

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

(Stockholm, Sweden, 6 to 13 September 1990)

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INTRODUCTION

The Fifth Meeting of the Working Group for the CCAMLR Ecosystem Monitoring Program (WG-CEMP) was held at the Royal Swedish Academy of Sciences and the Swedish Museum of Natural History, Stockholm, Sweden from 6 to 13 September 1990.

2. Participants were welcomed by Mrs Désiree Edmar, Assistant Under-Secretary of the Swedish Cabinet Office and Head of the Swedish Delegation to CCAMLR and Mr Olaf Tandberg, Foreign Secretary of the Swedish Royal Academy of Sciences. The Convener of the Working Group, Dr J. Bengtson (USA) thanked the Government of Sweden for inviting the Working Group to hold its meeting in Stockholm and expressed his gratitude to the Swedish Polar Research Secretariat and the Swedish Museum of Natural History for their assistance in organising the meeting.

3. The Convener opened the meeting and introduced the Provisional Agenda. The Agenda was adopted with the following changes: Item 11 was amended to read 'Designation and Protection of Sites' and a new agenda item 'Future Work of WG-CEMP' was added.

4. The Agenda is attached as Appendix A, a List of Participants is given in Appendix B and documents submitted for consideration at the meeting are listed in Appendix C.

5. The report of the meeting was prepared by Drs J. Croxall (UK), P. Boveng (USA), K. Kerry (Australia), V. Marín (Chile), D. Agnew and E. Sabourenkov (Secretariat).

REVIEW OF MEMBER'S ACTIVITIES

6. The Convener noted that many Members were now carrying out CEMP studies, and that some have information from activities dating back to before CEMP started which are of direct use in the program. Last year the Working Group summarised Members' activities into monitoring of predatory species in accordance with Standard Methods, research on assessing the utility of potential predator parameters and directed ecological research needed to

interpret changes in monitored predator parameters. It was agreed that relevant summary tables from the report of the 1989 Meeting of the Working Group should be updated at the meeting and appended to this report (Tables 1 to 3).

7. It was pointed out that these summary tables deal only with studies of predatory species and do not cover work on prey species and environment. It was agreed that, in addition to updating summary tables, Members should inform the Working Group on other aspects of their CEMP-related studies in the last season and advise on plans for the next season.

8. Studies by Argentina in 1989/90 were concentrated as in the previous season on monitoring parameters of Adélie penguins in the colonies at Stranger Point, King George Island, South Shetland Islands, and Mossman Peninsula, Laurie Island, South Orkney Islands, in accordance with Standard Methods A1 to A3 and A6 to A8. An attempt was being made to elaborate an annual index for the parameter A1 (adult weight on arrival at breeding colonies) (WG-CEMP-90/8). Work on a procedure for determining the sex of adult Adélie penguins by discriminant analyses of several morphometric measurements was continued (WG-CEMP-90/7 Rev. 1). In relation to the parameter A8 (penguin chick diet) a sampling design was suggested for optimisation of the detection of interannual variability and selectivity of prey by size (WG-CEMP-90/9).

9. In the 1990/91 season the CEMP studies of Argentina will continue work carried out in 1989/90. The Working Group was informed that plans for construction work at Esperanza Station (Antarctic Peninsula) had been cancelled and that Argentina will commence monitoring of Adélie penguins at this site starting with the 1990/91 season. Data available from previous studies at Esperanza will be submitted.

10. Australia has continued monitoring of Adélie penguins at Magnetic Island (Davis Station). Data for most of the approved parameters for penguins are being collected. At present funds are available for this work to be continued at least for another two years. There are plans to combine this work with offshore studies on prey and the environment, including radio-tracking of penguins at sea. An automated penguin monitoring system has been developed and will be field-tested during the 1990/91 season at an Adélie penguin colony near Mawson Station (WG-CEMP-90/24). This device will provide information on bird identity, weight and direction in and out of the breeding colony. When fully operational it will automatically provide data collected in accordance with Standard Methods A1, A2, A5 and possibly A7.

11. At present Australia does not conduct, for the purposes of CEMP, any research on prey and the environment. However, the new Australian research ship *Aurora Australis* (an icebreaker with commercial scale trawling capability) will provide new possibilities.

12. Australian scientists in 1989/90 collected a series of measurements (WG-CEMP-90/25) for possible use in sexing Adélie penguins by discriminant analysis of several morphometric measurements and as a result of this study an additional set of morphometric measurements was provided (WG-CEMP-90/25).

13. Brazil submitted a written report (WG-CEMP-90/26). In 1989/90 Brazil carried out monitoring of chinstrap and macaroni penguins at Stinker Point, Elephant Island, South Shetland Islands on parameters A6 to A8. Summary data on these parameters have been submitted to the CCAMLR Secretariat. Draft standard methods for monitoring suggested parameters of cape petrel are being prepared and will be submitted later to WG-CEMP. Plans for the 1990/91 season include the continuation of monitoring the same parameters of penguins at Elephant Island together with collecting data on several weather parameters by means of an automatic weather station.

14. Chile reported results of directed research on birds, mammals and plankton and of an hydrological survey around Livingston Island which were carried out in the 1989/90 season. This survey is a part of an overall program on the evaluation of energy transfer among elements of the ecosystem in parts of the Antarctic Peninsula Integrated Study Region. In the 1990/91 season Chile will continue monitoring parameters A3, A4 and A6 at Ardley Island and parameters C1 and C2 at Cape Shirreff. Chile is also conducting directed research at Coppermine Peninsula, Robert Island, South Shetland Islands, and has identified this site as an important location for multidisciplinary studies. In addition, Chile is conducting cooperative studies with the USA around Seal Island, South Shetland Islands to identify foraging ranges of penguins and fur seals.

15. Japan is conducting monitoring of annual trends in breeding population size of Adélie penguins at Syowa Station. This program was presented to the meeting. In the 1990/91 season, a survey of krill distribution together with the collection of data on some hydrological parameters is planned for the Elephant Island area from aboard RV *Kaiyo Maru*. Joint research with US scientists is planned during 1990/91 to investigate the foraging areas of fur seals and penguins near Seal Island, Elephant Island (aboard RV *Kaiyo Maru*), and the ecology of penguins breeding ashore at Seal Island. Simultaneous land-based and sea-bound observations on the diet and energy requirements of penguins are also planned in the near future. Plans also include satellite tracking of seals in the Prydz Bay Integrated Study

Region. This program will be carried out in cooperation with Australian scientists. Japanese scientists will continue to work with US scientists on satellite tracking of elephant and crabeater seals in the Weddell Sea and Antarctic Peninsula area.

16. Research activities of Korea in 1989/90 in support of CEMP were concentrated on a plankton survey in the Bransfield Strait during which samples were obtained at 29 oceanographic stations. Future programs will include more intensive studies of phyto- and zooplankton distribution, particularly krill, in the northern part of the Bransfield Strait and Gerlache Strait.

17. In the past Norway's contribution to CEMP has mainly been studies of hydroacoustic methods of krill stock assessments. In 1989/90 Norway established a permanent land station, 'Troll', in Queen Maud Land at 72°00'S, 02°34'E, and two field camps in the same general area. Studies have been initiated in a colony of about one million Antarctic petrels near one of the camp sites, 'Svarthamaren', some 200 km inside the edge of the ice-shelf at 71°53'S, 05°10'E. Directed research is expected to continue at this colony.

18. Efforts are currently being made by Norway to establish a regular long-term program of Antarctic research in cooperation with other Nordic countries, i.e. Sweden and Finland. This program, and future national Norwegian activities, might be expanded to include regular studies of seals and birds on Bouvet Island in accordance with CEMP Standard Methods. A report of censuses of seal and bird populations on the island during 1989/90 is currently being prepared for publication. The Working Group expressed its particular interest in the suggested initiation of monitoring on Bouvet Island (see paragraph 48 below).

19. South Africa is conducting several research programs outside the CEMP Integrated Study Regions. These programs include studies of macaroni and gentoo penguins and elephant seals on Marion Island. Monitoring of populations of these species is conducted largely in accordance with CEMP Standard Methods. Prey monitoring studies are designed mainly to understand the relationship between the distribution of prey species and hydrographic processes in the vicinity of the Prince Edward Islands. In the coming two years South Africa plans to start monitoring and directed research on a colony of Antarctic petrels located some 50 miles inland in Queen Maud Land from SANAE station (Robertskollen nunatukk, 71°27'S, 03°15'W).

20. Sweden welcomed the suggestion by Norway for cooperation among Nordic countries in CEMP-related research. At present Sweden does not participate in routine monitoring as part of CEMP. However, biological studies aimed at providing background information are

continuing in cooperation with scientists from the UK and USA. The recent launch of a new Swedish icebreaker, *Oden*, has created high expectations in developing new research programs.

21. United Kingdom land-based research in support of CEMP is conducted at Signy Island, South Orkney Islands and Bird Island, South Georgia. At Signy Island, parameters A3 and A6 are monitored for Adélie and chinstrap penguins. Long-term mark-and-recapture data for Weddell seals has recently been analysed in conjunction with USA and Australian data from continental sites (Testa *et al.* (1990) *J. Anim. Ecol.*, in press). At Bird Island parameters currently monitored are A1, A3, A6, A7, A8 and A9 (macaroni penguin), B1 to B3 (black-browed albatross), C1 and C2 (fur seal). In addition A3, A6 and A8 are monitored for gentoo penguin and there are comprehensive demographic programs on grey-headed and wandering albatrosses and Antarctic fur seal. Pilot studies aimed at developing constant-effort recapture methods to provide standardised demographic data for macaroni and gentoo penguins are in progress.

