Report of the Scientific Committee

The Committee met at 9.00am on 6 May 1988 and following days at the Catamaran Hotel, San Diego, USA, under the chairmanship of G.P. Kirkwood. A list of participants is given in Annex A. Many members of the Committee expressed their regret that there were no scientists present from the USSR for the first time since the IWC was established.

Credentials
The Scientific Committee followed the Commission's Rule of Procedure D1.

One scientist's credentials arrived during the opening day. The credentials of a second scientist who arrived on the third day of the meeting were received the next day; however, three days later his Government indicated that it was not participating in the meeting and the scientist concerned withdrew.

The *ad hoc* credentials group established under Rule of Procedure D1 (d) noted that resolution of these matters caused a significant loss of working time.

1. CHAIRMAN'S WELCOME AND OPENING REMARKS

The Chairman welcomed the Committee Members and Invited Participants. In the past year, two biologists taking part in the North Atlantic Sightings Survey, Tim Waters and Fred Fairfield, died in a survey plane crash. The Committee observed a minute's silence in their memory.

2. ADOPTION OF AGENDA

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

3. ARRANGEMENTS FOR MEETING

3.1 Appointment of rapporteurs
Donovan was appointed rapporteur with the assistance of various members of the Committee as appropriate. Chairmen of sub-committees appointed rapporteurs for their meetings.

3.2 Meeting procedures and time schedule
As last year, the Commission decided that the Committee should address the Comprehensive Assessment as well as its normal business. The Commission, primarily in response to the Committee's failure to agree a complete report last year, allocated an extra day to this year's meeting.

The Committee agreed to a work schedule proposed by the Chairman. This took fully into account comments, suggestions and procedures agreed to at earlier meetings (*Rep. int. Whal. Commn* 33: 36; *Rep. int. Whal. Commn* 38: 59) and the list of priority stocks developed in accordance with the procedure agreed to in 1982 (*Rep. int. Whal. Commn* 33: 65). Sub-committees were reminded that a full day must elapse between receipt of their reports by the Committee and discussion of them in Plenary Session. Further discussion of Scientific Committee procedures occurs under Item 11.

3.3 Establishment of sub-committees
The following sub-committees were established: Southern Hemisphere minke whales; North Atlantic minke whales; other baleen whales; protected species and aboriginal/subsistence whaling; and small cetaceans. Reports arising are dealt with under the relevant Agenda Items and Annexes.

Annex D Southern Hemisphere minke whales
Annex E North Atlantic minke whales
Annex F Other baleen whales
Annex G Protected species and aboriginal/subsistence whaling
Annex H Small cetaceans

An *ad hoc* sub-committee on Comprehensive Assessment was also established. Its report, and those of working groups, are incorporated under the relevant Agenda Items or as Annexes.

3.4 Computing arrangements
Allison outlined the arrangements for access to the University of Cambridge computer system. A digital link had been installed from the hotel to the international packet switching system (IPSS) via the Tymnet network, providing up to eight communications channels.

In addition four personal computers running MS-DOS were set up for the use of Committee members, with a variety of word processing, spread sheet and statistical analysis software installed on them.

4. REVIEW OF AVAILABLE DATA, DOCUMENTS AND REPORTS

4.1 Documents submitted
A list of documents is given in Annex C.

4.2 National Progress Reports
At last year's meeting (*Rep. int. Whal. Commn* 38: 32) a correspondence group was established to examine

'ways to improve the consistency of Progress Reports and review the types of information included within them.'

The report of the group is given as Annex I. The Committee agreed to the revised guidelines given that Annex. The Committee re-affirms its view of the importance of progress reports to its work and again

recommends that the Commission urges member nations to provide them following the approved guidelines. A minority statement is given in Annex Q.

4.3 Data collection, storage and manipulation

In SC/40/O 20 the reliability of the official catch records that formed the basis of the BIWS data base was discussed. Problems were identified in species identification, unreported catches, inconsistency in methods of length measurement, falsification of reported lengths, incomplete reporting of foetuses and inaccurate determination of their length and sex, and incomplete examination of stomach contents. Some of these features were obvious from an inspection of the basic statistics, others were not, and the quality of the data probably differed between operations and almost certainly with time. Several members of the Committee with personal experience confirmed that such problems had occurred. Users of the data base should be made aware of such problems, and it was suggested that others familiar with the data collection process for their national industry (or that of another region) should be encouraged to provide specific information as had been done in SC/40/O 20.

4.3.1 Catches and other statistical material from the previous season

Catch data for the 1987/88 season had been received by the Secretariat from Japan and Iceland. This had been coded and the summary statistics circulated. A computer tape containing individual catch records for Norwegian bottlenose, killer and pilot whales from 1938–81 had also been provided. This completed the provision of coded historical catch and effort data for Norwegian small-type whaling for the years 1938–1986. The Committee expressed its appreciation to Norwegian scientists for the work involved in the provision of these data.

Japan noted that it had supplied data to the Secretariat for its research catches, in the format in which it had previously supplied commercial catch data.

The Committee was disappointed to learn that Norway had not yet supplied the 1987 catch data as required by the Schedule. Norway referred to the submission of summary catch data for 1987 in its Progress Report and indicated that coded data for that year will be forwarded to the Secretariat within 2–3 weeks of the close of the Commission meeting.

4.3.2 Progress on data coding projects

Allison reported that good progress continued to be made with the data coding projects.

The systematic checking of the coding of the non-Antarctic catches from the 1949 season to the present had continued and it was expected that this would be completed within the next few months. A validated dataset containing details of the South Pacific and Australasian land station catches was available in addition to the North Pacific and South Atlantic (1970 onwards) datasets already completed.

Approximately half of the data from the International Marking Scheme have been coded and fully validated. This covers the Southern Hemisphere marking since 1960 and includes all minke whale data.

Borchers reported that validation of the 1986/87 IWC/IDCR cruise data had been completed. All data from the 1987/88 cruise had been encoded but have yet to be validated.

4.3.3 Progress on computing projects

At the start of the meeting, Allison reported that the validation of the estimation programs written by de la Mare, which fitted a population model to catch data and absolute abundance and/or abundance index data (HITTER & FITTER), was almost complete. During the course of the meeting the validation was completed and the program ready for use.

Little progress had been made on documenting existing programs held by the Secretariat.

Last year the Committee recommended that a programmer be appointed to allow the IWC computing facility to carry out second stage testing of selected management procedures. A programming assistant was appointed in December 1987 in order to free Allison to do this work.

Borchers reported that updated validation, analysis and graphics programs for the IWC/IDCR cruise data had been implemented on the Cambridge computer system. Data validation, routine abundance estimation and analysis of experiments from the 1986/7 cruise and coding of the data from the 1987/8 cruise had been completed.

4.4 Whale marking

No 'Discovery' marks were recovered in the 1987 or 1987/88 seasons. Three minke whales were marked in the North Atlantic (SC/40/ProgRep Norway). Information on research involving natural marks is given in SC/40/Rep 1 and discussed under Item 6.2.1. The Committee agreed that such information on natural marking might be included in future Annual Progress Reports (and see Annex I).

5. CO-OPERATION WITH OTHER ORGANISATIONS

5.1 Observers' reports

5.1.1 CCAMLR

The Committee had before it the report of the IWC observer at the sixth meeting of the Scientific Committee of CCAMLR (SC-CAMLR) in Hobart in October 1987 (IWC/40/10A). The organisation of the joint IWC/CCAMLR Workshop on the Feeding Ecology of Southern Baleen Whales is discussed under Item 6.2.2.

SC-CAMLR has recommended that krill predator monitoring studies should now begin in three monitoring regions. The initially selected predator species are fur seals, black-browed albatross and certain penguin species. SC-CAMLR also recommended further work on the utility of other potential predators (including minke whales).

SC-CAMLR is also attempting to keep under review the status of krill-dependent predators, especially those which are known or suspected to have changed significantly in abundance. In response to a request from Dr G. Chittleborough, who is compiling a list of such species for CCAMLR, Kirkwood has provided relevant extracts of IWC Scientific Committee reports and suggested further experts to contact.

The Committee thanked de la Mare for attending the SC-CAMLR meeting on its behalf and noted that he was representing CCAMLR at the IWC Scientific Committee meeting.

Kirkwood agreed to act as the IWC observer at the 1988 SC-CAMLR meeting.

5.1.2 ICES

The Committee had before it the report of the IWC observer at the 75th meeting of ICES held in Santander

from 1–9 October 1987 (IWC/40/10B). Three cetacean papers, two of which concerned strandings, were discussed by the Marine Mammals Committee. It recommended that the special theme for next year's meeting be 'Ecological interactions among fish populations, fisheries and top predators'.

The Committee was informed that ICES is organising a symposium on 'Multi–species Management of Marine Ecosystems' which will be held before the 1989 Statutory Meeting in the Netherlands. The symposium will include papers on marine mammals; members of the Scientific Committee who are interested in contributing should contact Harwood.

The Committee thanked Bjørge for attending the meeting on its behalf and he agreed to represent it at the next meeting.

5.1.3 ICSEAF

No observer's report was available at this year's meeting. The Committee noted that the IWC observers at ICSEAF meetings represented the Commission rather than the Scientific Committee itself and their reports were discussed at Commission meetings. It agreed that in future it would only consider the reports of IWC observers at ICSEAF meetings if they contained matters of special interest to the Committee.

5.1.4 IATTC

The Committee was pleased to welcome four observers from IATTC to the meeting. Matters of special interest to the IATTC were discussed at the meeting of the sub-committee on small cetaceans (Annex H). The Committee had before it the report of the IWC observer at the 45th meeting of the IATTC held in La Jolla, California, 8–10 March 1988 (IWC/40/10C). The Committee thanked Perrin for attending the meeting on its behalf. Le Gall agreed to represent the Committee at the next meeting of the IATTC in Paris in May 1989.

The Committee took note of the courses on marine mammal biology and assessment organised by IATTC and funded by UNEP and IATTC that have been held in five Latin American countries in 1986–87. The 130 students, from 11 countries, have included graduate students and working professionals in conservation and management. The courses have dealt with both the large and small cetaceans. The Committee notes the value of these courses in increasing marine mammal expertise in the nations of the region, and hopes that they will continue.

5.2 UNEP meeting on small cetaceans

UNEP wrote to the IWC in February 1988 requesting that the IWC considers co-sponsoring a meeting to 'review the status and problems of small cetaceans worldwide'. It noted that the meeting would probably be held in the USSR in late 1988 or early 1989 (IWC/40/10D).

A small working group of the sub-committee on small cetaceans was convened to examine the proposal. The working group's report is given in Annex H, Appendix 2. The Committee endorsed the working group's report and **recommends** that it be forwarded to UNEP.

The Committee agreed that the proposed meeting could be an important step towards improving our understanding of small cetacean problems and developing approaches to their solution.

For this reason and because members of the Committee have considerable expertise in the topics proposed to be addressed and the problems involved in convening such a meeting, the Committee **recommends** that the IWC co-operates in the planning and conduct of the meeting. It was agreed that this co-operation might include:

(i) assistance in the development of a list of potential participants;
(ii) provision of a member of a steering group;
(iii) dissemination of information concerning the meeting to the committee by the Secretariat.

The Committee noted that this level of co-operation, with no financial implications, was consistent with the 1980 resolution (*Rep. int. Whal. Commn* 31: 31) concerning its mandate to discuss scientific matters relating to small cetaceans.

5.3 Other matters

Last year the Committee had noted with regret that no advisors from FAO, UNEP or IUCN were present and had recommended that the Secretary write to these organisations informing them of the importance it attached to continuing co-operation. The Secretary reported that all three organisations had replied. IUCN explained that its observer to the 1987 meeting had been unable to attend at the last moment; FAO explained that while it valued co-operation with the IWC, in its current financial position it was unable to send an advisor; UNEP explained that the 1987 IWC meeting had conflicted with the meeting of its governing council.

An adviser from UNEP was present at this year's meeting.

6. COMPREHENSIVE ASSESSMENT OF WHALE STOCKS

6.1 Review of reports of contract studies

6.1.1 Biochemical genetics

A working group was set up to review the application of molecular genetic techniques for the identification of stocks and individuals, to discuss new methodologies and to make recommendations for future studies related to the Comprehensive Assessment. The report of this working group is given in Annex J1.

The Committee **recommends** that funds for the contract study for DNA experiments on stock identity and school structure be continued for the second year of the two year project.

The Committee **recommends** that the IWC Secretariat establish a data base containing information on the availability of existing, preserved cetacean tissue samples. This information, stored in a standardised format, would be available to investigators requiring tissue samples. The investigators would then make their own arrangements with the caretakers of the samples.

The Committee also **recommends** that the IWC Secretariat approach the Secretariat of CITES with a view to promoting exchanges of cetacean tissues between scientific institutions. Member Governments should also facilitate scientific institutions' export of tissue samples for studies related to the Comprehensive Assessment.

The Committee also **recommends** that the proposed workshop on the genetic and biochemical analysis of tissue samples collected by biopsy sampling and other means be held as outlined in Annex J2.

6.1.2 Analysis of Southern Hemisphere minke whale marking data

The Committee's discussion of the results of the analysis of Southern Hemisphere minke whale marking data (SC/40/Mi6) is given under Item 7.1.6.

The Committee also discussed the value of re-analysing the marking data for other species, and the status of the earlier recommendation for computerisation of all Antarctic mark and recovery data. The Committee reiterated the value of being able to examine these data, and **recommends** that the Secretariat complete the coding project. No new 'Discovery' marking experiments were recommended, but the potential value of studies using naturally marked individuals was noted (Item 7.1.7).

6.1.3 Analysis of Southern Hemisphere non-minke sighting data

In 1985 the Committee identified the need to examine the sightings data for species other than minke whales arising out of the IDCR surveys (*Rep. int. Whal. Commn* 36: 38).

This work was not completed by the time of this meeting and the Committee urges that it be completed as soon as possible. The results of this study will also be relevant to the Workshop on the Feeding Ecology of Southern Baleen Whales (Item 6.2.2).

6.1.4 Galapagos sperm whale study

The Committee welcomed the results of sperm whale studies at the Galapagos Islands carried out in 1985 and 1987 (Annex J11). The latter study was funded partially by the Commission. The Committee noted that results of studies on the breeding system, calving season, social organisation and movement of groups provided information relevant to the Comprehensive Assessment.

Planned development of the Galapagos sperm whale research includes: potential improvements in the clustering process by which identified whales are allocated to groups; investigation of reproductive rates from calf sightings and length distributions; additional field studies for several months in the Galapagos every two years, principally concentrating on the acquisition of fluke photographs; collection of sloughed skin and/or biopsy samples for DNA analysis of relatedness between and within groups; the development of computer-assisted matching techniques for individual photographic identifications of sperm whales; comparison of results from the field research with analysis of logbooks of 19th century sperm whalers in the Galapagos region.

The Committee re-iterated its support for this work and noted that a detailed research proposal concerning the continuation of the study would be received during the coming year for discussion at next year's meeting.

6.2 Review reports of intersessional meetings

6.2.1 Photo-identification workshop

The Committee had before it the Workshop Report (SC/40/Rep1). It noted that the main body of the report was still in draft form and would be agreed by correspondence. However, the recommendations in Section II of SC/40/Rep1 had been agreed by the participants before the end of the Workshop. Annex E, containing information on sampling strategies, was not available for circulation.

The Workshop was planned in accordance with the objectives, terms of reference and proposed topics detailed in *Rep. int. Whal. Commn* 38: 132–3. It was preceded by a successful symposium involving some 240 participants, from which there were 37 contributed papers and 26 posters (as listed in SC/40/Rep1, Annex C).

The Workshop discussions comprised three main elements: Methodology, End Uses and Recommendations. The Workshop had addressed not only the methodology of photo-identification, but also DNA fingerprinting and acoustic methods in so far as they relate to individual identification. It agreed that acoustic methods were unlikely to be useful at present for identifying individuals. DNA fingerprinting, on the other hand, can be used to identify all individuals sampled (which is not always the case in photo-identification studies), but has the drawback that the procedure takes more time and effort, both in collecting samples and analysis of results.

Natural marking photographs are a well-established technique for several species, particularly humpback and right whales. An indication of the extent of interest in the methodology was given by the tabulation of current and past activities (SC/40/Rep1, Table 1) which provides information on some 13,500 identified animals from 10 species of whale of particular interest to the IWC, involving more than fifty separate programmes or catalogues. The Committee noted that activity was centered in the Northern Hemisphere, with some 75% of the programmes.

Many studies were based on relatively small populations in restricted, particularly coastal, areas and it was recognised that the Scientific Committee would require information on their possible extension to large pelagic populations. To indicate the feasibility of such studies, estimates were provided of the approximate sample sizes needed (using capture-recapture methods) to estimate fin and minke whale populations of different sizes (SC/40/Rep1, Annex D). If high precision was not required, 270 fin whale 'encounters' per year (assuming 75% would be photographed and 100% would be individually identifiable) would be sufficient to estimate a fin whale population of 10,000. By contrast, some 19,000 encounters (assuming 75% would be photographed and 50% would be individually identifiable) would be needed in each of two years to estimate a minke whale population of 500,000 animals with high precision.

SC/40/Rep1, Annex E provided a review of sampling strategies, constraints and trade-offs in photo-identification studies in nine baleen whale and four toothed whale species. Frequently, compromises are necessary between obtaining broad geographical coverage, maximising the number of individuals sampled and dedicating sufficient sampling time per individual. Studies have a variety of objectives: behavioural studies, for example, may not be ideal for estimating population size and vice-versa. It was noted that in addition to providing information on population size, such studies can provide information on trends in population growth. In reviewing the uses to which such techniques can be put, the Workshop also agreed that they could be used for differentiating between populations and for identifying relationships of animals within populations. It was necessary to bear in mind that animals frequently show site and seasonal specificity, and that parameters may have to be estimated for a particular age or sex class of a population.

The Workshop had collated detailed information on techniques, including those involved in biopsy sampling, compiling genetic catalogues, photography (including

archival storage of photographs) and production of catalogues.

In reviewing methods for reidentifying individuals, SC/40/Rep1 draws attention to computer assisted techniques, involving, on the one hand, computerised storage and sorting of images (described in SC/A88/ID11 for humpback fluke photographs) and, on the other, a computerised 3-D model of the relevant target (SC/A88/ID9, developed for North Atlantic grey seals). The latter might be especially useful where there are complex pigmentation patterns (e.g. blue whales) or where the angle of the photograph can cause problems (e.g. right whale heads, see Item 6.4).

The Workshop examined the use of individual recognition studies in estimating population size and/or trends using capture-recapture techniques (Section 10.1). Strong emphasis was placed on the need to design specific estimating procedures for each particular set of circumstances; no single existing model can routinely be applied and statisticians should be involved in such studies at an early stage. There is a need to distinguish clearly between 'closed' and 'open' populations.

The estimation of survival rates (including juvenile survival) and reproductive parameters (such as age at first reproduction, calving interval and reproductive rate) were also addressed in some detail.

The Committee commented favourably on the Workshop and its outcome. In considering the eight Workshop recommendations that addressed matters of specific interest to the Commission (six of which sought IWC funding) the Committee agreed that a Working Group should review the recommendations and determine whether they were appropriate for discussion under the heading of the Comprehensive Assessment or by other sub-committees. The Committee endorsed the conclusions of the Working Group as given in Annex J3.

These are discussed further under Item 6.6 and Item 14.

6.2.2 Feeding Ecology Workshop

The Committee noted that recommendations for holding a Workshop on the Feeding Ecology of Southern Baleen Whales have been made by the Committee since 1983. At its last annual meeting, the Committee had recommended that this Workshop be held jointly with CCAMLR, with an associated IWC budgetary contribution of £13,500 (*Rep. int. Whal. Commn* 38: 134). This recommendation was adopted by the Commission.

