

**REPORT OF THE WORKING GROUP FOR THE  
CCAMLR ECOSYSTEM MONITORING PROGRAM**

(Cape Town, South Africa, 25 July to 3 August 1994)

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**REPORT OF THE WORKING GROUP FOR THE  
CCAMLR ECOSYSTEM MONITORING PROGRAM**  
(Cape Town, South Africa, 25 July to 3 August 1994)

INTRODUCTION

1.1 The Ninth Meeting of the Working Group for the CCAMLR Ecosystem Monitoring Program (WG-CEMP) was held at the Breakwater Lodge, Cape Town, South Africa, from 25 July to 3 August, 1994. The meeting was chaired by the Convener, Dr J.L. Bengtson (USA).

1.2 The Working Group was welcomed to Cape Town by Mr G. de Villiers, the Director of Sea Fisheries Administration in South Africa.

ADOPTION OF THE AGENDA

2.1 A Provisional Agenda had been circulated prior to the meeting. With one minor amendment under 'Other Business', namely, 'Coordination of CEMP Sites Protection within the Antarctic Treaty System', the revised Agenda was adopted.

2.2 The Agenda is included in this report as Appendix A, the List of Participants as Appendix B and the List of Documents submitted to the meeting as Appendix C.

2.3 The report was prepared by Drs I. Boyd (UK), P. Boveng (USA), J. Croxall (UK), B. Fernholm (Sweden), K. Kerry (Australia), P. Penhale (USA) and W. Trivelpiece (USA).

REVIEW OF MEMBERS' ACTIVITIES

3.1 In previous years, summaries of Members' activities have been provided in Tables 1, 2, and 3 (e.g., SC-CAMLR-XII, Annex 6) of the Working Group's report. At the present meeting, it was agreed that although these tables offered a useful summary of the considerable work undertaken within CEMP, because of the increasing length of these tables and a desire to shorten the annexes to the Scientific Committee's report, these tables should not be included in future reports. Instead, it was agreed that these tables should be updated annually and circulated as a background paper to: (i) the Scientific Committee, (ii) Working Group meetings concerned with CEMP, and (iii) recipients

of the CEMP Newsletter (see paragraph 3.8). Such a paper had been prepared by the Secretariat this year as SC-CAMLR-XIII/BG/2.

3.2 Participants at the present meeting provided brief reports on their recent and prospective activities as part of CEMP. A compilation of these reports is attached at Appendix D.

3.3 The reports of new developments in CEMP-related research by Norway, South Africa and Italy were particularly welcomed. Dr T. Øritsland (Norway) reported that Norway has recently made commitments to fund research supporting the objectives of CEMP. Proposals are currently being developed for possible studies on Antarctic fur seals and chinstrap and macaroni penguins (Bouvet Island), Antarctic petrels (continued at Dronning Maud Land), and crabeater seals (Weddell Sea). Dr J. Cooper (South Africa) noted that South African scientists have initiated a CEMP-related study on macaroni and gentoo penguins at Marion Island. Drs S. Focardi (Italy) and Kerry described the planned Australian and Italian bilateral CEMP-related project on Adélie penguins at Edmonson Point.

3.4 The Working Group noted that, as in previous years, it was disappointed not to have the benefit of the participation of scientists from several countries known to be conducting research of direct relevance to CEMP. It was considered particularly unfortunate that scientists from the very active marine mammal and bird research groups in Germany, France and New Zealand were unable to be present at the meeting. Relevant papers were tabled on behalf of German marine mammal and bird researchers who had been unable to secure funds to support their attendance. Researchers from France (who have initiated a 5-year program at Crozet specifically addressed at CEMP) and New Zealand (who are undertaking important population ecology studies) have expressed a desire to participate at CEMP meetings but have not yet succeeded in obtaining funding to attend.

3.5 It was also noted that scientists from several countries are undertaking seabird research related to CEMP. The projects focus on penguins at Deception Island (Spain), penguins at King George Island (Poland), petrels near Casey Station (the Netherlands in collaboration with Australia) and penguins near Syowa Station (Japan).

3.6 Based on the information available to it, the Working Group noted with regret that Brazil's involvement with CEMP predator-related research had apparently come to an end.

3.7 The Working Group recommended that the Scientific Committee strongly encourage Members not yet active in CEMP and/or not yet represented by their scientists at CEMP meetings to facilitate the participation of their scientists in the work of CEMP.

3.8 At its 1993 meeting, the Working Group had recommended that a short CEMP newsletter be circulated to scientists in the SCAR and CCAMLR communities. The Convener reported that he had been unable to prepare such a newsletter on time, but that he would endeavour to develop and circulate a newsletter following the 1994 meeting of the Scientific Committee. Dr Penhale offered to help with the production of this newsletter.

## MONITORING PROCEDURES

### Predator Monitoring

#### Sites and Species

4.1 No new requests had been received for CEMP sites to be accorded protection under Conservation Measure 18/IX.

4.2 It was noted that a draft management plan for an Antarctic Specially Managed Area (ASMA) was submitted to the Commission jointly by the Delegations of Brazil and Poland (CCAMLR-XII/BG/13). This proposal is in accordance with Article 6(2) of Annex V to the Protocol on Environmental Protection to the Antarctic Treaty; this Protocol is yet to come into force. The area proposed included important research sites of relevance to CEMP in Admiralty Bay, King George Island. This proposal and its implications for CEMP are discussed under Other Business (paragraphs 10.6 to 10.10) and in Appendix E.

4.3 South African scientists advised that they had commenced a monitoring program on gentoo and macaroni penguins at Marion Island. CEMP Standard Methods are being used in these studies. Although these species do not feed on krill during the breeding season, it was agreed that the program would make a valuable contribution to CEMP. The Working Group welcomed this program and noted that among the benefits would be an increased understanding of the biology of these species, which would help in the interpretation of data from other monitoring sites and also provide further insights into penguin-myctophid fish interactions. Myctophid fish are also subject to harvesting within the Convention Area.

#### Field Research and Data Collection Procedures

4.4 Members reported on new developments, potential problems and recommended techniques or solutions of relevance to CEMP activities. Papers were tabled and discussed, relating to:

- (i) revisions or additions to specific, existing standard methods for monitoring predator parameters;
- (ii) revisions or additions to procedures for determining the sex of penguins (relevant to several standard methods);
- (iii) prospective development of standard methods for monitoring at-sea behaviour of birds and seals, especially using time-depth recorders (TDRs);
- (iv) potential impact of field procedures on penguins and seals; and
- (v) new techniques or results relevant to CEMP activities or directed research.

#### Revisions to Existing Standard Methods

4.5 In accordance with the agreed procedures for proposed modifications to existing standard methods (SC-CAMLR-XI, Annex 7, paragraphs 4.5 to 4.7), two papers were circulated in advance of the meeting to the CEMP *Ad Hoc* Subgroups on Monitoring Methods and on Statistical Aspects (WG-CEMP-94/6 and 7).

4.6 In WG-CEMP-94/6, Dr Croxall made specific recommendations for revisions to the text of the standard methods for the black-browed albatross (B1, Breeding Population Size; B2, Breeding Success; and B3, Age-specific Recruitment and Survival). The proposed revisions, arising from a recent, major review of the population dynamics of black-browed albatrosses, consisted primarily of additional text and references to publications, describing and clarifying the methods used to obtain the black-browed albatross data presently on deposit in the CCAMLR database.

4.7 In response to a request made by WG-CEMP last year (SC-CAMLR-XII, Annex 6, paragraph 4.6), Dr Trivelpiece submitted proposed revisions to Standard Method A4, Age-specific Recruitment and Survival in Penguins (WG-CEMP-94/7). The proposed revisions supplement the existing sections on general procedures for data collection and potential problems to be considered. They also include examples of methods, presently in use by one research group, for data processing, analysis and presentation of results.

4.8 No objections or substantial changes to the proposed revisions to Standard Methods A4, B1, B2 or B3 were raised by the *ad hoc* subgroups on methods and statistics.

4.9 The Working Group noted that because the standard methods for black-browed albatrosses have only recently been included in CEMP, and because Standard Method A4 for penguins requires substantial time before demographic rates can be estimated for the initially-banded cohorts, all the methods addressed by WG-CEMP-94/6 and 7 have heretofore remained less complete and detailed than the other predator monitoring methods. It was also noted, however, that WG-CEMP is nearing the point of agreeing standard formats for submission of data from these methods. It was, therefore, agreed that it would be beneficial at this time to include in the text for those methods, examples of the procedures being followed by research groups within CEMP. A subgroup (Drs Croxall and Trivelpiece) revised the texts of both proposals, taking into account suggestions and editorial comments from Members at the meeting. It was agreed that the resulting text should be transmitted to the Secretariat for inclusion in the standard methods.

#### Revisions to Procedures for Determining the Sex of Penguins

4.10 Two papers were tabled to provide WG-CEMP with additional methods for determining the sex of penguins (*CEMP Standard Methods*, Appendix 2), a procedure that significantly enhances the utility of data for several CEMP parameters, especially weight on arrival (A1) and age-specific survival and recruitment (A4).

4.11 Paper WG-CEMP-94/8 included a proposal by Dr Kerry, supported by a recently published study, to supplement the existing procedures for determining the sex of Adélie penguins. The additional procedure is based on the observation that, at Béchervaise Island, only the male Adélie penguins are found on nests between 15 and 21 days following laying of the first egg. This allows males to be identified (and females when they return to a nest occupied by a known male) easily and with little disturbance to the colony.

4.12 Paper WG-CEMP-94/25 provided a discriminant function for determining the sex of chinstrap penguins using morphometric measurements. This method, which correctly classified 94.6% of penguins in the study sample, completes *CEMP Standard Methods* Appendix 2, inasmuch as at least one method is now available for each of the penguin species monitored by CEMP. It was agreed to include the information summarised in paragraphs 4.9 and 4.10 in the revision of *CEMP Standard Methods*, Appendix 2.

4.13 The Working Group noted that two other papers provided information that may be useful in future refinements of sex-determination methods. Paper WG-CEMP-94/24 presented a single, generalised discriminant-score method of sex-determination for all fulmarine petrel species. It may

be possible to devise an analogous procedure for the CEMP penguin species. Paper WG-CEMP-94/41 presented a method of determining the sex of Antarctic petrels. It was noted that both of these papers would prove useful for any future efforts to establish standard methods for these petrel species.

4.14 The Working Group noted that since the most recent edition of the *CEMP Standard Methods* handbook, which was produced in November 1992, substantial revisions to all penguin methods have been prepared as a result of the inclusion of the gentoo penguin as a selected species. Together with the revisions approved at this meeting, the Working Group felt that enough new material was to hand to justify printing and circulating a set of all existing revisions. The Working Group recommended that the Scientific Committee request the Secretariat to undertake this work, if possible prior to the forthcoming Antarctic field season.