22. Recent and current research at Bird Island has emphasised penguin and fur seal reproductive biology. Publications of particular relevance to CEMP include those on interannual variability in breeding chronology and biology (WG-CEMP-90/18, 90/37, 90/38), penguin chick fledging weight (WG-CEMP-90/13), penguin foraging trip duration (WG-CEMP-90/17) and year-round studies of gentoo penguin diet (WG-CEMP-90/16). Publications in preparation include comparisons of fur seal pup growth as assessed by CEMP Procedures A and B, relationships between time and activity budgets at sea and foraging-attendance cycle duration in fur seals, analysis of diving pattern and performance in penguins and fur seals and black-browed albatross demographic trends over the last 15 years. The current penguin research program is to be concluded in 1991 and will be succeeded by more intensive investigations of albatross demography and ecology. Monitoring studies will be maintained at their current level.

23. United Kingdom prey studies have concentrated on krill distribution and swarming behaviour using acoustics, nets and underwater photography. Studies on krill target strength continue. A study is in progress to provide advice on survey design for monitoring krill in predator/prey studies.

24. The United States conducted a variety of studies of relevance to CEMP in the Antarctic Peninsula Integrated Study Region during the 1989/90 season (WG-CEMP-90/22, WG-Krill-90/7). Monitoring of land-based marine mammals and birds was conducted at Seal Island and Palmer Station. Chinstrap and macaroni penguins were monitored at Seal Island

(Standard Methods A4, A5, A6, A7, A8 and A9) and Adélie penguins were monitored at Palmer Station (Standard Methods A4, A6, A7 and A8). Antarctic fur seals were monitored at Seal Island using Standard Methods C1 and C2. In addition, several directed research projects on marine mammals and birds were conducted at Seal Island: fur seal and penguin foraging behaviour and activity budgets; fur seal and penguin foraging areas; effects of instrument attachment on penguins (WG-CEMP-90/21); fur seal pup and penguin growth (WG-CEMP-90/34); fur seal diet; krill requirements of predators (WG-CEMP-90/30); and determining the sex of penguins by bill measurements.

25. United States CEMP investigations at sea focused on integrated studies of prey, predators, and environmental features as well as directed research on crabeater seals. Integrated studies in 1989/90 included research on surface water masses, primary production, krill distribution, and predator foraging in the vicinity of Elephant Island, South Shetland Islands (WG-CEMP-90/11). Studies of crabeater seal demography, life history parameters, and reproductive biology were conducted in collaboration with Swedish scientists (WG-CEMP-90/35). Seasonal patterns of crabeater seal feeding behaviour, activity budgets, and habitat use are being investigated using satellite telemetry in collaboration with scientists from Japan.

26. During 1990/91, the US plans to continue monitoring and directed research at Seal Island and Palmer Station in the Antarctic Peninsula Integrated Study Region. The US will also continue its integrated studies at sea using the NOAA Ship *Surveyor* in the vicinity of Elephant Island. Cooperative studies with Japan and Chile will involve simultaneous monitoring of penguin and seal foraging behaviour, foraging areas, and the distribution of krill. Scientists from Chile and Japan will also participate in joint research on penguins and fur seals at Seal Island. Analysis of crabeater seal data will continue in collaboration with Swedish scientists.

27. As in the past, Soviet research in relation to CEMP in 1989/90 was concentrated on trawl and acoustic surveys, mainly of krill, conducted simultaneously with large-scale oceanographic surveys. In total, six multidisciplinary research cruises were carried out in the Atlantic and Indian Ocean sectors of the Southern Ocean. In particular, surveys of krill spawning and post-spawning distribution were undertaken to the east of South Sandwich Islands and in the Prydz Bay Integrated Study Region. Some of the research effort focused on *Pleuragramma antarcticum* as a potential indicator species for CEMP. For the first time Soviet scientists made observations on the distribution and abundance of flying birds during the research cruise of RV *Akademik Fedorov* along the Antarctic coast. The results are presented in WG-CEMP-90/33.

28. For the 1990/91 season, the USSR plans to continue large-scale multidisciplinary studies of krill distribution and oceanography in various areas of the Southern Ocean. A total of seven research cruises is planned although specific details of the cruise tracks are not yet known. Two cruises are planned to undertake directed fisheries research and studies of krill distribution in the Atlantic Ocean sector between 30° and 60° W, south of 40°S. In the Indian Ocean sector, four cruises are planned for areas in Prydz Bay, the Lazarev Sea, and near Enderby Land. Krill and oceanographic variability will be investigated during a research cruise in the Pacific Ocean sector between 150° and 180°E.

29. Dr Croxall mentioned that several Members, not present at the meeting, were conducting research of relevance to CEMP. In particular he drew attention to ornithological research by France at Crozet and Kerguelen Islands and the potential for the resumption of Adélie penguin research (which could include CEMP monitoring) at Adélie Land after airstrip construction is completed. New Zealand was continuing aerial surveys of Adélie penguin colonies in the Ross Sea and is conducting satellite tracking of Adélie penguins to determine foraging ranges during the incubation period. The German Democratic Republic conducts bird and seal research at King George Island, including collaborative research with Chile at Ardley Island. The Federal Republic of Germany is studying diet and distribution of crabeater seals and ecology of *P. antarcticum* in the southern Weddell Sea.

30. The Secretariat reported that a letter had been received from a Czechoslovakian scientist seeking information to assist in planning ornithological research at Nelson Island, South Shetland Islands, as part of the Czechoslovakian Antarctic Program. He specifically requested information on CEMP. A copy of the Standard Methods document was sent to him as well as other documents published by CCAMLR and his letter was drawn to the attention of the Chairman of the SCAR Bird Biology Subcommittee.

31. The Convener noted the diversity and large volume of CEMP-related research now being conducted by Members. It was clear that by providing a forum for regular and frequent communication among scientists and the opportunity for international collaboration, CEMP had been most successful in stimulating research on topics essential to the work of the Commission.

RELEVANCE OF CEMP TO THE WORK OF THE COMMISSION

32. The Convener introduced this item, noting that it was a topic raised at a number of previous meetings of WG-CEMP.

33. In 1988, at its Seventh Meeting, the Commission sought advice from the Scientific Committee (CCAMLR-VII, paragraphs 140 to 141) on:

‘operational definitions for depletion and target levels for recovery of depleted populations’, and

‘the ability of the CCAMLR Ecosystem Monitoring Program to detect changes in ecological relationships and to recognise effects of simple dependencies between species including distinguishing between natural fluctuations and those induced by fisheries.’

34. In 1989, at their Eighth Meetings, the Scientific Committee and the Commission asked WG-CEMP to reconsider these questions and to address the wider issue of the development of appropriate approaches to management and conservation in the light of the objectives of the Convention.

35. ‘.....operational definitions for depletion and target levels for recovery of depleted populations’. WG-CEMP is chiefly concerned with the detection of change in predator and prey parameters selected for monitoring. For predators, these parameters currently involve demography (including population size) and various indices of reproductive performance (including foraging). Decreases in population size could obviously be direct evidence of depletion of that particular population or stock but WG-CEMP is unable to formulate operational definitions at present. WG-CEMP has considered extensively the design of sampling in its monitoring program and is recommending that monitoring of parameters should be aimed at detecting at least a 10% change at a 90% confidence level (SC-CAMLR-VIII, Annex 7, paragraph 29). It is likely, therefore, that information on defined levels of change in monitored parameters, including population size, will be available to the Scientific Committee and Commission in the future.

36. ‘.....the ability of the CCAMLR Ecosystem Monitoring Program to detect changes in ecological relationships and to recognise the effects of simple dependencies between species including distinguishing between natural fluctuations and those induced by fisheries.’ In SC-CAMLR-VIII, paragraph 7.12, WG-CEMP reported that it was investigating the possibility of distinguishing between changes in food availability that result from commercial harvesting and changes due to natural fluctuations in the biological and physical environment. Because of the complexity of this topic and the possible need for modelling studies, they noted that advice could not be provided at present and that further work and discussion will be needed. At its 1990 Meeting the Working Group noted that it felt unable to add anything

to this statement, beyond restating the clear expectation of being able to detect changes in biological parameters that would undoubtedly reflect changes in ecological relationships.

37. With regard to appropriate approaches to management, a specific priority for WG-CEMP is the development of ways of incorporating the data on monitored predator parameters into the formal management deliberations of CCAMLR at both the Scientific Committee and Commission levels.

38. As a basis for initial discussion, the document SC-CAMLR-VIII/9 (SC-CAMLR-SSP/6: 353-365) was reviewed. The paper suggested that it was relatively straightforward and highly desirable to devise a system for annually assessing the overall pattern of changes in indices at the levels of parameter, species, site and area. Management recommendations would arise from considering the patterns of change in predator indices in the light of available relevant biological and physical environmental data. Such recommendations would only be likely where there is evidence of significant broad-scale general effect, or of acute effects at more local levels. This would apply, however, even when there was no evidence that harvesting is, or has been, a contributing factor. The logic for this is that if predator populations may be in trouble, any level of harvesting, if conducted at critical times and places, may have significant adverse effects. Examples of possible management action, involving restrictions on krill catch size, timing and location were compared from the perspectives of ease of implementation, consequences for the fishery and the probability of aiding predators (SC-CAMLR-VIII, paragraph 7.14).

39. At CCAMLR-VIII there was general agreement that such approaches merited further investigation and development and WG-CEMP was encouraged to discuss the whole topic at its next meeting. Prof. T. Lubimova (USSR) had expressed reservations about the content of SC-CAMLR-VIII/9 noting it contained a number of speculative ideas based on one approach to the problem. It was agreed that these reservations should also be discussed.

