May (SC/45/SM8). No further information was available on the distribution and migration of Irrawaddy dolphins in Cambodia.

Several unverified sources summarised in SC/45/SM8 indicated incidental mortality of dolphins in gillnets and fish traps, deliberate mortality by shooting and mortality or indirect detrimental impact from explosives used in fishery operations in Cambodia.

Plans for studies of the Irrawaddy dolphin in Laos and Cambodia were presented in SC/45/SM8. The Committee **recommends** that surveys be undertaken to map the distribution of the species; to collect quantitative data on dolphin density and that full description be given of the survey methods (e.g. see the guidelines given in Annex J). Further it **recommends**: that samples for analyses of organochlorine contamination and for genetic studies are collected; that samples for genetic studies be exchanged with laboratories studying Irrawaddy dolphins in other areas; and finally that the studies be expanded to include interactions with fishery operations.

17.1.2 Takes of small cetaceans in the Philippines

There is no information on abundance or status of any population of cetaceans in the Philippines.

SC/O90/G29 (revised) contains information on incidental takes in fisheries in a portion of the Philippines (Palawan, Central Visayas and northern Mindanao). Data were collected in 1989–1991 from trips on fishing vessels, visits to fish markets, and interviews with crew members and owners of commercial and municipal fishing vessels, local fishermen, market vendors and middlemen. Seven localities were sampled. Six fishing methods/gears were found to kill cetaceans: (in descending order of importance) purse seines, driftnets, bottom set nets, 'bagnets' and drive nets, longlines and tuna troll lines.

Although dolphins were not directly targeted in the fishery operations, it is estimated that one dolphin is caught for every two tons of fish caught by a sampled fleet of five commercial tuna purse seiners fishing on FADs (fish aggregating devices) and based at Basay in southwestern Negros. This extrapolates to roughly 1,500–2,250 dolphins per season for the fleet. A fleet of ten smaller 'municipal

purse seiners' also based at Basay is estimated to accidentally kill 490–730 dolphins annually. Therefore, an estimated total of about 2,000–3,000 dolphins is killed annually by small purse seiners operating from this one small port. No information is available on the total number of purse seiners fishing in the Philippines.

SC/45/O 27 provided information on directed fisheries at five sites in Palawan and the Southern Visayas. The information was obtained from field notes and recollections of Philippine colleagues and from site visits in 1991. At Brooke's Point, Palawan, dolphins are harpooned for use as bait in a nautilus fishery established some time during the last 30 years. At San Francisco in Negros, four fishing crews have been taking dolphins and pilot whales for about 20 years. An estimated 480 are taken annually (plus about 50 struck and lost). At Selinoq Island, a directed fishery began about 20 years ago. Ten fishermen are estimated to take a total of about 120 dolphins annually. Manta ray fishermen at Pamilacan Island began to take dolphins about 10 years ago. An estimated 130 dolphins are landed annually, with a struck-and-lost rate of approximately 40%.

The species composition of incidental takes of small cetaceans in the Philippines is not well documented. The species killed in directed takes include spinner dolphins (*Stenella longirostris*), pantropical spotted dolphins (*Stenella attenuata*), bottlenose dolphins (*Tursiops truncatus*), Fraser's dolphins (*Lagenodelphis hosei*), melon-headed whales (*Peponocephala electra*) and dwarf sperm whales (*Kogia breviceps*).

The available data indicate that the incidental and directed take of small cetaceans in the Philippines is widespread and of large scale (at least thousands of animals annually). The impact on the dolphin populations is unknown but cannot be assumed to be insignificant. The Committee **recommends**: (a) that the sampling programme be expanded to cover the entire Philippines and be continued for the purposes of obtaining accurate and precise estimates of takes and for monitoring trends; (b) that a programme of sightings surveys to estimate abundance be initiated; (c) that morphological and genetic studies to determine stock identity and distribution of exploited stocks be carried out; and (d) that the likely impacts of the takes on the stocks be assessed.