#### Prospective Development of Standard Methods for Monitoring At-sea Behaviour of Predators

4.15 Since its 1991 meeting, WG-CEMP has considered the feasibility of incorporating into the monitoring program indices of predator foraging performance, based on at-sea behaviour (SC-CAMLR XII, Annex 6, paragraphs 4.10 to 4.21). To best take advantage of the considerable experience of Antarctic and other researchers in the use of TDRs (the primary instruments for quantifying diving behaviour), it was suggested at the outset that a workshop would be most fruitful. Until recently, however, there were sufficient developments pending from another workshop and publications in press to warrant postponement of a CEMP workshop on the topic (SC-CAMLR-XII, Annex 6, paragraph 4.12). In the meantime, Members were requested to provide summaries of TDR data collected thus far, to better assess the need for a CEMP workshop and the prospects for development of standard methods.

4.16 Summaries of TDR data (both published and unpublished results) were received (e.g., WG-CEMP-94/4) during the intersessional period from six research groups and were collated by Dr Boveng into tables presented as WG-CEMP-94/18. The Working Group noted that these summaries indicated that :

- (i) vast quantities of data from studies spanning the past 16 years have already been collected for several species, but with great variation in the techniques and devices used;

- (ii) because of such variation, it may not be possible to devise standard methods to apply in a *post hoc* fashion to these past data, particularly those already published, without substantial re-analysis;
- (iii) there remains a great deal of data collected more recently that has not yet been analysed, providing good scope for efficient application of any standard methods that may be developed in the near future; and
- (iv) because of the volume of data and the breadth of accumulated experience with TDRs on CEMP predator species, a workshop or other effort to devise standard monitoring methods should draw primarily on those data and experience rather than a previously considered alternative of giving equal balance to studies on species inside and outside the Antarctic.

4.17 It was also noted that most of the information anticipated from other workshops and publications (paragraph 4.15, above) had become available and that the outcomes had provided sufficient background to establish guidelines for WG-CEMP's work on the topic. Accordingly, an *ad hoc* subgroup, led by Dr Boyd, was asked to draft guidelines for consideration and to indicate which items would be most appropriately addressed by a workshop or by other means.

4.18 Regarding guidelines for the development of standard methods of foraging performance based on at-sea behaviour, the Working Group agreed that it is of priority to:

- (i) recommend the most appropriate methods for the deployment of TDRs for each species being considered (presently Adélie, chinstrap, gentoo and macaroni penguins, Antarctic fur seals and crabeater seals). Particular attention should be given to:
  - (a) shape and size of TDR;
  - (b) method of attachment;
  - (c) site of attachment; and
  - (d) effects of the TDR on the behaviour of individuals, including the latent effects of handling stress.
- (ii) recommend methods of data collection, with specific recommendations concerning:
  - (a) deployment duration;
  - (b) the timing of deployment within the breeding cycle of individual species;
  - (c) the sampling protocol, specifically the frequency of sampling;

- (d) methods for standardisation of the zero-offset correction; and
  - (e) definition of 'bin' size for satellite-linked TDRs.
- (iii) develop standard parameters as indices of foraging effort which are likely to reflect intra- and interannual variation in prey availability. Consideration should be given to changes in behaviour at three spatial and temporal scales:
- (a) *dive*, e.g., dive depth and duration, surface interval, ascent/descent rate, time spent feeding during dives (bottom time), dive shape;
  - (b) *bout*, e.g., bout duration, mean depth, proportion of time spent submerged, diving frequency, interval between bouts; and
  - (c) *foraging trip*, e.g., transit times, foraging times, total vertical distance dived, proportion of time spent submerged.

Evaluation of prospective standard parameters should include consideration of the minimum sample sizes required to provide the statistical power necessary to test for changes in parameters, based on current knowledge of the inter- and intra-individual variability in those parameters (e.g., WG-CEMP-94/19).

- (iv) Develop standard software for the calculation of indices of foraging effort from commonly available TDR data. Consideration should be given to:
- (a) format and content of historical data; and
  - (b) foreseeable developments in TDR technology, e.g., the potential inclusion of swim velocity as a parameter.

4.19 It was agreed that the first two items (deployment methods and data collection protocol) would be most efficiently addressed by tasking one or two individuals with developing draft text to be reviewed at the next meeting of WG-CEMP. Drs Boveng (seals) and Trivelpiece (penguins, in contact with Drs Rory Wilson and Boris Culik, University of Kiel) offered to draft methods for the deployment of TDRs. Drs Boyd and Croxall undertook to draft standard protocols for data collection.

4.20 The fourth item (development of standard software) would be best addressed by an individual or small group, in correspondence with potential users of the software. It was noted that producing this software would be facilitated by the fact that nearly all CEMP researchers using TDRs

have obtained the instruments from a single manufacturer (Wildlife Computers, Woodinville, Washington, USA), thereby rendering a common output format for the raw data. Dr Boyd informed WG-CEMP that the first steps had already been taken to develop such software and he would welcome guidance for its further development.

4.21 It is anticipated that the work implicit in guidelines (i), (ii) and (iv) above will be completed in 1995. The Working Group agreed, however, that a workshop will be required to develop standard methods and indices of foraging effort as set out in guideline (iii) above. There is a need to:

- (i) examine and evaluate the specific methods used to analyse data on the foraging behaviour of predators with a view to their potential adoption as indices of foraging effort;
- (ii) ensure that the analyses which are developed can be applied to historical data, at least in part, and to carry out analyses of example data sets; and
- (iii) provide detailed guidelines for statistical procedures and standard analytical software which will eventually be available for use by all parties.

4.22 The Working Group therefore recommended to the Scientific Committee that the workshop should be held in the intersessional period following the 1995 meeting of the Commission. Details of the workshop, including terms of reference and venue, will be prepared by the *ad hoc* subgroup, led by Dr Boyd. The Working Group requested that allowance should be made in the forward estimates for 1995/96 in the budget of the Scientific Committee.

4.23 The nature of the data on foraging trip duration of Adélie penguins was discussed with particular reference to the fact that the standard deviations approach, or exceed, the mean values in almost all years at all three sites from which these data have been reported. Studies by Drs Trivelpiece and Kerry (see paragraph 4.29) have shown that, depending on the location of prey and the stage of the breeding season, Adélie penguins may make long trips to the edge of the continental shelf or shorter, more localised, trips. The resulting bimodality in foraging trip duration would account for some of the variation in the data.

#### Potential Impact of Field Procedures on Birds and Seals

4.24 At its last meeting WG-CEMP considered a draft report of the 'Workshop on Researcher-Seabird Interactions', held in July 1993 in Minnesota, USA (SC-CAMLR-XII, Annex 6,

paragraphs 4.23 to 4.26; WG-CEMP-93/20). The *Ad Hoc* Subgroup on Monitoring Methods had been asked to review the final version of this report when made available during the intersessional period, and to recommend any appropriate modifications to the CEMP Standard Methods (SC-CAMLR-XII, Annex 6, paragraph 4.25).

4.25 Dr Trivelpiece, co-convenor of the workshop and member of the *Ad Hoc* Subgroup on Monitoring Methods, compiled recommendations (WG-CEMP-94/40) from the final workshop report that were specific to the banding procedures of Standard Method A4 (Age-Specific Annual Survival and Recruitment) and lavaging procedures of Standard Method A8 (Chick Diet). Both recommendations were phrased in precautionary language and were to be added to the sections entitled 'Problems to Be Considered'. It was agreed that the proposed wording should be added to the text of Standard Methods A4 and A8.

4.26 Dr Trivelpiece noted that WG-CEMP-94/40 also referred to sections of the workshop report pertaining to effects of the use of TDRs and to impacts of general disturbance at research sites. The Working Group noted that the report's recommendations regarding TDR effects on seabirds should be considered as part of CEMP's effort to develop standard methods for foraging performance (paragraph 4.15).

4.27 A specific effect of TDRs on the foraging behaviour of Antarctic fur seals was described in WG-CEMP-94/22. In that study, durations of foraging trips and attendance visits of seals carrying TDRs and radio transmitters were about 10% greater than those of seals carrying only radio transmitters. This relatively slight effect has not been detected before, possibly because large sample sizes are required. The exact cause of the increased durations is unknown, but the effect might be reduced or eliminated by using smaller instruments as they become available. It was agreed that these results should be taken into account when developing standard methods utilising TDRs (paragraph 4.18).

#### New Techniques or Results Relevant to CEMP Monitoring or Directed Research

4.28 Dr Boyd summarised WG-CEMP-94/12. Milk delivered to pups by Antarctic fur seals was measured, in terms of volume and energy content, and related to foraging trip duration. Both the volume and total energy of milk delivered during visits ashore increased in direct proportion to foraging trip duration, showing that females which make long foraging trips (five to six days) deliver more milk to their pups than those which make short foraging trips (two to three days). However, when averaged over the whole of lactation, milk delivery to pups will be similar for individuals making long and short trips.

4.29 Paper WG-CEMP-94/13 examined the validity of using heart rate to measure field metabolic rate in black-browed albatrosses. Albatrosses were made to walk on a treadmill within a respirometer. Simultaneous measurements were made of heart rate, oxygen consumption (respirometry) and CO<sub>2</sub> production (doubly-labelled water). A good concordance was found between these measurements of metabolism. There was a good curvilinear relationship between heart rate and metabolic rate, and it was concluded that heart rate was an appropriate measure of metabolic rate in albatrosses so long as grouped means were used.

4.30 As a matter related to further development of Standard Method A8, the Working Group was informed by Dr Croxall that the SCAR Bird Biology Subcommittee had recommended that a comprehensive review of penguin lavaging be commissioned from Dr G. Robertson (Australia). WG-CEMP requested that a draft of this review be circulated to the *Ad Hoc* Subgroup on Monitoring Methods for consideration of modifications to Standard Method A8. The Working Group also noted that it would be helpful to have a similar review for methods of monitoring the diet of procellariiforms. The Convener was requested to ask Dr A. Veit (University of Washington, USA) if he would be prepared to undertake such a review in time for consideration at the Working Group's next meeting.

4.31 At its last meeting, WG-CEMP considered papers presented by Lic. R. Casaux (Argentina), describing the diet composition of piscivorous blue-eyed shags, estimated from examination of regurgitated casts (pellets) at Nelson Island, South Shetland Islands (SC-CAMLR-XII, Annex 6, paragraphs 4.29 to 4.33). The shags' diet included juvenile members of both harvested and unexploited fish species, suggesting the possibility of monitoring littoral fish populations by recording changes in shag diet. It was noted at that meeting, however, that experience with diet studies of other shag species showed discrepancies between actual diets and those estimated from pellets and, therefore, appropriate validation studies would be required before embarking on such a monitoring program.