40. Present discussion focused on suggested assessment procedures. It was agreed that these should involve:

- (i) determining the magnitude and significance of changes in individual parameters;
- (ii) evaluating overall patterns of change within species, sites and areas;

- (iii) reviewing factors potentially influencing or correlated with the changes; and
- (iv) identifying factors unlikely to be implicated in the changes.

41. There was general agreement that it was both appropriate and desirable to determine annually the magnitude and direction of year-to-year changes and overall trends in each of the predator parameters being monitored at each site. The level of significance of change and trends should also be calculated. These results would be evaluated annually by WG-CEMP, with particular attention to comparisons within species, sites and regions and a summary of conclusions prepared. The results of these analyses would then be considered by WG-CEMP in the light of available data on relevant aspects of the biological environment (e.g. current/recent diet of monitored species, current/recent prey stock assessments and level and distribution of commercial catches at appropriate temporal and spatial scales) and physical environment (oceanographic features, weather and climate prevailing, especially during the monitoring period). Such a review would, where appropriate, enable WG-CEMP to formulate advice to the Scientific Committee.

42. There was also general support for the view that analysis and evaluation of submitted CEMP data and the development of recommendations based thereon did not require, and should not await, the determination of the precise quantitative nature of predator/prey/environment relationships.

43. It was agreed that the Secretariat should, as soon as possible after the deadline for receipt of the annual data submission, prepare a summary of the data received, including determining the magnitude and level of significance of changes and trends in comparison with the previously submitted data. Members were also encouraged to conduct similar analyses of their own data.

44. It was noted that, in respect of many parameters, the procedure outlined in paragraph 43 would require the development of explicit instructions for analysis of submitted data. Members were asked to submit proposals to the next meeting of the Working Group.

45. Mr D. Miller (South Africa) drew attention to parallel initiatives in the Working Group on Krill (WG-Krill) aimed at the development of standardised procedures for the formulation of management advice on krill to the Scientific Committee. These included consideration of data from predators, specifically predator food (i.e. krill) requirements and levels of krill escapement from harvesting activities necessary to meet such requirements. These particular topics are discussed in more detail in paragraphs 95 and 135. There was

agreement that such development emphasised the continued need for close liaison, including interchange of results of data analysis, between WG-CEMP and WG-Krill.

PREDATOR MONITORING

Sites and Species

46. The Convener invited discussion of current and new sites, drawing attention to the report of the SCAR Bird Biology Subcommittee (WG-CEMP-90/32). This report indicated Esperanza might become a CEMP Network Site. The potential importance of Esperanza, on the boundary between the Weddell Sea and the Bransfield Strait, was noted. Dr D. Vergani (Argentina) confirmed that there were plans to begin monitoring Adélie penguins at Esperanza in the coming season.

47. The SCAR Bird Biology Subcommittee also noted the importance of the long-term penguin research activities by US scientists at Admiralty Bay, King George Island. It was noted that data from this program would provide a valuable contribution to CEMP, and that the US should be encouraged to consider appropriate arrangements, as feasible, to include the site in CEMP.

48. The Working Group welcomed the comment (paragraph 18) that Norway might consider continuing research activities and initiating monitoring activities at Bouvet Island. Bouvet Island is an important site because it is 'downstream' of major krill fisheries, it is in an oceanographic transition zone, as well as being a site of penguin and fur seal colonies. The Working Group agreed that developing such studies at Bouvet, the only proposed land-based site in Subarea 48.6, would be a valuable contribution to the CEMP program.

49. Chile has identified Cape Shirreff, Livingston Island as an important site and will expand its past research efforts there by beginning CEMP monitoring during 1990/91 as part of an ecosystem study that includes oceanographic surveys in the surrounding waters. Joint studies between Chile and the US are also being planned for this site.

50. It was noted that construction activity at Dumont D'Urville Station is expected to conclude in the near future. The Working Group encouraged France to re-initiate monitoring efforts at this site as soon as feasible.

51. The Working Group decided to change the eastern and southeastern boundaries of the Antarctic Peninsula Integrated Study Region to coincide with the corresponding boundaries of Subarea 48.1. This change will make it easier to incorporate the fine-scale krill catch data into CEMP studies, but will not change reporting requirements for fine-scale data.

52. A proposal by the United Kingdom to include gentoo penguins (*Pygoscelis papua*) as a designated CEMP species was accepted. The species meets all the CCAMLR criteria, it is a year-round resident at many sites, and it attains sexual maturity at a younger age than most other penguins. Dr Croxall was asked to draft the appropriate modifications for gentoo penguins to the Standard Methods and tables and to report these proposed changes to the Working Group's next meeting.

Data Collection Methods

53. The draft second edition of the CEMP Standard Methods (WG-CEMP-90/43), revised during the intersessional period by a small subgroup, contained many new sections. In particular, recent developments in the analytical techniques and new data reporting sheets were included. The Convener invited the Working Group to comment on the new edition, noting that several papers for this session were relevant to the evaluation of the methods (WG-CEMP-90/7 Rev. 1, 8, 9, 12, 13, 15 to 18, 21, 24 to 27, 32, 34, and 37 to 41).

54. The Working Group agreed that, although several comments that had been expected from experts outside CEMP had not yet been received, the evaluation and adoption of the second edition should proceed. It was noted that the process of developing the methods is dynamic, and that each method may be subject to revision periodically as new information becomes available. The Secretariat was requested to incorporate the agreed revisions into a new version of the document to be distributed at the Ninth Meeting of the Scientific Committee.

55. During discussions of individual standard methods, the following general comments were made.

- (i) A concern was expressed that some items listed under MANDATORY DATA were so obvious as to not need explicit mention. The Working Group was reminded that the MANDATORY DATA section is as much for aiding the development of field data forms as for describing the procedures and that, therefore, that section should remain intact.

- (ii) The Working Group was reminded that data may now be available for filling in gaps in tables of relevant dates for each species and location for each method. Members were requested to provide information that would add to or revise those tables as soon as possible.
- (iii) Members were requested to provide to the Secretariat, no later than 15 October 1990, relevant references to update the lists of BACKGROUND PAPERS for each method.

56. In reviewing Members' activities, the Working Group reiterated its view that many CEMP activities require the collection of data for sustained periods of time. To fulfil the many objectives inherent in monitoring, such time periods should be uninterrupted. Both these factors have to be taken into account when developing new monitoring programs.

Standard Methods for Penguins

Standard Method A1.2: Adult Weight on Arrival at Breeding Colony

57. Dr Vergani presented WG-CEMP-90/8, which contained a description of a technique intended to provide an index of Adélie penguin weight on arrival, when no information about sex or age of the birds is available. Because several Members expressed reservations about the primary statistical method (separating 'modes' of a composite distribution) it was agreed not to alter the analytical portion of the standard method at this time. The Working Group, however, encouraged further developments, particularly regarding techniques for determining the sex of Adélie penguins (discussed below in paragraphs 71 to 74).

Standard Method A2.2: Duration of the First Incubation Shift

58. The method was adopted as drafted but it was noted that investigators from Argentina and Chile may have additional comments when they have had time to review the method and reporting form.

Standard Method A3.2: Breeding Population Size

59. The method was adopted as drafted.

Standard Method A4.2: Age-specific Annual Survival and Recruitment

60. No analytical methods have yet been drafted for this method because of the variety and complexity of available techniques. Members were requested to inform the Working Group of protocols now in use by their investigators.

Standard Method A5.2: Duration of Foraging Trips

61. A study by US scientists (WG-CEMP-90/21) indicated that radio-transmitters may increase durations of foraging trips by chinstrap penguins. Dr Croxall noted that a similar study on gentoo penguins did not detect an effect (WG-CEMP-90/17). The Working Group agreed that efforts to detect and minimise the potential effects of attached instruments should be continued.

62. It was agreed that the method should include specific information regarding which brands of adhesives have been found to work, and which do not work, for the attachment of instruments. Also, it was noted that some investigators have successfully attached transmitters to penguins without adhesives, using metal hose clamps or plastic cable-ties.

63. Members were reminded of the request made in item 2 of the COMMENTS section of this method, for input on the issue of whether each individual of a nesting pair should be included in studies of foraging trip durations. Issues bearing on this topic include statistical independence of the two parent birds and representation of both sexes in the study.

Standard Method A6.2: Breeding Success

64. It was noted that because the former version of Procedure B included activities that related to two different approaches to estimating breeding success, this section was split into Procedures B and C in the second version. Procedure B now pertains to chicks raised per breeding pair and Procedure C relates to chicks raised per colony.

Standard Method A7.2: Chick Weight at Fledging

65. Dr Croxall noted that the findings of WG-CEMP-90/13 suggest that chick weight at some intermediate development stage (say 30 days of age) may be more revealing than

fledging weight (at about 60 days) because an inverse relationship had been observed between chick meal size and weight at 60 days. It was agreed to insert appropriate comments in the data collection and data interpretation sections of this method.

Standard Method A8.2: Chick Diet

66. Because much of the work described in the General Procedures pertained to HIGHLY DESIRABLE DATA (not mandatory), the Working Group developed text for the two procedures: Procedure A aims to characterise the general composition of chick diet; Procedure B provides detailed information about the composition of prey in the diet. Members were requested to consider specific objectives that might be desirable based on the types of data available from Procedure B.