Dolphins taken in directed fisheries are used as bait for shark and nautilus fisheries as well as for human consumption. Given that the takes are substantial and may be found to have a significant effect on the populations of dolphins, the Committee **recommends** that the suitability and availability of alternative baits be investigated as a contingency precaution.

There was no new information available to the Committee on abundance or takes of small cetaceans in other countries in the study area. These countries include: Australia (Timor Sea and the Gulf of Carpenteria), Brunei, Cambodia (coastal and estuarine waters), Hong Kong, Indonesia, Macao, Malaysia, People's Republic of China (southern coast), Singapore and Vietnam. Extensive coastal fisheries are known to operate in some of the countries in the region and interactions between small cetaceans and fishery operations are likely to occur. The Committee, therefore, **recommends** that research on abundance, incidental and directed takes of small cetaceans in this region be initiated and that relevant international organisations (e.g. UNEP) be encouraged to facilitate such research in co-operation with national and regional research institutes.

17.1.3 Information from other countries in the region
Recent achievements of legislative protection of cetaceans in Taiwan together with plans to study distribution of small cetaceans by questionnaires to fishermen and by sighting surveys, were presented to the Committee. Little information was available on the abundance and takes of cetaceans in Taiwan. The Committee **recommends** that published literature and experts on questionnaire surveys and sighting surveys be consulted before such studies proceed and that a full description of methods is provided when the results of such studies are presented (e.g. see guidelines in Annex J). The Committee **recommends** that the objectives of the studies should be expanded to record stranded and incidentally caught cetaceans, and that such cetaceans be utilised for relevant scientific studies.

Preliminary results from recently initiated research in Thailand was communicated to the Committee by M. Andersen and C.C. Kinze. Concerns were expressed regarding the status of four species of small cetaceans in Thailand (the bottlenose dolphin, *Tursiops truncatus*, Irrawaddy dolphin, *Orcaella brevirostris*, Indo-Pacific humpbacked dolphin, *Sousa chinensis*, and finless porpoise, *Neophocaena phocaenoides*). These species are reported to have deserted large parts of their previous range of distribution in inshore waters, possibly due to habitat degradation. The Committee **recommends** that the research in Thailand is augmented and that such research should include studies of habitat use and habitat requirements of coastal small cetaceans. The Committee noted that information from such studies will be valuable for coastal zone planning and any plans for habitat protection in Thailand's coastal waters.

17.2 Information on other stocks

17.2.1 The Platanista river dolphins
Recent information on *Platanista* river dolphins was reviewed at the 'Seminar on the Conservation of River Dolphins of the Indian Subcontinent' convened in New Delhi, 18–19 August 1992. The proceedings from the seminar (Reeves *et al.*, 1993) including a set of recommendations, were submitted to the Committee for consideration.

Information on present distribution, abundance and takes of both the Ganges river dolphin (*Platanista gangetica*) and the Indus river dolphin (*P. minor*) were insufficient for a full evaluation of the status of the two species. The range of distribution for both species seems to be shrinking, mainly in the upper parts of the main rivers (Ganges and Brahmaputra for *P. gangetica* and Indus for *P. minor*) and their tributaries. Surveys in the central parts of their range show no declining trends but are inconclusive due to poor documentation of methods and survey efforts (Reeves *et al.*, 1993).

Incidental and directed takes are documented. The data are probably incomplete, but the total catch of the Ganges river dolphin is roughly estimated to be 350 dolphins per year (R.S. Lal Mohan cited in Reeves *et al.*, 1993). The physical changes to the riverine habitats by construction of barrages, dams and flood control projects and removal of water for irrigation purposes is regarded as an important threat to the future of the two species. The barrages physically divide the species into sub-populations. The Committee, therefore, believes there is an urgent need to include experts on river dolphins in an early stage of planning and impact assessment of major construction works that may change the river habitat, and **recommends**

that the proposal made by Reeves *et al* (1993) for prompt establishment of a regional Asian river dolphin committee to improve communication and monitor progress be acted on as soon as possible.