When this matter was then discussed by CCAMLR at its 1987 meeting, it was agreed by the CCAMLR Scientific Committee that further refinement of the terms of reference proposed in *Rep. int. Whal. Commn* 38: 134 was needed, and it recommended that a joint CCAMLR/IWC steering committee should meet to accomplish this. Two members of the CCAMLR Scientific Committee were nominated (Miller, Shimadzu) to serve on the joint steering committee and they were present in San Diego on 9–10 May.

Best, Harwood, Kirkwood and Lockyer represented the IWC Scientific Committee on the joint steering committee with the CCAMLR representatives, and this Committee met to develop revised terms of reference and plans for the Workshop. The report of this steering committee is given in Annex J4.

After discussion, the Committee endorsed the proposed objectives, terms of reference, workshop topics and pre-workshop tasks outlined in Appendix 4, and **recommends** that this joint workshop take place. It noted that no additional budgetary allocation was needed from the IWC, and that CCAMLR would consider the steering committee's proposals at its meeting in October 1988. Harwood was nominated as a co-convenor representing the IWC Scientific Committee.

6.3 Review reports of intersessional working groups

6.3.1 Analysis of catch curves

Horwood reported on the working group on catch-at-age data, established last year (*Rep. int. Whal. Commn* 38: 41), which had corresponded during the year (SC/40/O 5). In December 1987, the Scientific Committee met in Cambridge to review the Japanese Research Permit (Feasibility Study). Various documents presented at that meeting had addressed the question of information which can be obtained from catch-at-age-data (SC/D87/32, 34, 36, 37 and SC/40/O 1).

It was agreed that a contract study was not required to address the question, but several members agreed that a protocol should be adopted for the consistent evaluation of any proposed techniques. The report of the working group established to develop such a protocol is given in Annex J5. The Committee received the Report and agreed that the implementation of a final agreed protocol should be discussed at its next meeting if progress with the development of the techniques warrants this.

The Committee then discussed several papers addressing questions of what can be obtained from catch-at-age-data. SC/40/O 23 reports on simulations conducted to test a method (Tanaka, *Rep. int. Whal. Commn* 38: 140–2) which estimates the trend of age-dependent natural mortality. Simulations were conducted for two patterns of recruitment. In one, constant recruitment is assumed regardless of year and in the other, recruitment increased from 1940 to 1970 at a rate of 5% per year. Two sets for natural mortality at age (M_a), were assumed: M_a constant at 0.12 and M_a increasing linearly from 0.08 at age 10 by 0.008 per year. Sample size was assumed either to be 1,650 in year one and five, or 825 in year one, two, five and six. Simulations were conducted 100 times for each case and increasing trends of M_a were measured by the regression slope (b). Although the variability of the estimated b was large, it is likely that an increase of M_a as large as 0.008 per year is detectable. When a constant M_a was assumed, absolute values of b were generally small in comparison with 0.008. Changes in recruitment and past commercial catches had little effect on the estimated b value.

Horwood commented that the recruitment rate in the simulation reported in SC/40/O 23 ceases to increase in 1970 and its effect on the sampled age distributions (taken from 1986 and truncated at age 30) is negligible. In the subsequent estimation a value $\bar{R} = 0$ is imposed. It is thus best to regard the exercise as independent of the possible problems of estimating $\bar{R}$.

Horwood further indicated that the mathematics show that the estimated average mortality (a Heinke-like M) is weakly biassed as a function of $\bar{R}$ (providing $\bar{R}$ is constant) as reported last year (*Rep. int. Whal. Commn* 38: 141). Deviations of the age-specific rate from the average are independent of a constant value of $\bar{R}$. The simulation shows that under the assumptions of the simulation a linear trend in age-specific rates can be estimated. He further pointed out that the simulation assumes multinomial sampling above some age (1 or 10 years). For 'research'

sampling (q=1, a>1), the CV on the linear slope, of M_a with a, is 40–60%, (with M_a increasing by 0.008/yr). The results imply that, for this sample strategy and this magnitude of increase in M_a, trends could be detected but with high CVs. The exercise is based on strong assumptions, as it assumes unbiassed sampling of the population, random selection at age, exact ageing, essentially a value of $\bar{R} = 0$ and constant, and a specific pattern of variation in assumed natural mortality with age.

Responding to the comments by Horwood, Sakuramoto and Tanaka conducted further simulations for the case where recruitment increased up to the present at 5% per year (Annex J6). They stated that these showed that the effect of increasing recruitment is negligible.

A Bayesian cohort model for analysing catch-at-age data was presented in SC/40/O 25. The model assumes the usual form of population dynamics equations. It also assumes that catches are unselective with respect to age, and that they are small compared with the population size. Sampling variability in catch-at-age is assumed to have a lognormal distribution. The procedure uses prior information on the approximate level of fishing effort in each year. In the case of research catches, the level of effort is approximately known. Therefore, the number of whales taken in the research is expected to be proportional to population size.

Some members felt that this was generally a promising method for estimating natural mortality rate and recruitment but various concerns were expressed. These concerns included: (1) the prior assumptions essentially represent prior knowledge of the parameters of interest which is not enhanced by the age data; (2) that the prior assumptions would lead to estimates with reduced trends (although deterministic results do not show this property, it is not clear that this would be robust to the effects of sampling variability); and (3) that variability in catch and effort data is likely to lead to poor precision in any estimates. It was agreed that the next step should include incorporation of variability in the parameters of the model and that both deterministic and stochastic estimation be tested relative to the agreed protocol.

SC/40/O 1 examined the extent to which a time series of catch-at-age data could be used to calculate age-dependent natural mortality rates, recruitment rates and trends in population size for the case where samples can be collected free of the effects of age-specific selectivity. The analysis considered that population age distributions are known without error. The analyses, as do those in SC/D87/32 and SC/40/O 25, indicate that without prior information it is not possible to estimate a time series of recruitment rates and age-dependent mortality rates from catch-at-age data. It was also demonstrated that estimates of age-specific mortality and net recruitment rates were very sensitive to errors in the prior assumptions.

Butterworth (Annex J7) argued that it might be possible to assess recruitment trends adequately from catch-at-age data augmented by information that did not necessarily include relative abundance time series, and correspondingly that age-structure data may improve or extend recruitment trend estimates based on relative abundance time series. The presence of nonlinear effects in the analysis of age-structure data meant that Tanaka's method (*Rep. int. Whal. Commn* 38: 140–2) of estimating $\bar{R}$ was not necessarily undetermined. Arguments and calculations in SC/D87/32 and 34 suggested that continuing catch-at-age data from Southern Hemisphere minke whales might enable the effects of recruitment trends and age-specific natural mortality to be distinguished, as the latter effect could reasonably be assumed to be time invariant, while the former might not be so. He commented that stochastic simulations were necessary to determine the time periods and data sample sizes required to be able to estimate adequately the effects in question.

6.3.2 Management procedures

The Workshop on Management Procedures (*Rep. int. Whal. Commn* 38: 163–70) had elaborated a standard protocol for first stage simulation testing of management procedures. Four papers were presented which contained results for some or all of the tests on several potential management procedures. In SC/40/O 19, the standard screening protocol was applied to a management procedure based on explicit feedback principles. The procedure adjusts catch limits according to whether the estimate of stock depletion is above or below a specified target level. Although it is difficult to draw concise conclusions, the results indicate that the procedure is quite successful at maintaining stocks at, or restoring them to, a level above a protection level. The author made suggestions for further development of the procedure.

Sakuramoto commented that the simulations in SC/40/O 19 were based on estimates using the standard baleen whale model and that the results may change if other population models are assumed. De la Mare responded that tests were conducted for data corresponding to different MSY levels to that assumed by the estimation procedure, which is similar to testing the management procedure on alternative population models.

SC/40/O 24 reported on a simulation study to test the approach of Sakuramoto and Tanaka (SC/38/O 10). The information needed to apply the management procedure is the index of abundance, one sighting survey before the whaling commences, and the age at sexual maturity. Information about the reproduction curve, such as MSY or MSYL, was not used. In no cases investigated did the procedure lead to extinction.

Butterworth reported that SC/40/O 26 was an investigation of an extension to the procedure of SC/39/O 17. The basic algorithm in SC/40/O 17 is replaced by one fitting a population model to time series data, in years in which this model fit to the data satisfies specified consistency criteria. The primary initial purpose of the work was to determine if a simple approximate estimator for the population model performed adequately, because, if so, considerable computer time could be saved in conducting the simulation tests required. The management procedure proposed in conjunction with this estimator was incompletely developed at this stage; difficulties had been encountered for the case of a depleted resource with no relative abundance information available for the period over which the depletion took place.

SC/40/O 40 reported on the results of simulation trials on a modification of the management procedure of Cooke (SC/A86/CA9). The procedure appears to be effective at avoiding excessive depletion of any stock.

A Working Group was established to consider how to proceed with the further evaluation of management procedures. Its report is given in Annex J8. The Committee accepted the report and **recommends** that the Workshop described therein be held (see Item 6.6).

As it did last year (*Rep. int. Whal. Commn* 38: 40), the Committee also **recommends** that a discretionary fund of £5,000 be provided for 1988/89 to which Scientific Committee members carrying out further development of management procedures may apply (maximum of £1,000 per member/group of members).

6.3.3 Biological parameters

Last year the Committee established a correspondence working group that was to develop appropriate terms of reference to review biological parameters and their changes over time. Ohsumi reported that the group had not corresponded over the past year. No additional work was proposed but the Committee believed that this topic was an important one which needed consideration at next year's Annual Meeting.

The Committee also had available to it SC/40/Ba1 that presented an analysis of BIWS pregnancy rate data on Southern Hemisphere fin whales. The author (who was not present) concluded that the most significant factors explaining the variation in the relationship between the proportion of females pregnant and their length were expedition and season. He further concluded that there had been a significant increase over season in maximal pregnancy rate and a corresponding decrease in length at which pregnancy rate is half the maximum rate. These latter conclusions were at variance with the conclusion of an earlier analysis of these data (*Rep. int. Whal. Commn* special issue 6: 401- 410).

In discussion of the analysis and conclusions drawn in SC/40/Ba1, a number of points were made, including (i) while nation and season had also emerged in earlier analyses as significant factors, so had month, whereas surprisingly it had not been found significant in SC/40/Ba1; (ii) in the presence of a strong expeditions effect, it is very difficult to draw reliable conclusions on true seasonal trends in pregnancy rate; (iii) data from biological samples do not support a decline in mean length at sexual maturity; (iv) in any case, because of inconsistent reporting, the BIWS foetus data are unreliable.

On the basis of these comments, the Committee concluded that the BIWS pregnancy rate data were sufficiently flawed (and see SC/40/O 20) that further analyses were not called for. Further description of the analyses in SC/40/Ba1 and more detailed comments on the paper are given in Annex J12.

6.4 Other studies

6.4.1 Sighting surveys

All sub-committees noted that data from sighting surveys were becoming an important, if not the most important, aspect of the assessments that their groups were conducting. Special attention was drawn to the continued development of the Southern Hemisphere IDCR survey, which Japan has indicated a willingness to continue this next season, and the work of the international North Atlantic Sighting Survey (NASS-87).

The Southern Hemisphere minke whale assessment cruise is discussed further in Annex K. It was noted that NASS-87 provided the first ever estimates of abundance for some North Atlantic stocks, and the Committee believed that continuing these surveys would greatly improve the assessments of important stocks. Several separate studies were planned for the present year (Annex E) and a second international survey in the North Atlantic is planned for 1989. The value of timely planning for the 1989 survey was recognised, and informal discussions began at the present meeting. Such planning is particularly important as suitable procedures for surveys in the North Atlantic are still being developed, and several specific problems identified in the presently available data need to be addressed.

The Committee agreed to repeat its **recommendation** of previous years calling for the continuation of monitoring studies including the Antarctic IDCR cruises, the North Atlantic surveys, and surveys of the eastern North Pacific gray whales, the South African right whales and the Bering Sea bowhead whales. The Committee noted that information from the gray and right whale surveys will be important to its consideration of maximum sustainable yield rate (Item 6.4.4).

In this connection, and in view of the recommendation in SC/40/Rep1 that high priority be given to providing one-year only bridging funding to monitoring studies where the absence of one year of data in a series seriously limits the value, the Committee strongly **recommends** that SC/40/RP11, to continue right whale aerial surveys off South Africa, be funded (and see Annex G).

In the light of SC/40/O 41, the Committee discussed the utilisation of the results of sighting surveys, including the need to evaluate how to utilise data that cover only a portion of a stock, and to what degree densities can be extrapolated from other areas, and objective criteria for deciding when surveys could not be used to estimate abundance. The importance for identifying the intended use of sighting survey data during the planning stage, and for identifying how various logistic and related problems would be handled in advance, was noted. Some members noted that some of the survey data that the Committee had used had been collected incidentally during cruises for other purposes, such as fish distribution and abundance, and that such results may be difficult to interpret, especially for estimating absolute abundance. The Committee agreed that this subject should be considered further next year.

6.4.2 Telemetry and remote sensing

The report of a working group established to discuss telemetry and remote sensing is given as Annex J9. Discussions focussed on the application of this field of work to determining aspects of the assessment of large whale stocks. While recognising the role of photogrammetry and satellite imagery, the working group considered that radio telemetry would provide information of more direct value to the Committee, in particular, by establishing stock identity and stock boundaries. 'Conventional' telemetry, using VHF or HF transmitters has been successfully utilised by cetacean biologists for many years but it has significant restrictions, particularly in the relatively short range of its output. However, 'satellite' telemetry, whereby signals are relayed via Earth orbiting satellites, provides excellent potential for gaining long-term data from free-swimming whales.

The Committee considered the causes of earlier problems in the application of radio telemetry to whales and determined several ways in which these problems are being, or can be, overcome. As the availability of this technology improves, three areas need to receive more attention to ensure optimal use of the technology in addressing concerns of the IWC: (i) investigators need increased interactions through regular meetings to maximise speed of development of technological aspects; (ii) proposals for telemetry studies would benefit from

increased peer review; (iii) approaches for efficiently analyzing the large amount of data that can be obtained and for designing studies need to be developed, perhaps using data from the successful studies to date.

The Committee **recommends** that the Commission request the Secretary to write to Service Argos, NOAA and NASA urging them to implement the concept of a dual beam interferometer on future satellites to provide locations from single messages.

The Committee also **recommends** that the Commission urges member governments provide adequate funding to allow the development and use of telemetry to progress rapidly, and further **recommends** that such funding be of several years continuous duration in recognition of the fact that although considerable development work has been undertaken, the benefit of this will be lost if these projects are not continued to completion. The Committee noted that telemetry, particularly using satellite-linked transmitters, provides and will increasingly provide valuable information of use in the assessment of the status of whale stocks in relation to management.

6.4.3 Follow up to CPUE Workshop

Last year the Committee agreed that as part of its programme for the Comprehensive Assessment of whale stocks, the CPUE series for the North Atlantic minke whale fisheries warranted detailed examination of the kind outlined in SC/39/Rep2. It had recommended, and the Commission agreed to request, that those nations who have exploited minke whales in the North Atlantic (i.e. Norway, Iceland, Denmark (Greenland) and a non-member nation, Canada) should supply a detailed description of the methods and strategy of these operations (*Rep. int. Whal. Commn* 38: 39)

The Secretary therefore wrote to those countries in September 1987, asking if they could provide the information in sufficient time for it to be circulated to interested members of the Scientific Committee for analysis and evaluation at the May 1988 meeting of the Committee.

Norway replied that a partial description of its minke whaling operations has already been provided. It would attempt to provide a further response in the spring, but owing to the pressure of time this might still only be provisional.

Iceland responded that its coastal fishery was described in *Rep. int. Whal. Commn* 32: 287–95. This paper includes an account of the history of exploitation of minke whales in Icelandic waters (up to and including the 1980 season); vessel types and catch equipment used; processing; catch regulations; estimated and recorded catches; distribution of catches and the CPUE relationship. Updating of CPUE series has been presented annually in the Icelandic progress reports. However, it is clear that much of the information described in SC/39/Rep2 will never be available for this fishery or will require substantial efforts. Such a study might be conducted in the near future, but in the light of the promising results of aerial sightings surveys in the area in the recent two years, this will probably not be regarded as a task of high priority.

SC/40/Mi22 discussed the strategy of the Norwegian small-type whaling vessel operating off West Greenland from 1979–85 (and see Annex E, Item 6.4.2).

During the meeting, a paper from Canada was received describing the Canadian east coast minke whale fishery (SC/40/Mi25).

The Committee welcomed these replies to its request.

The Committee agreed that, at this stage, reanalysis of existing CPUE data was not a high priority. However, because CPUE data are the only historical abundance data available for some stocks the Committee again identified three potential areas of future work for 'stocks' identified as having high priority in terms of the Comprehensive Assessment. These areas include:

(1) obtaining detailed operational information;
(2) use these data to develop models of the CPUE/abundance relationship;
(3) develop models to determine the effects of whale movement.

Øritsland noted that CPUE studies were given a lower priority in the Norwegian national program for minke whale research (SC/40/Mi7) because the many problems in quantifying factors affecting CPUE would limit the utility of such indices in an overall effort to establish acceptable estimates of current stock size and recent trends. Allowance has been made, however, for future studies of the properties of CPUE indices within the framework of the program.

Øritsland indicated that in general the description given in SC/40/Mi22 would also apply to offshore Norwegian small-type whaling in other areas of the North Atlantic but would not be valid for coastal whaling in nearshore or inshore waters along the coast of the Norwegian mainland.

6.4.4 Estimating maximum sustainable yield rate

Butterworth (Annex J10) considered the question of MSY % (maximum sustainable yield rate, i.e. the ratio of MSY to MSYL expressed as a percentage, where MSYL is the population size at which MSY is achieved – SC/39/Rep3) and suggested that: (1) sources of existing estimates (or opinions) should be listed; (2) the methods and assumptions used in reaching these estimates should be critically reviewed; and (3) future research priorities, particularly as regards the development of absolute or relative abundance time-series from direct surveys, should be specified.

The Committee agreed that this problem warrants more study and that papers dealing with this should be prepared for the next Annual Meeting. Butterworth presented some suggestions in this regard which are detailed in Annex J10 addendum. The Committee agreed that (1) existing data sets should be examined and reanalysed; (2) consideration be given to the design for collecting adequate data and the procedures for analysing them; and (3) the justification for interspecific and inter-stock comparisons should be examined.

6.5 Data inventories and coding

Donovan reported on the current status of replies to the data inventories (Table 1). Members noted with appreciation that most of the countries had now responded. However, several members identified potentially useful data that existed in some of the countries that had not yet responded (e.g. Chile, Peru, New Zealand, the Netherlands). The Committee **recommends** that the countries holding such data be further encouraged to respond. The Committee noted that the inventories were being coded so that they could be made available on floppy disc to interested members of the Committee.

Table 1

Summary of data inventory replies to date. Key: x = information supplied; – = no information available. A space signifies that these data may be submitted later.

Country/ Notes	Data						
	Catch	Effort	Age	Sight-ings	Natural marking	Artificial marking	Repro-ductive
Argentina Not yet complete			x				x
Australia Almost complete	x	x	x	x	x	x	x
Brazil Complete	x	x	–	x	–	–	–
Canada Not yet complete	x		x	x			x
Denmark (Greenland) Complete	x	x	x	x	x	x	x
Ireland No data							
Iceland Complete	x	x	x	x	x	x	x
Japan Complete	x	x	x	x	x	x	x
Republic of Korea Not yet complete	x						
Mexico Complete	–	–	–	x	x	–	–
Norway Complete?	x	x	x	x	–	x	x
South Africa Complete	x	x	x	x	x	x	x
Spain Complete	x	x	x	x	–	x	x
USSR Complete	x	x	x	x	–	x	x
UK Complete	x	x	x	x	–	x	x
USA Complete	x	x	x	x	x	x	x

6.6 Future work

6.6.1 Priority groups/stocks and studies

As last year, the Committee recognises that one of the major problems it faces is the question of stock identity. Therefore, in most cases priorities must be considered in terms of broad population/regions rather than stocks. Exceptions to this include the eastern North Pacific stock of gray whales and the Bering-Chukchi-Beaufort Seas stock of bowhead whales. Following its comments of last year, the Committee agreed that from a scientific viewpoint priority should be assigned to the following categories:

(a) those for which substantial work is underway i.e. Southern Hemisphere minke whales; North Atlantic minke, fin and sei whales; North Pacific Bryde's and minke whales;

(b) those which have been protected from commercial whaling for some period and which are now showing varying degrees of recovery i.e. eastern North Pacific stock of gray whales and the Bering-Chukchi-Beaufort seas stock of bowhead whales noted above;

(c) those other fully protected stocks for which considerable data bases exist, the study of which will help to resolve general methodological problems and improve our knowledge of whale population dynamics, e.g. some stocks of right and humpback whales.