67. In that regard, WG-CEMP-90/9 demonstrated the use of nested ANOVA for the design of a study to detect interannual variability and prey size selectivity. Particular sampling regimes will depend on economic constraints which inevitably vary among Members' programs. Dr Marín suggested that the portion of the technique up to partitioning of the expected mean squares would be of more general use than the final sample size estimates. Because the method pertained to research that might be conducted under Procedure B (see previous paragraph), no specific proposal was warranted at this time.

68. To estimate krill size distributions from carapace lengths in samples that are not in suitable condition to reliably distinguish the sexes, additional regression equations should be added to Table 1 for this method. The new equations should be formed as composites of the regressions for the individual sexes. Separate equations should be developed for adult and subadult krill. Within each of these age groups, equations should be provided for several sex ratios. This would enable investigators to use the approximate sex ratio in a sample to choose the appropriate equation. The US Delegation agreed to provide the composite equations to the Secretariat by 15 October 1990.

69. Because of the potential for time-of-day effects on the composition of penguin chick diet, it was agreed that the mandatory data include both date and time of day, both to be recorded as GMT.

Standard Method A9.2: Breeding Chronology

70. This method involves the recording of dates of various events over the breeding season. It is most useful when the full set of dates is reported, but the chronology of individual events is also of value to monitoring. It was agreed therefore that Members be encouraged to collect data on breeding chronology even if their investigators may not have arrived at a particular site sufficiently early in the season to have collected complete data on breeding chronology. Breeding chronology data should be collected for those portions of Method A9 (e.g. hatching dates, fledging rates) which correspond to the relevant Methods A1 to A8.

Standard Method Appendix 1: Determining the Sex of Penguins

71. Substantial progress has been made in these methods, allowing nearly 100% accuracy for some species. However, further research has shown that the early version of this appendix was insufficiently detailed to treat all CEMP penguin species. Adélie penguins in particular, because of their small, tapered bills, are difficult to measure precisely, as pointed out by Dr Kerry in WG-CEMP-90/25.

72. Dr Vergani summarised WG-CEMP-90/7 Rev. 1 in which a method using several allometric parameters in addition to bill depth was used to correctly determine the sex of about 87% of a sample of Adélies. The Working Group agreed that the method was promising and encouraged efforts to increase the accuracy of the method.

73. A subgroup including Drs Kerry, Vergani and Croxall agreed to redraft Standard Methods Appendix 1, incorporating specific methods for each species, and recent improvements in the techniques. Draft diagrams and outstanding textual information for the revised version should be sent to the Secretariat not later than 8 October 1990.

74. The ability to accurately determine the sex of penguins (including juvenile birds) is important in penguin research generally and essential in respect of several CEMP methods. Members were encouraged to examine additional ways of determining the sex of penguins.

Standard Methods for Flying Birds

Standard Method B1.2: Breeding Population Size

Standard Method B2.2: Breeding Success

Standard Method B3.2: Age-specific Annual Survival and Recruitment

75. South Georgia is the only suitable site for applying these methods (which pertain to black-browed albatross). Because Dr Croxall felt the methods and reporting forms needed only minor revisions, the Working Group agreed to adopt these methods pending minor changes to be discussed with the Data Manager.

Standard Methods for Seals

Standard Method C1.2: Duration of Cow Foraging/Attendance Cycles

76. Dr Croxall described preliminary results from a study at Bird Island which indicated that visual twice-daily monitoring of fur seal foraging trips underestimated trip duration by 7% and overestimated duration ashore by 18% when compared to monitoring by radio-telemetry. Durations of trips monitored visually were more variable (CV = 45%) than trips monitored by telemetry (CV = 40%). Visually monitored durations ashore were less variable (CV = 38% vs. CV = 52%). Also, no significant effect of instruments on foraging cycles was detected. Full details will be available at the next meeting of the Working Group.

Standard Method C2.2: Pup Growth

77. Dr Kerry suggested that the Working Group consider using implanted passive transponder tags (PTTs) to mark individual fur seal pups as an aid to conducting Procedure A (growth rates of known individuals), or as a method of avoiding multiple captures of individuals when using Procedure B (growth rates of random samples of pups). The Working Group acknowledged that PTTs could be useful but also noted that background studies would be necessary to determine specific aspects of implanting, retaining, and detecting PTTs in fur seal pups.

78. WG-CEMP-90/34 suggested a statistical method for comparing growth rates among years and applied it to data from three years of monitoring fur seal pup growth at Seal Island, Antarctic Peninsula Integrated Study Region. No significant differences in growth rates were

detected among the three years. There were, however, significant differences in the estimates of pup weights on specific dates. It was agreed that it would be useful to investigate whether pup weight at a certain age or date would be a useful index to complement existing monitoring parameters for fur seals.

79. The Working Group adopted the second edition of 'Standard Methods for Monitoring Parameters of Predator Species', noting that agreed revisions would be communicated to the Secretariat by 15 October 1990.

Field Research Techniques

80. Dr Bengtson expressed his concern and the Working Group agreed that in conducting monitoring studies on Antarctic marine mammals and birds, WG-CEMP should take appropriate steps to ensure that field research techniques were carried out in a manner that:

- (i) avoided or minimised adverse effects on wildlife;
- (ii) followed recognised techniques and therefore were compatible with the results of other studies; and
- (iii) did not significantly alter the behaviour or welfare of the species being studied.

81. There were two areas of particular concern:

- (i) techniques of handling seals and seabirds; and
- (ii) general procedural effects.

Handling techniques include such activities as capture and restraint, tagging and banding, stomach pumping, and attaching or removing electronic instruments. Examples of possible general procedural effects include disturbing colonies by investigators' presence or increasing the energetic requirements of seals and birds by attaching electronic instruments to their backs.

82. Some of these items had already received explicit attention. The Standard Methods identify specific steps that investigators should follow to minimise disturbance in penguin and fur seal colonies. In addition, evaluations of the extent to which electronic instruments affected the behaviour of gentoo penguins (WG-CEMP-90/13) and chinstrap penguins

(WG-CEMP-90/21) were tabled at the meeting. The US Delegation reported that it planned to undertake further studies on the potential effects of instrument deployment on penguins during the 1990/91 field season. Members were encouraged to continue considering the topic of potential effects of monitoring procedures and to report their findings to the Working Group.

83. Additional possibilities of investigators using improper handling techniques arise as new programs and personnel initiate monitoring and directed research activities as part of CEMP. Such problems may develop because of errors associated with developing new techniques, investigators' inexperience, or just unfortunate mistakes made in the course of research activities. Even for those techniques that are well-developed, minor changes in the recognised procedure may cause problems. For example, it was noted that improper techniques for capturing (holding the bird or seal too tightly), bird banding and seal tagging (fastening bands incorrectly or placing tags in the wrong place on the flipper), penguin stomach pumping (using the wrong diameter of tubing or inserting the tube too far) might result in harming or even killing the bird or seal being studied.

84. The Working Group recognised that in the course of any field research operation, occasional mistakes are almost inevitable. To help minimise such errors, the Working Group agreed that it would attempt to enhance the exchange of information on the finer points of handling techniques, problems to avoid, problems encountered and solutions developed.

85. The Working Group agreed that, for the purposes described above, it would be desirable to produce a videotape recording demonstrating some of the bird and seal handling techniques utilised in CEMP activities. Members were requested to prepare video recordings of these field activities, with the view to editing these recordings into a single tape at a future workshop on field techniques.

86. It was also agreed that arranging demonstrations of various types of field equipment and techniques (e.g. stomach pumping, tagging, banding, determination of sex and the use of electronic instruments and recording equipment) at such a workshop would be an effective way to increase the efficiency of studies and data quality while decreasing the probability of potentially adverse impacts on the study animals.

87. Members were encouraged to bring more detailed proposals for such a workshop to the next meeting of the Working Group.

Standardising Activity Budget Methods

88. Noting that a Standard Method for activity budgets of birds and seals at sea might be proposed in the future, the Working Group considered convening a workshop to standardise sampling protocols, set-up, use and data analysis from instruments used in these studies (i.e. time-depth recorders and satellite transmitters). The Working Group agreed that such a workshop, attended by both scientists using these instruments and instrument manufacturers, should be held and noted that Seattle might be a desirable venue because a major manufacturer of such devices is located there. The Working Group welcomed an invitation from the US National Marine Mammal Laboratory to hold the workshop in Seattle. It was noted it would involve specialists who may not normally attend WG-CEMP meetings and that it might be necessary to seek CCAMLR funds to assist some of them to attend.

89. It was agreed that the Convener should write to scientists currently using instruments as described above to seek their views on the timing, duration and organization of the proposed workshop and to inquire about likely funding requirements. He should report to the next meeting of the Working Group.

Other Field Research Procedures

90. Dr Kerry described an unattended monitoring system for penguins that weighs and logs arrivals and departures of birds and also identifies specially tagged birds as they pass the detector (WG-CEMP-90/24). The tags are 'domino-sized' electronic tags that are glued to the feathers. Data recorded by the system are transmitted from the remote monitoring station via VHF radio and satellite. Smaller surface acoustic wave (SAW) tags are anticipated to be available in the future. They could be permanently attached by fixing them to a flipper band. The present cost of the monitoring system, which includes an automated weather station, is about A\$25 000. The Working Group agreed that the method appears promising and looks forward to hearing of new developments, especially regarding the availability of SAW tags.

91. Because several national directed research programs on seals use different standard measurements, the Working Group encouraged SCAR to expedite the publication of the Manual on Research Methods for Antarctic Seals. The Working Group also agreed that, until such a manual is available, standard measurements of seals should follow, where appropriate, those approved by the American Society of Mammalogists (American Society of Mammalogists. 1967. Standard Measurements of Seals. *J. Mammal.* 48).