17.2.2 Small cetaceans in Japanese waters
Last year the Committee recommended that research be carried out to provide reliable estimates of abundance and that studies be undertaken to determine stock structure and boundaries of small cetacean populations in Japanese waters (IWC, 1993f, p. 84). The Committee, therefore, appreciates the work conducted by Japan and the papers submitted in response to the requests from the Committee.

Abundance of Baird's beaked whales, *Berardius bairdii*, was estimated from sighting surveys in August-September 1991 and 1992 off the Pacific coast of Japan (SC/45/SM6). The total abundance was estimated at 4,219 (CI 1,511–11,784) assuming $g(0)$ equal to one. Applying $g(0)$ equal to 0.836 (Miyashita, 1986) the total abundance was estimated at 5,029 (CI 1,801–14,085). The question of an appropriate method for estimating variance requires further work.

SC/45/SM5 gives preliminary results on striped dolphins sampled to examine the hypothesis of offshore and coastal stocks of this species off Japan. A total of 43 dolphins were taken by hand harpoon in offshore waters east of 142°E and 34 by driving and harpooning in coastal waters. The Committee agreed with the overall conclusion drawn in SC/45/SM5 that the preliminary results from biological analyses did not provide firm evidence on the stock structure of striped dolphins in that area.

The Committee **recommends** that genetic analyses should be carried out on the available samples. The Committee further **recommends** that samples from striped dolphins incidentally caught in the former Japanese driftnet fisheries on the high seas of the North Pacific and the present driftnet fishery within Japan's EEZ should be analysed in order to expand the sample size and the geographical area of this study. Similarly the Committee **recommends** that samples should be exchanged with laboratories holding samples for genetic studies of striped dolphins in the eastern Pacific.

The Committee recalled the concerns it expressed last year on the level of takes of the striped dolphins in Japanese drive fisheries and the status of the striped dolphin stock in Japanese coastal waters (IWC, 1993f, p. 84).

Drive fisheries for dolphins have operated in Japanese waters since the late 17th century. During this century striped dolphins have been most frequently caught at Izu Peninsula and at Taiji. Catches of striped dolphins have declined in recent years at both Taiji and Izu. Before 1963, total striped dolphin catches were as high as 10,000 to 20,000 per year. Between 1963 and 1980, the mean catch was 7,350. The mean catch from 1980 to the present was 2,390. Regulations were implemented in 1982 that set a catch limit of 5,000 delphinids for Taiji, with no catch limit for Izu. In 1991, the quota was reduced to 2,900 delphinids for Taiji with an additional quota of 657 dolphins for Izu, and subsequently to 2,500 delphinids in 1992, including a limit of 1,000 striped dolphins (IWC, 1993h).

The sub-committee noted that there has been a reduction of takes of striped dolphins from 4,803 in 1981 to about 1,000 in the years 1990–1992, possibly because of decreased abundance. There has, however, been no further reduction of the total takes in the period 1990–1992. An increase in the harpoon fishery in 1992 (SC/45/ProgRep Japan) was of particular concern to the

Committee. Kasuya reported that these fisheries are managed by yearly regulations following the calendar year and that most of the 1992 catch probably occurred in early 1992.

In light of the continued harvesting of striped dolphins since 1990, the Committee reiterated its concern of last year that:

'the population cannot support continued exploitation at the current level. Further because of:

(1) the long-standing concern regarding the status of the striped dolphin taken in the coastal waters of Japan; and
(2) the lack of appropriate data on which to set a sustainable catch limit under which the population can begin to recover,

the Committee strongly **recommends** that an assessment is made of this population as a matter of urgency. This assessment would include sufficient information on stock identity and distribution for a reliable estimate of abundance to be obtained and an evaluation of the effects of incidental catches and possible direct catches on the population and estimates of sustainable catch limits that will allow recovery of the population.

The Committee also strongly advises that there should be an interim halt in all direct catches of striped dolphins until this assessment is completed.