After a request from the Committee last year, the Technical Committee indicated that it believed that 'the Scientific Committee should give priority to those stocks on which there was substantial whaling activity before the moratorium, and where much information has been accumulated and substantial scientific work is underway.' The Committee recognised that this is similar to its category (a) above.

The Committee also noted that it must carry out a Comprehensive Assessment of stocks subject to aboriginal subsistence whaling (Schedule Para 13(a)(3)).

It was agreed that, before 1990, the Eastern North Pacific gray whales should be the subject of an assessment in greater breadth and depth than is usually possible at an annual meeting (Annex G), for the following reasons:

(i) there is no problem with stock identity;
(ii) it falls into category (b) above;
(iii) it is subject to aboriginal/subsistence whaling.

Braham indicated that the US National Marine Mammal Laboratory was attempting to synthesise and provide relevant information to assist the Committee in conducting an assessment of gray whales by 1990 under the Comprehensive Assessment.

As agreed at the planning meeting for the Comprehensive Assessment (*Rep. int. Whal. Commn* 37: 152), the Committee reiterates that priority studies are those which address methodological problems common to a number of stocks or specific problems which arise in the Comprehensive Assessment of particular priority populations/regions as noted above. Addressing either of these may require analysis of data from populations/regions not given priority above. The Committee again notes the importance of the development of management procedures which take into account uncertainty in stock identity and population parameters (*Rep. int. Whal. Commn* 38: 40).

These priorities are reflected in the Committee's funding priorities noted under Item 14, and in its workplan for 1988/89.

6.6.2 Work plan for 1988/89 and 6.6.3 Preliminary workplan for 1989/90

During the discussion of Item 6 above, the Committee has made several recommendations for work to be carried out in the coming year. The Committee's views of how it should consider Comprehensive Assessment matters at next year's Annual Meeting are given under Item 15.

7.1 Southern Hemisphere minke whale stocks (see also Annex D)

The Committee concentrated on providing assessments of the minke whale stocks in the Southern Hemisphere using a consistent procedure with the data collected on IWC/IDCR cruises conducted between 1978/79 and 1986/87. For those Areas which had been surveyed twice, it developed adjustment factors to make the two sets of results more comparable.

7.1.1 Estimates of stock size and abundance from sightings

Until the 1984/85 sightings cruise, all surveys had been carried out in Closing Mode (where the survey vessel closes with each school of whales that it detects in order to determine the species, the school size and the percentage of takeable animals). From 1984/85 onwards, surveys had

been conducted both in Closing Mode and in Passing Mode (where the vessel does not close with the schools it sights, but their species composition and size are estimated by the observers) because the Committee had identified a number of problems with the analysis of Closing Mode data which it hoped could be overcome by surveying in Passing Mode. From 1985/86 onwards, observations had also been made by an independent observer (the IO) who collected information independently from the top men in the barrel. The IO's observations can be used to attempt estimation of g(0), the proportion of whales on the trackline which are actually seen by the observers in the barrel.

The Committee agreed that the best estimates of school density for Southern Hemisphere minke whales came from Passing Mode surveys with an IO. No IO had been present on the 1984/85 cruise and it was agreed to use a pooled value from the Passing Mode and Closing Mode surveys as the best estimate of abundance from this cruise. It was also agreed to calculate estimates of abundance based on Closing Mode results for all surveys so that results from repeat surveys in the same Area could be compared.

Last year the Committee had developed an agreed protocol for analysing the data from all of the IWC/IDCR cruises conducted up to 1986/87, but it had not had time to complete the necessary calculations for all of the cruise results. That process was completed at this meeting.

Appropriate hazard rate functions had been fitted to data from all of the cruises up to 1983/84 last year. The same methodology has since been applied to the data from the 1984/85, 1985/86 and 1986/87 cruises. In the case of the surveys conducted in Closing Mode in 1986/87, so few schools had been sighted in some strata that it was necessary to pool results to obtain a satisfactory fit. It was agreed to pool all transects from the 'near ice' strata of Area II, and to do the same for all transects in the 'far ice' strata.

The analyses described above provide an estimate of the density of whale *schools* in each stratum. To obtain an estimate of the density of *whales*, it is necessary to multiply these density estimates by an estimate of mean school size. Last year it had been agreed to estimate school size in each stratum by reanalysing the distribution of perpendicular distances to sightings obtained in Closing Mode using sightings of whales rather than schools. School size is then estimated by dividing the density estimate based on whales by that based on schools. The protocol for doing this is described in *Rep. int. Whal. Commn* 38: 84. Only results from Closing Mode surveys were used in this analysis because school size tends to be underestimated in Passing Mode. Mean school sizes were estimated for all of the surveys up to 1986/87 at this meeting. The Committee noted that the variances that had been calculated for these estimates were approximate and it **recommends** further work to develop a more accurate estimator.

Last year the Committee had agreed on a suitable stratification of the data from all cruises. However, in the time available it had been unable to carry out the stratification procedure agreed upon for Area IV. Since that meeting the data had been reanalysed using the agreed statification and the results of this analysis were reported in SC/40/Mi14.

The Committee noted that the cruises from 1984/85 onwards had been designed with a view to applying the variable coverage probability analysis described in SC/37/Mi21. It therefore **recommends** that a computer program to implement this method should be added to the existing suite of IDCR programs by the Secretariat's computing staff with the assistance of the author of SC/37/Mi21.

Estimates of density from line transect data have to be corrected for deviations from the assumption that all whales, or schools, on the track line are seen. Over the course of the IDCR cruises a number of experiments have been conducted in an attempt to estimate g(0). SC/40/Mi 20 described two different procedures for estimating g(0) from data collected on the 1985/86 and 1986/87 cruises. Neither method provided a satisfactory description of the observed distribution of duplicate sightings (schools which were seen both by the IO and the barrel). The Committee considered a number of hypotheses which would have explained the fact that more duplicates than expected were seen at some distance from the vessel and fewer than expected were seen close to it, but was unable to evaluate the relative merits of these different hypotheses in the time available.

The Committee recognised the advances that had been made in the analysis of these data in the past year. However, further analysis of the data was clearly necessary. The Committee therefore **recommends** that more work be carried out on the identification of duplicates in the parallel ship experiments and on the theoretical basis for the estimation of g(0) from the independent observer data. A satisfactory expression for the variance of the estimate of g(0) would also be required. In addition, it noted that, ultimately, estimates of g(0) were required which were appropriate for the surveys carried out in Closing Mode only until 1984/85.

In the absence of an agreed estimate for g(0) for the recent cruises, it was decided to continue using a value of 1.0 for g(0) and the correction factor h.

The Committee had no new information on the effects of whale movement (m) and of the percentage of takeable animals (t). It agreed to continue to use a value of 0.985 for the correction factor m, and of 0.658 for t. Some members considered that 'percent takeable' was irrelevant for stock estimation in Southern Hemisphere minke whales because, in general, there has been no legal size limit for these stocks. The Committee therefore agreed to calculate estimates of total stock size as well as of takeable stock. It noted that a considerable amount of information on the proportion of animals that were classified as takeable in each sub-Area had accumulated since it had decided to use a single value for this parameter in all Areas. It therefore **recommends** that the data on the proportion of takeable animals and on estimated size should be reanalysed in time for its next meeting to determine whether any changes in this correction factor were required.

7.1.2 Population estimates

The agreed best estimates from each survey are shown in Table 2.

These estimates apply only to that part of each Area (in general, approximately 60% of the area south of 60°S) which had been surveyed.

The results from the repeat surveys in Areas II, IVW and V shown above are not strictly comparable because different survey methods were used in each survey. Even if results from Closing Mode surveys only are used, there is a problem that different parts of each Area were surveyed in different years. In particular, vessels usually surveyed further north in the second survey in each Area. The results can be made more comparable by adjusting the

Table 2

Best estimates of Southern Hemisphere minke whale population sizes. 'Pooled' survey mode = pooled closing + passing without IO.

Area	Year	Survey mode	Total		Takeable	
			Population	CV	Population	CV
I	1982/83	Closing	55,050	0.203	36,223	0.206
II	1981/82	Closing	37,306	0.213	24,547	0.216
	1986/87	Passing	121,549	0.285	79,979	0.288
III	1979/80	Closing	61,272	0.188	40,317	0.191
IV	1978/79	Closing	72,357	0.156	47,611	0.160
IVW*	1984/85	Pooled	19,980	0.181	13,147	0.185
V	1980/81	Closing	133,382	0.216	87,765	0.219
	1985/88	Passing	303,284	0.172	199,520	0.176
VI	1983/84	Closing	80,283	0.232	52,826	0.235

* = 70°-100°E

Table 3

Comparison of results for surveys in the same Areas in different years (see text). P = probability that difference is due to chance.

Area	Year	Total population	CV	P
II	1981/82	37,306	0.213	0.020
	1986/87	71,973	0.206	
IVW (70–100°E)	1978/79	33,983	0.198	0.045
	1984/85	18,484	0.215	
V	1980/81	133,382	0.216	0.517
	1985/86	160,256	0.186	

estimates to take account of this difference in area coverage. The resulting set of comparable results is shown in Table 3.

The Committee noted that there were significant differences between the two sets of estimates for Area IVW and for Area II. In the case of Area IVW, different vessels had been used in the two surveys and there was evidence (SC/40/Mi20) that the distribution of sightings from these vessels was different. In addition, the timing of the two cruises had been different, with Area IVW being surveyed in the first half of the cruise in 1978/79 and in the second half of 1984/85. The Committee also noted that large concentrations of whales were seen in Prydz Bay in 1978/79 but few whales were seen there in 1984/85. It was suggested that some of the difference may have been due to changes in the distribution of krill swarms in Area IV.

In the case of Area II, the ice edge had extended so far north in 1986/87 that the most southerly stratum surveyed between 40°W and 20°W was north of the most northerly stratum surveyed in 1981/82. The Committee had adopted an *ad hoc* measure to correct this.

The Committee recognised that there were problems with the somewhat arbitrary procedures it had adopted to make the results from repeat surveys in the same Area more comparable. It **recommends** further work on the development of procedures for comparing estimates of abundance obtained in the same Area in different years.

7.1.3 Description of differences from previous assessments

The estimates given above differ from those provided in 1987 in that the stratification procedure agreed last year has now been applied to the surveys carried out in Area IV, and estimates from the surveys of Area V in 1985/86 and of Area II in 1986/87 have been provided.

7.1.4 Other sightings techniques

During the 1986/87 IWC/IDCR cruise, observers on one vessel (the SM2) had carried out the cue counting procedure on all transects conducted in Passing Mode (SC/40/Mi4). On some transects an IO had also collected cue counting data. From this information it was possible to calculate the density of whales in the area surveyed by SM2 in a manner analogous to that used with the line transect data. However, in this case it was also possible to estimate q(0), the probability that a cue is seen close to the vessel, which is analogous to g(0). The density estimate using a value of 0.717 for q(0) is 0.162 whales/n.miles^2. The equivalent value from line transect data collected in passing mode on the same vessel is 0.205 whales/n.miles^2.

The Committee recognised that cue counting had now been used on three IWC/IDCR cruises and had provided density estimates which could usefully be compared with those from conventional line transect analysis. In addition, the technique avoided some of the problems that made the analysis of line transect data for large whales difficult. It therefore **recommends** that consideration should be given to carrying out cue counting and line transect sampling simultaneously on one of the vessels in any future IWC/IDCR Southern Hemisphere sightings cruise. It also **recommends** that blow rate information should be collected at regular intervals during such a survey.

7.1.5 Reports on IWC/IDCR Cruises

SC/40/O 16 provided a compendium of the results from the ten years of data which had been collected on the Southern Hemisphere IWC/IDCR sightings cruises. The Committee congratulated the authors on producing a valuable report and noted that it would undoubtedly prove extremely useful to any other organisation that was planning sightings cruises of this general nature. It also noted that SC/40/O 16 did not provide any description of the methods which had been used for analysis of the data and of the theoretical rationale behind the many experiments which had been conducted on these cruises. It **recommends** that a complementary review along these lines should be prepared in time for its next meeting, and suggested that consideration should be given to preparing a Special Issue on the Southern Hemisphere cruises which would include both reviews.

The Government of Japan had indicated that it intended to make two vessels available for a further cruise in 1988/89. The Committee welcomed this generous offer and **recommends** that such a cruise should take place (see Item 12.2). It also **recommends** that some of the experimental data collected on the 1987/88 cruise should be analysed in time for the planning meeting for the 1988/89 cruise (detailed in Annex D).

7.1.6 Mark-recapture analysis

Buckland reported on the results of a reanalysis of the mark-recovery data for Southern Hemisphere minke whales which he had conducted under contract to the IWC (SC/40/Mi6). A number of mark-recapture models were used to provide estimates of abundance and survival. The major potential sources of bias in the estimates are likely to lead to overestimation of abundance and underestimation of survival. These biases can be corrected for if there is information on rates of mark shedding, marking mortality, geographical variation in the probability that a whale is taken, discovery and reporting rates for marks, mis-reporting of the numbers effectively marked, and

inadvertent and unrecorded double-marking. There were too few recoveries to yield meaningful estimates of abundance for Areas I, II and VI, but estimates were obtained for the remaining three Areas both separately and combined. The total stock size in the combined Areas III+IV+V was estimated to be 400,000 to 450,000. Annual survival was estimated to be between 0.902 and 0.933. Little evidence was found for long-term mark shedding.

The Committee welcomed this thorough analysis of a difficult data set. In discussion it was noted that the variances of the estimates of abundance were undoubtedly underestimated because of heterogeneity in the probability of marking and recapture. Some simulation work had indicated that the methods used might be robust to these effects if a number of areas were pooled, the Committee therefore **recommends** an analysis of the effect of these heterogeneities on mark-recapture estimates. Such analyses might be used in the future in interpreting the results of studies based on individual recognition or biopsy dart sampling.

The Committee discussed at some length the usefulness of mark-recapture experiments based on Discovery tagging for estimating abundance. Some members considered that the method was flawed because estimates were subject to an unquantifiable bias if there was substantial short-term mark shedding or marking-related mortality. In addition, they noted that the available variance estimates were unreliable.

Studies of captive animals (Geraci and St Aubin, 1986) have indicated that metal objects inserted into the flesh of dolphins tend to be rapidly ejected if any part protrudes into the blubber layer, whereas they are quickly encapsulated and retained if they are entirely within the muscle layer. The Committee recognised that data from the test firing of marks into whale carcasses on Japanese factory ships, and on mark site and wound condition in actual mark recoveries, might provide some insight into the level of short-term mark shedding and mortality. It therefore **recommends** that these data be examined to see if they can provide an insight into this difficult problem.

In conclusion, the Committee noted that many of the problems encountered in the analysis of the data from marking with Discovery-type marks could be overcome if biopsy darts were used to 'mark' whales using the DNA fingerprinting technique (see *Rep. int. Whal. Commn* 38: 138). However, if this marking was carried out in the absence of any commercial catch, sample sizes of at least 500 whales marked per season in each Area would be necessary to obtain reliable estimates of abundance and survival.

7.1.7 Potential of individual recognition methods

The Committee noted that the report of the Workshop on Individual Recognition (SC/40/Rep1) had recommended that 'in the event of a further IWC/IDCR minke whale assessment cruise, the equivalent of 1–2 days work under good conditions be allocated to photo-identification of minke whales, as a feasibility study.' The Committee had reservations about the usefulness of the technique for estimating the abundance of Southern Hemisphere minke whales because of the large sample sizes which would be required (see SC/40/Rep1, Annex D). It was also concerned about dedicating two of the small number of days of good conditions usually encountered on the IWC/IDCR cruises to this experiment. Joyce indicated that he intended to coordinate an analysis of a collection of photographs of minke whales which had been collected on the IWC/IDCR cruises to determine whether Southern Hemisphere animals could be recognised individually. Persons experienced in identifying individual minke whales will be involved. The Committee **recommends** that this analysis should be carried out before any time is dedicated to this activity on an IWC/IDCR cruise. It noted that there were a large number of photographs of minke whales taken on board Japanese factory ships. It considered that it would be very useful if these could also be made available for this analysis.

The Committee also noted that the photo-identification technique would be particularly appropriate for a study of minke whales off the coast of Brazil, where animals are found within a well-defined area (*Rep. int. Whal. Commn* 33: 419–427; SC/40/ProgRep Brazil). A study in this region could provide extremely useful information on biological parameters, in particular on calving intervals. The Committee **recommends** that a shipboard survey along these lines should be carried out off the coast of Brazil.

7.2 North Atlantic minke whale stocks (see also Annex E)

Stock identity

The Committee had no new information to allow it to address the question of stock identity. It recognised, however, that this issue was of crucial importance, particularly with respect to the provision of management advice to the Commission on the status of West Greenland minke whales (see Item 7.2.3). The Committee **recommends** that genetic studies, as outlined in Annex J1, (see Item 7.2.3.4) and telemetry studies, as outlined in Annex J9, be initiated to try to resolve the question of stock identity.

North Atlantic Sightings Surveys

The Committee received several papers relating to the North Atlantic Sighting Survey which took place in the summer of 1987 (NASS-87). The objectives of NASS-87 were to investigate the distribution and estimate the abundance of the three primary target species; fin, minke and pilot whales. Shipboard surveys undertaken by Iceland, Norway, the Faroe Islands and Spain and aerial surveys undertaken by Iceland, Norway and Denmark searched a total of almost 30,000 n.miles on transect. Data from these surveys have been used in preliminary analyses to estimate numbers of minke whales in the North Atlantic.

The Committee recognised the large amount of work represented by the planning and execution of NASS-87 and by preliminary analyses of the data. It expressed appreciation to the scientists involved in the survey and to Iceland, Norway, Denmark, the Faroe Islands, Spain, the Nordic Council of Ministers, the USA, Japan and the UK for making the research possible, and it looked forward to the results of further analyses at next year's meeting.

The report of the joint post-cruise meeting of the 1987 North Atlantic Sightings Survey (SC/40/O 28) had recommended that the next coordinated international survey effort be postponed until 1989. The Committee welcomed the intentions of Norway, Iceland and Denmark to conduct another such survey at that time because of the importance of obtaining estimates of absolute abundance. It noted that the participation of the Faroe Islands and Spain had greatly increased the value of the 1987 survey and urged participation by these and other countries in 1989.

Recognising the importance of such surveys covering as wide an area as possible, the Committee **recommends** that the Commission instruct the Secretary to contact the government of Canada informing it of the survey planned for 1989 and requesting their cooperation and participation in this survey.