PREY MONITORING

Review of the Working Group on Krill Report

92. Mr Miller (Convener of WG-Krill) reviewed the report of WG-Krill's recent meeting in Leningrad from 27 August to 3 September 1990 (Annex 4). Among the items considered at this meeting were various questions raised by WG-CEMP at its 1989 Meeting (SC-CAMLR-VIII, Annex 7, paragraph 88). Specifically those questions address the problem of developing suitable survey designs for prey (especially krill) monitoring surveys.

93. WG-Krill agreed that acoustic surveys offer the most practical approach to assessing krill biomass over large areas. Consequently WG-Krill recognised the need for accurate krill acoustic target strength values in order to obtain absolute estimates of krill biomass. WG-Krill is therefore undertaking further work on krill acoustic target strength in order to standardise the values to be used in surveys of krill biomass.

94. WG-Krill also recognised the need to develop standard management procedures for krill resources in the context of the requirements of Article II of the Convention. Although there was some disagreement concerning the details of such an approach, the Working Group was able to develop four basic concepts underlying the development of a standardised krill management procedure. These concepts comprised:

- (i) a basis for assessing the status of the krill resource in areas of interest;
- (ii) suitable algorithms for specifying appropriate regulatory mechanisms as a function of such assessments as carried out under (i);
- (iii) a basis for testing performance of any selected management procedure (i.e. (i) and (ii) above); and
- (iv) an operational definition of CCAMLR Article II to provide criteria against which performance can be assessed (Annex 4, paragraph 55).

95. Although WG-Krill was unable to develop detailed operational definitions derived from Article II in the time available to its meeting, four general concepts on which such definitions might be based were developed (Annex 4, paragraph 61). Two of these concepts were of direct relevance to the work of WG-CEMP and are aimed at:

- ensuring that any reduction of food to predators which may arise because of krill harvesting is not such that land-breeding predators with restricted foraging ranges are disproportionately affected in comparison with predators present in pelagic habitats; and
- examining what level of krill escapement would be sufficient to meet the reasonable requirements of krill predators.

96. WG-CEMP understood the second concept in paragraph 95 to refer to food requirements of krill predators at broad temporal and spatial scales (e.g. year-round within subareas) and the first concept to refer to the special circumstances of predators with restricted foraging ranges while breeding on land.

97. On a broad scale, WG-Krill has already suggested an approach to the determination of appropriate yields from krill populations (Annex 4, paragraph 63) which includes a term for **M**, the natural annual mortality rate of krill. Determining the production surplus to the requirements of predators would require quantifying that element of **M** which comprises mortality of krill due to predation. WG-CEMP thought it unlikely that estimates of year-round subarea-wide krill consumption by all predators would be available in the near future.

98. On a smaller scale, for predators with restricted foraging ranges during their breeding seasons, the models being developed within WG-CEMP (Agenda Item 9, Estimates of prey requirements for krill predators) would offer considerable assistance in the development of operational definitions of Article II.

99. Other items considered by WG-Krill and specifically pertaining to the work of WG-CEMP were contained in paragraphs 87 through to 126 of WG-Krill's report (Annex 4). In particular, WG-CEMP considered WG-Krill's suggestions concerning:

- basic requirements for prey surveys (Annex 4, paragraph 91);
- the degree of precision required for krill biomass estimates, compilation of data on krill areal distribution and methods for assessing relationships between survey design, effort and resultant precision of biomass estimates (Annex 4, paragraph 93);

- the formation of a subgroup to undertake intersessional work on a variety of problems associated with the general problems of prey (i.e. krill) survey design as well as the statistical combination of line transect data measurements of animal density to estimate biomass over a region and provide an associated variance estimate (Annex 4, paragraph 97);
- interim guidelines for prey surveys (Annex 4, paragraph 100);
- the consideration of suitable parameters to be derived from acoustic survey data for prey monitoring requirements; and
- the need for advice from WG-CEMP on changes in predator foraging ranges, behaviour and diet likely to occur during predator breeding cycles (Annex 4, paragraph 104) with a view to refining prey survey requirements with respect to spatial and temporal integration of surveys.

100. In particular, WG-CEMP noted and accepted the conclusion of WG-Krill that krill surveys within the foraging ranges of selected land-breeding predators will best be undertaken using acoustics combined with an underlying net sampling program for target identification. It was also agreed that data on the relative abundance of krill on a subarea scale, which is also very relevant to predators, are more likely to become available from fisheries-dependent indices (e.g. catch-per-unit-effort) or indices of relative krill abundance (e.g. the Composite Index of Krill Abundance discussed by WG-Krill at its 1989 Meeting).

101. With respect to the basic requirements for prey monitoring surveys developed by WG-Krill (Annex 4, paragraphs 91 and 100), WG-CEMP agreed that such surveys should cover the period December to February annually and should be located within a radius of 100 km of land-based monitoring sites. For operational reasons related to attenuation at the recommended acoustic frequencies (120 kHz or higher) combined with limited capability for detecting near-surface targets, acoustic surveys would effectively be confined to between 5 m (transducer depth) and 150 m from the sea surface.

102. WG-CEMP welcomed the formation of the WG-Krill subgroup to undertake the detailed development of krill surveys for prey monitoring purposes (Annex 4, paragraph 97). Members of WG-CEMP were encouraged to participate in the subgroup's work during the intersessional period. An important outcome of the subgroup's work would be some indication of survey requirements, particularly the commitment of ship time, in relation to levels of expected precision from survey results. There was also recognition of the

importance of the subgroup's task in considering the characteristics of krill aggregations (specifically including vertical distribution, density within and outside swarms) in the development of various sampling regimes.

103. WG-CEMP agreed that until the subgroup is able to provide detailed krill survey specifications to assess prey availability in predator foraging areas, Members should follow WG-Krill's interim operational guidelines for the implementation of such surveys (Annex 4, paragraph 100). These guidelines suggest that surveys be conducted by spacing as many transects as possible over the area being surveyed and if possible repeating individual transects several times during the two-and-half-month survey period (i.e. December to February). As far as possible surveys should also be undertaken during a period of six to eight hours either side of solar noon and combined with net sampling at approximately three-hourly intervals.

104. In response to WG-Krill's question concerning changes in predator foraging ranges, diet and behaviour likely to occur during predator breeding cycles (paragraph 99 above), WG-CEMP agreed that it was not in a position to provide detailed information. At present, in any consideration of prey survey design, the information contained in Table 3 of Annex 4 should be assumed to be constant over the spatial and temporal scales identified in paragraph 101 above. As more detailed information for predators becomes available, WG-CEMP will recommend changes, if any, which might be appropriate for both prey survey design and subsequent data analysis.

Other Species

105. The Working Group noted the importance of prey distribution and abundance in any consideration of prey-switching by predators. In this connection, it was agreed that further directed research in particular on *P. antarcticum* and *Euphausia crystallorophias* as prey items should be encouraged.

106. With respect to *P. antarcticum*, WG-CEMP supported the Working Group on Fish Stock Assessment (WG-FSA) in calling for the reporting of fine-scale data on this species and especially improvement of catch locality information (SC-CAMLR-VIII, Annex 6, paragraph 144).

107. Prof. Lubimova reported that the USSR has provided two years of catch data on *P. antarcticum* to CCAMLR. Papers are also being prepared by Soviet scientists on the population structure of the species and maturity stage development in the Sodruzhestva, Davis and Mawson Seas and at Prydz Bay.

ENVIRONMENTAL MONITORING

108. Environmental features identified as having both indirect (through effects on prey) and direct (through effects on predators) importance to the CEMP program were considered.

109. The Working Group agreed with WG-Krill (Annex 4, Table 5) in its assessment of the most important environmental parameters (i.e. water movements, physical/chemical properties of water and sea-ice) to be monitored when considering prey surveys. The Working Group encouraged the collection of these types of environmental data by Members.

110. The Working Group also noted that WG-Krill considered data on large-scale hydrographic processes to be information needed for understanding krill distribution, and supported the approaches recommended by WG-Krill (Annex 4, paragraphs 107 to 110 and 129).

111. Prof. Lubimova informed the Working Group that Soviet surveys conducted around the Antarctic continent in 1989/90, examining large-scale oceanographic processes, had collected information on the distribution of seals and birds especially in relation to the distribution of drifting sea-ice and local polynya formation.

112. Dr R. Holt (USA) informed the Working Group of US intentions to analyse in detail temperature, chlorophyll, cloud cover and ice conditions obtained from recent satellite imagery from the Antarctic Peninsula Integrated Study Region. He agreed to report on progress with this analysis at the next meeting of the Working Group.

Standard Methods

113. Three papers concerning the monitoring of environmental parameters of direct importance to predator monitoring (identified in SC-CAMLR-VIII, Annex 7, Table 6) were

discussed. The papers addressed draft standard methods for monitoring environmental parameters (Methods F1 to F4) (WG-CEMP-90/5), sea-ice observations (WG-CEMP-90/10) and meteorological observations (WG-CEMP-90/19) at CEMP sites.

114. Some revisions were made to the data collection section of the draft standard methods document (WG-CEMP-90/5) but it was decided that no detailed recommendations concerning analysis and reporting of environment data would be formulated until the Working Group has had the opportunity to examine actual data from CEMP sites.

115. It was agreed that, at this stage in the development of the program, Members be requested to collect the data specified in Methods F1, F3 and F4. These data should be held at national data centres. Investigators should note the occurrence of sudden, abrupt changes in environmental conditions of potential importance to predators on the appropriate data submission forms for predator parameters.