Hatanaka, Nomura, Matsuoka and Katsuyama confirmed their view that such advice is unacceptable for the reasons given in Annex S1, but stated that the Government of Japan has been implementing conservation and regulatory measures, including the establishment of catch limits, as it sees most appropriate.

17.2.3 Dolphins in the eastern tropical Pacific

Trends in abundance of dolphins associated with tuna fisheries in the eastern tropical Pacific were reported in SC/45/SM7. The results indicate that for pantropical spotted dolphins, *Stenella attenuata* (northeastern and western/southern stocks, and these stocks combined), spinner dolphins, *S. longirostris* (eastern and whitebelly stocks) and common dolphins, *Delphinus delphis* (central and southern stocks) there has been no significant decline or increase in recent years, after a decline in the 1970s. For the northern stock of the common dolphin, a decline is estimated, but this was believed by the authors to be related to changes in distribution.

SC/45/SM9 reports preliminary estimates of absolute abundance based on sightings made onboard two research vessels covering the offshore waters between 100°W and the Pacific coast of Central America by northwest/southeast tracklines at 2° intervals. The survey was specifically designed to estimate the size of the central stock of common dolphins. The total abundance of this stock was estimated at 210,000 (CV=0.15), approximately half the previous estimate by Wade and Gerrodette (1992). The author however, stated that it is premature to conclude that the decline is significant until the methodology for estimating variance in from the present study has been developed more thoroughly.

SC/45/SM1 gives estimates of the total mortality of dolphins in the ETP purse seine tuna fishery in 1992 based on data collected by observers onboard the fishing vessels. Rates of coverage varied by country and the average observer coverage for the entire international fleet was approximately 87%. The total mortality was estimated at 15,470 dolphins (SE=656) using mortality per set and 15,992 animals (SE=746) using mortality per ton. Species-specific mortality was reported for several stocks. Using the most recent estimates of abundance for dolphin populations affected by this fishery (Wade and Gerrodette, 1993), estimated mortalities in 1992 for all stocks were less than 1% of their respective population sizes. The highest

level of incidental take (0.63%) occurred for the northeastern stock of spotted dolphins (SC/45/SM1).

SC/45/SM2 reported a total kill of 431 dolphins by the US tuna purse seine fishery in the ETP.

SC/45/SM1 reported that the total mortality in the ETP purse seine tuna fishery monitored by IATTC in 1992 was about half that of 1991 (15,470 versus 27,292) in spite of a 7% increase in number of sets, and that the mortality in 1992 was about 10% of the mortality in 1986 (15,470 versus 133,174) The Committee **recommends** that upper and lower confidence limits of the estimates of relative mortality (i.e. kill/population size) should be given and used in addition to point estimates.

For 1993, an international agreement, negotiated by IATTC, set annual vessel quotas for the IATTC member nations and cooperating nations (e.g. Mexico). The mortalities for the first quarter of 1993 are reported to be about 1/3 of the 1992 levels for the same period of the year (SC/45/SM1). It was noted that the parties to the international agreement are committed to reduce mortality annually between 1992 and 1999. By 1999, the annual incidental mortality of dolphins in the ETP purse seine fishery will be no greater than 5,000 dolphins.

The Committee has examined this issue for several years, and expressed concern at the level of mortality. It appreciates the reduced mortalities in 1992 and the recent agreements negotiated by IATTC. It also recognises the considerable effort put into releasing dolphins made by the fishermen and urges that efforts to further reduce the mortality be continued.

Nomura expressed his concern that the IATTC programme to continue reducing the mortality of dolphins during the course of purse-seine fishery operations may have negative impacts on the ecosystem in the ETP and the western Pacific, because it will substantially change the pattern and magnitude of fishing targeting at tunas. The sub-committee, however, observed that the substantial reduction in dolphin mortality has been achieved without any reduction of fishing effort for tuna in the ETP.