4.32 At the present meeting, Lic. Casaux presented results of a preliminary validation study (WG-CEMP-94/29), wherein a captive blue-eyed shag at King George Island was fed local fish species and the composition of otoliths in the pellets was compared with the known composition of the diet. The results of this study confirmed that fish species are differentially represented by otoliths in the pellets. The Working Group welcomed this effort and encouraged the authors to develop the method further, if possible, by increasing the sample size and more realistically simulating natural feeding conditions.

4.33 Lic. Casaux extended the results presented last year with two additional studies of blue-eyed shag diet. In WG-CEMP-94/31, stomach contents of shags at Nelson Island were compared with the contents of pellets from the same colony. The more labour-intensive method of stomach content analysis reduces errors arising from erosion or loss of otoliths during digestion. Therefore, this method may provide additional information useful for improving the accuracy of pellet analysis, at a lower cost and effort than actual feeding trials. In WG-CEMP-94/32, blue-eyed shag diet derived by pellet analysis at Half-Moon Island, South Shetland Islands, was presented. This complemented similar information from Nelson Island presented last year (see paragraph 4.31).

4.34 The Working Group noted that, as reflected in the Scientific Committee's report (SC-CAMLR-XII, paragraph 8.6), several Members, including Australia, France, Norway and South Africa, have current and recent research projects on fulmarine petrels, including Antarctic and cape petrels. These Members, in conjunction with other Members as appropriate, were urged to undertake as a matter of some priority the development of standard methods for monitoring those species. Dr F. Mehlum (Norway) offered to coordinate this effort, to invite the participation of Dr J. van Franeker (the Netherlands) and others, and to circulate any draft methods to the *Ad Hoc* Subgroup on Methods.

4.35 Dr Bengtson noted that recent results from studies at Seal Island of cape petrel fledgling size and breeding success (WG-CEMP-94/21) emphasised the importance of determining breeding chronology for the proper interpretation of other parameters.

4.36 Dr Croxall introduced WG-CEMP-94/15, which reported on studies may may lead to the inclusion of data from other krill-eating predators into CEMP (here, specifically, the Antarctic prion at South Georgia). The evaluation of the breeding biology and diet of Antarctic prions in three consecutive years, which included one year (1991) when krill availability to predators was very reduced at South Georgia, indicated that although Antarctic prions were excellent samplers of zooplankton (being able to switch to amphipods and copepods when krill were unavailable), this very adaptability resulted in little observable interannual variation in most aspects of their breeding biology and ecology.

4.37 Dr Kerry presented WG-CEMP-94/33, which described the foraging strategy of Adélie penguins at Béchervaise Island. It was shown by satellite tracking, time-depth recording and stomach contents analysis that during the chick rearing period, birds make a series of short trips of 15 to 18 km within the shelf zone, returning with amphipods, *Euphausia crystallorophias* or *Pleuragramma antarcticum*. These trips are interspersed with journeys of 100 to 120 km to the shelf break, from which birds return with predominantly *E. superba*. The observation that Adélie

can forage in different zones requiring different travelling times has implications for the interpretation of CEMP parameters on foraging trip duration and diet.

4.38 Paper WG-CEMP-94/27 reports innovative work by German scientists at Ardley Island, King George Island, suggesting potential for using penguins, appropriately instrumented, to record environmental data (e.g., water temperature) and indices of prey distribution and availability (based on simultaneous recording of location and of prey ingestion events). Although considerable further work would need to be undertaken to refine and validate the data being collected (particularly on prey ingestion), the Working Group felt that these approaches held considerable promise for acquiring data on the physical and biological environment at scales particularly relevant to predator foraging behaviour. Continuation of this research program at Ardley Island would be a valuable contribution to CEMP's work in developing potential new monitoring indices.

4.39 Dr Croxall noted that a recently published study (WG-CEMP-94/23) by J. Ulbricht and D. Zippel (Germany) presents results relevant to the interpretation of Standard Method A2 (Penguin Incubation Shift Duration). Because Adélie penguins are able significantly to prolong fasting, apparently without detrimental effects, the incubation shift duration of that species may not be as closely related to prey availability and conditions as previously thought. Members are encouraged to examine existing data and to provide input on this topic to the Working Group.

4.40 Dr Kerry presented two papers (WG-CEMP-94/34 and 35), co-authored by Dr J. Clarke, intended to raise awareness of and encourage investigation of infectious diseases and parasites of CEMP monitoring species. Agents of disease, though rarely evident, may often be present in the population at sub-clinical levels. Various types of stress on a population may lead to increased presence of disease symptoms or parasite load. Because there is very little information available to CEMP on these topics, the authors suggested noting the presence of disease and parasites and perhaps later incorporating monitoring procedures into CEMP.

4.41 The Working Group welcomed these very informative papers. It was noted that there are two approaches that may be relevant to better understanding the effects of diseases and parasites on populations. One approach is to document the incidence of acute disease or parasite outbreaks so that these can be taken into account in the interpretation of changes in variables or indices. A second, but much more difficult, approach is to attempt to identify cause-effect linkages between chronic (sub-clinical) infestations and their demographic effects. It was noted that, based on the considerable literature for terrestrial animal populations, the prospect for accomplishing this in a marine context within CEMP seemed remote at present.

4.42 The Working Group agreed that, at present, only the first approach is likely to be appropriate within CEMP. Drs Kerry and Cooper agreed to prepare for the next meeting procedures necessary for collecting diagnostic samples if and when an outbreak of disease or parasite infestation is observed in a seabird colony. The Working Group noted that in an event of such an outbreak or increased infestation, there may be interest in whether any contaminant or pollutant has contributed to the outbreak. It was therefore suggested that this effort include consultation with Dr Focardi to ensure that sample collection procedures included those necessary for *post hoc* testing for contaminants.

### Prey Monitoring

4.43 WG-CEMP noted the valuable paper on recruitment variability of Antarctic krill (WG-Krill-94/22), based on data from 1975 to 1994 for the Antarctic Peninsula area (chiefly around Elephant Island). The paper provides recruitment indices for 16 years. The Joint Meeting of WG-Krill and WG-CEMP (WG-Joint) had noted that these indices would be applicable throughout Subareas 48.1 and 48.2, but that their application to Subarea 48.3 needed further investigation. WG-CEMP noted that these recruitment indices offered considerable scope for assessing relationships between krill and predators using appropriate time series of data.

4.44 Further discussion of these matters can be found in paragraphs 5.7 to 5.20 of the report of the Joint Meeting (Annex 7).

### Environmental Monitoring

#### Remote Sensing

4.45 Data on sea-ice extent were presented in WG-CEMP-94/16 by the Secretariat. These data were derived from the Joint Ice Centre (JIC) weekly ice charts for the split-years 1988 to 1990 as requested by CEMP. Listed were the dates of ice movement southward and northward past each CEMP site and the ice-free periods. The data as presented were noted but not discussed in detail, as additional information on the presence of ice around the site and the distance to consolidated pack-ice needs to be compiled (as set out in SC-CAMLR-XI, Annex 7, paragraphs 4.30 to 4.32).

4.46 The Secretariat is planning to bring the extraction and presentation of historical sea-ice data up to the present over the next two years. Additional funds may be required if the project extends beyond 1995.

4.47 Dr K.-H. Kock (Germany) informed the Working Group that the IWC (International Whaling Commission) was investigating the relationship between the edge of sea-ice and the sighting of whales, and that satellite data were being used to evaluate sea-ice. The Convener was asked to request details of this program with particular emphasis on the analysis of the sea-ice data. Dr Trivelpiece noted that analysis of JIC ice data was being undertaken by a research student at the University of California, Santa Barbara, and that he would investigate the matter and report back to the Working Group.

4.48 It was noted that although the data compiled by the Secretariat from JIC charts appeared to provide useful information, it was important, where possible, to compare these data with land-based observations and other data for specific sites. Members with relevant data were asked to compare these with the JIC data.

4.49 Dr Øritsland drew attention to the importance of good quality sea-ice images from the AVHRR satellite data in determining the edge of the fast-ice and the distribution and dynamics of the unconsolidated pack-ice. It was noted that several Members are collecting and archiving such images.

## REVIEW OF MONITORING RESULTS

### Predator Data

#### Status of Data Submissions

5.1 The Secretariat submitted WG-CEMP-94/16 which summarised current and past data submitted to CEMP for designated monitoring species and sites. A summary of the 1994 submission is given in Table 5.1. Data had been submitted from five national programs which included a total of 46 sets of data for 11 parameters and eight sites (Table 1). The Working Group welcomed the inclusion of Adélie penguin data from the new monitoring site at Terra Nova Bay submitted by Italy.

5.2 It was noted that Argentina had not submitted any data since 1990. It was confirmed that Argentina still had an active monitoring program at Jubany Station on King George Island and that the data for 1994 will be submitted together with 1995 data. The meeting encouraged the continuance of these data contributions because they are from an area where there is currently little coverage.

5.3 Overall, the lack of submission of data to CEMP, which had been noted in 1993, (SC-CAMLR-XII, paragraphs 8.16 and 8.17) has not improved. No historical data were submitted by any Member in 1994.

5.4 In general, there was good congruence between data submitted to CEMP and the data appearing in WG-CEMP-94/16. The Working Group suggested that, when possible, the Secretariat should forward draft copies of the annual summary of indices and trends (i.e., WG-CEMP-94/16) to the contributors in advance of the meeting to ensure that data are checked for accuracy.

#### Report on Indices and Trends

5.5 Individuals responsible for the data submissions from each of the monitoring sites updated the appropriate sections of Table 5 from the 1993 WG-CEMP report (Table 2). This table is the first attempt to examine CEMP data for trends across years and among and within sites for the various indices. It has been updated annually since 1992.

5.6 Although statistical methods described in the *CEMP Standard Methods* had been used to compare various indices, it was noted that most of these comparisons showed highly statistically significant differences between years for most parameters at all sites. Doubts were expressed about the validity of the statistical tests and the relevance of some of the comparisons being undertaken. It was agreed that the issue of which statistical procedures would be most appropriate, in addition to how trends should be illustrated, should be passed to the Statistics Subgroup for consideration during the intersessional period in consultation with the Data Manager.

5.7 The Working Group noted that the application of appropriate statistical analyses to the data collected by CEMP is viewed as a high priority. Considerable progress has been made with procedures for data collection, submission to CEMP and collation and index calculation by the Secretariat. The Working Group is now in a position to begin quantitative evaluations of these data.

#### Environmental Data

5.8 Patterns of sea-ice distribution were reported in WG-CEMP-94/16.

5.9 There were no reports of other notable environmental events, such as severe storms, affecting CEMP monitoring sites in 1994.