116. It was noted that there may be existing meteorological stations in the vicinity of CEMP sites already collecting the data specified in Method F3. In these cases, it would be sensible to leave it to the local investigators to judge whether or not the information being gathered at such stations was adequate for CEMP purposes.

117. A specific analysis of sample sizes required for recording meteorological data (Method F3) (WG-CEMP-90/19) was discussed in some detail. Investigators were encouraged to consider the implications of this paper when developing sampling regimes.

118. The Secretariat was asked to investigate procedures for acquiring and archiving summary data on sea-ice distribution (Method F2) available from organisations which process and supply satellite imagery. The Working Group also asked the Secretariat to prepare a paper on the information and analysis techniques available for these data that would be of use in the routine monitoring of sea-ice distribution for CEMP.

119. The Working Group noted the importance of obtaining data on sea-ice and sea-surface conditions from survey vessels to complement satellite data. Information from vessels would also provide valuable 'ground truth' information for data derived from satellite imagery.

120. As amended, the Standard Methods for Monitoring Environmental Parameters were adopted. Because the methods specified in F1 to F4 have not yet been developed to the same

degree of detail as the predator methods, it was agreed that for the present time they would be appended to the 'Standard Methods for Monitoring Parameters of Predatory Species' as 'Standard Approaches for Monitoring Environmental Parameters'.

REVIEW OF SUBMITTED DATA

121. The Working Group noted that four types of information are currently being reported to CCAMLR relevant to CEMP:

- (i) brief references to CEMP work in 'Reports of Members' Activities' in the Convention Area;
- (ii) identification of future CEMP activities in reports of Members' research plans;
- (iii) summary tables listing CEMP activities (i.e. Tables 3, 7 and 8 of SC-CAMLR-VIII, Annex 7); and
- (iv) summaries of CEMP predator data to be submitted in the formats agreed by WG-CEMP.

122. It was agreed that the information contained in the summary Tables 3, 7 and 8 (SC-CAMLR-VIII, Annex 7) should be updated each year as part of the Reports of Members' Activities to CCAMLR. Since this same information will be of value to WG-CEMP at future meetings it was agreed that a request for updated versions of Tables 3, 7 and 8 would also be made at the time that the WG-CEMP Provisional Agenda was circulated.

123. It was noted that Table 7 of SC-CAMLR-VIII, Annex 7 had been updated during the intersessional period and presented in the Secretariat's paper WG-CEMP-90/6 as Table 3. The Working Group examined Table 3 for each parameter, noting that data from Argentina, Brazil (WG-CEMP-90/26), Chile, UK and USA were available for some predator parameters and would be submitted to the CCAMLR Data Centre by the 30 September 1990 deadline. Additional data were expected to be submitted after the deadline of 30 September.

124. The Working Group noted that since data access protocols and reporting formats had been agreed (SC-CAMLR-VIII, paragraph 5.11), both recent and historic data on predator parameters should be submitted to the CCAMLR Data Centre. The Working Group noted that the decision taken by the Scientific Committee concerning the submission of CEMP data

placed an obligation on Members of CCAMLR under Article IX of the Convention to meet these commitments according to agreed formats and schedules.

125. Members agreed that it would be desirable in maintaining the efficient conduct of the program for the Working Group to have the opportunity to review the data submitted for the most recent Antarctic season. Some Members suggested that, in order to meet this requirement, the deadline for the submission of CEMP data should be brought forward from 30 September to 30 June.

126. It was agreed, however, that because some Members had not felt in a position to recommend a change in the deadline until they had had a chance to consult with their colleagues involved in their national programs, input from the appropriate investigators should be sought prior to the Ninth Meeting of the Scientific Committee so that their comments could be considered before a decision is taken.

ESTIMATES OF PREY REQUIREMENTS FOR KRILL PREDATORS

Review of Current Information

127. Analyses of fine-scale catch data for Subareas 48.1, 48.2 and 48.3 indicated that a substantial proportion of krill harvesting had occurred within the foraging ranges of breeding predators being monitored by CEMP (SC-CAMLR-VIII, paragraph 5.24). The WG-CEMP (SC-CAMLR-VIII, Annex 7, paragraphs 91 and 92), Scientific Committee (SC-CAMLR-VIII, paragraphs 5.26 and 5.27) and Commission (CCAMLR-VIII, paragraph 59) asked Members to synthesise data on predator population size, diet and energy budgets in order to provide estimates of krill requirements of predators in Integrated Study Regions.

128. The Scientific Committee requested that advice be obtained from relevant specialists on the best way to proceed towards this goal. The SCAR Bird Biology Subcommittee and the SCAR Group of Specialists on Seals (WG-CEMP-90/32 and WG-CEMP-90/27, respectively) provided advice to WG-CEMP. The advice from the former group can be summarised as follows:

- (i) the task of estimating prey consumption is complex but uncertainties in predator data are not necessarily greater than those associated with other important parameters such as prey abundance. Therefore, the apparent complexity should

not prevent the Working Group from moving forward on the more tractable aspects of the problem;

- (ii) the most effective approach will be to limit the scope of the early analyses to the best studied parts of Integrated Study Regions (ISRs), to the foraging ranges of breeding predators, and to the predators for which the greatest amount of relevant information is available (penguins and fur seals). Subsequent analyses can be extended to complete ISRs and to a large suite of species. Members should be encouraged to synthesise information on the distribution and abundance of seabirds in the ISRs in preparation for these steps; and
- (iii) in order to evaluate potentially suitable models and to define appropriate parameter values CCAMLR should convene a workshop.

129. The SCAR Group of Specialists on Seals offered the following advice to the Working Group:

- (i) studies should focus on Antarctic fur seals, crabeater seals, and perhaps leopard seals, at Prydz Bay, the Antarctic Peninsula, and South Georgia; and
- (ii) many crucial parameters have not been estimated for the ice seals. Therefore, the Working Group should consider beginning with models that incorporate values known for northern phocids. These models will help to identify important gaps in the data. Information on fur seal females will be easier to include in models because more is known about their energetics and activity budgets.

130. Dr Croxall summarised WG-CEMP-90/31, describing a model used by the UK to estimate food consumption of predators in the South Georgia Integrated Study Region. The model includes improvements over previous versions (used to produce the papers tabled as SC-CAMLR-VIII/BG/12 and BG/15), in the form of improved diet data, and in allowing for within-season fluctuations in energy content of prey, in diet composition, and in body weight of predators. The model is in the form of a general program that accepts inputs of parameters for a variety of predator and prey populations. It was also noted that the prey portion of the model, though currently being run with a suite of prey species, could be used to identify predators' consumption of various sex and age components of the krill population.

131. Another model, for energy and prey requirements of breeding Adélie, chinstrap, and gentoo penguins, and Antarctic fur seal females breeding in the Antarctic Peninsula Integrated Study Region was tabled by the US Delegation (WG-CEMP-90/30 Rev. 1). This model incorporated recent empirical estimates of energetic parameters and some allowances for weight fluctuations in a similar fashion to the model in WG-CEMP-90/31. The results of calculations using this model estimated that these predators consume 345 000 metric tonnes of krill from 1 December to 30 March. Recent commercial harvests for Subarea 48.1 have been equal to approximately 15% of this estimated prey requirement.

132. WG-CEMP agreed that these models represented substantial steps towards estimating krill consumption of penguins and fur seals during their breeding seasons within the Integrated Study Regions. Such models were seen as valuable tools for identifying data needs and planning research.

Action Needed for Further Progress

133. The Working Group noted the concern expressed by Prof. Lubimova that every effort be made to use inputs for such models that are appropriate for the particular Integrated Study Region considered. It was acknowledged that as new empirical parameter estimates become available, the models can be made more precise for specific areas.

134. The Working Group discussed the importance of broad-scale krill movements, residence times, and swarm structure in providing estimates of krill availability to relate to the models described above. It was agreed, however, that details of krill distribution and abundance would remain within the purview of WG-Krill until such time as better information becomes available.

135. The Working Group noted that the estimation of prey consumption in the Integrated Study Regions would form an important contribution to addressing the question posed by WG-Krill (Annex 4, paragraph 61), concerning 'levels of krill escapement sufficient to meet the reasonable requirement of krill predators' (see also paragraph 95 above).

136. WG-CEMP agreed to establish a subgroup under the coordination of Dr Croxall to correspond during the intersessional period with the aim of:

- (i) formulating a more detailed outline of the precise models and data sets to be investigated during a workshop along the lines of that indicated in paragraph 128;
- (ii) determining the necessary preparatory work required in advance of such a workshop; and
- (iii) identifying suitable places and times for a workshop.

137. In the meantime, Members working in each Integrated Study Region who possess data relevant to the models presented are encouraged to collaborate in making these available to CCAMLR and in planning research designed to provide additional priority data.

GENERAL MATTERS

Interdependence Between Predator and Prey Monitoring

138. In 1988 the Scientific Committee requested Members to consider four questions pertaining to the analysis of interdependence between sampling methods and results of monitoring activities (SC-CAMLR-VII, paragraph 5.43). Responses to these questions were not received in 1989 (SC-CAMLR-VIII, paragraph 5.32), and Members were encouraged to reconsider these questions (SC-CAMLR-VIII, Annex 7, paragraph 67; SC-CAMLR-VIII, paragraph 5.33) so that these issues could be addressed at the 1990 Meeting of WG-CEMP.