Table 4

Estimates of numbers of minke whales from the 1987 North Atlantic sightings survey

	Shipboard	Aerial
1. Northeastern stock		
Norwegian survey block A (part)	2,961 (0.287)	
Norwegian survey aerial part of block A	547 (0.287)	244 (0.517)
Norwegian survey block B1	5,787 (0.415)	
Norwegian survey block B2 (part)	2,098 (0.316)	
Norwegian survey block C1	2,625 (0.477)	
Norwegian survey block C2	-	
Norwegian survey Svalbard area	-	787 (0.451)
Faroese survey blocks 11-14	4,610 (0.220)	
Icelandic survey ship block 7	-	
2. Central stock		
Norwegian survey block A (part)	729 (0.287)	-
Norwegian survey block B2 (part)	2,393 (0.316)	-
Icelandic aerial area/ship blocks 1,2,10 form part of this area	6,456 (0.099)	8,645 (0.202)
Iceland survey ship blocks 3-6, 8, 9	7,717 (0.139)	
3. West Greenland stock		
Danish survey		1,153 (0.417)

Notes to the Table:
(1) Norwegian shipboard estimates have been recalculated by fitting a hazard rate model to unsmeared data truncated at 0.5 n.miles pooled over both closing and passing mode for all blocks. They have then been assigned to stock area as in SC/40/Mi9.
(2) Norwegian aerial estimates have been calculated from the total estimate given in SC/40/O 12, adjusted for a mean surfacing rate of 53/hr.
(3) Icelandic shipboard estimates are those presented in SC/40/O 30 multiplied by 1.39 to convert the effective search width from twice the median perpendicular distances to that for the negative exponential.
(4) Icelandic aerial estimate is that presented in SC/40/O 12 using the effective search area stratified by Beaufort, adjusted for a mean surfacing rate of 53/hr.
(5) Faroese shipboard estimates are as presented in SC/40/O 30.
(6) Danish aerial estimate has been calculated using the effective search area in SC/40/O 12, the number of cues and coverage probabilities from SC/40/O 11 and a mean surfacing rate of 53/hr.
(7) CVs for all aerial estimates include components for inter-transect and effective search area variability but not for variability in mean surfacing rate.
(8) CVs for Icelandic and Faroese shipboard estimates do not include components for variability in effective search width or mean school size.

7.2.1 Northeastern stock

7.2.1.1 Sightings estimates

The Committee examined estimates of abundance calculated from the Norwegian shipboard surveys (SC/40/Mi9). It noted the large apparent difference between the distributions of perpendicular distance collected during passing and closing mode. This difference was tested and found not to be significant for the data truncated at 0.5 n.miles; the data were pooled to estimate a single effective search width. There was no significant difference between the sighting rates in closing and passing modes and a single population estimate was calculated for each block using the pooled data. These estimates were accepted by the Committee as provisional estimates of the number of whales in each survey block. They are presented in Table 4.

This management area also includes the area covered by the Faroese ship survey, provisional results of which are presented in SC/40/O 30 and Table 4.

The Committee examined an analysis of the Norwegian aerial survey data (SC/40/O 12). The data were collected according to the cue counting method as described in SC/40/Mi4. This method calculates the density of cues (surfacings in the case of North Atlantic minke whales) seen in an effective search area estimated from the radial sightings distances. Density of cues is then divided by a mean surfacing rate. The method uses duplicate sightings of the same cue to check the accuracy of the radial distance estimates and to account for whales missed at zero radial distance. SC/40/O 12 presented a combined estimate of minke whales from both the aerial surveys in Norway. This figure was recalculated using a mean surfacing rate of 53 surfacings/hour (based on data presented in SC/40/Mi15 and SC/40/Mi23) for Svalbard and north Norway separately.

The Committee accepted these aerial estimates of the number of animals in these areas at the time of the survey. They are given in Table 4. Members noted that the density in the area west of Svalbard was considerably lower than the density from a shipboard survey conducted in 1985 in the same area (SC/37/Mi3).

The Committee agreed that a provisional estimate of total stock size was the sum of the estimates for each survey block from Table 4 using aerial estimates where available. This gives a figure of 19,112 (CV=0.163) animals. There was very little survey effort in the part of block B2 in the Northeastern stock management area (SC/40/Mi9). If block B2 is excluded, the estimate is 17,014 (CV=0.179) animals. These estimates are considered to be provisional because they are based largely on shipboard sightings surveys with a very low coverage and no indication of how many animals were missed on the transect line.

7.2.1.2 CPUE analyses

At last year's meeting the Committee recommended that new analyses be undertaken taking account of discussions at that meeting (*Rep. int. Whal. Commn* 38: 90). No new analyses were presented to the meeting. Further analyses of CPUE series using detailed information available from ship's logbooks might be undertaken as part of the Norwegian five year programme of research (SC/40/Mi7). It was noted that Norwegian catch data and effort data, insofar as they exist, for the period 1938–1986 had been lodged with the Secretariat as recommended last year (*Rep. int. Whal. Commn* 38: 91) and were thus available according to the normal rules of the Commission. Data on operational details had to be sought in deck-logbooks of individual ships. Øritsland reported that work on further analyses of CPUE series would receive a low priority in the Norwegian programme of research.

7.2.1.3 Stock assessment

The Committee agreed that it was important to try to assess this stock because the five year programme of research proposed by Norway involved a scientific take, although no indication had been given of when commercial whaling might resume.

However, several reasons for not attempting an assessment at this meeting were put forward; (i) the unresolved problems with CPUE series; (ii) no agreed basis for choosing a range of MSY percents; (iii) the provisional nature of the stock estimate; and (iv) the

likelihood of a change in age at recruitment over the period of the catch. Although not all members agreed with all of these reasons, the Committee agreed not to attempt an assessment at this meeting.

7.2.1.4 Management advice

At last year's meeting (*Rep. int. Whal. Commn* 38: 45) some members believed that the assessment attempted showed that there was no basis for changing classification of the stock and that it should remain classified as a Protection Stock. Other members believed that there had been no basis for attempting an assessment and that there was consequently no basis for providing advice on the classification of the stock.

This year, in the absence of a new assessment, the Committee was unable to provide further advice on classification of the stock.

Horwood noted that if the stock size was about 20,000, as indicated above, then previous modelling (*Rep. int. Whal. Commn* 37: 103) showed that the stock was in the Protected category. Holt and de la Mare associated themselves with this view.

7.2.1.5 Norwegian programme to study and monitor Northeastern Atlantic minke whales, 1988–1992

Last year, the Committee discussed a provisional programme of research proposed by Norway (SC/39/O 11). This year, the Committee received SC/40/Mi7, a revised Norwegian programme to study and monitor Northeastern Atlantic minke whales, 1988–1992.

The revised proposal was much more broadly based than SC/39/0 11 both in the scope of the research and in the organisations involved. The objectives of the programme were to conduct research leading to identification of stocks, stock assessments and quantifying the role of the minke whale in the environment.

Those aspects of the programme related to the catches to be taken under Scientific Permit are discussed under Item 10.4.

The work planned for 1988 included a major sightings survey in the northeastern Atlantic using six ships, one of which would carry a helicopter. The duration of this survey was expected to be 5 weeks. The Committee noted that plans to develop methodology to estimate the proportion of whales missed on the transect line from shipboard surveys were included in SC/40/Mi7 and that such estimates could be applied to earlier survey results. It also noted that it was planned to cover some areas by ship and helicopter, and independent observer experiments could be attempted on a limited scale in high density areas. The Committee noted the importance of addressing the problems in estimating absolute abundance and it welcomed this survey as a valuable contribution towards this end.

7.2.2 Central stock

7.2.2.1 Sightings estimates

The Committee examined estimates of abundance calculated from the Icelandic shipboard surveys (SC/40/O 30) and discussed some of the sources of negative bias identified by the authors. Part of the searching effort had been conducted in weather conditions unsuitable for sighting minke whales, because the surveys were also for fin whales, although it should be possible to account for this in further analyses. The observers were used to searching out to the horizon for fin whales and may have missed minke whales on the transect line. No independent observer experiments to estimate the proportion of animals seen on the transect line had been planned because the personnel required could not be accommodated on the vessels.

The Committee recalculated the abundance estimates using a negative exponential model to estimate effective search width. These were accepted as provisional estimates because of the problems discussed above, and are given in Table 4.

SC/40/O 12 presented two abundance estimates for the Icelandic aerial survey. One was calculated using an unstratified effective search area, the other using an effective search area stratified by sea state. The Committee agreed to accept the preferred stratified estimate from the survey, using 53 surfacings/hour (see Item 7.2.1.1). This estimate is presented in Table 4.

The Committee accepted as a provisional estimate of stock size the sum of the aerial estimate and appropriate shipboard estimates from Table 4. This figure is 17,091 (CV=0.330), or 19,484 (CV=0.292) if the estimate for the Norwegian shipboard block B2 is included (see Item 7.2.1.1).

7.2.2.2 Stock assessment

Some members believed that a stock assessment should not be attempted at this year's meeting for similar reasons as stated for the Northeastern stock: the lack of an acceptable CPUE series and the lack of an agreed basis from which to choose an appropriate range of MSY percents.

Other members believed that an assessment should be attempted in light of the new estimates of abundance from NASS-87. The results of a simulation procedure using program HITTER (Annex L) are given in Table 5.

Table 5

Results of an assessment of the Central stock of minke whales (see text). Model parameter values: MSY level = 60%; Natural mortality rate = 0.1; Age at maturity = 6; Age at recruitment = 4; 1987 stock size = 17,091 (total stock aged 1 and over); No CPUE data.

MSY%	A	Total exploitable stock in 1941	Total exploitable stock in 1988	1988 stock size / 1941 stock size
1%	0.135	17,593	12,457	70.8%
2%	0.270	16,531	12,360	74.8%
3%	0.405	15,658	12,286	78.5%
4%	0.539	14,943	12,234	81.9%

7.2.2.3 Management advice

Those members who believed that an assessment should not be attempted at this meeting consequently also believed that no advice on classification of the stock could be given, and that the stock should remain unclassified.

Those members in favour of the assessment believed that the results of this simulation showed that the Central Stock, currently unclassified, should be classified as a Sustained Management Stock. Horwood also believed that the stock should be classified as a Sustained Management Stock for the reasons given in Annex E.

7.3 Other Baleen Whale Stocks (see also Annex F)

7.3.1 Western North Pacific Stock of Bryde's whales

Stock identity

A comparison of biological data obtained from catches of Bryde's whales taken by land-based fisheries off the Bonin Islands in 1981–87 with those taken off the Pacific coast of Japan in 1981–86 was presented (SC/40/Ba2). From

differences in the mean length at sexual maturity of males and females and in length frequency distributions, it was suggested that different stocks might inhabit the coastal Kuroshio current area and the offshore Kuroshio counter–current area.

During discussions of this paper it was pointed out that a refined statistical analysis was needed to ascertain whether the differences found for age at maturity were statistically significant. Otherwise, it was thought that these findings would not necessarily provide evidence of stock separation. The Committee noted that biochemical analyses were under way which might provide definitive information on genetic differences between Bryde's whales in these two areas and looked forward to receiving these results.

Estimates of abundance

In response to last year's recommendation of the Scientific Committee, SC/40/Ba3 presented an analysis of the sightings data obtained from 1983 and 1984 summer cruises in the Western North Pacific which used the smearing technique and a hazard-rate model fitted to the perpendicular sighting distance distribution (*Rep. int. Whal. Commn* 38: 257–63). Correcting for animals missed along the trackline, for a divergence from the trackline in 1984 and for stock areas surveyed in earlier years, and then extrapolating to the unsurveyed area of the entire range of the stock, a total population estimate of 18,000 Bryde's whales was obtained. Survey data from 1985–87 were not used since these cruises were not targeted on Bryde's whales and hence covered only a small proportion of the total stock area.

Taking account of the generic problems regarding sightings estimates given in SC/40/O 41 and other observations arising during discussions, it was thought that the following problems were applicable to this estimate of abundance:

(i) the selection of particular years as a basis for estimating abundance from among a series of annual surveys may introduce bias; hence the selection of 1983 and 1984 may be problematical;
(ii) the 1983 and 1984 surveys failed to cover the entire stock area and biases may arise in selecting and combining data from previous surveys to estimate abundance for the areas missed;
(iii) some areas of the stock's summer distribution had never been surveyed and it was unclear as to whether or not the estimate for the surveyed areas should be extrapolated to these areas. Moreover, it was unclear what the boundaries were for the Bryde's whales' summer distribution and if and how they might vary with environmental variables such as sea surface temperature;
(iv) rather than obtaining a new estimate of the probability of missing animals along the trackline, the estimate obtained by Miyashita and Kasamatsu (*Rep. int. Whal. Commn* 35: 363–8) had been used.

Consequently, the Committee noted that, because of these problems, the sub-committee on Other Baleen Whales had not made use of this estimate for assessment purposes. It **recommends** that the following analyses addressing these and other problems be undertaken before the stock is next assessed:

(i) a re-analysis of all available sightings data by 5° squares as outlined in Appendix 2 of Annex F;
(ii) a synthesis of all information on the summer distribution of Bryde's whales to ascertain the appropriate range for stock estimates and future survey coverage. This should also examine the factors affecting inter-annual variability of distribution, such as sea surface temperature;

The Committee also **recommends** re-examination of the mark-recapture data with the view of obtaining an alternative estimate of abundance. It was noted that, since these data arose from the Japanese national research programme, a Japanese scientist would be responsible for this task.

Catch data

The Committee noted that Appendix 3 in Annex F provides an accepted, refined historical catch series for this stock and requested that they be entered into the IWC database.

7.3.2 Okhotsk Sea-West Pacific stock of minke whales

An analysis of size distribution, sexual maturity and apparent pregnancy rate based upon biological data collected from 1969–86 catches (SC/40/Mi17) showed marked latitudinal segregation, as has been the case for many other minke whale stocks.

In response to last year's recommendation of the Scientific Committee, SC/40/Mi16 presented abundance estimates based on sightings cruises from 1978–86. These estimates were considered preliminary only and the Committee **recommends** that further studies should include analysis by 5° squares, investigation of the results of seasonal trends in distribution, and examination of stratification boundaries. The Committee also requested that the range of future sightings surveys be expanded with the cooperation of the USSR and the USA, since much of the summer distribution of this stock occurs within the 200-mile EEZ of these two countries.

7.3.3 East Greenland-Iceland stock of fin whales

Biological parameters

Preliminary studies of reproductive data (SC/40/Ba12) found that there was stability in length at sexual maturity and suggested that changes in age at sexual maturity and in the proportion of the catch having a corpus luteum were correlated with environmental (and hence feeding) conditions. However, the Committee noted that, because of no specific presentation of quantitative data on environmental conditions, it was not possible to evaluate these suggestions at this meeting.

Given the lack of a significant trend with time, the Committee agreed that it would assume a constant age at sexual maturity for assessment purposes.

Sigurjónsson noted that SC/40/Ba8 showed that the apparent pregnancy rate in recent years had varied considerably, and this was to be studied further in relation to the energetic condition of the animals.

Estimates of abundance

SC/40/O 30 provided a line transect estimate of abundance of fin whales based upon sightings data obtained from Icelandic surveys undertaken during NASS-87. Upon discussing the estimate, it was noted that parts of some Icelandic survey blocks actually belonged to other stock areas and should be omitted. Taking account of these adjustments gave an estimate of 5,757 (CV = 0.132) fin whales in the Icelandic survey area. It was further noted

that data from the Norwegian survey around Jan Mayen provided additional sightings of fin whales which could be included in the estimate for the East Greenland-Iceland stock area. The Norwegian sightings effort was not available at the meeting to estimate the abundance in this northern sector directly but a simple approximation yielded an estimate of 679 fin whales, for which the coefficient of variation could not be determined. Combining these two estimates gave an estimate of 6,436 for the stock area which was used for assessment purposes. However, the Committee regarded this to be a preliminary estimate of abundance and **recommends** that it be updated by undertaking an appropriate line transect analysis of the Norwegian sightings data.

Stock trajectories and stock assessment

SC/40/Ba4 provided an analysis of possible population trajectories from an initial 1883 stock size using the HITTER/FITTER computer program, which incorporates a Pella-Tomlinson stock recruitment function. The trajectories obtained were compared with a crude catch per boat series available for 1895–1915, and modern CPUE series for 1962–87. The authors concluded that if the MSY-rate was much lower than 7%, the early CPUE series overestimated the population decline and that the recent series underestimated it. They concluded that the possibility of the MSY rate for this stock being higher than 4% thus could not be ruled out.

Several members of the Committee pointed out that the outcome of this interpretation was largely dependent upon the admittedly crude early CPB series, together with the consequences of the variability in the modern series. They indicated that a thorough examination of this early series was needed, including a detailed description and analysis of the methods and strategy of the coastal whaling operation at that time, in accordance with the view agreed agreed by the Scientific Committee in receiving the report of its CPUE Workshop last year (*Rep. int. Whal. Commn* 38: 35). Until such an analysis was available and its sensitivity to variability in the modern series had been examined, they would be unable to accept these findings as being any more than qualitative speculations.

Magnusson responded that the whole point of the simulations was that, if the stock had collapsed, as was indicated by the CPB series, then the catches which were taken during the modern era could only have been possible if there had been a MSY rate greater than 4%. Several other scientists associated themselves with this view.

Holt and others observed that there was no way to discriminate the level to which the population had collapsed in the beginning of the century, and that such discrimination is critical to the evaluation being offered.

Butterworth and Magnusson pointed out that results in Appendix 4 of Annex F showed that the estimated stock trajectory and MSY-rate were hardly changed if the early CPB series (which indicated a stock collapse at the beginning of the century) was excluded from the analysis This suggested to them that acceptance or otherwise of this CPB series as an index of abundance was not critical to the stock trajectory evaluation offered.

The simulation program HITTER/FITTER was used to compute stock trajectories, given the agreed population estimate of 6,436, the catch series from 1883–1987 and a selection of CPUE series. Results of this assessment exercise were problematical, particularly in that the estimated MSY rate of 11–13% exceeded the gross recruitment rate values of 4–6% previously estimated from catch curves (*Rep. int. Whal. Commn* 33: 125). Some members of the Committee believed that the exercise indicated that either there were problems in using a Pella-Tomlinson stock-recruitment function, or there were problems with the CPUE series or that problems with both the function and the CPUE confounded the result. It was noted that the inclusion of the early CPUE series made little difference in the results.

Butterworth, Magnusson and Horwood commented that while they had separate reservations about the high estimates for MSY rate, the above simple comparison made to the gross recruitment rate estimates was inappropriate and did not allow immediate inferences to be drawn. This is because the population trajectories shown in Appendix 4 of Annex F indicated that the population was generally well above MSY level for the period to which the gross recruitment rate estimates applied, and accordingly the population simulation model would reflect a net recruitment rate considerably less than MSY rate over that period.

The Committee agreed that it would be inappropriate to utilise the assessment discussed by the sub-committee at this very preliminary stage of development. It **recommends** that more detailed simulation studies be carried out in relation to the stock-recruitment function, the CPUE series and the possible effects of environmental conditions on biological parameters. The Committee also requested that the results be presented with the calculated confidence bounds.

7.3.4 Iceland-Denmark Strait stock of sei whales

Estimate of abundance

SC/40/O 30 presented estimates of sei whale abundance arising from sightings obtained during the Icelandic portion of the 1987 North Atlantic sighting survey. The estimates were considered inappropriate for assessment purposes in that the survey had not attempted to cover the population's summer distribution. The Committee **recommends** that an estimate of abundance which is appropriate for assessment purposes be obtained by extending the survey area to cover as much as possible the population's summer distribution. The Committee noted the intention to take up this recommendation in planning the next survey, to be undertaken in 1989.

7.3.5 British Isles – Spain – Portugal stock of fin whales

Sightings of fin whales obtained during the Spanish component of NASS-87 (SC/40/Ba13) yielded a line transect estimate of exploitable population size of 4,127 with a total population size of 4,485 (95% CI: 3,369–5,600) for the area surveyed. The Committee suggested that the 1987 results be compared with previous population estimates, and to pool across years if possible. However, it was pointed out that the 1987 survey used a different cruise track design, and unlike previous years most of the sightings effort was conducted in passing mode.

8. PROTECTED SPECIES AND ABORIGINAL SUBSISTENCE WHALING
(see also Annex G)

8.1 Bering – Chukchi – Beaufort Seas stock of Bowhead whales

Recent catches

A total of 31 of the allowed strike quota of 32 were taken in 1987. By 2 May 1988, 18 had been taken of the 35 allowed for 1988.

Of the 22 whales landed in 1987, 45% were over 13m in length. The mean length of the catch was 12.4m, adult females comprising 32%, both slightly higher than previously (mean length 11.8m, 1981–86; adult females 25%, 1978–86).