17.2.4 Cetacean mortality in California fisheries

SC/45/SM2 and SC/45/O 22 provided information on mortality in California driftnet and set net fisheries in 1992. The estimated mortalities of the three most frequently killed cetacean species in the drift net fisheries were (standard errors in parentheses): 356 (66) common dolphins (*Delphinus delphis*), 45 (17) Cuvier's beaked whales (*Ziphius cavirostris*) and 38 (18) Risso's dolphins (*Grampus griseus*). Total mortalities of 12 (9) harbour porpoises (*Phocoena phocoena*), 4 (5) common dolphins and 2 (3) unidentified cetaceans were estimated for the set net fisheries (SC/45/O 22).

17.2.5 Distribution and abundance of small cetaceans in Antarctic waters

SC/45/SHBa4 provided abundance estimates for several species in Antarctic waters: beaked whales (mostly southern bottlenose whales, *Hyperoodon planifrons*), 599,300, CV 0.15; killer whales *Orcinus orca*, 80,400, CV 0.15; long-finned pilot whales *Globicephala melas*, 200,000, CV 0.35; and hourglass dolphins *Lagenorhynchus cruciger*, 144,300, CV 0.17.

17.3 Request from CITES

CITES has requested comments on five species of small cetaceans which it proposed be transferred onto CITES Appendix I. These species are: Irrawaddy dolphin

(*Orcaella brevirostris*), rough-toothed dolphin (*Steno bredanensis*), Risso's dolphin Grampus griseus, short-finned pilot whale Globicephala macrorhynchus and dwarf sperm whale Kogia simus. The Committee agreed that the Secretariat should provide CITES with relevant information from its Reports since 1991 (IWC, 1991d; 1992f; 1993h). It was agreed that if CITES desired more detailed information or has additional questions, details of the listing proposals and justifications should be provided to the Secretariat and considered at next year's meeting, or, if necessary, intersessionally.

18. DATA PROCESSING AND COMPUTING NEEDS FOR 1994

Highest priority was given to validation of computer programs for population assessment models (Item 10.1), followed by completion of coding of catch and marking data for humpback whales (Item 8) and running the implementation trials specified at this meeting for North Pacific minke whales (Item 7.2.3). Other work identified included: further documentation of the program implementing the CLA (Item 7.1.1); coding of humpback whale catch records from the 1920s, including that held at the UK Natural History Museum (Item 8.2); coding of data for North Pacific Bryde's whales (Item 9.1); preparation of an Omnibus BIWS volume (Item 21).

Validation of the population assessment model programs can not be carried out without adequate documentation. Developers must ensure that documentation reaches the Secretariat by 1 January 1994.

The Committee also requests the Secretariat to determine if the software it now holds (e.g. with respect to abundance estimation, implementation of the RMP, HITTER/FITTER) is subject to legal constraints on distribution (e.g. if they include commercial software).

19. FUNDING REQUIREMENTS FOR 1993/94

Items requiring funding for the coming year were identified as:

Invited participants to Scientific Committee	£22,200
IDCR Southern Hemisphere minke whale cruise	£69,755
Establishment of sightings survey database and analysis software	£30,000

Southern Hemisphere humpback Comprehensive Assessment

— Data copying and coding	£1,600
— Humpback whales off the west coast of South Africa	£6,740
— Humpback whale stock identity in the Southern Ocean	£12,240
	£20,580

Other research needs previously identified by the Committee

— Stock identity of fin whale populations in the Gulf of St. Lawrence and off West Greenland	£9,500
— Stock identity of white whales off Russia, Greenland and Canada	£7,500
	£17,000
Total	£159,535

20. INITIAL AGENDA FOR 1994 MEETING

An initial agenda and a revised workplan will be drafted by the Chairman in consultation with convenors and the Secretariat following the meeting of the Commission and circulated to Committee members

21. PUBLICATIONS

The Committee agreed, in accordance with the procedures outlined in *Rep. int. Whal. Commn* 32:63, that the Editorial Board should comprise Donovan, Hammond, Reilly, Bannister and Bjørge. The Committee agreed that the Secretariat should submit a draft 'Omnibus' volume of whaling statistics, following the suggestions given in Annex R.

22. ELECTION OF OFFICERS

Hammond and Reilly were re-elected Chairman and vice-Chairman, respectively.