139. (a) The origin of the four questions referred to above is in SC-CAMLR-VII, paragraph 5.22, subparagraphs (iii) and (iv) where two broad topics of relevance to CEMP were addressed, viz:
- (iii) the power to detect inter-dependencies, which might be time and space varying and non-linear (e.g. how does the trade-off between the number of penguin colonies sampled, and the intensity of sampling at each, change the ability to use inter-annual variability of krill to distinguish possible relationships between breeding success and krill abundance?); and

- (iv) the potential adequacy of the data and estimates to meet the requirements of CCAMLR in distinguishing between natural variations in prey abundance and those induced by fishing activity.
- (b) The second of these topics was extensively addressed by WG-CEMP at its 1990 Meeting under Agenda Item 4 (Relevance of CEMP to the work of the Commission).

140. The first question noted above (paragraph 139(a) (iii)) was further elaborated in SC-CAMLR-VII, paragraph 5.43 where Members were requested to:

- (i) identify precise questions relating to analyses of these types of inter-dependent relationships;
- (ii) suggest appropriate analyses for investigating these relationships;
- (iii) indicate which data are needed adequately to conduct such analyses; and
- (iv) indicate the extent to which such data are currently available.

141. Some progress has been made in addressing these questions (paragraphs 139(a) (iii) and 140) in relation to sampling intensity and design, and results have been incorporated in the advice on data collection and analysis in the Standard Methods document. In respect of the ability to use interannual variability of krill to examine relationships between monitored predator parameters and krill availability, WG-CEMP reiterated its comments (SC-CAMLR-VIII, paragraph 5.30(b)) that these are complex issues, which are currently under study.

Approaches to Integrated Analyses of Predator/Prey/Environmental Data

142. The Working Group noted that progress in identifying appropriate techniques for integrated analyses of predators, prey, and environmental conditions has been limited and the use of models might be helpful in this regard. Indeed, the models discussed under Agenda Item 9 (Estimates of Prey Requirements for Krill Predators) demonstrate this point. Thus, the difficulties in answering the questions discussed in the previous paragraphs does not imply that it will not be possible to progress with integrated analyses prior to completing empirical

studies of important ecological relationships. Furthermore, models could be used to make designs of those studies more efficient and to identify data needs.

143. It was felt that efforts to integrate predator, prey and environmental data should focus on matters of priority concern to CEMP (e.g. in terms of species, parameters and areas) and not attempt to explain how Antarctic ecosystems function.

144. The Working Group discussed the possible application of Geographic Information Systems (GIS) in comparing data from different national programs and examining relationships among CEMP parameters. The Working Group accepted an offer from Dr Holt to examine the potential utility of such a system, possible arrangements for its use by CCAMLR or individual Members and the costs involved, and report to the next meeting.

DESIGNATION AND PROTECTION OF SITES

145. At its Seventh Meeting, the Scientific Committee developed detailed guidelines in respect of registration and protection (including management plans) of approved CEMP land-based monitoring sites (SC-CAMLR-VII, paragraphs 5.17 to 5.20).

146. The Commission has not yet decided how it wishes to implement the formal designation and protection of land-based CEMP monitoring sites.

147. WG-CEMP agreed that it should confine its discussion to a review of the tabled proposals for the designation of CEMP monitoring sites in order to determine whether they conformed to the guidelines approved by the Scientific Committee.

Magnetic Island (Prydz Bay Integrated Study Region)

148. Subject to a number of suggested minor modifications, this proposal, by Australia, was agreed to conform to the guidelines (WG-CEMP-90/23).

Cape Shirreff, Livingston Island (Antarctic Peninsula Integrated Study Region)

149. Subject to minor changes, this proposal, by Chile and USA, was agreed to conform to the guidelines (WG-CEMP-90/29).

Seal Islands, Elephant Island (Antarctic Peninsula Integrated Study Region)

150. Subject to two minor changes, improving the delineation of the area under designation, it was agreed that this proposal, by the USA, conformed to the guidelines (WG-CEMP-90/28).

151. As a general rule, and in the specific cases of the three proposals above, WG-CEMP reiterated the general understanding of the Scientific Committee (SC-CAMLR-VII, paragraph 5.20(v)) that, at present, the duration of monitoring studies conducted according to CEMP methods should be regarded as indefinite and that the full proposal (including management plan) should be reviewed and resubmitted for approval at five-year intervals from the date of its entry into force.

152. The Working Group recommended that the corrected versions of the three site designation proposals above be submitted to the Secretariat by 30 September 1990.

153. The Working Group was pleased to note the progress in designation of CEMP sites and development of management plans and encouraged the prompt submission of similar proposals for the other approved CEMP monitoring sites.

AWARENESS OF CEMP

154. The Ecosystem Monitoring Program is an important initiative of CCAMLR in implementing the ecosystems approach implicit in Article II of the Convention. In recognition of this, the Working Group last year began discussion on the need to promote awareness of CEMP among CCAMLR Members and in the scientific community generally. The Scientific Committee, at its 1989 Meeting, carried the discussion further and, taking up a suggestion of WG-CEMP, asked the Secretariat to prepare a brief article describing the aims and principles adopted in the development of CEMP (SC-CAMLR-VIII, paragraph 5.38).

155. The Secretariat prepared a draft text for an information brochure suitable for general distribution and submitted it for consideration to WG-CEMP (WG-CEMP-90/20). It was agreed that, with some minor editing, the draft text contained an informative, accurate description of the program at the required level of detail. It was recommended that the amended text be submitted to the Ninth Meeting of the Scientific Committee with a recommendation that it form the basis of an information brochure to be published in the four languages of the Commission. Participants at the Working Group were invited to make

available photographs that might help the Secretariat to make the brochure colourful and interesting. It was emphasised that the brochure should be made available to all Members and be distributed widely.

156. The attention of the Working Group was drawn to the Antarctic Science Conference, to be held in Bremen in September 1991. The Conference is being convened to commemorate the 30th anniversary of the coming into force of the Antarctic Treaty. The Working Group suggested that CCAMLR, as an important element of the Antarctic Treaty System, should be represented and should take advantage of the Conference to increase awareness of its scientific activities. The Working Group recommended that the Scientific Committee consider the possibility of including a CCAMLR poster in the Poster Session of the Conference. It was suggested that the proposed brochure on CEMP would be a useful means of providing background information on CCAMLR at meetings such as this Conference.

FUTURE WORK OF WG-CEMP

157. The Working Group reviewed progress made at the meeting and felt that there were a number of issues that would benefit from further consideration during the next year and agreed that an intersessional meeting in 1991 would be desirable.

OTHER BUSINESS

158. The Working Group discussed the current status of the proposed Workshop on the Feeding Ecology of Southern Baleen Whales (SC-CAMLR-VIII, paragraph 5.36). The Workshop was originally planned to have been held in 1988/89, with funds being provided by CCAMLR and the IWC, assisted by a special grant from the USA. At the request of the IWC, the Workshop was postponed. WG-CEMP agreed that the Workshop is still of potential value in the development of CEMP, but before making any recommendation on its future, the Working Group asked the Executive Secretary to write to the Secretary of the IWC, to enquire about the current status of the proposed Workshop within the activities of the IWC.

159. The Working Group noted that, throughout its discussions, many references had been made to work being undertaken by scientists from Member countries of CCAMLR who were not represented at the meeting. It was agreed that the future development of CEMP would benefit from the widest possible range of expertise. The Working Group asked the Scientific

Committee and the Commission to encourage more Member countries to have their scientists involved in the work of WG-CEMP.

160. Dr Vergani informed the Working Group of the recent recommendations of the SCAR Group of Specialists on Seals regarding declining populations of southern elephant seals in some sectors of the Antarctic. SCAR has proposed that, in order to consider adequately these population trends and to respond effectively to questions asked by the Scientific Committee (SC-CAMLR-VIII, paragraph 6.6), it would be helpful to convene a workshop to address this issue. The Working Group noted that this matter was of interest to CEMP and endorsed the proposal for a workshop. It further noted that this topic would be discussed under the 'Marine Mammal and Bird Populations' agenda item at the forthcoming meeting of the Scientific Committee.

ADOPTION OF THE REPORT

161. The report of the meeting was adopted.

CLOSE OF THE MEETING

162. The Convener thanked the participants for their assistance in making good progress at this meeting. He thanked the rapporteurs and the CCAMLR Secretariat and finally expressed his thanks on behalf on the Working Group to the Polar Research Secretariat, the Royal Academy of Sciences and the Museum of Natural History, not only for providing the facilities for the meeting but for the excellent support and assistance provided by their staff.

Table 1: Summary of Members' CEMP activities on monitoring approved predator parameters.