A bisexual animal taken in 1987 is the third reproductively aberrant individual recorded since 1981. The Committee believes that because of this relatively high incidence (3 out of 81 animals examined since 1980) the situation should continue to be monitored. Genetic implications for the population are being investigated. It was noted that if the population genetics of the trait can be adequately modelled, it may be possible to estimate the population size at its lowest level.

Struck and lost rates

The 1987 rate (22 landed, 9 lost: 29%) was the same as in 1986, maintaining the significant decrease in struck and lost rate since 1982. The Committee believes that efforts to reduce the rate further should continue.

A penthrite bomb is being developed which should be more reliable and powerful than existing bombs. Four small whales have been killed with it so far in 1988.

Incorporation of radio-transmitters into floats has continued. Since 1983 at one village (Kaktovik) and 1986 at another (Nuiqsut), 11 whales have been struck with harpoons attached to radio-instrumented floats; one whale which would otherwise have been lost was relocated. The use of the device is believed worthwhile where open water allows the float to surface and transmit a signal. Evaluation of the programme is continuing. Where radio transmitters are unsuitable e.g. in thick ice, sonic devices attached to the harpoon are again being considered.

Biological information

Studies of the anatomy of the bowhead's digestive tract (SC/40/PS7) suggest that the narrow diameter of the connecting channel forming the third stomach chamber could lead to blockages if pollutants such as tarballs or discarded plastics are ingested.

Information was available in SC/40/PS8 on length at sexual maturity, the mechanism of ovulation, dates of conception and birth gestation and calving interval, based on material from 15 sexually mature females This was compared with similar reproductive parameters provided by the US National Marine Fisheries Service in their study of 13 sexually mature females (Nerini, Braham, Marquette and Rugh, 1984, *J. Zool.*, 204: 443–68). The Committee recognised the physical difficulties of obtaining biological material from the catch, particularly small foetuses, especially where technicians are no longer present in each of the villages.

The Committee was unable to determine whether the poor correlation between body length and corpora number (from corpora counts from ovaries of 10 animals) was due to a lack of relationship between body size and corpora accumulation or because corpora do not persist in the ovaries. An independent age determinant is required, but bowhead earplugs are unreadable, age determination using the baleen is not yet considered reliable and routine examination of the animal's physical maturity is impractical. As a long-term alternative, natural marking data could provide age-specific reproductive information, particularly since 1,400 animals have now been individually identified. The Committee is concerned that continuation of the photoidentification programme is jeopardised because of funding constraints.

The Committee strongly **recommends** that the morphological analyses continue and that aerial photoidentification surveys should resume in spring 1989, particularly given that each can potentially enhance the other. It noted that continuation of the series of photoidentification surveys would be in accord with the strong view expressed in SC/40/Rep1 that the value of such studies lies largely in the fact that they should be long-term and uninterrupted.

Distribution

Aerial surveys in the eastern Alaskan and western Canadian Beaufort Sea in August/September from 1979 to 1986 show that bowhead whales consistently occur near the US/Canadian border and from 50–150km north of Barter Island, Alaska (SC/40/PS2). Sighting rates were lowest in the second half of August. Bowheads move into relatively shallow water (<50m) in early September, swimming mainly northwest but alternating bouts of swimming with feeding, milling or resting. Feeding was observed most commonly in shallow water (<20m) east of the US/Canadian border.

The Committee is concerned that large-scale surveys are now being curtailed. It noted that passive acoustic monitoring can be used to supplement information from aerial surveys in bad weather or darkness (as described in SC/40/PS3) and **recommends** that acoustic monitoring should continue to be used to supplement aerial surveys rather than to replace them.

Aerial transect surveys off Pt. Barrow in the spring of 1984–1986, flown to determine the offshore distribution of migrating whales and the proportion of offshore animals missed by the shore-based census, gave rather different results to those from photogrammetric surveys. Between 6 and 58% of whales have been recorded beyond the ice-based observers' maximum visual range of 5km. Immature whales were found further offshore in 1986 than mature whales.

The Committee recognises the difficulties inherent in both transect and photogrammetry flights. Photogrammetry flights have tended to concentrate on inshore areas; both are affected by the degree of ice cover. It **recommends** that both kinds of flights should continue and that ice cover should be constantly monitored on the flights. Given the need to assign priority to these costly programmes of aerial survey, transect flights and photogrammetry flights, the Committee believes that highest priority should be given to the photogrammetry flights.

Stock size - initial

Data on animals landed since 1816 were provided from a literature search and interviews with Eskimo people (SC/40/PS10). The Committee agreed that the 157 landed whales not previously included up to 1977 should be added to the existing catch data set used in estimating historical population size. However, there was no new independent information available on initial stock size.

Stock size - current

Acoustic analysis of hydrophone array recordings resulted in an estimate of 5,633 for the total number of vocalising bowheads off Point Barrow in 1986 (SC/40/PS4). This number differed from last year's estimate based on 1986 data, particularly because more data had been analysed and a geometric correction factor based on empirical

results had been used. To improve confidence in the choice of input parameters and hence reduce the variance of the population estimate, preliminary analysis had been undertaken of bowhead swimming tracks based on the characteristics of individual animals' calls (Annex G, Appendix 2). The aim is to provide information on whale swimming parameters independent of visual observations, particularly minimum swimming speed and direction of migration. Calling can be used by the whales to coordinate group movement, to navigate by determining distance from heavy ice floes and perhaps to assess changes in their environment.

Two estimates of stock size were provided to the Committee, each using the same data set but different methodology. A new mark-recapture estimate of 1986 population size, using visual and acoustic data (SC/40/PS5) and methodology described last year (Zeh, Turet, Gentleman and Raftery, 1988, *Rep. int. Whal. Commn* 38: 349–64) but with several innovations, was recomputed using a correction for whales travelling close together, as agreed by the Committee and detailed in Annex G, Appendix 3. The population estimate obtained was 8,200 (SE 2,000). The weighted average of that estimate and the estimate of the 1985 population provided last year (*Rep. int. Whal. Commn* 38: 49) was 7,800.

A new approach, using the Bayes empirical Bayes method (SC/40/PS6), provided a probability distribution of the number of whales in the population, taking into account current gaps in knowledge, errors arising from the use of the tracking algorithm and uncertainty in the tracking parameters. The confidence intervals obtained also take account of the main sources of variability. However, the population estimate obtained in SC/40/PS6 used a minimum swimming speed of 1–3 km/hr. Adjusting the estimate for a minimum swimming speed of 1km/hr, as described in Annex G, Appendix 3, gave a population estimate of about 8,200, similar to that obtained by the mark-recapture method.

The Committee agreed that the approach used in SC/40/PS6 provides more realistic confidence intervals than obtained using normal distribution theory. It therefore accepted the average point estimate of population size of 7,800 (obtained by adjusting the mark-recapture estimate of PS/40/PS5), with a 95% confidence interval of 5,700 to 10,600 (obtained by using the probability distribution approach of SC/40/PS6, as described in Annex G, Appendix 3).

Effects of industrial development

Although it had no new information on this matter, the Committee is concerned over the decrease in aerial survey effort, since large-scale monitoring surveys remain the best method for detecting the cumulative effects of industrial activities over a number of years. It therefore **recommends** that large scale surveys be continued, and that they be carried out objectively to determine the effect of any future impacts.

The Committee was informed that the recently available study on the importance of the eastern Alaskan Beaufort Sea for feeding in this population (noted in *Rep. int. Whal. Commn* 38: 111) concluded that the area is not a significant contributor to the stock's energy needs. A peer review had found that the data presented do not support that conclusion.

The Committee agreed that this emphasises the need for careful design of such large studies to fulfil their objectives.

Management advice

A simulation was undertaken using the HITTER program with the same input values as last year (*Rep. int. Whal. Commn* 38: 116) and an updated population estimate, but with the catch series adjusted to incorporate the additional data from SC/40/PS10, as described in Annex G, Appendix 4.

Annex G, Appendix 5, Table 1, gives the calculated replacement yields for MSY rates of 1–5%, using the agreed weighted average point estimate of population size of 7,800 and the agreed range (5,700–10,600). The calculated replacement yields are given in Table 6.

Table 6

Calculated replacement yields for bowhead whales (see text).

Population estimate	MSY rate				
	1%	2%	3%	4%	5%
5,700	43	77	107	132	155
7,800	56	99	135	165	192
10,600	71	119	153	178	196

Although the sensitivity tests recommended last year (*Rep. int. Whal. Commn* 38: 50) had not been carried out because the model had only recently been validated, the Committee accepted the simulation results as the basis for recommending stock classification. In most instances the simulation indicated classification as a Protection Stock, and the Committee therefore **recommends** that the stock remains a Protection Stock.

The Committee noted that the simulation indicated an increase under an estimated annual average removal since 1910 of 27 animals, but it had no information on the rate of increase and therefore which MSY rate to use. The most appropriate values of replacement yield are those associated with the weighted average point estimate of the population size i.e. 7,800. It **recommends** that efforts be made to determine any population trends from the population estimates now available since 1978. It also **recommends** that sensitivity tests and reconciliation of current estimates with previous studies be undertaken as described in Annex M.

Under the provisions of the Aboriginal Whaling Scheme only a proportion of the replacement yield should be taken, to allow the stock to increase to MSY level, and the Committee notes that the smaller the proportion taken, the greater the rate of population increase.

While the benefits to the stock may only be marginal, the Committee again **recommends** that any catch should be directed to smaller (<13m) animals, but it will review the situation again next year, given that views on the status of the stock have altered since the question was last considered in detail (*Rep. int. Whal. Commn* 37: 50).

8.2 Eastern North Pacific gray whales

A total of 158 whales were reported taken by the USSR from the stock off Chukotka, Bering Sea in 1987, of which 154 were landed (SC/40/ProgRep USSR). The catch, below quota, was restricted by a late start to the season and bad weather. There were no whales caught by the USA in 1987.

A recent census had addressed the three questions of offshore distribution, missed whales and estimation of animals passing in early and late migration (SC/40/PS12). Using two independent observation posts (to give a mark-recapture correction factor for missed whales) and

aerial surveys (to determine offshore distribution) a population estimate was obtained of 21,113 (SE = 688). The small standard error was questioned. The possibility that swimming speeds are different between day and night was raised but previous radio tagging had shown little difference between day and night travel rates. The Committee accepted the point estimate of 21,113 whales.

Because a different model and a new correction factor were used to obtain the 1987/88 estimate, it is not possible to compare the current result with previous population estimates. The Committee agreed that while the new estimate represents a considerable improvement in estimation of this stock's abundance, recent trends in abundance also need to be examined. Either the earlier data require analysis of the kind used for the 1987/88 data, or the 1987/88 data should be reanalysed using the earlier model and information from only one of the two observation posts. Offshore distance-correction factors would also need to be developed for the 1984/85 and 1985/86 data. The Committee **recommends** that such analyses should be carried out before the next meeting.

This stock may now be near its original abundance. Shore censuses should therefore continue, although depending upon the expected rate of population change and accuracy of monitoring needed it may be possible to reduce their frequency. The Committee **recommends** that an analysis of the survey frequency requirement be undertaken before the next meeting.

Because of the potential of photo-identification for providing information on calving intervals, age at first parturition and juvenile survival rates, the Committee **recommends** that all groups currently and previously involved in this work should be contacted to evaluate the status of their photographic collections and to investigate what information is available. A proposal for this to occur, involving relevant Mexican and US scientists, and with appropriate statistical advice, was developed during the meeting. The Committee agreed that the extent of interchange of animals between the breeding lagoons and outside waters should be included in the items to be considered.

The Committee **recommends** that the current Magdalena Bay study (see SC/40/ProgRep Mexico) should continue, to provide estimates of reproductive parameters and survivorship from an uninterrupted time series.

The eastern North Pacific stock of gray whales is of special interest and importance to the Committee because of its demonstrable recovery and the considerable amount of information available on stock identity, population size and trends in abundance. The importance of this stock in the context of the Comprehensive Assessment is discussed under Item 6.6.1.

The Committee would welcome receiving the results of recent Soviet biological work on this species, including age distribution and reproductive parameters. It reiterates its previous request that photo-identification studies be undertaken of the animals off Chukotka.

The stock is well above its minimum population size. While its classification will have to await a broad, in-depth assessment, the population increased by about 2.5% (0.3–4%, Reilly, 1987, *Rep. int. Whal. Commn* 37: 347–9) per year between 1967 and 1980, despite an annual catch of about 179 animals, which comprises only 0.8% of the best estimate of current population size. Pending such an assessment, the Committee therefore **recommends** no change in the catch limit in 1988.

8.3 West Greenland fin whales

A stock estimate of 1,693 whales, was available from the North Atlantic minke whale sub-committee, based on the NASS-87 aerial survey off West Greenland in July/August (SC/40/O 11). Because of inter-transect variation in cue sighting rate, and variability in the estimated effective search area, the coefficient of variation of the estimate was large (0.47). The reliability of the mean surfacing rate estimate was also unknown.

While the discreteness of this population is uncertain, and no information is available on its status, the population estimate represents a considerable improvement on previously available information. Nevertheless, at this stage the Committee is unable to predict the long-term effect of a continuing aboriginal take of 10 whales, in the absence of a more robust estimate and more information on stock identity and status.

The Committee **recommends** that aerial surveys of this stock should continue and that experiments designed to estimate surfacing rates, including radio-tagging, should be undertaken. It was pleased to note that Danish authorities intend undertaking aerial surveys in 1988 at double the 1987 effort. It also **recommends** photo-identification of this population for comparison with results already available from other areas of the Northwestern Atlantic.

8.4 Western North Atlantic humpback whales

New mark-recapture estimates based on photo-identified individuals were available (SC/A88/ID2). That using all photographs from the northern areas of the feeding grounds was considered the best estimate for total population size, i.e. 5,505 ± 2,617, for the years 1979–1986. A rate of population increase of 10.3% (95% confidence interval 2–23%) using photo-identified animals from the Gulf of Maine was obtained.

Fifteen dead humpback whales stranded off Cape Cod and New York in late 1987, including thirteen previously photo-identified individuals. The reason appeared to be ingestion of mackerel contaminated with 'red tide' biotoxins (SC/40/ProgRep USA). Four others washed ashore in the Dominican Republic. The mortality reported for the northeastern United States represents 6.25% of the estimated Gulf of Maine feeding aggregation (240 ± 93; SC/A88/ID2) although that population size may be underestimated (SC/A88/ID4).

The Committee was informed of the catch of one calf in Bequia in 1987. It agreed that although the direct relationship between animals from the Bequia–St. Vincent breeding area and other humpback whales in the northwest Atlantic is unknown, a catch of up to three animals would be unlikely to harm the stock unduly. It **recommends** that photo-identification studies should be undertaken in the Bequia region.

8.5 West Greenland stock of minke whales (see also Annex F)

Sightings estimate

The Committee received an estimate of 1,153 (CV = 0.417) from the West Greenland aerial survey calculated from data in SC/40/O 11, SC/40/O 12 and using a mean surfacing rate of 53 surfacings/hour (see Item 7.2.1.1). It noted that the CV did not include a component for variability in mean surfacing rate. Although minke whales were known to occur north of the survey area (north of 71°30'N) and to the west of it (west of 57°W, between 67°N and 69°N), the Committee agreed that most of the stock

could be expected to be within the survey area. The aerial survey estimate was accepted as an estimate of the number of animals in the management area.

CPUE data

In response to the recommendation from the CPUE Workshop that such details be made available, SC/40/Mi21 described operational details for the Norwegian small-type whaling vessel *Kato* working off West Greenland during the period 1979–85. Searching was not at random but was based on information from previous catches and on weather and ice conditions. It was also based on information from other fishing vessels acting effectively as 'scouts' in the area. Data on operational details and time budgets would be provided to the Commission before the end of the year and would be available according to the normal rules of the Commission.

The Committee welcomed the information contained in SC/40/Mi21. It was confirmed that *Kato's* pattern of searching was typical of offshore Norwegian small-type whaling operations. The Committee recognised that it would be difficult to quantify the effects of this searching strategy, especially as fishing vessels outside the whaling fleet were acting as 'scouts'.

Stock assessment and management advice

At its 1985 meeting most members of the Committee believed that this stock should be classified as a Protection Stock. This was based on the stock assessment presented at that meeting (*Rep. int. Whal Commn* 36: 43) which indicated a probability of 0.74 that the stock was in the Protection Stock category. Other members, however, expressed doubts about the validity of this assessment and believed that the stock should remain unclassified. At that meeting, the Committee recommended that a catch limit of less than 50 whales be set for one year only. The stock was subsequently classified by the Commission as a Protection Stock, but an aboriginal subsistence catch limit substantially higher than this number was set.

At its 1987 meeting, the Committee drew to the attention of the Commission that the catch limit recommended in 1985 had not been put into effect (*Rep. int. Whal. Commn* 38: 51). It reminded the Commission of the continuing uncertainties about the identity, current size and replacement yield for the stock.

At this meeting, the Committee reiterates its concerns about the question of stock identity. There was substantial evidence, relating to the absence of calves and lactating females and the continuing high proportion of females in the catch (SC/37/Mi4 and subsequent Danish Progress Reports), that the minke whales off West Greenland did not constitute a separate biological stock. Resolving this question was of crucial importance to the assessment of minke whales off West Greenland in relation to the provision of advice to the Commission about the aboriginal subsistence take in this area.

Despite these concerns, the Committee had insufficient information to suggest a change in stock boundary for West Greenland minke whales. It agreed to attempt to provide advice on the basis of the existing stock boundary.

This year, for the first time, an estimate of the size of the management stock was available. Some members believed that a simulation using the program HITTER (Annex L) would help them in formulating their advice to the Commission. The results of this simulation are given in Table 7.

Table 7

An assessment of the West Greenland stock of minke whales (see text). Model parameter values: MSY level = 60%; Natural mortality rate = 0.1; Age at maturity = 7; Age at recruitment = 5; 1987 stock size = 1,153 (total stock aged 1 and over); No CPUE data.

MSY	A	Exploitable stock in 1948	Exploitable stock in 1988	1988 stock size / 1948 stock size	1988 RY
1%	0.135	7,100	904	12.7%	-48
2%	0.270	6,809	904	13.3%	-47
3%	0.405	6,549	904	13.8%	-47
4%	0.539	6,315	904	14.3%	-47

The results show that under the range of parameter values chosen, neither the predicted level of depletion nor the 1988 replacement yield was sensitive to the range of values of MSY% chosen. The Committee agreed that it was difficult to interpret the result of these simulations, especially in light of the marked difference between the observed sex ratio in the catch and the predicted sex ratio in the population (Appendix 3, Annex E).

Nevertheless, given that the stock (estimated to be 1,153 animals) was smaller than had previously been thought and that the average annual catch during the last 10 years had been 263 animals per year, the Committee believed that the stock was severely depleted, below the level believed in 1985. The Committee **recommends** that the stock remain a Protection Stock. It agreed that it had no evidence that any catch would allow the stock to move towards its MSY level.

8.2.3.4 Priorities for future research

It was important to try to resolve the question of the identity of this stock. The Committee welcomed the existence of research programmes in Denmark, Iceland and Norway which were trying to address this issue. It noted that Danish research in this area includes the use of a large number of samples of existing tissue from West Greenland. Samples would also be taken from animals taken under aboriginal subsistence whaling from East Greenland where possible. The Committee **recommends** that biopsy samples from whales in the Central stock management area be collected as a matter of urgency. It noted that Norway may be able to take such samples from whales encountered during surveys around Jan Mayen if suitable equipment could be provided.

The Committee noted that information on the relationship of minke whales off West Greenland to those off eastern Canada is also of interest. It **recommends** that the Commission instruct the Secretary to contact the Government of Canada to inform it of the useful work being undertaken in Greenland and Denmark on analysis of genetic material from minke whales found in the Davis Strait, and requesting their cooperation in providing old materials and new biopsy materials from the Canadian East Coast Stock for comparative studies.