## ECOSYSTEM INTERACTIONS

### Matters Arising from the Joint Meeting with WG-Krill

6.1 The Working Group noted that the proposed terms of reference for the proposed new Working Group joining WG-CEMP and WG-Krill provided for the longterm continuity of CEMP initiatives addressing ecosystem interactions.

6.2 Discussion of this topic can be found in Section 6 of the report of the Joint Meeting (Annex 7).

### Estimation of Prey Requirements of Predators

6.3 The WG-CEMP meeting in 1993 reviewed recent progress with this topic, formerly accorded high priority by the Scientific Committee (SC-CAMLR-XII, Annex 6, paragraphs 7.1 to 7.7).

6.4 In order to keep this topic fully up to date, the Working Group had requested Members to table relevant publications (SC-CAMLR-XII, Annex 6, paragraph 7.6).

6.5 Paper WG-Joint-94/14 reviewed approaches by the ICES study group on seabird/fishery interactions which was dealing with the same topic as that under consideration by WG-CEMP. The document is a useful review of the state of the art (1993) and, although the detail is principally applicable to the North Sea situation, most of the approaches are very similar indeed to those developed within WG-CEMP.

6.6 Paper WG-Joint-94/15 provides a recently published annual and seasonal quantitative assessment of energy and food consumption by all penguins (king, macaroni, rockhopper, gentoo) at the Prince Edward Islands (Subarea 58.7).

## ECOSYSTEM ASSESSMENT

7.1 Under this agenda item WG-CEMP is required to determine annually the magnitude, direction and significance of trends in each of the predator parameters being monitored; evaluate annually these data by species, sites and regions; consider conclusions in light of relevant information (e.g., prey and environment); and formulate appropriate advice to the Scientific Committee.

7.2 In 1992 and 1993 the assessment procedure included: (i) a review of background information available to the Working Group in submitted papers; and (ii) evaluation of predator, prey, environmental and fishery data.

7.3 This year the general review of background information took place largely in the Joint Meeting. Therefore attention in WG-CEMP was confined chiefly to assessments of predator, prey and environmental data.

7.4 Last year WG-CEMP had recommended that the table summarising the assessments of these data should, at least for the predator parameters, be replaced by one recording the calculated year-to-year changes together with the statistical significance of any differences (SC-CAMLR-XII, Annex 6, paragraph 6.37).

7.5 In addition, WG-CEMP agreed that from the 1994 meeting:

- (i) the formal annual assessment of predator data would be confined to data on parameters collected annually and submitted [to the CEMP database] by the due date according to the approved standard methods;
- (ii) data on other predator parameters (i.e., those not subject to CEMP Standard Methods) collected annually by standard procedures and tabled at WG-CEMP for examination would also be considered for similar annual assessment. These data and assessments would be clearly indicated as distinct from those in (i), above; and
- (iii) other predator data, whether for approved parameters or not, or whether collected annually or not, would receive separate consideration.

7.6 The recommendations in paragraphs 7.4 and 7.5 were endorsed by the Scientific Committee (SC-CAMLR-XII, paragraph 8.27).

7.7 In the absence of summarised data on the magnitude of the year-to-year changes (in WG-CEMP-94/16) and the potential problems identified with the calculation of statistical significances, the tasks set out in paragraph 7.4 could not be undertaken this year.

7.8 WG-CEMP noted that resolving this situation was amongst its highest priorities. Therefore it requested that the statistics subgroup should, by intersessional meeting and correspondence:

- (i) evaluate all the current analytical methods and advise on necessary changes;

- (ii) identify any changes that would require modifications to the nature of the submitted data; and
- (iii) propose appropriate ways of preparing tables and graphs to illustrate best the nature and significance of interannual changes and trends in the submitted data.

7.9 In the meantime, it was only feasible at the present meeting to update SC-CAMLR-XII, Annex 6, Table 5 in a similar fashion to that of the two previous years. In doing this it was agreed that data actually submitted to the database should be clearly distinguished from other data considered in these evaluations.

7.10 The updated table assessing predator, prey and environmental data since 1988 (Table 2 - which was Table 5 in WG-CEMP's previous two reports) was then reviewed by the Working Group.

7.11 Some general observations were made:

- (i) data are currently being submitted to the CEMP database for five sites only, two in the Antarctic Peninsula (Subarea 48.1) ISR (Anvers Island and Seal Island), one network site in Subarea 48.2 (Signy Island), one in the South Georgia (Subarea 48.3) ISR (Bird Island) and one in Division 58.4.2 (Béchervaise Island). The need for more of the data apparently being collected by CEMP Standard Methods to be submitted to the database was emphasised;
- (ii) for some of the parameters which are currently being submitted to the CEMP database, historical data exist which were also collected by CEMP Standard Methods. Members are urged to submit these data as soon as possible;
- (iii) Table 2 includes summaries of several sets of quantitative data collected annually by consistent procedures (but not CEMP Standard Methods). Members collecting these data were strongly encouraged to propose standard methods that would allow these data to be submitted to the CEMP database; and
- (iv) valuable data are known to exist for some CEMP selected species (e.g., crabeater seal, cape and Antarctic petrels) for which no standard methods have yet been proposed. Members conducting research on these species were requested to prepare standard methods and/or to submit relevant data for the consideration of CEMP.

7.12 Discussion then turned to more specific points concerning the data summarised in each of the sub-tables of Table 2.

7.13 At Anvers Island, Antarctic Peninsula (Table 2.1), the data indicated a fairly typical year, although fledging mass of Adélie penguins was 10% lower than in the three previous years.

7.14 At Cape Shirreff, Livingston Island, South Shetland Islands (Table 2.2), the census data indicated that fur seal populations are still increasing and that chinstrap penguin breeding populations may have been slightly smaller than in the previous year. Environmental conditions were apparently normal and no ice was reported at sea in the area during the summer.

7.15 At Admiralty Bay, King George Island (Table 2.3), gentoo penguin populations remained high and enjoyed average breeding success; Adélie penguin populations remained low (but had increased slightly) and had a very productive breeding season; chinstrap penguins had intermediate success. All data were indicative of a fairly typical good year.

7.16 At Ardley Island/Stranger Point, King George Island (Table 2.4), the few data available suggested a fairly typical year.

7.17 At Seal Island, Elephant Island (Table 2.5), virtually all data indicated a normal-to-good year for predators. The only possible exception was the relatively low fledging mass of chinstrap penguins. Diet samples indicated that krill was widely available.

7.18 There was considerable interest in seeking further information on the situation in the Seal Island area where, as far as predator indices were concerned, 1994 was a normal breeding season, whereas observed local krill biomass estimated from research surveys was only one fifth of the values of previous years (these data are included in Table 2.5). More detailed investigation of the information on krill distribution and biomass is currently underway. The Working Group drew attention to the valuable opportunity provided by a five-year time-series of data on various aspects of prey and predator performance. It recommended that a comparative investigation of the whole data set be undertaken with particular attention to the circumstances and conditions prevailing in 1991 ('normal' krill biomass, poor predator performance) and 1994 (low krill biomass, good predator performance) against the background of the other three years where such anomalies do not appear to exist.

7.19 At Signy Island, South Orkney Islands (Table 2.6), penguin breeding population sizes were normal but breeding success was within the lowest quartile of values recorded over the last fifteen years. Poor breeding success could not be linked to the prolonged presence of sea-ice; no data on penguin diets were available.

7.20 At Bird Island, South Georgia (Tables 2.7 and 2.8), breeding populations of penguins, albatrosses and fur seals were only just below average. With the exception of macaroni penguins, breeding success of all these krill predators was exceptionally low - and for fur seals the lowest ever recorded. Diet studies indicated that krill availability to these predators was also very low and that these species had taken significant quantities of other crustaceans and fish in 1994. Macaroni penguins were feeding predominantly on the amphipod *Themisto gaudichaudii*; the resulting reduction in meal size and energy content was reflected in chicks fledging at a mass some 15 to 20% lower than in previous years.

7.21 The highly anomalous breeding season of 1993/94 at South Georgia followed the most successful breeding season for a decade there in 1992/93. Data (apart from those submitted to CEMP) indicate that krill availability did not change markedly until some time in the July to September 1993 period, which may explain why breeding population sizes in 1994 were relatively normal. To identify the causes of the exceptionally bad year for krill predators at Bird Island will require analysis and examination of the extensive data available on prey and environment (deriving from the BAS research cruise JR06 conducted during December to February 1993/94) together with other, broader scale, information on prey and environmental conditions.

7.22 At Béchervaise Island (Table 2.9) the data so far available indicate an average-to-good year for Adélie penguins. Of note was that incubation shift duration for both males and females has become progressively shorter over the last three years; the reason for this is unknown.

7.23 The overall conclusion of WG-CEMP was that 1993/94 had been a rather unusual year in the South Atlantic sector. Thus:

- (i) throughout Subarea 48.1 predators enjoyed a year of average-to-good productivity and reproductive performance despite, at least in the part of Subarea 48.1 around Elephant Island, local estimates of krill biomass being substantially lower than normal;
- (ii) at the South Orkney Islands - the only site in Subarea 48.2 for which data were available - penguin breeding populations were normal but breeding success was substantially reduced; and
- (iii) at South Georgia, very low krill biomass was reflected in exceptionally low reproductive performance and breeding success for all krill predators (especially fur seals) except macaroni penguin. Even for the latter, able to switch diet from krill to *T. gaudichaudii*, the abnormally low fledging weights of chicks may ultimately result in poor survival rates for this year's cohort.

7.24 The Working Group recommended that a concerted effort be initiated to investigate the biological and physical characteristics of the marine environment that existed in these three subareas during 1993/94 in order to help explain the apparently very different patterns of predator performance and prey availability/abundance.

7.25 The Working Group recognised that it would take some time to undertake this comparative work. It drew attention to the growing importance of retrospective re-assessment of predator, prey and environmental data whenever relevant information becomes available. It is crucial to the furtherance of CEMP objectives to maintain effective liaison on these topics among the different groups of scientists involved in analysis of data from the different sources.

#### CCAMLR POLICY ON DATA ACCESS AND USE

8.1 WG-CEMP considered that WG-Krill-94/19 provided a very useful explanation of how the CCAMLR policy on data access and use actually operated, and of the principles that should guide the interpretation of this policy.

8.2 WG-CEMP noted that following the procedures set out in WG-Krill-94/19 should prevent some of the difficulties that have arisen in the last couple of years concerning the status of data in documents not actually tabled at CCAMLR meetings but circulated intersessionally for analyses to be presented at subsequent CCAMLR meetings.