23. OTHER BUSINESS

There was no other business.

24. ADOPTION OF REPORT

The report was adopted by the Committee at 18:34, 3 May. Items 18–24 were finalised by the Editorial Board.

REFERENCES

Amos, B. and Hoelzel, A.R. 1991. Long-term preservation of whale skin for DNA analysis. *Rep. int. Whal. Commn* (special issue 13):99–103.

Baker, C.S. 1993. Molecular genetic identification of sex and stock identity among humpback whales of the Southern Oceans. Paper SC/45/RP4 presented to the IWC Scientific Committee, April 1993 (unpublished). 28pp.

Baker, C.S., Gilbert, D.A., Weinrich, M.T., Lambertsen, R., Calambokidis, J., McArdle, B., Chambers, G.K. and O'Brien, S.J. 1993a. Population characteristics of DNA fingerprints in humpback whales (*Megaptera novaeangliae*). *J. Hered.* 84(4):281–91.

Baker, C.S., Perry, A., Bannister, J.L., Weinrich, M.T., Abernethy, R.B., Calambokidis, J., Lien, J., Lambertsen, R.H., Urban, J., Vasquez, O., Clapham, P.J., Alling, A., O'Brien, S.J. and Palumbi, S.R. 1993b. Abundant mitochondrial DNA variation and world-wide population structure in humpback whales. *Proc. Natl Acad. Sci. USA.* 90:8,239–43.

Baker, C.S., Slade, R.W., Bannister, J.L., Abernethy, R.B., Weinrich, M.T., Lien, J., Urban-R, J., Corkeron, P., Calambokidis, J., Vasquez, O. and Palumbi, S.R. 1993c. Hierarchical structure of mtDNA gene flow among humpback whales, world-wide. *Genetics* : in press. [Information paper presented to the IWC Scientific Committee, April 1993.]

Beddington, J.R., Cooke, J.G., Christensen, I., Oritsland, T., Oien, N. and Rorvik, C.J. 1984. Assessments of the northeast Atlantic stock of minke whales. *Rep. int. Whal. Commn* 34:285–91.

Cooke, J.G. 1985. On the relationship between catch per unit effort and whale abundance. *Rep. int. Whal. Commn* 35:511–9.

Ginzberg, L.R. 1986. The theory of population dynamics: I. Back to first principles. *J. Theor. Biol.* 122:385–99.

Gong, Y. and Hwang, B.N. 1984. Effort, catch and sightings data for the minke whale fishery in Korean waters. *Rep. int. Whal. Commn* 34:335–7.

International Whaling Commission. 1982. Report of the Scientific Committee, Annex I. Meeting procedures (see Agenda Item 4.1). *Rep. int. Whal. Commn* 32:127.

International Whaling Commission. 1988a. Report of the Scientific Committee. *Rep. int. Whal. Commn* 38:32–155.

International Whaling Commission. 1988b. Report of the sub-committee on Southern Hemisphere minke whales. *Rep. int. Whal. Commn* 38:76–87.

International Whaling Commission. 1989a. Report of the Comprehensive Assessment Workshop on Catch Per Unit Effort (CPUE), Reykjavik, 16–20 March 1987. *Rep. int. Whal. Commn* (special issue 11):15–20.

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

International Whaling Commission. 1989c. Report of the Scientific Committee, Annex I. Report of the working group on progress reports. *Rep. int. Whal. Commn* 39:130.

International Whaling Commission. 1990a. Report of the Scientific Committee. *Rep. int. Whal. Commn* 40:39–180.

International Whaling Commission. 1990b. Report of the sub-committee on biological parameters and MSY rates. *Rep. int. Whal. Commn* 40:119–30.

International Whaling Commission. 1990c. Report of the sub-committee on management procedures, Appendix 6. Report of the subgroup set up to reconsider the statistics presented for each trial, to revise specifications of existing second stage screening trials and to detail new trials. *Rep. int. Whal. Commn* 40:112–8.