The Committee agreed that it was important that the number of minke whales in the West Greenland minke whale stock area should continue to be monitored, and recommends that further surveys be conducted. It welcomed the intention of Denmark to conduct an aerial survey off West Greenland in 1988 with twice the survey effort expended in 1987, and a further aerial survey in 1989 as part of the proposed international North Atlantic Sightings Survey.

8.6 Information on other stocks

A collation of information from documents available at the meeting is included in Annex G as Item 7.

9. SMALL CETACEANS (see also Annex H)

9.1 Beaked whales (including bottlenose whales)

The sub-committee on small cetaceans conducted a review of the beaked whales, giving attention to distribution, stock identity, abundance, migration, life history, exploitation and status. The results are summarised in section 5 of Annex H.

9.1.1 Stocks of Baird's beaked whales

Judging from new information on migration, at least three stocks of Baird's beaked whales exist in the western portions of the range of the species: a western Pacific stock; a Sea of Japan stock; and an Okhotsk Sea stock. The whales have not been observed to cross the shallow-water barriers between these regions. The western Pacific stock and Okhotsk Sea stocks migrate in and out of Japanese waters, but the Sea of Japan stock may be resident year round. Another stock may exist around the Kurile Islands and still others to the east in North American waters.

In part to resolve questions about the oceanic distribution of Baird's beaked whale so that more reliable population assessments can be accomplished, Japan this summer will conduct a 4-vessel survey between 3° and 45°N across the North Pacific from Asia to North America. An additional single-vessel survey will be carried out in Japanese coastal waters to gather data for an estimate of abundance in the region. The Committee looks forward to receiving the results of these surveys at next year's meeting.

9.1.2 Higher mortality rates in female beaked whales than in males?

In the beaked whales for which sufficient data exist to allow estimation of sex ratio, it appears that females may have much higher mortality rates than males. For example, in juvenile Baird's beaked whales, the ratio is about 1:1, but males predominate in adults; the oldest female in catches sampled in Japan was 54 (had 54 GLGs in the teeth) and the oldest male 84. A similar skew was seen in stranded specimens and in a large series of stranded *Ziphius cavirostris*; the maximum age known for *Ziphius* females is 28 and for males 47. A fishery sample of northern bottlenose whales contained 75 males and 53 females. While it is possible that these samples are biased, the phenomenon is general enough to merit attention; it may reflect unusual life histories and breeding systems among these whales.

9.1.3 Unidentified bottlenose whale in the tropical Pacific

There is a large unidentified beaked whale species in the tropical Pacific that may prove to be a species of *Hyperoodon* or an undescribed species of beaked whale of some other genus. Individuals have been seen and photographed numerous times by different investigators in the western Pacific, mid-equatorial Pacific and eastern Pacific. It may prove to be *H. planifrons* (the type specimen of which came anomalously from 20° S), but this would be an extraordinary extension of the range of that supposedly cool- and cold-water species. Because of the value to science of determining the identity of this whale, the Committee **recommends** that an effort be made to collect two adults (a male and a female) in the western Pacific. The possibility of collecting biopsy samples for molecular analysis was also raised, but there likely would be difficulty in collecting a sufficient number of samples from the Antarctic, the North Atlantic and the western Pacific to resolve the unknown whale's identity.

9.1.4 Unidentified Mesoplodon in the eastern tropical Pacific

Another unidentified and possibly undescribed beaked whale inhabits the eastern tropical Pacific and is relatively common there. It has been encountered and photographed frequently during dolphin abundance surveys and most likely is a species of *Mesoplodon*. It was first thought to resemble the strap-toothed whale, *M. layardi*, in coloration, but comparison of photographs during the sub-committee sessions demonstrated that its colour pattern does not match that of any beaked whale for which the colour pattern is known. Only the colouration of *M. pacifus* remains undescribed, and the unknown whale is probably too small to be of that species.

9.1.5 General recommendations on beaked whales

It became evident in the review that extremely little is known about most of the beaked whales. Four general research recommendations are offered:

(1) *Non-lethal research* — The Committee **recommends** that the new techniques for studying living cetaceans, such as individual identification using natural marks, which have proven successful for larger whales, be encouraged for application to the beaked whales, particularly where there are reasonably consistent concentrations of a well-marked species for which concern exists about population size and stock identity (e.g. the northern bottlenose whale in the North Atlantic).
(2) *Effects of gillnets* — It is **recommended** that offshore gillnet fisheries be monitored to determine the nature and extent of impact on beaked whales.
(3) *Sampling catches* — The Committee **recommends** that, when possible, beaked whales taken in direct fisheries be examined thoroughly by biologists to collect data and samples that can be used to estimate life history parameters.
(4) *Strandings* — Because information on life history is so sparse for most of the beaked whales, the Committee **recommends** that efforts be made to collect full suites of data and specimens for all stranded animals.

9.2 New information on other stocks

Takes of small cetaceans in 1987 are summarized in Appendix 3 of Annex H.

9.2.1 Dolphins associated with tuna in the eastern Pacific

The sub-committee on small cetaceans received and briefly discussed several papers relating to dolphins associated with the international tuna fishery in the eastern tropical Pacific. The sub-committee did not carry out a substantive review of the issue but recommended that such be done in the future. In response to requests made last year, papers were submitted this year re-analysing data on abundance collected aboard commercial tuna boats to compensate for biases in the data and presenting indices of abundance based on data collected in a large sightings survey employing research vessels. The Committee expressed its appreciation to the scientists involved. Annex H summarises the discussions of the papers; four research recommendations are given below.

(1) The Committee is concerned that the mortality of dolphins (estimated by one method at 115,000 in 1987) remains high when compared to the most recent estimates of absolute abundance (based on surveys conducted in 1979) and **recommends** that every effort be made to reduce this mortality and to assess its impact on the stocks. An attempt should be made to produce updated estimates of absolute abundance.
(2) Beyond the substantial improvement that could be expected to result from better application of existing dolphin-rescue gear and techniques, further reduction of the kill would probably require development of new technology. For example, members noted that kill rates are very much higher for common dolphins than for other species involved in the fishery and that research into the behavioural reasons for this could well lead to design of new gear and procedures to reduce the high kill rates. The Committee **recommends** that such research aimed at lowering kill rates be undertaken.
(3) Kill estimates would be most useful for purposes of comparisons with estimates of abundance if they were calculated on a stock-by-stock basis; the Committee **recommends** that this be done where possible.
(4) Only about one quarter of the dolphins killed by vessels carrying scientific observers are presently examined to obtain biological data and samples. On occasion, 50 or more dolphins are killed in a single net set. Complete suites of data and samples from such large series would be extremely valuable in population analysis, and the Committee **recommends** that the level of biological sampling be increased, if necessary by returning the carcasses from large-kill sets to research facilities ashore for processing.

9.2.2 White whales in Alaska
New data indicate that estimated subsistence removals from some white whale stocks are large enough (up to 6.7%) to cause concern about their sustainability, and the Committee agrees with the **recommendation** of the authors of SC/40/SM4 that the estimates of abundance and harvests be refined and further work carried out on stock identity.

9.2.3 Other species
New information on pilot whales, killer whales, harbour porpoises, and a large number of other small cetacean species is summarised in Annex H.

9.2.4 Nomenclature
The Committee **recommends** two changes in the 'List of smaller cetaceans recognised' (*Rep. int. Whal. Commn* 27: 30); from *Globicephala melaena* to *G. melas* for the long-finned pilot whale, and from *Phocoena dioptrica* to *Australophocaena dioptrica* for the spectacled porpoise.

10. SCIENTIFIC PERMITS

10.1 Report of the special meeting
The Committee received the report of the special meeting of the Scientific Committee to consider the Japanese Research Permit (Feasibility Study). It noted that this had already been forwarded to the Commission. Recommendations to the Scientific Committee contained in the report are discussed under Item 11.

10.2 Guidelines for the review of scientific permits
SC/40/O 4 provided a suggested mechanism to resolve the overlap between Commission resolutions (*Rep. int. Whal. Commn* 37: 25; 38: 27) and guidelines developed by the Scientific Committee (*Rep. int. Whal. Commn* 36: 133) on the procedures for reviewing scientific permits. It was proposed that discussions should be grouped under five general headings: (1) the proposal; (2) objectives; (3) methodology; (4) effect of catches; and (5) participation in research by other nations. The author had attempted to combine similar guidelines among the total of 18, using wording close to the original guidelines but attempting to clarify them in places.

The Committee believed that it was inappropriate to alter the wording of the Commission's guidelines at the present meeting. However, it agreed to structure its discussions under the headings proposed in SC/40/O 4, but keeping all 18 guidelines in their original wording (Annex O).

The Committee noted that separate treatment of each of the 18 guidelines at the Special Meeting and at this meeting had proved an extremely cumbersome and time consuming procedure. This has led to an unhelpful degree of cross-referencing and difficulties in providing an easily understandable report. It draws the Commission's attention to the fact that it intends to attempt to revise the current guidelines at its next annual meeting in order to simplify its work in reviewing scientific permits and more effectively provide advice to the Commission.

10.3 Review of research results based on existing Scientific Permits

10.3.1 Japan
SC/40/Mi18 provided a report on catches taken under the Special Permit issued by the Government of Japan in 1987. A total of 273 animals out of a proposed catch of 300 had been taken over a wide latitudinal range from 55°S to the ice edge. This included one diminutive form minke whale taken from a school of two at 58°S. This is the most southerly record for this form. Appropriate samples were taken and the skeleton was retained. Earplugs had been collected from 271 animals. These included the fragile plugs from smaller animals which had proved difficult to extract undamaged in the past.

It was reported that it had proved relatively easy to implement the proposed random sampling scheme. Preliminary results indicated that sexually mature females tended to concentrate along the edge of the pack ice whereas mature males appeared both close to the pack ice and offshore. Small and immature animals tended to be solitary whereas larger or mature males tended to occur in larger schools associated with similar sized females. No lactating females had been taken. The average size of the animals taken was substantially less than that in the commercial catch. Where two animals were taken from the same school, the lengths of the first and second animals were not significantly different.

Hester, Best, Sigurjónsson, Le Gall, Kato and Øritsland commented on the useful biological information presented in the preliminary analysis given in SC/40/Mi18.

The Committee noted that one of the primary aims of the feasibility study was to test a protocol for collecting a representative sample from the population. However, some members (Chapman, de la Mare, Harwood, Holt, Horwood, Lankester, Tillman) pointed out that the preliminary results indicated that the protocol had not

been entirely successful. First, it had proved more difficult to sample animals in schools of three or less individuals than those in larger schools. This, combined with the fact that at most two whales were taken from each school meant that some transformation of the sampled age structure would be necessary to generate a representative sample. Second, schools were not sampled at random because large schools were known to be relatively more sightable than small ones. In addition, it was necessary that animals were sampled in proportion to their density. However, density was extremely variable in the ice edge area where the largest concentrations of animals were found. This would introduce an additional element of variability into the estimated population structure. The evidence that there was a differential segregation of males and females, which could not be distinguished at sea, and the lack of lactating females added to the sampling difficulties.

In response the Japanese scientists expressed their appreciation of these comments. They indicated that they had already recognized many of these problems and were taking action to modify any future sampling programme in an appropriate way.

Harwood and Reilly commented that even if random sampling could be achieved, they believed that the results in SC/40/Mi18 revealed that the expected level of variability would render the analysis of the data proposed in the original proposal problematic. Some members (Arnbom, Chapman, de la Mare, Holt, Horwood, Lankester, Tillman) drew attention to the underlying methodological problems as expressed at the December special meeting and in Item 6.3.1 of this report, i.e. that it had not been demonstrated that the main objective of the original proposal, the determination of age-specific natural mortality, could be achieved with the proposed methods. They concluded that although the results of the feasibility study might provide information of general biological interest, neither those results nor the objectives and described methodology of the original proposal would contribute to the rational management of stocks nor the Comprehensive Assessment.

In response the Japanese scientists reported that the preliminary results of the feasibility study had provided them with information on how to improve their sampling procedure such that they could obtain random samples, and had thus fulfilled its objectives.

Some members (Gunnlaugsson, Hester, Kato, Magnusson, Øritsland, Vikingsson) noted that SC/40/Mi18 reported preliminary results and therefore it was improper to draw final conclusions as to the value of the research from the data, although other members of the Committee were willing to do so. In their opinion, criticism concerning randomness of sample collection was premature since this was a feasibility study to address this very point. The same variety of problems and uncertainties apply to the design and execution of the IWC/IDCR sighting surveys, which apparently are to form the basis for the assessment of this stock(s). The addition of biological information, such as segregation of whales by length (age) and sex suggested in the report, appears useful for improving assessments based on such sighting surveys. Further, biological sample data has the potential for improving some population and biological parameter estimates.

10.3.2 Iceland

SC/40/O 8 reported on the status of the different research projects undertaken under Iceland's 4-year research programme. The Committee noted that in 1987 Icelandic permits allowed the catch of 80 fin and 20 sei whales, of which 80 fin and 20 sei whales were caught. Progress on electrophoretic and biochemical studies, as well as on 6 general studies was specifically noted.

In SC/40/Ba9, a simple isoenzyme system (carbonic anhydrase) was reported to demonstrate that fin whales caught off Iceland in 1971 and 1981–87 belong to a breeding unit in Hardy-Weinberg equilibrium, with some young males coming from other units in some years. SC/40/Ba10 described a study of enzyme loci which showed that there were no differences between fin whales caught off Iceland and Spain. SC/40/Ba11 reported on progress in undertaking electrophoretic analyses of liver esterases in fin whales from Icelandic and Spanish waters.

SC/40/O 34 reported the occurrence of polymorphisms of C4 genes in fin and sei whales using a human cDNA probe; data on mother-foetus pairs demonstrated simple allele transmission. The fact that the human C4 probe hybridises with cetacean DNA demonstrated that it is possible to use human probes under some conditions. Species-specific patterns were noted as well as polymorphic patterns within fin and sei whales.

Studies on growth layer formation in tympanic bullae of fin whales caught during the 1986 and 1987 season were presented (SC/40/Ba5). Preliminary results show a relationship between ear plug growth layers and tympanic bullae growth layers for immature animals only.

Preliminary work on chlorophyll and zooplankton densities collected during whaling operations was presented (SC/40/O 33) in an attempt to monitor oceanic conditions on the whaling grounds.

A progress report on sei whale morphometric studies was presented (SC/40/Ba6). Results indicate isometric growth, with a slight tendency towards positive allometry of the head region. Further studies will include a Principal Component Analysis of the measurements, and additional comparative studies with data from sei whales caught in other regions.

A preliminary report on energy content of blubber and muscle of fin and sei whales was presented (SC/40/Ba7). It concluded that for fin whales the females had a slightly higher lipid content in 1987 than in 1986, but that the reverse was true for the males. Because the study followed Lockyer's (1986, *Can. J. Fish. Aquat. Sci.* 43: 142–7) approach which had demonstrated a relationship between reproductive status and energetic status, the Committee suggested that the data should be analysed in greater detail by sexual and reproductive class.

A progress report on hormonal levels in whales caught in Icelandic waters was presented (SC/40/Ba8). Results confirm that serum progesterone seems to be a good indicator of pregnancy condition in fin whales. There is also a correlation between age and hormonal levels, and for length and hormonal levels in females. There is also an apparent rise in testosterone levels in males during the whaling season, the implications of which will need further examination.

Some members (Arnbom, Chapman, Cooke, de la Mare, Harwood, Holt, Horwood, Lankester, Tillman) commented on the difficulties of evaluating the results of the permit catches on the basis of the studies presented to the meeting, which combined these with results from previous commercial catches. They believed that more detailed analyses of the commercial and research data should be provided (e.g. of CPUE data, reproductive data), and that the existing data should be presented in

such a way that the research component is clearly shown. They believed that the results so far produced do not show that the programme is assisting the Comprehensive Assessment or providing information of importance to management.

Sigurjónsson, Gunnlaugsson and Magnusson responded that the results presented so far were from two years of a four-year programme to improve assessments and monitor the stocks. They believed that the results on progress on over 30 projects, including those on stock identity, age, reproduction, CPUE evaluation and monitoring and the body condition of animals with respect to environmental conditions and reproductive success, showed that the programme was addressing questions of importance to both the Comprehensive Assessment and management. They believed it inappropriate to present and analyse results from the research programme separately from previous results as the programme was designed to continue to monitor stocks and should not be seen in isolation.

Hester, Ikeda, Kato, Le Gall, Ohsumi, and Øritsland stated that they believed the Icelandic programme to be wide ranging and that the results clearly showed that the programme was improving our knowledge of the stocks and contributing to the Comprehensive Assessment.

Further comments on the results of the Icelandic programme so far are included in the discussion of future Scientific Permit catches under the programme in the light of the Commission's guidelines (Item 10.4.3).

10.4 Review of new or continuing Scientific Permit proposals

10.4.1 Japanese proposal, Southern Hemisphere minke whales

The Committee was informed that the Government of Japan will decide what research programme is to be implemented once the analysis of data collected in 1988/1989 had been completed. The Committee agreed that it was therefore not possible to discuss the matter further at this meeting. Should a proposal arise during the coming year, the Committee draws the Commission's attention to its view (Item 11.3) that intersessional reviews of scientific permits can best be achieved by special meetings.

It noted that the effect of continuing takes had been discussed by the sub-committee on Southern Hemisphere minke whales (Annex D).

10.4.2 Norwegian proposal, Northeast Atlantic minke whales (SC/40/Mi7)

The Committee had before it SC/40/Mi7, 'A programme to study and monitor Northeast Atlantic minke whales, 1988–1992', which describes a programme of 19 research projects of which four specifically involve the capture of minke whales under a special permit in 1988. Although SC/40/Mi7 alludes to further catches of unspecified numbers of whales during 1989–92, the Committee agreed to limit discussion under this agenda item to those parts of the programme which required a research take of animals in 1988.

It is proposed that, in 1988, 35 whales be caught for methodological studies under four projects: feasibility of radio tagging – 5 whales; food selection and intake – 10; food digestion – 10; and body composition – 10.

The five whales to be used to investigate the possibility of attaching radio tags to live-captured animals would be anaesthetised and later released if the technique was successful. The remaining 30 whales would be used in as many studies as possible but each project would have priority on ten whales. The Committee agreed that the question of whether or not a special permit was required to experiment on live-captured animals was beyond the competence of the Committee and referred this to the Commission.

Holt wished to record his view that the use of the word 'take' throughout Section 10 of this report, as meaning either to catch and kill or to entrap and attempt to hold a whale alive is confusing and inappropriate since this sense is quite different from that defined in the Convention (Schedule IC). He also believed that live-capture experiments were inappropriate for discussion under scientific permits and that he considered the permit proposal was thus for 30 whales only.

(A) The Proposal: The relevant guideline is as follows.

'A Statement as to whether the permit proposal adequately specifies the four sets of information required under paragraph 30 of the Schedule.' (*Rep. int. Whal. Commn* 36: 133).

1. 'Objectives of the research;' (Sched. Para. 30)
2. 'Number, sex, size and stock of the animals to be taken;' (Sched. Para. 30)
3. 'Opportunities for participation in the research by scientists of other nations; and' (Sched. Para. 30)
4. 'Possible effect on conservation of the stock.' (Sched. Para. 30)

The Committee agreed that the proposal did adequately specify the objectives of the research. The general objectives of the overall programme were: the identification of stocks; stock assessments; ecological studies. The objectives for the particular studies requiring takes were:

(i) the feasibility of radio-marking minke whales (project 4.1.2) – to evaluate existing knowledge and technology, investigate methods of implantation and to prepare a programme, including experimental work, for adaptation or development of radio-transmitters to track and to record the activity and behaviour-patterns of minke whales;

(ii) minke whale food selection and intake (project 4.3.2) – to provide data on minke whale feeding in relation to energetic requirements and availability of potential prey species;

(iii) food digestion in minke whales (project 4.3.3) – to provide a basis for evaluation and analysis of stomach contents through studies of the transport and digestion of food items;

(iv) the body composition, fat content and thermal radiation of minke whales (project 4.3.4) – to obtain data for calculation of parameters for the whale energetics model (WHAERG).