#### ORGANISATION OF FUTURE WORK

##### Desirability of Expanding the Scope of CEMP and its Priorities and Needs

9.1 The Convener, in opening this agenda item, reviewed the history of the formation and development of CEMP. He pointed out that although the terms of reference of WG-CEMP are broad and that its scope includes all interactions between predators and harvestable resources, the Working Group had, since its inception, focused on the interactions of krill and its major predators in the context of the actual and potential harvest of krill. He noted that this work had progressed extremely well and that data on predators, and to a much lesser extent, prey, had been collected according to standard methods over several years and were being analysed by the Working Group.

9.2 The need for expanding CEMP, at least to consider interactions between fish and fish predators, had been raised at the meeting of the Working Group in Korea (SC-CAMLR-XII, Annex 6, paragraphs 4.34 and 4.35). The Working Group had agreed to discuss this matter further at the present meeting.

9.3 One example of approaches relevant to the quantitative assessment of fish-predator interactions and to the potential use of fish predators in providing useful data on the relative abundance and other characteristics of their prey is provided by the work on blue-eyed shags by Lic. Casaux and his colleagues (WG-CEMP-94/29, 31 and 32).

9.4 A second example of recent and current relevant research is the suite of research programs (by Australia at Macquarie and Heard Islands, France at Crozet Islands, South Africa at Marion Island and Sweden at South Georgia) investigating interactions between king penguins and myctophid fishes.

9.5 Myctophids are also important in the diet of macaroni and gentoo penguins at Marion and Crozet Islands and in the diet of the white-chinned petrels at South Georgia (as demonstrated in WG-CEMP-94/14).

9.6 A third example of relevant initiatives relates to *P. antarcticum*, already a selected prey species within the CEMP Program. For Adélie penguins breeding on the Antarctic continent this fish is an important element of their diet, which is currently being studied within the CEMP Program at Béchervaise Island. Considerable research on interactions between Weddell seals and *P. antarcticum* have been and are being conducted by US and German scientists, particularly in the Ross and Weddell Seas.

9.7 These examples demonstrate the considerable amount of current research relevant to quantification of interactions between harvestable fish species and their predators. Most of this research is currently not available for discussion within CCAMLR.

9.8 The Working Group agreed that very valuable monitoring and directed research could be undertaken on predators of fish, particularly those fish species that have been or may be of commercial interest, and that it would be profitable to widen the scope of CEMP in this regard. This, however, should be carefully planned and should not dilute the considerable effort required to maintain the existing CEMP Program. Therefore the Working Group encouraged Members with interest in these topics to participate in further discussions on this matter.

9.9 The Working Group drew the attention of the Working Group on Fish Stock Assessment (WG-FSA) to these developments.

## ORGANISATION OF THE WORKING GROUP

9.10 The Working Group discussed briefly its possible structure. It noted particularly the importance of a very close link with WG-Krill in determining the functional relationship between krill and its major predators and the overall role of both Working Groups in providing advice concerning management of the krill harvest.

9.11 Two options for organisation were noted: (i) maintenance of both WG-Krill and WG-CEMP, and (ii) merging the two Working Groups. It was noted that having two separate groups which met at a separate time allows scientists to attend meetings of both and would probably allow an overall greater attendance at both. The major disadvantage of this arrangement is that the Working Groups tend to operate separately and there is the potential for lack of understanding of one another's requirements.

9.12 There was general agreement that the most desirable system would be the merging of the two Working Groups in such a way as to enable free exchange of information and views but to have the ability for technical aspects of CEMP to be addressed by subgroups. It was felt that many subgroups within a new joint working group would likely benefit by including experts on predators and prey among their members. Further discussion of this topic was held over for joint discussions with WG-Krill, the results of which are found in the report of the Joint Meeting (Annex 7).

## OTHER BUSINESS

### IUCN Assessment of Marine Protected Areas

10.1 At its 1993 meeting, the Working Group discussed the IUCN initiative to assess the world's protected marine areas and identify priority areas for conserving global marine biodiversity. The Convener and Dr Penhale had been asked to pursue this matter further and report to the present meeting. They reported that, at least at the present time, it seemed unlikely that financial support for CEMP activities could be obtained through this initiative. However, it was noted that Dr D. Vergani (Argentina) had offered, via correspondence, to attempt to obtain more information about this program and report to the Working Group at a future meeting.

## SCAR APIS Program

10.2 The Convener introduced the Draft Implementation Plan of SCAR's Antarctic Pack Ice Seals (APIS) Program (WG-CEMP-94/20). This program had been welcomed by the Scientific Committee (SC-CAMLR-XII, paragraphs 9.2 to 9.9), which noted that it was likely that APIS would make a strong contribution to the work of CCAMLR. The Draft Implementation Plan describes the continued development of this program, including additional details on logistical and scheduling aspects. WG-CEMP noted that the program will address several research topics of direct relevance to WG-CEMP and that it has an interest in crabeater seals.

10.3 The Working Group drew the attention of the Scientific Committee to the continued development of the APIS Program, and agreed that efforts to ensure close coordination and effective communication between CEMP and APIS should be maintained.

## SO-GLOBEC

10.4 Dr R. Holt (USA) reported on the SO-GLOBEC meeting that was held in Bremerhaven, Germany, in June 1994. It was noted that elements of SO-GLOBEC, especially for top trophic level predators and prey, were potentially of great interest to CCAMLR. WG-CEMP is eager to form a close liaison with the SO-GLOBEC Program as it continues to develop and be implemented to ensure coordination of the research programs of interest to both GLOBEC and CCAMLR. To facilitate improved awareness of such developments, it was hoped that reports from the SO-GLOBEC meetings be speedily produced and circulated.

## Ecology of the Antarctic Sea-Ice Zone (EASIZ)

10.5 Dr Croxall drew the attention of WG-CEMP to the development of SCAR's Coastal Zone EASIZ (Ecology of the Antarctic Sea-Ice Zone) Program, which addresses topics largely complementary to SO-GLOBEC and focuses on ecological interactions in the coastal zone. The proposed program is being tabled for formal adoption as the main marine ecological program within SCAR's IGBP initiative at the SCAR meeting in September. The first scheduled cruise within the Coastal Zone EASIZ Program is planned to be a European coordinated cruise on the *Polarstern* of the Alfred Wegener Institute, probably in 1996/97. This cruise may offer good opportunities for research programs of interest to CCAMLR to be undertaken.

## Consultation with the ATCM Concerning Protection of Sites

10.6 Dr Penhale reported on the intersessional activity of the *Ad Hoc* Subgroup on the Protection of Sites. The subgroup had been charged with three tasks: (i) to provide comments on the joint proposal by Brazil and Poland to the ATCM for an Antarctic Specially Managed Area (ASMA), Admiralty Bay, King George Island; (ii) to consider appropriate procedures to deal with such draft management plans received from the contracting parties to the Antarctic Treaty; and (iii) to consider to what extent to revise the provisions of Conservation Measure 18/IX so that they correspond to the provisions of Annex V to the Protocol on the Antarctic Environment. The subgroup's report is included as Appendix E.

10.7 With regard to the joint proposal by Brazil and Poland, only general remarks were provided because the draft available to the subgroup was not the latest version that had been reviewed by SCAR/Group of Specialists on Environmental Affairs and Conservation (GOSEAC).

The Working Group agreed that such proposals should:

- (i) indicate the extent to which other interested parties have been consulted in the process of producing proposals;
- (ii) be received by the Executive Secretary of CCAMLR for distribution to Members three months prior to the WG-CEMP meeting; and
- (iii) include high-quality topographic and bathymetric maps and charts, and note the exact location of seabird and marine mammal colonies as well as any available information on foraging areas and ranges.

10.8 It was noted that, due to the complexities of the two protected area systems under the Antarctic Treaty and CCAMLR, additional time is required to review and prepare recommendations to revise Conservation Measure 18/IX.

10.9 The implementation of Annex V to the Environmental Protocol to the Antarctic Treaty will involve the redrafting of current management plans for existing protected areas. Thus, CCAMLR is likely to receive several such plans for review and approval in the near future.

10.10 Improved coordination of CEMP site protection within the Antarctic Treaty System is likely to require further communication between the ATCM and CCAMLR, and their relevant subsidiary bodies.

## SUMMARY OF RECOMMENDATIONS AND ADVICE

11.1 The Working Group made the following recommendations to the Scientific Committee:

- (i) that Members not yet active in CEMP and/or not represented by their scientists at CEMP meetings be strongly encouraged to facilitate the participation of their scientists in the work of CEMP (paragraph 3.7);
- (ii) that the Secretariat be asked to print and circulate a set of revisions to the CEMP Standard Methods (paragraph 4.14);
- (iii) that a workshop on the at-sea behaviour of marine mammals and birds be held during the intersessional period following the 1995 meeting of the Commission (paragraph 4.22); and
- (iv) that a concerted effort be initiated to investigate the contrasting characteristics of the biological and physical marine environment in relation to predator performance in Subareas 48.1, 48.2 and 48.3 in 1993/94 (paragraph 7.24).

## ADOPTION OF THE REPORT AND CLOSE OF THE MEETING

12.1 The report of the meeting was adopted.

12.2 In closing the meeting the Convener thanked participants, rapporteurs, subgroups and the Secretariat for their work and assistance during the meeting. Special thanks were extended to the Government of South Africa and the Sea Fisheries Research Institute for hosting the meeting. The pleasant venue and excellent meeting arrangements had enabled the Working Group to progress through its work most efficiently.

12.3 The Convener expressed his view that the work of CEMP was increasingly being recognised as being at the forefront of approaches to managing marine living resources. He congratulated the scientists who had contributed to the development of CEMP over the past 10 years, and he stated his hope that as CEMP enters a new phase of its implementation, it would continue to advance the innovative ecosystem perspective being pioneered within CCAMLR.

12.4 Dr Bengtson informed the Working Group of his wish to step down as Convener of WG-CEMP following the conclusion of the Scientific Committee's 1994 meeting. He noted that the period of five years in which he had served in this capacity was longer than he had expected when originally encouraged to accept this role, and that he felt it was appropriate now for someone else to assume this responsibility.

12.5 The Working Group thanked Dr Bengtson for his great service to WG-CEMP over the last decade and in particular for his outstanding leadership, wise guidance and hard work over the years of his Convenership.

Table 1: Data submission for the 1993/94 season.