International Whaling Commission. 1991a. Chairman's Report of the Forty-Second Meeting. *Rep. int. Whal. Commn* 41:11–50.

International Whaling Commission. 1991b. Report of the Scientific Committee. *Rep. int. Whal. Commn* 41:51–219.

International Whaling Commission. 1991c. Report of the sub-committee on management procedures, Appendix 4. Report of the *ad-hoc* trials subgroup. *Rep. int. Whal. Commn* 41:108–12.

International Whaling Commission. 1991d. Report of the sub-committee on small cetaceans. *Rep. int. Whal. Commn* 41:172–90.

International Whaling Commission. 1991e. Report of the Workshop on the Genetic Analysis of Cetacean Populations, La Jolla, 27–29 September 1989. *Rep. int. Whal. Commn* (special issue 13):3–21.

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

International Whaling Commission. 1992b. Report of the Fourth Comprehensive Assessment Workshop on Management Procedures, Annex D. Single stock trials for finalised procedures. *Rep. int. Whal. Commn* 42:317–8.

International Whaling Commission. 1992c. Report of the Scientific Committee. *Rep. int. Whal. Commn* 42:51–270.

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

International Whaling Commission. 1992e. Report of the Scientific Committee, Annex L. Report of the *ad-hoc* working group on g(0). *Rep. int. Whal. Commn* 42:252–8.

International Whaling Commission. 1992f. Report of the sub-committee on small cetaceans. *Rep. int. Whal. Commn* 42:178–234.

International Whaling Commission. 1992g. Report of the Third Comprehensive Assessment Workshop on Management Procedures, Annex H. Specification for second phase of second stage trials, H2: new trials. *Rep. int. Whal. Commn* 42:293–4.

International Whaling Commission. 1992h. Report of the Third Comprehensive Assessment Workshop on Management

Procedures, Annex J. Specification of trials for stock boundary uncertainties: coastal whaling case. *Rep. int. Whal. Commn* 42:295–6.

International Whaling Commission. 1993a. Chairman's Report of the Forty-Fourth Annual Meeting. *Rep. int. Whal. Commn* 43:11–53.

International Whaling Commission. 1993b. Chairman's Report of the Forty-Fourth Meeting, Appendix 2. Resolution on the need for research on the environment and whale stocks in the Antarctic region. *Rep. int. Whal. Commn* 43:39–40.

International Whaling Commission. 1993c. Chairman's Report of the Forty-Fourth Meeting, Appendix 3. Resolution on the Revised Management Scheme. *Rep. int. Whal. Commn* 43:40.

International Whaling Commission. 1993d. Chairman's Report of the Forty-Fourth Meeting, Appendix 4. Resolution on a Sanctuary in the Southern Hemisphere. *Rep. int. Whal. Commn* 43:41–8.

International Whaling Commission. 1993e. Report of the population assessment models working group. *Rep. int. Whal. Commn* 43:197–202.

International Whaling Commission. 1993f. Report of the Scientific Committee. *Rep. int. Whal. Commn* 43:55–92.

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

International Whaling Commission. 1993h. Report of the sub-committee on small cetaceans. *Rep. int. Whal. Commn* 43:130–45.

International Whaling Commission. 1993i. Report of the sub-committee on Southern Hemisphere baleen whales. *Rep. int. Whal. Commn* 43:104–14.

International Whaling Commission. 1993j. Report of the working group on implementation trials. *Rep. int. Whal. Commn* 43:153–96.

International Whaling Commission. 1993k. Special Meeting of the Scientific Committee on the Revised Management Procedure. *Rep. int. Whal. Commn* 43:223–39.

Katona, S.K. and Beard, J.A. 1990. Population size, migrations and feeding aggregations of the humpback whale (*Megaptera novaeangliae*) in the western North Atlantic Ocean. *Rep. int. Whal. Commn* (special issue 12):295–305.

Reeves, R.R., Leatherwood, S. and Lal Mohan, R.S. 1993. A future for Asian river dolphins. Paper SC/45/SM4 presented to the IWC Scientific Committee, April 1993 (unpublished). 39pp.