With respect to the number, sex, size and stock of the animals to be taken, the Committee agreed that all but sex and size were adequately specified. SC/40/Mi7 specified a take of up to 35 whales. Project (i) above for five whales recognised that the study, which involved the live-capture and anaesthetisation of animals, might result in their deaths. Ten whales each were specified for projects (ii)-(iv) although this was an indication of priorities and it was planned to collect information for all three studies from each of the 30 whales where possible. Øritsland reported that the sex of the catches had not been specified as it is impossible to determine the sex of minke whales at sea. The size of animals had not been specified because of the timing and logistics of the sampling programme. Holt

noted that he believed that the size of animals to be taken was important to specify and should be seen as an integral part of the methodology.

The Committee agreed that the proposal did specify the opportunities for participation in the research by scientists or other nations.

It also agreed that the proposal did address the question of the possible effect on conservation of the stock.

(B) Objectives

The relevant guidelines are as follows:

1. 'Comments on the objectives of the research to be carried out under the proposed scientific permit, including in particular how they might relate to research needs identified by the Scientific Committee;' (*Rep. int. Whal. Commn* 36: 133)
2. 'The proposed research is intended, and structured accordingly to contribute information essential for rational management of the stock;' (*Rep. int. Whal. Commn* 37: 25)
3. 'The research addresses a question or questions that should be answered in order to conduct the comprehensive assessment or to meet other critically important research needs;' (*Rep. int. Whal. Commn* 38: 27–8)

It should be noted that the discussion below relates only to the objectives of the proposal, and not methodologies.

The Committee noted the similarity of guidelines (1) and (3) above in the light of its discussions on the overall priority it has assigned to the Comprehensive Assessment (Item 14).

Øritsland reported that the ecological studies (projects ii-iv above) were not designed to contribute in an immediate way to the Comprehensive Assessment. In the light of Norway's commitment to a future multi-species management of the Barents Sea, he believed that the lack of information on minke whales for input into a multi-species model (MULTSPEC) being developed for that area rendered the research as meeting a 'critically important research need' of Norway. He believed that this type of research would contribute to the rational management of the stock in the long-term. He noted that the feasibility study on radio-marking minke whales was ultimately aimed at the question of stock identity, which the Committee had identified as a priority under the Comprehensive Assessment.

Bjørge noted that the ecological objectives of the proposal address a recommendation of ICES to consider marine mammals in multi-species assessment as a basis for future ecosystem management. This objective should therefore be considered to address a 'critically important research need'. He noted that this comment referred to objectives and not methodology.

Hester, Le Gall, Ohsumi, and Sigurjónsson believed that the objectives of the research, including those of the ecological studies, did address questions of interest to the Comprehensive Assessment. In particular they noted that the North Atlantic minke whales had been identified as a priority population/region in the Comprehensive Assessment (Item 6.1.1).

Arnbom, Chapman, Clark, Cooke, de la Mare, Holt, Lankester and Perrin noted that the proposal did not give sufficient information to evaluate whether the take of whales was critical to the development of the multi-species model mentioned in the proposal and whether developing such a model constituted a critically important research need.

While the Committee agreed that the first two general objectives of the programme – those relating to stock identity and stock assessment – were relevant to the three guidelines above, it noted that, with the exception of the live-capture experiment, the specific objectives that involved the take of whales in 1988 (listed under (A) above) fell within the third main objective of the programme, namely that relating to ecological studies. Some members felt that those latter objectives were relevant to guidelines (1) to (3) above, while others (Chapman, Cooke, de la Mare, Holt, Lankester) believed that they were of only marginal relevance.

(C) Methodology

The relevant guidelines are as follows:

1. 'Comments on the methodology of the proposed research and an evaluation of the likelihood that the methodology will lead to achievement of the scientific objectives. These comments may also include evaluation of the methodology in terms of current scientific knowledge;' (*Rep. int. Whal. Commn* 36: 133)
2. 'The objectives of the research are not practically and scientifically feasible through non-lethal research techniques;' (*Rep. int. Whal. Commn* 37: 25)
3. 'The research addresses a question or questions that cannot be answered by analysis of existing data and/or use of non-lethal research techniques; (*Rep. int. Whal. Commn* 38: 27–28)
4. 'The number, age and sex of whales to be taken are necessary to complete the research and will facilitate the conduct of the comprehensive assessment;' (*Rep. int. Whal. Commn* 37: 25)
5. 'Whales will be killed in a manner consistent with the provisions of Section III of the Schedule, due regard being had to whether there are compelling scientific reasons to the contrary.' (*Rep. int. Whal. Commn* 37: 25)
   [The Commission agreed that it has been intended by this for the Committee to report if cold grenade harpoons were used in special permit catches. (*Rep. int. Whal. Commn* 38: 13).]
6. 'The research is likely to yield results leading to reliable answers to the question or questions being addressed.' (*Rep. int. Whal. Commn* 38: 27–28)

The Committee agreed that the discussion of these guidelines could be centred on four areas: (i) sample sizes; (ii) whether the proposed methodology will answer the questions being asked; (iii) whether the questions could be answered by analysis of existing data or non-lethal research; (iv) whether non-explosive harpoons were being used.

Lankester, Cooke and Holt inquired why for each of the projects (ii) and (iii) ten whales would be needed, while at the same time the proposal mentions that samples will be collected from all whales taken.

Øritsland reported that the size of the take had been decided via a combination of the number of animals needed to investigate the potential of the methodologies and the operational capabilities of two vessels working for three weeks. He also stated that estimation of sample sizes on statistical grounds was not appropriate for this stage of the programme.

Lockyer noted that the small sample size may mean that little information on stomach contents is obtained and that any results would be confounded by a number of factors (e.g. how long the animal was chased). Øritsland reported that the aim of the first year of the study was more to examine procedures in identification and classification of prey items by species, sex and size structures.

Cooke, Chapman, de la Mare, Holt, Lankester, Perrin, and Tillman believed that the sample sizes proposed were neither justified on methodological grounds nor sufficient to provide a quantitative analysis in terms of their stated objectives. They believed the information obtained will not facilitate the Comprehensive Assessment.

With respect to the ecological studies, a number of members (Clarke, Chapman, Cooke, Hammond, Harwood, Horwood, Lankester, Lockyer, Perrin, Swartz)

reiterated that it was difficult to assess the proposed methodologies because of the limited experimental detail provided in SC/40/Mi7. It was also impossible to determine how important these individual projects were to the MULTSPEC model. However, even with the limited information available, it was clear that there were potentially severe methodological problems with aspects of these projects.

Øritsland responded that the funding for the proposal had only recently been agreed by the Norwegian government and so that detailed planning had only recently begun. Furthermore, the research was being carried out by a number of institutions in Norway and he was not capable of responding to detailed inquiries at this meeting. However he welcomed comments on the methodology and would ensure that they would reach the relevant research groups.

Considerable comment was made on the proposal to attempt to anaesthetise and live capture up to five minke whales in order to surgically implant radio-tracking devices. Concern was expressed by many members that the project as specified did not appear to appreciate the difficulties in anaesthetising cetaceans which have a voluntary respiration system (e.g. Schevill, W.E., Ray, C., Kenyon, K. Orr, T. and Van Gelder, R.G. 1967. *Science* 157: 630–1.). They believed the proposed research was unlikely to be successful and suggested that this project be reconsidered by its proponents.

Øritsland responded that the research worker concerned was a veterinarian and had recently reviewed the use of drugs in the humane killing of whales for the IWC Technical Committee (Øen, 1984, TC/36/HK2). He noted that this was a feasibility study and that it was reasonable to assume that the research group would consider all available literature on the subject.

In the discussion of the analysis of existing data, Øritsland reported that preparatory work for all studies would include a review of available information. Tillman and Holt expressed the view that this analysis should be presented before the proposals could be adequately assessed.

Holt noted a problem in addressing the question of whether the research could be achieved by non-lethal means. While certain aspects of the study could be achieved by non-lethal means, others, e.g. detailed examination of stomach contents, could clearly not be achieved by such means. It was not clear from the proposal how the results of that research were to be incorporated into the proposed model. With more information on the model, it might be possible to provide the necessary data using non-lethal techniques.

Hammond, Harwood, Horwood, Lockyer, Mizroch, Perrin, Reilly and Tillman, noted that it had already proved possible to design research programmes to investigate the ecological role of marine mammals which relied solely on non-lethal techniques, although it was not possible to address all of the specific objectives of the Norwegian programme in this way.

Arnbom, Clark, de la Mare, Holt, Lankester and Swartz expressed the opinion that the Norwegian scientists are to be applauded for their ambitious research intentions. However, as a scientific document which is intended to support the validity of the research programme and demonstrate the probability that the research will lead to improvements in our knowledge of the minke whale, they found the proposed Norwegian programme deficient by the usual criteria expected in a scientific research proposal. Good intentions and multidisciplinary involvement do not justify the lack of scientific argument for the necessity of the research catches. Furthermore, the rationale explained in discussion that we will learn more about the limitations of the present methods, and resultant improvements in the methods will lead to a better understanding of these inherent limitations is circular and illogical. Finally, the proposal fails to demonstrate the connection between the proposed research's specific objectives and a more global understanding of ecological relationships, population structures, reproduction, digestion etc. of whales. Although the intentions of the programme as stated are laudable, in reality the possible benefits based on the methods presented are limited and are not likely to contribute to the Comprehensive Assessment or provide solutions to real problems facing the Scientific Committee.

In response to this, Ikeda, Gunnlaugsson, Ohsumi and Sigurjónsson believed that such a categorical statement on a comprehensive research programme was inappropriate. They further noted that the proposed studies involve a number of highly competent researchers at universities and research laboratories in Norway and are thus a serious research effort of great potential value, which should be commended.

Finally, the Committee noted that the thirty animals to be taken for ecological studies would be killed using the penthrite grenade harpoon.

(D) Effect of catches on the 'stock'

The relevant guidelines are:

1. 'A review of the most recent information on the stock or stocks concerned, including information on any exploitation, stock analysis and recommendations by the Scientific Committee to date (including, where appropriate, alternative analyses and conclusions and points of controversy).'
(*Rep. int. Whal. Commn* 36: 133)
2. 'An evaluation of the specification in the permit proposal of 'possible effect on conservation of the stock'. As appropriate, the Scientific Committee may carry out its own analysis of the possible effects.' (*Rep. int. Whal. Commn* 36: 133)
3. 'The research can be conducted without adversely affecting the overall status and trends of the stock in question or the success of the comprehensive assessment of such stocks;'
(*Rep. int. Whal. Commn* 38: 27–28)

The Committee recognised that it does not have an agreed assessment for this stock, which has been classified as a Protection Stock. It was agreed not to attempt an assessment of the stock at this year's meeting (Annex E). The Committee noted the provisional estimates for this stock from the North Atlantic sightings surveys of around 19,000 (CV 0.16) or 17,000 (CV 0.18) depending on decisions concerning which survey blocks to include (see Item 7.2.1.1 and Annex E).

The Committee noted that the proposed removal of 30 to 35 whales was for the first year of a five year programme. However, SC/40/Mi7 had stated that the 'need for further catches after 1988 must necessarily be evaluated and decided on the basis of results from the first field season. It is anticipated, however, that continued studies of temporal and spatial food selection and intake may require an annual sampling of even larger numbers throughout the program period, i.e. each of the years from 1989 to 1992.'

The Committee was therefore only able to consider the effect of a single take on the status of the stock. It agreed that the effect would be negligible. It stressed, however, that the effect of a small take in a single year would always be negligible. It also agreed, for similar reasons, that the

1988 take would not adversely affect the status or trends in the stock or the success of the Comprehensive Assessment.

The Committee is unable to consider the effects of any takes associated with the entire five-year programme until more details become available.

10.4.3 Iceland, fin and sei whales

The Committee noted that it has examined these proposals at its three previous meetings (*Rep. int. Whal. Commn* 36: 31–2; *Rep. int. Whal. Commn* 37: 29; and *Rep. int. Whal. Commn* 38: 53). It was agreed at this meeting to confine major discussion to the most recent set of guidelines (*Rep. int. Whal. Commn* 38: 27– 8) against which the permit has not yet been addressed.

(1) *The research addresses a question or questions that should be answered in order to conduct the Comprehensive Assessment or to meet other critically important research needs;*

Gunnlaugsson, Hester, Le Gall, Magnusson, Ohsumi, Øritsland and Sigurjónsson referred to their view expressed under Item 10.3.2, that the programme does facilitate the Comprehensive Assessment and is important for management purposes.

Furthermore, Magnusson noted that the narrowing of the range of possible MSY rates has been identified at this meeting as an important task (Item 6). He noted that information on pregnancy rates, and age at maturity (and also natural mortality rates) helps in establishing bounds on MSY rates and believes they are therefore important for management purposes.

In this regard, Holt and de la Mare expressed their view that while past catches had indicated the general values of certain biological parameters such as pregnancy rate and size/age at maturity, continued monitoring of such parameters, even for a long period, could not yield information sufficient for future management unless accompanied by similar monitoring of all the other critical parameters which enter into an estimation of sustainable or replacement yield. These other parameters include, notably, the live birth rate and the juvenile/ pre-recruitment mortality rates, for which no estimation methods exist or have yet been proposed for these stocks.

Chapman, de la Mare, Holt, Lankester and Tillman, referring back to their view expressed under Item 10.3.2, reiterated that they did not believe the programme addressed questions that should be answered in order to conduct the Comprehensive Assessment.

(2) *The research can be conducted without adversely affecting the overall status and trends of the stock in question or the success of the Comprehensive Assessment of such stock;*

The Committee's discussion on the status of the fin whale stock is given under Item 7.3.3 and Annex F. The Committee had before it a preliminary sightings estimate of fin whales in the Icelandic area of 6,436. Although an assessment had been carried out (Annex F), the Committee agreed that it was inappropriate to use this at this meeting.

The Committee's discussion on the status of the sei whale stock is given under Item 7.3.4 and Annex F. Although a sightings estimate was available for the number of sei whales in the Icelandic survey area, this was not considered appropriate for assessment purposes as the survey had covered only a portion of the population's summer distribution.

Proposed catches for 1988 and 1989 are 80 fin and 20 sei whales each year.

Sigurjónsson believed that in the case of fin whales, the estimate of stock size of about 6,000 animals, combined with the results of calculations given in SC/40/Ba4 and Annex F (Appendix 4) which indicated an MSY rate of more than 4%, and, to a lesser extent, the existence of a stable CPUE series since 1962, all indicate that a take of 80 animals (1.2% of the estimated stock) will not adversely affect the status of the stock. Similarly, he believed that the estimate of 1,243 animals for only part of the sei whale stock showed that the take of 20 animals could not affect the status of the stock. Ohsumi concurred with this view.

Chapman did not agree that we have information on MSY rates or replacement yields, but agreed that the proposed catches would not adversely affect the status of the stocks.

De la Mare pointed out that the criterion of stable CPUE series to infer stock stability had not been used by the Committee since 1983 because it is not reliable (*Rep. int. Whal. Commn* 34: 42; SC/39/Rep2).

Holt expressed his view that a take of 320 fin whales over the four-year period may adversely affect the status of the stock.

Bjørge, Gunnlaugsson, Ikeda, Kasamatsu, Kato, Ohsumi, Sigurjónsson and Vikingsson believed that the Committee should consider only the proposal for a catch in 1989 although they also believed the effect of catches in both 1988 and 1989 should be discussed. Brownell, Chapman, Clark, de la Mare, Harwood, Holt, Lankester, Perrin, Tillman and Zeh believed that it was appropriate to discuss both the 1988 and 1989 proposed catches, noting that the 1987 resolution referred to 'existing special permits'.

(3) *The research addresses a question or questions that cannot be answered by analysis of existing data and/or use of non-lethal research techniques;*

Sigurjónsson expressed his belief that none of the major studies underway (e.g. monitoring of pregnancy rates, effects of environmental factors on body condition and reproduction) could be carried out using non-lethal techniques, particularly in view of the time frame of the programme. Although Iceland is intending to begin a fin whale photo-identification catalogue, he noted the practical difficulties in obtaining sufficient sample sizes under the field conditions prevalent off Iceland, where for example SC/40/Rep1 indicates that to obtain a mark-recapture estimate, some 200 photographs in each of two years would be required – representing an estimated 8 months ship time.

Holt agreed that some of the studies underway in the programme could not be carried out using non-lethal techniques. However, as in the case of the Norwegian proposal, he questioned whether these studies were important to either management issues or the Comprehensive Assessment. Non-lethal techniques were already used to estimate abundance (i.e. sightings surveys). Photo-identification studies and DNA fingerprinting (from biopsy samples) have been shown to be of value in stock identity and biological parameter estimation (SC/40/Rep1).

Hester and Kato agreed with Sigurjónsson's concerns about the difficulties of using photo-identification methods. Hester also noted that DNA fingerprinting studies are still in their developmental phase. Ohsumi commented that the Icelandic programme combined lethal and non-lethal techniques and that he believed this was the best scientific approach.

Chapman noted that the difficulties referred to earlier in separating results from the programme made it difficult for him to comment on whether non-lethal techniques could replace the lethal techniques.

(4) *The research is likely to yield results leading to reliable answers to the question or questions being addressed*

The Committee noted that it has addressed this question in previous years (*Rep. int. Whal. Commn* 36: 31–2; 37: 97; 38: 53).

Sigurjónsson referred to his comments under Item 10.3 and in previous years and reiterated his belief that the programme will lead and is leading to reliable answers to the questions being asked.

Tillman commented that he found it difficult to assess the reliability of any analyses as the proposers have not addressed the questions of required sample size or the need for random sampling as has been the case in the Japanese proposal.

Sigurjónsson responded that the Icelandic programme did not aim to achieve random sampling. The limitations of a land-based operation do not allow sampling over the entire summer range of the stock as is the case for the Japanese study on minke whales in the Antarctic. The main point is to continue to monitor the growth rate and fecundity between years. No major differences between age classes in ovulation or pregnancy rates have been demonstrated. This indicates that the sample obtained is representative of the stock. Further the study was designed such that the CPUE series obtained is in all major aspects comparable with earlier series.

Chapman, Cooke, de la Mare, Harwood, and Holt expressed disappointment at the quality of the analysis from the lethal sampling to date, and were concerned that the research may not yield reliable results if the data collected are not to be made available for in-depth analysis by the wider scientific community.

11. SCIENTIFIC COMMITTEE PROCEDURES

11.1 Style of reporting of Committee discussions and conclusions

For many years, the Committee has adopted a form of reporting discussions and recommendations in which individual member's names are rarely assigned to differing views expressed, except in minority statements. At the 1987 Annual Meeting, several Commissioners expressed the desire that the scientists supporting particular views should be identified, especially in relation to consideration of Scientific Permits. The Committee was asked to do everything possible to clarify its reports in future. An *ad hoc* procedure was adopted at the recent Special Meeting whereby it was agreed that members associated with differing views would be identified.

There was considerable discussion of the matter at the present meeting. Arising out of this, the Committee agreed to the following procedure.

(i) Sub-committee reports would continue to be formulated in the traditional manner. As usual, members would have the right to ask for their names to be attached to particular views should they so wish.
(ii) In the full Scientific Committee report, where appropriate, names may be attached to differing views (either directly or in the form of a footnote). Members may associate themselves with particular views at the report reviewing stage.

The Committee noted that (ii) above should particularly be applied in the case of issues directly relating to guidelines or criteria formulated by the Commission itself, for example the review of scientific permits and the classification of stocks.

Sigurjónsson, Øritsland and Best, while reluctantly accepting this procedure, noted their worry that it approached the situation of voting, which they believed to be inappropriate.