Site	Parameter/Species																										
	A1		A2	A3				A5		A6				A7				A8				A9			B1,2	C1	C2
	EUC	PYD	PYD	EUC	PYD	PYN	PYP	PYD	PYN	EUC	PYD	PYN	PYP	EUC	PYD	PYN	PYP	EUC	PYD	PYN	PYP	EUC	PYD	PYN	DIM	SEA	SEA
Anvers Is				USA				USA		USA				USA				USA									
Béchervaise Is		AUS	AUS	AUS						AUS				AUS				USA									
Bird Is	GBR			GBR			GBR			GBR			GBR	GBR				GBR			GBR				GBR	GBR	GBR
Cape Shirreff																											
Magnetic Is			AUS	AUS						AUS				AUS													
Seal Is								USA		USA		USA				USA				USA						USA	USA
Signy Is				GBR	GBR	GBR					GBR	GBR	GBR														
Terra Nova				ITA																							

Species code:

Country code:

EUC macaroni penguin  
 PYD Adélie penguin  
 PYN chinstrap penguin  
 PYP gentoo penguin  
 DIM black-browed albatross  
 SEA fur seal

AUS Australia  
 CHL Chile  
 ITA Italy  
 GBR UK  
 USA USA

Table 2: Assessment of predator and prey studies, 1988 to 1994. Predator parameters were obtained from WG-CEMP-94/16 unless otherwise referenced in the tables. Data are given qualitative rankings High, Medium, Low, Very Low (H, M, L, VL). The symbols +, 0, - indicate changes in parameters between successive years. Foraging duration is expressed as relative length of foraging trips to sea (S = short, M = medium, L = long, VL = very long). Information within the boxes relates to assessments based on the data actually submitted to the CEMP database.

2.1 Site: Anvers Is, Subarea 48.1

Year	Adélie				Krill			Environment			
	Breeding Population Size/Change (A3)	Breeding Success (A6)	Fledging Mass (A7)	Foraging Trip (A5)	Catch		CPUE	Biomass	Snow	Sea-ice	Ocean
					100 km radius	Subarea					
1988		-									
1989		-									
1990		L	L	M							
1991		L	M	L							
1992	H (First census)	H	H	L							
1993	L --	H	H	S							
1994	L - or 0	H	L	M							

2.2 Site: Cape Shirreff, Livingston Is, Subarea 48.1

Year	Antarctic Fur Seal <sup>1</sup>		Chinstrap <sup>2</sup>		Krill			Environment				
	Breeding Population Size/Change		Breeding Success	Breeding Population Size/Change (A3)	Breeding Success (A6)	Catch		CPUE	Biomass	Snow	Sea-ice	Ocean
						100 km radius	Subarea					
1988	L		M									
1989												
1990			L									
1991	M	+	H	?					H			
1992	H	+	H	0					M	+Brash		
1993	H	+	H	0					L	iceberg		
1994	H	+	H	-					L	-		

<sup>1</sup> WG-CEMP-92/53  
WG-CEMP-94/28

<sup>2</sup> *Boletín Antártico Chileno*, Vol. 11 (1): 12-14.  
Unpublished data.

2.3 Site: Admiralty Bay, King George Is, Subarea 48.1

Year	Gentoo		Adélie		Chinstrap		Krill			Environment			
	Breeding Population Size/Change (A3)	Breeding Success (A6)	Breeding Population Size/Change (A3)	Breeding Success (A6)	Breeding Population Size/Change (A3)	Breeding Success (A6)	Catch		CPUE	Biomass	Snow	Sea-ice	Ocean
							100 km radius	Subarea					
1988	M -	M	H +	M	L -	M							
1989	M +	H	H +	H	M +	H							
1990	M -	M	M -	M	M -	L							
1991	L --	M	L --	L	L --	L							
1992	H ++	H	L +	H	M +	H							
1993	H +	H	L -	M	M +	M							
1994	H - or 0	M	L +	H	M +	M							

(This summary table was constructed without reviewing the actual data and may contain source errors)

2.4 Site: Ardley Island and Stranger Point combined, King George Island, Subarea 48.1. Esperanza data used for 1991 for Stranger Point.

Year	Adélie <sup>1</sup> - Ardley		Chinstrap <sup>2</sup> - Ardley		Adélie <sup>3</sup> - Stranger		Krill			Environment			
	Breeding Population Size/Change (A3)	Breeding Success (A6)	Breeding Population Size/Change (A3)	Breeding Success (A6)	Breeding Population Size/Change (A3)	Breeding Success (A6)	Catch		CPUE	Biomass	Snow	Sea-ice	Ocean
							100 km radius	Subarea					
1988	H	H	M	M	L -	H							
1989	H	M	M	H	L -	H							
1990	M	L	H	L	M -	M							
1991	L	M	L	M	M -	L							
1992	M	?	L	M	? +	?							
1993	M	L	L	M									
1994	H +	M	L +	M									

<sup>1</sup> WG-Krill-92/21; WG-CEMP-92/54; Valencia, unpublished data

<sup>2</sup> WG-CEMP-92/54; Valencia, unpublished data

<sup>3</sup> WG-CEMP-92/6; WG-CEMP-92/45

Note 1991 data from Esperanza

2.5 Site: Seal Island, Elephant Island, Subarea 48.1

Year	Chinstrap <sup>1</sup>				Antarctic Fur Seal <sup>2</sup>				Krill <sup>3</sup>			Environment			
	Breeding Population Size/Change (A3)	Breeding Success (A6)	Fledging Mass (A7)	Foraging Trip (A5)	Pups Born Number/Change	Foraging Trip	Pup Growth Rate (C2)	Weight at Age	Catch		CPUE	Biomass g/m <sup>2</sup>	Snow	Sea-ice	Ocean
									100 km radius	Subarea					
1988	M ?	M	H	S	M +	M	M	H							
1989	L -	L	H	L	VL -	?	H	L							
1990	H +	H	M	L	M +	M	L	L			58.6				
1991	M -	L	L	M	L -	L	H	L			26.3				
1992	H +	M	M	M	M +	M	M	H			45.4				
1993	H -	M	M	S	M 0	L	M	M			111.4 <sup>4</sup>				
1994		M	L	M	M 0	M	M	H			8.8				

<sup>1</sup> Data are from the CCAMLR Data Centre and documents WG-CEMP-90/21, 91/11, 91/33, 92/17 and 93/27

<sup>2</sup> Data are from the CCAMLR Data Centre and documents WG-CEMP-89/21, 90/34, 90/41, 91/11, 92/17 and 93/27

<sup>3</sup> Data from document WG-Joint-94/9; <sup>4</sup> Value may be artificially high due to difficulty differentiating between echo signals from salps and krill

2.6 Site: Signy Is, South Orkneys, Subarea 48.2

Year	Adélie		Chinstrap		Gentoo		Krill			Environment			
	Breeding Population Size/Change (A3)	Breeding Success (A6)	Breeding Population Size/Change (A3)	Breeding Success (A6)	Breeding Population Size/Change (A3)	Breeding Success (A6)	Catch		CPUE	Biomass	Snow	Sea-ice <sup>1</sup>	Ocean
							100 km radius	Subarea					
1988	H +	M	L -	H	H ++	H						H	
1989	H 0	L-M	L 0	H	H +	H						H	
1990	M -	L-M	M +	L	H +	L						L	
1991	L --	M	L -	H	M -	H						M	
1992	M +	M-H	L-M +	H	M -	H						H	
1993	M 0	H	M 0	H	H +	M						?	
1994	M +	L	M +	L	H +	L						?	

<sup>1</sup> Murphy *et al.*, unpublished data

2.7 Site: Bird Island, South Georgia, Subarea 48.3

Year	Gentoo					Macaroni						Black-browed Albatross			
	Breeding Population Size/Change (A3)	Breeding Success (A6)	Krill in Diet (A8)	Meal Size (A8)	Fledging Mass (A5)	Breeding Population Size/Change (A3)	Breeding Success (A6)	Krill in Diet (A8)	Meal Size (A8)	Arrival Mass (A1)	Fledging Mass (A5)	Breeding Population Size/Change (B1)	Breeding Success (B2)	Adult Survival (B3)	Growth Rate <sup>1</sup>
1988	M -	M	M	H		M -	L	-	-			L ---	VL	M	-
1989	H ++	M	H	M-H	M	H +	H	M	M	M	H	M ++	M	L	H
1990	H -	L-M	M	M	H	M -	H	M	M	H	M	M 0	M	VL	L
1991	L --	VL	L	L	L	M -	H	L	L	L	M	L-M -	VL	?	M
1992	M +	H	M	M	H	M 0	M	H	H	M	H	L -	M	?	H
1993	M 0	H	H	M-L	M	M 0	M-H	H	M	M	M	L +	H	?	H
1994	L-M -	VL	VL	VL	L	L-M -	M	VL	L	M	L	L -	VL	?	?

Krill				Environment		
Catch		CPUE	Biomass	Snow <sup>2</sup>	Sea-ice <sup>3</sup>	Ocean
100 km radius	Subarea					
				H	H	
				M	M	
				M	L	
				M	L	
				H	M-H	
				M	L-M	
				M	?	

<sup>1</sup> P.A. Prince, unpublished data

<sup>2</sup> Black-browed albatross only

<sup>3</sup> Lunn *et al.* (WG-CEMP-93/10)

2.8 Site: Bird Island, South Georgia, Subarea 48.3

Year	Antarctic Fur Seal <sup>1</sup>								Krill			Environment		
	Pups Born Number/Change <sup>1</sup>	Birth Mass <sup>2</sup>	Perinatal Period <sup>2</sup>	Foraging Trip (C1)	Pup Growth Rate (C2)	Wean Mass <sup>2</sup>	Breeding Success <sup>3</sup>	Catch		CPUE	Biomass	Snow	Sea-ice <sup>1</sup>	Ocean
								100 km radius	Subarea					
1988	H	0	H	M	S	M	M					H		
1989	H	-	H	M	M	H	M					M		
1990	H	+	H	M	S	L-M	M					L		
1991	L	--	L	S	VL	M	M					L		
1992	M	+	M	M	M	M	M-H					M-L		
1993	H	+	M	M	M-L	M-H	M-H					M-L		
1994	M	-	M	?	VVL	M	L					?		