Rorvik, C.J., Gong, Y. and Cooke, J.G. 1984. Report of the sub-committee on Northern Hemisphere minke whales, Appendix 2. Analysis of abundance indices for the Sea of Japan-Yellow Sea-East China Sea stock of minke whales. *Rep. int. Whal. Commn* 34:109–11.

Schweder, T., Ulltang, O. and Volden, R. 1991. A review of the Norwegian catch and effort in northeast Atlantic minke whaling from 1952 to 1983. *Rep. int. Whal. Commn* 41:401–15.

Taylor, B.L. and DeMaster, D. 1993. Implications of non-linear density dependence. *Mar. Mammal Sci.* : in press. [Information paper presented to the Scientific Committee, April 1993.]

Wade, P.R. and Gerrodette, T. 1992. Estimates of dolphin abundance in the eastern tropical Pacific: preliminary analysis of five years of data. *Rep. int. Whal. Commn* 42:533–9.

Wade, P.R. and Gerrodette, T. 1993. Estimates of cetacean abundance in the eastern tropical Pacific. *Rep. int. Whal. Commn* 43:477–93.

Annex A
List of Participants

AUSTRALIA
G.R.V. Anderson
W.K. de la Mare
T. Polacheck

DENMARK
F. Larsen
B. Sloth

FRANCE
M. Pascal
D. Robineau

GERMANY
P. Deimer
K.-H. Kock

JAPAN
Y. Fujise
H. Hatanaka
T. Ichi
K. Inoue
T. Iwasaki
T. Kasuya
H. Kato
K. Katsuyama
H. Kishino
T. Kishiro
T. Kitahara
M. Komatsu
K. Matsuoka
S. Misaki (I)
R. Miura
T. Miyashita
M. Naganobu
Tadahiko Nakamura (I)
Takashi Nakamura

S. Nishiwaki
I. Nomura
K. Ogiso (I)
T. Ohashi
S. Ohsumi
H. Shimada
E. Tanaka
S. Tanaka
A. Tomita (I)
K. Yamamura
M. Yoshioka

MEXICO
H. Pérez Cortés

NETHERLANDS
K. Lankester

NEW ZEALAND
M. Donoghue
E. Slooten

NORWAY
A. Bjørge
S. Grønvik (S)
T. Haug
N. Øien
T. Schweder
L. Walløe

**ST VINCENT AND
THE GRENADINES**
F. Hester

SPAIN
S. Lens

UK
P.S. Hammond
C. Lockyer
A.R. Martin
T.K. Stokes
Y. Zheng

USA
T.F. Albert
G.C. Broadhead
R.L. Brownell
D. DeMaster
C.W. Fowler
G.H. Givens
W.F. Perrin
A. Raftery
S.B. Reilly
T.D. Smith
S.L. Swartz
M.F. Tillman
J.E. Zeh

**INVITED
PARTICIPANTS**
J.L. Bannister
P.B. Best
D.L. Borchers
D.S. Butterworth
M.W. Cawthorn
C.T. Chen
L.S. Chou
S.J. Holt
F. Kasamatsu
A. Kawamura
A. MacCall
H.K. Mok
A.E. Punt
R. Rowlett

D. Sampson
P.J. Stacey

**NON-MEMBER
GOVERNMENT OBSERVER
Austria**
M. Stachowitsch

**INTERNATIONAL
ORGANISATIONS**
W.K. de la Mare
(CCAMLR)
T.K. Stokes (FAO)
T.D. Smith (ICES)
J.G. Cooke (IUCN)
M. Borobia (UNEP)

NGO OBSERVER
R.S. Spill (Animal
Welfare Institute)

LOCAL SCIENTISTS
H. Ishikawa
K. Mori
L. Pastene
F. Sato
Y. Taga
K. Tatsukawa
J.Y. Wang
R. Zenitani

IWC
C. Allison
G.P. Donovan
R. Gambell

(I) = Interpreter
(S) = Support Staff