11.2 Procedures for the planning and conduct of special meetings

The Committee agreed that special (i.e. intersessional) meetings could be divided into two categories:

(i) those which are arranged at an Annual Meeting of the Committee or Commission and whose reports are submitted to the following Annual Meeting of the Committee;
(ii) those which are established between Annual Meetings under the Commission's Rule of Procedure B1 and whose reports are submitted directly to the Commission.

An example of the latter is the recent Special Meeting to consider the Japanese Research Permit (Feasibility Study). Concern has been expressed that the short notice given for that meeting might have resulted in very few members being able to attend although in fact this was not the case. Table 8 summarises the nature of and participation at recent special meetings of the Committee.

The Committee **recommends** that if such meetings are called in the future, suitable notice is given wherever possible. A minimum period of 60 days is suggested and the Committee urges the Commission to consider adopting Rules of Procedure such that this can normally be achieved.

The Committee also considered the question of the need for a quorum, as raised at the special meeting. It agreed that in terms of formulating advice, the most important factor was the presence of suitable expertise. The precise number of participants or countries present was not directly relevant. In particular it was agreed that a rigid rule would be inappropriate for special meetings on specialised topics where only a small number of Committee members may wish to attend (see Table 8).

It was noted that the problem of limited participation was potentially more serious for meetings in category (ii) above, but that this would be avoided if the recommendation of giving sufficient advance notice is adopted. This would not preclude members from providing written comments.

Given that the Scientific Committee is an advisory, rather than executive body, the Committee draws the Commission's attention to the fact that it believes the rigid application of the concept of a quorum is inappropriate for Scientific Committee meetings.

11.3 Intersessional review of Scientific Permit programmes

Rule F(4) of the Scientific Committee's Rules of Procedure provides for a mail procedure for the review of Scientific Permits between annual meetings of the Committee. The last time this was discussed (*Rep. int. Whal. Commn* 37: 37), the Committee had recognised the difficulties this would lead to in formulating a 'Committee view', although it also noted that at that time the procedure had not yet been invoked. This has become more of a problem given

Table 8

Participation in Special Meetings of the IWC Scientific Committee. Meetings marked with an asterisk are those which reported directly to the Commission. 'IWC' signifies the number of member nations at the time. The number in square brackets signifies the number who elected to be represented on the Scientific Committee. Under 'Present', the first number signifies the number of member governments present; the second the number of intergovernmental observers or advisors. 'People' refers to number of participants, including, in square brackets, the number of invited participants.

Meeting	Venue	Date	IWC	Present	People
Age determination	Oslo	Feb/Mar 1968	16	8 + 2	14
Sperm assessments	Honolulu	March 1970	15	7 + 1	14
Antarctic fin	Honolulu	March 1970	15	7 + 1	14
Sperm	Parksville	May 1972	14	7 + 1	13
Sei + management	La Jolla	Dec 1974	15	9 + 1	24
Sperm	La Jolla	March 1976	15	6 + 1	19
Sei	Tokyo	April 1977	17	5	16
Sperm*	Cronulla	Nov 1977	17	6 + 1	18
S.H. minke	Seattle	May 1978	17	9 + 2	16 [2]
Sperm assessments*	La Jolla	Nov/Dec 1978	17	9 + 2	31 [4]
S.H. sei	Cambridge	June 1979	23 [17]	7 + 2	23 [2]
S.H. minke	Cambridge	June 1981	25 [23]	12 + 1	37 [1]
W.N. Pacific sperm*	Cambridge	Feb/Mar 1982	33 [25]	12 + 1	32 [2]
Comprehensive Ass't	Cambridge	April 1986	41 [24]	15 + 1	38 [5]

the recent Commission resolutions on how the Committee should review such permits, where it is clear that a Committee view, rather than a compilation of individual views, is required.

The Committee believes that, in the exceptional circumstances that a scientific permit is proposed by a Contracting Government between Annual Meetings, it will be necessary to consider it at a Special Meeting of the Scientific Committee called for that purpose. Whilst recognizing the cost of such a procedure, the Committee suggests that at its next meeting it should formulate wording to extend its Rule of Procedure F.4 specifically to provide for review of scientific permit proposals at such a Special Meeting.

In addition to the provision under Rule F(4) of the Committee the Chairman of the Commission can call such a special meeting under the Committee's Rule D1, as was the case for the recent special meeting. The Chairman of the Commission had consulted the Chairman of the Scientific Committee before calling the special meeting. The Committee expressed its appreciation and **recommends** that this practice be continued.

11.4 Policy on access to data

Last year the Commission endorsed several suggestions of the Committee to amend guidelines concerning data availability (*Rep. int. Whal. Commn* 38: 23–24, 59). It also agreed that the Secretariat should develop a discussion paper on the general question of data availability and research carried out under the Comprehensive Assessment. This paper, SC/40/O 2, was prepared and circulated in advance of the meeting. It proposed a new Appendix 1 to the Committee's Rules of Procedure to take these points into account.

The Committee **recommends** that the new Appendix 1 given as Annex P to this report be adopted. It draws the Commission's attention to the fact that on three occasions, alternative forms of words are presented. While noting that the aim of the Committee is to encourage as much data as possible to be made available, the Committee believes that it is more appropriate for the Commission to choose among the alternatives present.

Last year it was noted that the Secretariat would seek clarification from countries over data submitted voluntarily, initially to BIWS and now to the secretariat. The responses from Japan, the USSR and Norway are given in Annex P.

11.5 Other

A series of comments concerning Scientific Committee procedures, particularly with respect to the review of scientific permits, were made by Commissioners during the year. These were compiled and made available to the Committee as SC/40/O 3 and were taken into account during the Committee's discussion of Items 11.1–11.3.

12. SECOND INTERNATIONAL DECADE OF CETACEAN RESEARCH

12.1 Review results from 1987/88

(a) *Radio-telemetric study of the behaviour of blue fin and humpback whales*

SC/40/PS1 reported on progress in the above study. Logistical problems led to a shorter field season than anticipated. As a consequence, field testing of equipment was carried out but no animals were tagged in the first year of the five year programme.

(b) *Galapagos sperm whales*

Results of a study of social organisation of sperm whales off the Galapagos funded by the Commission in 1986 (SC/40/Sp2–4) are discussed under Item 6.1.4.

(c) *IWC/IDCR Southern Hemisphere minke whale assessment cruise 1987/88*

Last year, the Committee agreed that this item should be considered an IDCR item as well as being a contribution to the Comprehensive Assessment (*Rep. int. Whal. Commn* 38: 40). Papers dealing with the 1987/88 IDCR minke whale cruise and earlier cruises are discussed in Annex D. The early date of this year's Scientific Committee meeting had not allowed time for completion of data coding and validation for the 1987/88 cruise. Joyce reported on progress in organising a catalogue of natural marking photographs from IDCR cruises.

12.2 Review proposals for 1988/89

All proposals recommended for support here will be subject to the Committee's guidelines on data availability as agreed under Item 11.4.

(a) *Radio-telemetric study of the behaviour of blue, fin and humpback whales*

This is discussed in Annex G. The Committee **recommends** that the proposal (SC/40/RP2) to continue the study to assess the retention and performance of sub-dermal VHF radio tags in blue, fin and humpback whales be funded.

(b) *Analysis of photographs for North Pacific humpback whales: preliminary work towards estimating juvenile mortality*

This is discussed in Annex G. The Committee **recommends** that this be funded.

(c) *IWC/IDCR Southern Hemisphere minke whale cruise 1988/89*

This is also discussed under Item 6, Comprehensive Assessment. The Committee **recommends** that this cruise be funded as a contribution to the Comprehensive Assessment, as outlined in Annex K.

(d) *Analysis of IDCR photographs of minke whales*
The Committee **recommends** that photographs of minke whales taken on the IDCR cruises should be analysed to determine if they can be used for the identification of individual animals (see Item 7.1.7).

(e) *Proposed meeting on mortality of cetaceans in fishing nets and traps*
In 1985 the Committee recommended that a Workshop be convened to examine the question of the incidental catch of both small and large cetaceans in gillnet and other static net fisheries (*Rep. int. Whal. Commn* 36: 37). The meeting was not held due to funding problems and last year the recommendation to hold the Workshop was repeated and an offer to host the meeting by the Southwest Fisheries Centre in La Jolla, California, was accepted. Perrin was appointed convenor.

At this meeting, a working group was established to examine draft terms of reference and prepare a budget. The report of the group is given as Annex N. The Committee **recommends** that the meeting be held as described in the Annex. A steering group of Perrin, Brownell, Puddicombe, Arnbom, Harwood, Jones and Kasuya was established.

13. DATA PROCESSING AND COMPUTING NEEDS FOR 1987–88

Progress on data processing and computing projects in the past year is discussed under Items 4.3.2 and 4.3.3. For data coding projects to be carried out in 1988–89, the Committee **recommends** the following priority order:

(i) 1988/89 IDCR cruise data coding;
(ii) Comprehensive Assessment data inventory coding;
(iii) completion of coding of catch data from 1949 onwards;
(iv) coding of pre-1932 Antarctic baleen whale catches and 1932–49 Southern Hemisphere land station catches;
(v) completion of coding of marking data.

A number of computing requirements were developed during discussions of the Comprehensive Assessment and of sub-committee reports, and the Committee **recommends** that these be carried out in the following year:

(i) develop programs for screening of management procedures (see Item 6.3.2);
(ii) in preparation for the Feeding Ecology Workshop, prepare data files on Antarctic baleen whale catches in cooperation with Mizroch and on sightings densities by species, month and 1° square (see Item 6.2.2);
(iii) carry out sensitivity tests and associated studies on the use of the HITTER program to fit data from the bowhead whale stock (see Annex — and Item 7.3.3);
(iv) validate new versions of the HITTER/FITTER program that allow estimation of confidence limits (see Annex E);
(v) as a background task, continue documentation of programs held by the Secretariat, with priority given to those now used most frequently by the Committee in assessments.

In relation to the first item in this list, the Committee noted that a junior programmer had been appointed to the Secretariat this year to relieve the burden of routine computing tasks from Allison, leaving her time to undertake the work associated with screening new management procedures developed as part of the Comprehensive Assessment. This appointment had been in response to the Committee's recommendations last year (*Rep. int. Whal. Commn* 38: 60).

In addition to the computing projects listed above, the Secretariat has now taken over the task of data coding, validation and routine analysis of IDCR sightings cruise data, with this task being assigned to Borchers. Under Item 7.1, a number of additional sets of analyses were recommended by the Committee. On examining a consolidated list of analyses needed on these data resulting both from this and last year's meeting, the Committee noted that these would require substantially more than 12 man-months work. It therefore **recommended** that a replacement for Borchers (whose contract expires in mid 1989) be appointed by November this year, so that he could assist in this very important work. A list of the IDCR computing projects identified and associated priorities is given in Annex K.

14. FUNDING

Priorities
The need for revising the guidelines for review of research proposals (*Rep. int. Whal. Commn* 32: 47) was identified. Gambell noted some difficulties in evaluating proposals, especially those received independent of the Scientific Committee, and that the current priority of funding work that directly related to the Comprehensive Assessment is not reflected in the earlier guidelines (*Rep. int. Whal. Commn* 38: 60).
The Committee agreed to the following priorities:

(1) Projects relevant to the Comprehensive Assessment (including those arising from Scientific Committee Workshops). These can be classified as:
  (a) those relating to the specific priority stocks;
  (b) those relating to assessment methodology;
  (c) those relating to the development of management procedures.

Priority among these is determined by examination of the Committee's needs as identified in its most recent Report of this item.

(2) Projects contributing to the second IDCR.
It is suggested that the past practice of preferring to give partial support to a number of projects ('seed money') rather than total funding for a few programmes should be continued.

Awarding of contracts
The procedures used for awarding contract studies were reviewed and Kirkwood identified three problems. One is identifying appropriate potential contractors, especially where the study is in an area where the Committee has relatively little expertise. A second is the basis for selection of one contractor. It was noted that this has been done by consultation among the Secretariat, the Chairman of the Scientific Committee, and the convenors of relevant sub-committees and workshops, where such had resulted in the recommendation of the contract study. The third and related problem was the extent to which a proposal that does not fully address all of the terms of reference should be considered.

The Committee discussed these procedures at some length. It agreed that a possible revised protocol would involve the following elements.

(a) At the time of identifying the need for a contract study, the Committee should identify detailed terms of reference, a budget and a group of reviewers who will be responsible for assessing all proposals received within a specified time interval after the Commission's meeting. This group would evaluate the submissions against the terms and budget of the work proposal. It would normally include the Chairman of the Scientific Committee, the convenor of the appropriate sub-committee (if relevant), the Secretary and nominated specialist reviewers from within or without the Committee. Criteria for review should be based on those used to review research proposals.
(b) A formal request that Committee members and Commissioners bring the contract study to the attention of appropriate scientists who may be interested in submitting proposals.
(c) When written reviews have been received of the proposals submitted, the contract will be awarded to that scientist or group rated most highly by the review panel.

The Committee agreed that some details of this protocol need further thought (especially the mechanism and responsibility for awarding the contract). Since there are no proposed new contract studies this year, it was agreed to defer further discussions on this.

14.1 Comprehensive Assessment

The funding implications of work recommended under Item 6.6 are provided in Table 9. A total of £174,350 is required for these projects, and the Committee **recommends** that these funds be provided.

14.2 Other research items

The Committee **recommends** the projects outlined under Item 12.2 be funded as shown in Table 10.

Table 9

Comprehensive Assessment activities. Item (1) includes £1,500 for the attendance of one researcher at the 1989 Scientific Committee meeting. Item (5) includes £8,200 for a year's salary, £1,500 for attendance at the 1989 meeting and £1,300 running costs. Item (6) includes £13,200 for one person's salary and travel costs, £10,000 for a second person's salary and recruitment costs, £3,000 for the attendance of both at the 1989 meeting and £3,900 running costs.

	Activity	£
(1)	Funding for year two of Dept of Genetics, Cambridge University contract	32,000
(2)	Workshop on the genetic and biochemical analysis of tissue samples collected by biopsy sampling and other means	15,000
(3)	Development of a computer-aided matching procedure for photographs of cetacean natural markings	8,750
(4)	Management procedures workshop	15,000
(5)	Computer programming assistance for management procedures	11,000
(6)	Discretionary fund for development of management procedures (<£1,000 per scientist)	5,000
(7)	Right whale survey, South Africa	12,000
(8)	IDCR Minke Whale Cruise 1988/89	45,250
(9)	Analysis of data from previous IDCR Minke Whale Cruises	30,100
(10)	IDCR minke photo analyses	250
	Total	174,350

Table 10

Activities under the second IDCR

	Activity	£
(1)	Meeting on cetacean mortality in fishing nets	30,000
(2)	North Pacific humpback whale photographs	10,000
(3)	Radio-telemetry study	6,000
	Total	46,000

14.3 Invited participants

The Committee has on several occasions (e.g. *Rep. int. Whal. Commn* 37: 37) noted the important role played in its work by invited participants. This is particularly true in the context of the Comprehensive Assessment, where new approaches to some of the major problems facing the Committee (e.g. DNA fingerprinting, telemetry) are being considered.

The Committee **strongly recommends** that funding of £9,000 be made available for invited participants.

14.4 Priorities

A total of £229,350 is required for the items identified above. Funds have already been set aside for the Workshop on the Feeding Ecology of the Southern Baleen Whales, for Studies of Southeast Pacific Sperm Whales and for the compilation of an inventory of photographs collected on the Southern Hemisphere IDCR cruises. In addition, a total of £56,000 is in hand from unallocated funds. Thus, the total new money required to implement all the recommended projects in 1988/89 is £173,350.

At its 1987 meeting, the Commission recommended that the Scientific Committee should indicate in its funding request for 1988–89, which activities are of lower priority to allow for a 5% and 15% shortfall (*Rep. int. Whal. Commn* 38: 25). The Committee noted that in developing the list of recommended projects in Items 14.1 and 14.2, it had only included those that it accorded the highest priority, and it **strongly recommends** that all of these projects are funded. However, in response to the Commission's instruction, it further offers the following advice.

If there is a shortfall of 5% in available funding, the Committee **recommends** that the budget for the meeting on cetacean mortality in fishing nets and traps should be reduced to £21,500. The remainder of the funds required for this meeting should then be sought from other national and international organisations (e.g. UNEP). If there is a shortfall of 15%, it **recommends** that, in addition to a reduction in the budget for the meeting on cetacean mortality in fishing nets and traps, the workshop on genetic analysis should be postponed for one year.

15. INITIAL AGENDA FOR 1989

In discussing this agenda item during previous meetings, the Committee had expressed the view that attempting to consider both the Comprehensive Assessment and normal business during its annual meetings has led both to an extremely heavy work-load and a less than adequate amount of time being available to devote to either topic. While acknowledging this problem, the Commission has to date agreed that it does still wish the Committee to provide annually advice on stocks currently being exploited and on scientific permit proposals.

This year, the Committee agreed that, if it is to present to the Commission in 1990 a detailed report on progress towards the Comprehensive Assessment, it is essential that most, if not all of its 1989 Annual Meeting should be devoted to planning for the preparation of such a report. Despite this, the Committee recognises that the Commission may still require advice on other matters. If this is the case, the Committee strongly urges that the Commission consider reducing to a minimum the amount and scope of other advice requested from the Committee at its 1989 Annual Meeting. The Committee agreed that discussion of assessments and other issues outside the Comprehensive Assessment should take place only as specifically directed by the Commission.

The Committee agreed that, in addition to planning for 1990, the following Comprehensive Assessment items should be given priority at its 1989 meeting:

(i) Further development of management procedures;
(ii) MSY rates;
(iii) Stock identity (including genetics and photo-identification studies);
(iv) Sightings surveys (concentrating on any remaining methodological problems, rather than stock assessment).

In view of the proposed Workshop on the Feeding Ecology of Southern Hemisphere baleen whales and the ICES Multispecies Management Workshop to be held in the coming year, the Committee agreed that it would include an agenda item addressing the implications for whale management of inter-specific interactions.

In relation to the organisation of its meeting next year, the Committee agreed that it may no longer be appropriate for the usual sub-committees to be established. Instead consideration should be given to forming sub-committees to consider specific subjects, e.g., sightings surveys.

The Committee agreed that the Chairman should be given maximum flexibility in developing an agenda for its 1989 annual meetings. It requested that a preliminary draft agenda be prepared by the Chairman as soon as possible after the 1988 Commission meeting and circulated to members of the Committee.

The Committee agreed that a similar level of computing support would still be required at its next Annual Meeting, even if the level of assessment work diminishes as much as hoped.

16. PUBLICATIONS

The Committee agreed, in accordance with the procedures outlined in *Rep. int. Whal. Commn* 32: 63, that the Editorial Board should comprise Donovan, Braham, Brownell, Harwood, Hammond, Kirkwood, Perrin and Tillman.

17. ELECTION OF OFFICERS

The Committee accepted with regret, the resignation of Dr G.P. Kirkwood, after three years as Chairman of the Committee, a period during which he had guided its deliberations with fairness, wisdom and good humour.

In accordance with the procedure agreed in 1983 (*Rep. int. Whal. Commn* 32: 61), Brownell and Hammond were elected Chairman and Vice-Chairman, respectively.

18. OTHER BUSINESS

The Committee agreed that the provision of microphones during its plenary and sub-committee sessions had greatly facilitated its discussions, and it **recommended** that similar provision be made at further meetings.

The Committee wished to record its appreciation of the long hours, hard work and cheerful service of the Secretariat during the meeting. It is also very grateful for the hard work of staff of the SWFC in making arrangements for the meeting.

19. ADOPTION OF REPORT

At the request of the Committee, last year the Commission extended the length of the Committee's meeting this year by one day. This additional day was devoted entirely to reviewing the report, and the Committee was able to adopt those sections of the report covering Items 1–11, 13 and 17. The remaining sections of this report are an account of deliberations agreed by the Rapporteur, the Chairman, the Vice-Chairman and sub-committee chairmen. Individual members were invited to submit comments on the report to this group and the comments received have been taken into account.

The Committee **recommends** that the length of its 1989 Annual Meeting should be 14 days, as this year.