<sup>1</sup> Lunn *et al.*, in press (WG-CEMP-93/10) and BAS unpublished data

<sup>2</sup> Data from Lunn and Boyd, 1993 (WG-CEMP-92/41), Lunn *et al.*, 1993 (WG-CEMP-93/9), Boyd, unpublished data

<sup>3</sup> Boyd, unpublished data

2.9 Site: Béchervaise Island, Mawson, Division 58.4.2

Year	Adélie							Krill			Environment			
	Arrival Mass (A1)	Incubation Shift (A2)		Breeding Population Size/change (A3)	Breeding Success (A6)	Fledge Mass (A7)	Krill in Diet (A8)	Catch		CPUE	Biomass <sup>1</sup>	Snow	Sea-Ice	Ocean
		1st	2nd					100 km radius	Subarea					
1991		Start		Start	Start		Start					L	M	
1992	Start	0	0	+2	0	Start	0					L	M	
1993	0	-	-	-	0	-	0					Ma	M	
1994		-	-	+	0	+	0					L	L	

<sup>1</sup> WG-Krill-92/23

<sup>2</sup> *Proc. Nat. Inst. Polar Res.*, 6 (1993)

0 = no change

Snow: L = little snow or none; Ma = medium snow during pre-egg stage; Mb = medium snow during chick fledging; H = snow in colony for most of the season

Ice: H = fast ice continuous to horizon late January; M = open water to horizon mid-January; L = late December

**AGENDA**

Working Group for the CCAMLR Ecosystem Monitoring Program  
(Cape Town, South Africa, 25 July to 3 August 1994)

1. Opening of the Meeting
2. Adoption of the Agenda
3. Review of Members' Activities
4. Monitoring Procedures
  - (i) Predator Monitoring
    - (a) Sites and Species
    - (b) Field Research and Data Collection Procedures
    - (c) Data Analysis and Submission Procedures
  - (ii) **Prey Monitoring Data Collection Procedures [joint meeting with WG-Krill]**
  - (iii) Environmental Monitoring
    - (a) Land-based Observations
    - (b) Remote Sensing
5. Review of Monitoring Results
  - (i) Predator Data
    - (a) Status of Data Submissions
    - (b) Report on Indices and Trends
  - (ii) **Review of Available Prey Data [joint meeting with WG-Krill]**
  - (iii) Environmental Data
    - (a) Sea-ice Patterns
    - (b) Other Environmental Events or Trends
6. **Ecosystem Interactions [joint meeting with WG-Krill]**

7. Ecosystem Assessment
  - (i) **[Items from the joint meeting with WG-Krill]**
  - (ii) Updating Ecosystem Assessment Summaries
  - (iii) Advice to the Scientific Committee
8. CCAMLR Policy on Data Access and Use
9. Organisation of Future Work
  - (i) Desirability of Expanding the Scope of CEMP
  - (ii) Future Priorities and Needs of CEMP
  - (iii) **[Items from the joint meeting with WG-Krill]**
10. Other Business
  - (i) IUCN Assessment of Marine Protected Areas
  - (ii) SCAR APIS Program
  - (iii) SO-GLOBEC
  - (iv) Coordination of CEMP Sites Protection within the Antarctic Treaty System
11. Summary of Recommendations and Advice
12. Adoption of the Report
13. Close of the Meeting.

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**REPORTS OF MEMBERS' ACTIVITIES RELATING TO CEMP**

This appendix summarises reports of Members' activities in relation to CEMP that were submitted to this meeting by participants (Argentina, Australia, Chile, Italy, Japan, Republic of Korea, Norway, South Africa, Sweden, UK and USA).

2. During the 1993/94 summer season, Argentina continued developing its ecosystem monitoring program at Stranger Point, King George Island, at Hope Bay in the Antarctic Peninsula and at Mossman Peninsula, South Orkney Islands. The project is under the direction of Lic. Daniel Vergani and is mainly focused on population trends and breeding success of Adélie penguins.

3. During February and March 1994 a cruise mainly focused on demersal fish was conducted around South Georgia Island and the South Orkney Islands. Preliminary information was sent to WG-Krill describing those points that may be of interest for the Working Group.

4. Argentinian studies continued in relation to the use of the blue-eyed shag, *Phalacrocorax atriceps bransfieldensis*, as indicator of changes in coastal fish populations at Duthoit Point, Nelson Island; Low Rocks, King George Island; at Half Moon Island and at Pirie Peninsula, South Orkney Islands. For the next season it is planned to extend the sampling area to Marguerite Bay in the Antarctic Peninsula.

5. Routine monitoring of Adélie penguins was continued by Australia at Béchervaise Island near Mawson. Data on all parameters were gathered manually and by an automatic penguin monitoring system (APMS). Additional studies on the foraging ecology during the breeding season were undertaken using satellite tracking and time depth recorders (TDRs). An additional monitoring site was established on nearby Verner Island. Here human interaction with the birds is being kept to an absolute minimum and monitoring will be conducted using the automated monitoring system. These monitoring and research studies will be continued in 1994/95 and additional studies undertaken on disease and winter foraging of fledglings and adults. Related monitoring studies were conducted at Magnetic Island using an APMS.

6. In 1993/94 a team from the Instituto Antártico Chileno carried out censuses on fur seals at Cape Shirreff and San Telmo Island, which included weighing pups. The counts of animals at Cape Shirreff and San Telmo have been 50 (1966), 1 745 (1973), 8 929 (1987), 10 768 (1992), 13 242 (1993) and 15 139 (1994). Pups were weighed twice during the season (15 December 1993 and 22 January 1994), using CEMP Standard Method C2. On each occasion 48 individuals of each sex

were measured. Average weight for males was 7.20 kg (December) and 10.62 (January). For females it was 6.70 kg (December) and 9.73 kg (January). In addition, environmental parameters were recorded and censuses were carried out on other species of seals (Weddell seals 75, the same number as in 1993; one specimen of both leopard and crabeater seal; and the post-breeding colonies of elephant seals were 526 (1993), and 1 375 (1994) animals). A total of 280 kg of plastic marine debris was collected and sent to Santiago for further studies. Three peripheral males of *Arctocephalus gazella* were seen wearing neck collars. As a support to our field research the Servicio Hidrografico y Oceanografico de la Armada de Chile (SHOA) produced in July 1994 the first draft of a bathymetric chart of waters around the SSSI No. 32 and CEMP site (SHOA Chart No. 14 301, to a scale of 1:15 000).

7. In 1993/94 population studies of seabirds were carried out at Ardley Island; this will be continued during 1994/95. Each October and January the breeding activities of pygoscelids are studied. The numbers of penguin nests at Ardley Island during the 1993/94 season were: gentoo 5 746 (5 336 in 1992/93); Adélie 1 516 (1 120) and chinstrap 58 (38). The total number of nests recorded was 7 320 (6 494 in 1992/93). A map of Ardley Island to a scale of 1:4 000 is being prepared, showing the distribution of all penguin colonies present there. These studies have been conducted by Dr José Valencia, Universidad de Chile, supported by the Instituto Antártico Chileno.

8. Italy is planning to contribute to CEMP through the establishment of a monitoring program on Adélie penguins. This work will be undertaken at Edmonson Point (74°21'S, 165°05'E). A site was chosen for the program in November 1993 and a count of the penguins made according to the CEMP Method A3. A field camp will be established in October 1994. It is planned to obtain data on CEMP parameters A1 to A3 and A5 to A9 according to the standard methods, and in some instances using an APMS. Additionally, studies will be undertaken on foraging ecology (using satellite tracking and TDRs) and on the toxicology of pollutants.

9. Japan continues to monitor the annual trends in breeding population size of Adélie penguins near Syowa Station. In the future, studies on Adélie penguins with emphasis on prey-predator interaction using new techniques will be conducted in the Indian Ocean sector in cooperation with Australia.

10. The timing of hatching and chick growth of gentoo and chinstrap penguins was observed and banding was continued during early December 1993 to late January 1994 near King Sejong Station, King George Island, by the Republic of Korea.

11. TDRs were used for describing the diving behaviour of chinstrap penguins. Dive duration was between 20 and 120 seconds and diving effort was concentrated around midnight with a slight peak around noon. Dive depth averaged 20 to 30 m around midnight and 40 to 50 m around noon.

12. With logistic support from Sweden and South Africa, Norwegian studies of Antarctic petrels were continued in the 1993/94 season at Svarthamaren, Queen Maud Land, by the Norwegian Institute of Nature Research, Trondheim. Counts confirmed that the number of chicks shows great variation between years, increasing again from a minimum in the 1992/93 season. Preliminary results from study plots indicate a recapture probability of 0.90 and a survival probability of 0.95 for adult petrels between the seasons of 1991/92 and 1992/93. The median hatching dates were found to be 12 to 13 January as in previous years. The studies also included collection of stomach content samples and recording of data on adult weights, egg size, hatching success and duration of incubation shifts. Satellite tracking of three breeding birds indicated extremely long distances of travel. Experimental studies of parental investment were continued.

13. Results from satellite tracking and TDR studies of crabeater seals in the Weddell Sea pack-ice in 1993 by the Department of Arctic Biology, University of Tromsø, are now being published.

14. The funding agency for the Norwegian Antarctic Research Program, the Norwegian Research Council, has now been committed to allocate funds for longterm CEMP-related monitoring and research. Plans for a monitoring site for fur seals and chinstrap and macaroni penguins on Bouvet Island, directed studies of crabeater seals in the Weddell Sea and a monitoring site for Antarctic petrels at Svarthamaren, will be developed by the Norwegian Polar Institute during the forthcoming year.

15. Sweden has no CEMP-related monitoring activity. Basic research on king penguins and elephant seals is undertaken in cooperation with BAS (UK); research on crabeater seals is in cooperation with the USA.

16. South Africa commenced monitoring of macaroni penguins and gentoo penguins at Marion Island (Prince Edward Islands) in May 1994 as a contribution to CEMP. In the first year of monitoring, attempts will be made to apply many CEMP Standard Methods for penguins to both species. However, banding of gentoo penguins will not be undertaken, and if certain procedures result in high disturbance of gentoo penguins those methods will be discontinued for that species. Attempts will be made to quantify disturbance to both species of penguin during monitoring in 1994/95.

17. Limited monitoring of rockhopper penguins and imperial cormorants will be undertaken. Ongoing research on albatrosses and southern elephant seals will be continued.

18. United Kingdom land-based research in support of CEMP is conducted at Signy Island, South Orkney Islands and Bird Island, South Georgia. Parameters measured in 1994 were identical

to those recorded in 1992 and 1993 (SC-CAMLR-XI, Annex 7, Appendix D, paragraph 20) and are listed in Table 1.

19. In addition, the detailed demographic studies on grey-headed and black-browed albatrosses and on Antarctic fur seals were continued, and these now provide annual data on population size, adult survival, juvenile survival (recruitment), breeding frequency and breeding success for albatrosses and age-specific fecundity rate, maternal mass, pup birth mass and breeding success for fur seals.

20. Additional directed research (summarised in Table 2) is being carried out on:

- (a) chick growth, foraging trip duration, meal size and at-sea activity budgets of albatrosses, especially black-browed albatross;
- (b) aspects of diving performance and at-sea activity budgets in Antarctic fur seals; and
- (c) activity-specific energy budgets using implanted recorders to measure heart rate and other parameters in gentoo penguins, black-browed albatrosses and Antarctic fur seals.

21. In 1994 substantial additional research, especially on the distribution and foraging of albatrosses and penguins, was carried out in conjunction with the predator-prey cruise of the *James Clark Ross* (see below). Some of the shipboard research involved collaboration with US scientists and the shore-based research benefited from the continuing collaboration with Swedish scientists on research of king penguins.

22. Of papers tabled in 1992, WG-CEMP-92/41 (*Symp. Zool. Soc. Lond.* (1993) 66: 115-129) is now published. Of papers tabled last year WG-CEMP-93/6 (*Ibis* (1994) 136:50-71), 93/7 (*Ornis Scand.*) (1993) 24: 243-245), 93/9 (*J. Mammal.* (1993) 74: 908-919), 93/11 (*J. Zool.* (1993) 229: 177-190), 93/12 (*Mar. Ecol. Prog. Ser.* (1992) 86:15-30), 93/13 (*J. Anim. Ecol.* (1993) 62: 551-564) and 93/14 (*Mar. Mamm. Sci.* (1993) 9: 424-430) are all published. WG-CEMP-93/8 (*Penguin Biology Symposium*) and 10 (*J. Anim. Ecol.*) are still in press.

23. Six papers concerning predators are tabled this year. WG-CEMP-94/12, describing the identification of different types of foraging activity of Antarctic fur seals and interannual variation in these, has already been widely circulated as part of the review of data for TDR-based studies. WG-CEMP-94/11 shows that Antarctic fur seal foraging trip duration is negatively correlated with the rate of milk energy production at sea, but positively correlated with subsequent milk energy production

on land. WG-CEMP-94/13 describes progress towards using heart rate as an activity-specific index of energy costs, using data for black-browed albatrosses. WG-CEMP-94/14 reports on the diet of white-chinned petrels at South Georgia showing that this combines krill, myctophid fish and squid (particularly *Martialia*). Studies of white-chinned petrels, therefore, may have considerable potential for integrating with CCAMLR research on currently and potentially exploited resources. WG-CEMP-94/15 reviews interannual variation in the diet of Antarctic prions, suggesting that this closely reflects variation in the relative abundance of krill, amphipods and copepods. Again, studies of this species have significant potential for enhancing CEMP research. WG-CEMP-94/10 paper presents model analyses of the interaction of predators with a prey resource being advected by ocean currents past a central colony.

24. During January and February 1994 a series of research projects was undertaken on board RRS *James Clark Ross* (Scientist in Charge: Martin White) in the vicinity of South Georgia. Larger-scale studies were conducted during transects between South Georgia, South Orkneys and Falkland Islands and across the Polar Front. Shipborne observations were made by scientists from BAS in conjunction with others from USA, Spain and Germany. Part of the cruise was undertaken with the South African research vessel *Africana* (Scientist in Charge: Denzil Miller). This work was part of a major cruise undertaken by the Pelagic Ecosystem Studies group at BAS. Areas of interest were identified by linking data from satellite-tracked predators with information on large-scale bathymetry and remotely-sensed surface data. The large-scale studies undertaken during the cruise were part on an ongoing study of large-scale variability of the Southern Ocean ecosystem.

25. Studies on the pelagic trophic interactions in a system dominated by ommastrephid squid at the Antarctic Polar Frontal Zone were undertaken along with concurrent observations on feeding aggregations of seabirds. Throughout the cruise krill were found to be scarce, providing valuable opportunities for observing predator-prey interactions in a 'poor' krill year and for setting this in the context of the large-scale studies. Observations were made of foraging aggregations of seabirds and mammals associated with krill aggregations.

26. United States activities in 1993/94 directly related to CEMP consisted of:

- (i) land-based predator studies at Seal Island, near Elephant Island, and at Palmer Station, Anvers Island;
- (ii) repeated surveys of hydrographic conditions, phytoplankton production, and krill abundance and distribution in the waters surrounding Elephant Island; and
- (iii) analyses of data on crabeater seal demographics, and ecology.

Preliminary reports on activities (i) and (ii) are provided in the AMLR field season report, WG-CEMP-94/37.

27. At Seal Island, monitoring according to CEMP Standard Methods and directed research in support of CEMP objectives were conducted on populations of Antarctic fur seals, chinstrap penguins, macaroni penguins and cape petrels. Field procedures were conducted for Standard Methods A4, A5, A6 (procedures A and C), A7, A8, A9, C1 and C2. In addition, directed research was conducted on foraging ecology and at-sea behaviour of fur seals and penguins, penguin breeding population size and penguin chick growth. An automated, land-based system for tracking seals and penguins to determine foraging locations was further developed and tested.

28. Two 30-day cruises were conducted aboard the NOAA ship *Surveyor* from mid-January to mid-March 1994 in the vicinity of the Seal Island CEMP site near Elephant Island. Chlorophyll *a* concentrations, primary production rates, organic carbon concentrations, phytoplankton species compositions, nutrient concentrations, and solar irradiance were measure and mapped. In addition, the distribution and abundance of krill were measured using sampling nets and hydroacoustic instrumentation.

29. Analyses and manuscripts were completed for studies of interannual variability in cohort strengths of crabeater seals and of the distribution and movements of crabeater seals relative to sea-ice and the continental shelf/slope break.

30. In support of the NSF's LTER Program, two oceanographic cruises were conducted by the NSF ship *Polar Duke* in August 1993 and January 1994. Primary production rates, chlorophyll *a* concentrations, organic carbon concentrations, microbial production rates, nutrient concentrations and irradiance were investigated in an area from Palmer Station to Rothera Station. Krill distributions were measured using nets and acoustic instrumentation. Seabird surveys were conducted and Adélie penguin diet samples were collected in the Palmer Station area.

31. Anticipated CEMP-related field work in 1994/95 will include continued penguin and fur seal monitoring and directed research at Seal Island and penguin monitoring at Palmer Station. A collaborative cruise with Japanese scientists aboard the RV *Kaiyo Maru* will be conducted near Elephant Island to investigate predator/prey interactions among Antarctic krill and its marine mammal and bird predators. Shipboard surveys of hydrographic conditions, phytoplankton production, krill distribution, abundance and demography will be conducted around Elephant Island. In addition, the LTER Program will continue to conduct research similar to that conducted this year.

**REPORT OF THE WG-CEMP *AD HOC* SUBGROUP ON  
THE DESIGNATION AND PROTECTION OF SITES**

The *Ad Hoc* Subgroup on the Designation and Protection of Sites, consisting of Drs K. Kerry (Australia), P. Penhale (USA) and D. Torres (Chile), was charged with three tasks during the intersessional period: (i) to provide comments on the joint proposal by Brazil and Poland to the ATCM for an Antarctic Specially Managed Area (ASMA), Admiralty Bay, King George Island; (ii) to consider appropriate procedures to deal with draft management plans received from the Contracting Parties to the Antarctic Treaty; and (iii) to consider to what extent to revise the provisions of Conservation Measure 18/IX so that they correspond to the provisions of Annex V to the Protocol on environmental protection to the Antarctic Treaty.

(i) Comments on the Admiralty Bay ASMA Proposal

2. At its last meeting the Commission asked the Scientific Committee and its Working Groups to review the draft management plan for Admiralty Bay. This plan had been prepared by the Delegations of Brazil and Poland as CCAMLR-XII/BG/13 (CCAMLR-XII, paragraph 10.9) as an ASMA in accordance with Annex V to the Protocol. It was submitted to the Commission for its consideration as would be required under Article 6 (2) of Annex V to the Protocol once the Protocol came into force.

3. It was noted by the *ad hoc* subgroup that the joint proposal had been referred to the SCAR Group of Specialists on Environmental Affairs and Conservation (GOSEAC) for consideration and subsequent review and re-drafting by SCAR. Given also that the Protocol is not yet in force, the proposal must be considered as preliminary and likely to be subject to change.

4. Many nations are known to be working in the region detailed in the proposal, yet it is not clear from the document what degree of consultation has taken place among those parties and whether or not their interests have been taken into account.

5. It was noted that the protection of seabird and mammal colonies and the known foraging areas of the various species in the area are of particular interest to CCAMLR. To this end, more detailed, annotated maps and marine bathymetric charts, where available, would have improved the document.

(ii) Procedures to Deal with Draft ATCP Management Plans

6. With regard to procedures to deal with such management plans, it was recommended that the draft Antarctic Specially Protected Areas (ASPAs) and ASMAs which include marine areas should be received by the Executive Secretary for transmission to all Members of the Commission at least three months prior to consideration by WG-CEMP (similar to procedures in Conservation Measure 18/IX).

7. It was noted that the review by the *ad hoc* subgroup and by WG-CEMP would be facilitated by the receipt of any guidance that has been provided by ATCM bodies to the originators of the proposal and is available prior to the meeting of WG-CEMP.

8. The provision of the following information *inter alia* is considered to be important to CCAMLR in its assessment of any ASMA or ASPAs.

- (i) Locations of all colonies of birds and seals, including points of entry into and departure from the sea.
- (ii) The areas in which vertebrate species, associated with or breeding in the proposed management area, are known to forage.
- (iii) The location of sites where monitoring studies are being undertaken in support of CEMP. This should be irrespective of whether or not the site has been formally declared a CEMP site under Conservation Measure 18/IX.

9. It was noted that in order to review the proposals fully, the inclusion of high quality topographic maps and bathymetric charts is critical. The exact location of seabird and marine mammal colonies, as well as any available information on foraging areas and ranges, is an important element for consideration.

(iii) Possible Revisions to Conservation Measure 18/IX

10. The extent to which it might be appropriate to revise the provisions of Conservation Measure 18/IX was considered. In order to facilitate a comparison of the management plans for CEMP sites and ASPAs, the Science Officer had prepared a comparative table of management plan elements (WG-CEMP-94/9).

11. The *ad hoc* subgroup noted the usefulness of this table, and provided additional annotations and revisions to the table for future reference. A number of similarities and differences were noted in the comparison between elements of both management plan systems.

12. In order to improve consistency, several revisions to Conservation Measure 18/IX, Annex A, may be appropriate.

13. A general area of inconsistency of detail concerns restrictions on material and organisms which may be brought into an area and the collection or removal of anything not brought into an area by a permit holder or visitor.

14. Another example of inconsistency is that the Antarctic Treaty System management plan system includes provisions for site inspections and reports thereof, while the CEMP management plan does not. Additional examples may be found.

15. It was considered that due to the complexities of the two protected area systems, additional time was required for the review and the preparation of recommendations for revision of Conservation Measure 18/IX.

(iv) General Comments

16. It was observed that the implementation of Annex V to the Protocol involves the re-drafting into the ASPA and ASMA format of current management plans for existing protected areas under the agreed measures for the conservation of Antarctic fauna and flora. Thus, CCAMLR may expect to receive several such management plans for review and approval in the near future.

17. It was also noted that concern was raised during ATCM XVIII regarding the possible use of mandatory prohibitions within the management plans for ASMAs. It was noted (ATCM XVIII, paragraphs 110 and 111) that clarification of this point would be necessary before designating any ASMAs under Article 6 of Annex V of the Protocol.

18. Improvement of coordination of CEMP site protection within the Antarctic Treaty System is likely to require further communication between the ATCM and CCAMLR and their scientific advisory bodies.