Method Sheet Number	Parameter	Species:					Country	Site name/ Integrated Study Region/ Network Site	Site Location	Year Started	1989/90* Data Submission
		A-Adélie penguin M-Macaroni penguin C-Chinstrap penguin B-Black-browed albatross F-Fur seal									
		A	M	C	B	F					
-1-	-2-	-3-	-4-	-5-	-6-	-7-	-8-	-9-	-10-	-11-	-12-
Penguins											
A1	Weight on arrival at breeding colonies	X					Australia	Magnetic Is Davis Station/ Prydz Bay	68°33'S 77°54'E	1983/84	Being prepared
		X					Argentina	King George Is Stranger Point/ S. Shetland Is	62°14'S 58°30'W	1987/88	Being prepared
		X					Argentina	Laurie Is Mossman Peninsula/ S. Orkney Is	60°45'S 44°44'W	1987/88	Being prepared
			X				Argentina	Esperanza Station/ Ant. Peninsula	63°24'S 57°00'W	1990/91	
				X			UK	Bird Is/ South Georgia	52°00'S 38°02'W	1988/89	Submitted
A2	Length of the first incubation shift	X					Australia	Magnetic Is Davis Station/ Prydz Bay	68°33'S 77°54'E	1983/84	Submitted
		X					Argentina	King George Is Stranger Point S. Shetland Is	62°14'S 58°30'W	1987/88	Being prepared
							Argentina	Esperanza Station/ Ant. Peninsula	63°24'S 57°00'W	1990/91	
A3	Annual trends in breeding population size	X					Australia	Magnetic Is Davis Station/ Prydz Bay	68°33'S 77°54'E	1983/84	Being prepared
		X					Argentina	King George Is Stranger Point/ S. Shetland Is	62°14'S 58°30'W	1987/88	Being prepared
				X	X		Brazil	Elephant Is S. Shetland Is/ Ant. Peninsula	61°04'S 55°21'W	1986	No inf. available
			X		X		Chile	Ardley Is S. Shetland Is/ Ant. Peninsula	62°11'8"S 58°55'W	1982	Being prepared
			X				Japan	Syowa Station/ Network site	69°00'S 39°30'E	1970	No inf. available
				X			UK	Bird Is/ South Georgia	52°00'S 38°02'W	1975/76	Submitted
			X		X		UK	Signy Is/ Network site	60°43'S 45°38'W	1978/79	Submitted
				X	X		USA	Seal Is S. Shetland Is/ Ant. Peninsula	60°59.5'S 55°24.5'W	1987/88	No inf. available
A4	Demography	X					USA	Anvers Is. Palmer Station/ Ant. Peninsula	64°06'S 64°03'W	1987/88	No inf. available
					X		CHILE	Ardley Is S. Shetland Is/ Ant. Peninsula	62°11'8"S 58°55'W	1982	Being prepared
				X	X		Brazil	Elephant Is S. Shetland Is/ Ant. Peninsula	61°04'S 55°21'W	1986	No inf. available
				X	X		USA	Seal Is S. Shetland Is/ Ant. Peninsula	60°59.5'S 55°24.5'W	1987/88	No inf. available
		X					USA	Anvers Is Palmer Station/ Ant. Peninsula	64°06'S 64°03'W	1987/88	No inf. available
A5	Duration of foraging trips	X					Australia	Magnetic Is Davis Station/ Prydz Bay	68°33'S 77°54'E	1983/84	Being prepared
					X		USA	Seal Is S. Shetland Is/ Ant. Peninsula	60°59.5'S 55°24.5'W	1987/88	Submitted

Table 1 (continued)

-1-	-2-	-3-	-4-	-5-	-6-	-7-	-8-	-9-	-10-	-11-	-12-		
A6	Breeding success	X					Australia	Magnetic Is Davis Station/ Prydz Bay	68°33'S 77°54'E	1983/84	Being prepared		
		X					Argentina	King George Is Stranger Point/ S. Shetland Is	62°14'S 58°30'W	1987/88	Being prepared		
			X	X			Brazil	Elephant Is S. Shetland Is/ Ant. Peninsula	61°04'S 55°21'W	1986	Submitted		
					X		Chile	Ardley Is S. Shetland Is/ Ant. Peninsula	62°11'8"S 58°55'W	1982	Being prepared		
				X			uk	Bird Is/ South Georgia	52°00'S 38°02'W	1975/76	Submitted		
			X		X		uk	Signy Is/ Network site	60°43'S 45°38'W	1978/79	Submitted		
				X	X		usa	Seal Is S. Shetland Is/ Ant. Peninsula	60°59.5'S 55°24.5'W	1987/88	Submitted		
			X				usa	Anvers Is Palmer Station/ Ant. Peninsula	64°06'S 64°03'W	1987/88	Being prepared		
		A7	Fledging weight	X					Australia	Magnetic Is Davis Station/ Prydz Bay	68°33'S 77°54'E	1983/84	Being prepared
				X					Argentina	King George Is Stranger Point/ S. Shetland Is	62°14'S 58°30'W	1987/88	Being prepared
X							Argentina	Laurie Is Mossman Peninsula/ S. Orkney Is	60°45'S 44°44'W	1987/88	Being prepared		
					X	X	Argentina	Esperanza Station/ Ant. Peninsula	63°24'S 57°00'W	1990/91			
				X			Brazil	Elephant Is S. Shetland Is/ Ant. Peninsula	61°04'S 55°21'W	1986	Submitted		
					X		uk	Bird Is/ South Georgia	52°00'S 38°02'W	1988/89	Submitted		
						X	usa	Seal Is S. Shetland Is/ Ant. Peninsula	60°59.5'S 55°24.5'W	1987/88	Submitted		
	X						usa	Anvers Is Palmer Station/ Ant. Peninsula	64°06'S 64°03'W	1987/88	Being prepared		
A8	Chick diet			X					Australia	Magnetic Is Davis Station/ Prydz Bay	68°33'S 77°54'E	1983/84	Being prepared
				X					Argentina	King George Is Stranger Point/ S. Shetland Is	62°14'S 58°30'W	1987/88	Being prepared
		X					Argentina	Laurie Is Mossman Peninsula/ S. Orkney Is	60°45'S 44°44'W	1987/88	Being prepared		
					X	X	Argentina	Esperanza Station/ Ant. Peninsula	63°24'S 57°00'W	1987/88	Being prepared		
				X			Brazil	Elephant Is S. Shetland Is/ Ant. Peninsula	61°04'S 55°21'W	1986	Submitted		
						X	Chile	Ardley Is S. Shetland Is/ Ant. Peninsula	62°11'8"S 58°55'W	1982	No inf. available		
					X		UK	Bird Is/ South Georgia	52°00'S 38°02'W	1985/86	Submitted		
						X	USA	Seal Is S. Shetland Is/ Ant. Peninsula	60°59.5'S 55°24.5'W	1987/88	Submitted		
			X				USA	Anvers Is Palmer Station/ Ant. Peninsula	64°06'S 64°03'W	1987/88	Being prepared		
		A9	Breeding chronology	X					Australia	Magnetic Is Davis Station/ Prydz Bay	68°33'S 77°54'E	1983/84	No inf. available
X							Argentina	Laurie Is Mossman Peninsula/ S. Orkney Is	60°45'S 44°44'W	1987/88	Being prepared		
	X						UK	Bird Is/ S.Georgia	52°00'S 38°02'W	1978/79	Being prepared		

Table 1 (continued)

-1-	-2-	-3-	-4-	-5-	-6-	-7-	-8-	-9-	-10-	-11-	-12-
A9 (cont.)				X			USA	Seal Is S. Shetland Is/ Ant. Peninsula	60°59.5'S 55°24.5'W	1987/88	Submitted
Flying Birds											
B.1	Breeding population size				X		UK	Bird Is/ South Georgia	52°00'S 38°02'W	1976/77	Being prepared
B.2	Breeding success				X		UK	Bird Is/ South Georgia	52°00'S 38°02'W	1976/77	Being prepared
B.3	Age-specific annual survival and recruitment				X		UK	Bird Is/ South Georgia	52°00'S 38°02'W	1976/77	Being prepared
Seals											
C1.0	Pup Growth					X	Chile	Cape Shirreff/ Ant. Peninsula	62°28'S 60°47'W	1984/85	No inf. available
						X	UK	Bird Is/ South Georgia	52°00'S 38°02'W	1972/73 1977/78	No inf. available
						X	USA	Seal Is S. Shetland Is/ Ant. Peninsula	60°59.5'S 55°24.5'W	1987/88	Submitted
C2.0	Cow foraging/ attendance cycles					X	Chile	Cape Shirreff/ Ant. Peninsula	62°27'S 60°47'W	1987/88	No inf. available
						X	UK	Bird Is/ South Georgia	52°00'S 38°02'W	1978/79	
						X	USA	Seal Is S. Shetland Is/ Ant. Peninsula	60°59.5'S 55°24.5'W	1987/88	Submitted

* "submitted" - data were available at the Meeting of the WG-CEMP or confirmed to be submitted to the Secretariat before 30 September 1990.

Table 2: Summary of Members' directed programs on assessing the utility of potential predator parameters.

Parameter	Areas ^(a) from which data are available for analysis/evaluation	Members' Research Activity					
		Undertaken 1988/89		Undertaken 1989/90		Proposed for 1990/91	
		Analysis of existing data	Acquisition of new data	Analysis of existing data	Acquisition of new data	Analysis of existing data	Acquisition of new data
-1-	-2-	-3-	-4-	-5-	-6-	-7-	-8-
Penguins^(b)							
- Macaroni incubation shift	4,5,11,14	UK (11)	Brazil (2)	Brazil (2)	Brazil (2)	S.Africa (14,M)	S.Africa (14,M)
- Macaroni weight prior to moult	2,15,14,4,5?	Brazil (2)	Brazil (2)	Brazil (2)	Brazil (2)	S.Africa (14,M)	S.Africa (14,M)
- At-sea diving behaviour and activity patterns (a,c,m)	2,4,6	Australia (6,A) USA (2,C,M)	Australia (6,A) UK (4,M) USA (2,C,M)	Australia (6,A) UK (4,M) USA (2,C,M)	Australia (6,A) USA (2,C,M)	Australia (6,A) USA (2,C,M)	UK (4,M) USA (2,C,M)
- Weight recovery during incubation (a,c,m)	4,6	Australia (6,A)	Australia (6,A)	Australia (6,A)	Australia (6,A)	Australia (6,A)	
- Survival (a,c,m)	1,2,6,11	Australia (6,A) Brazil (2) Chile (12) UK (4,M)	Australia (6,A) Brazil (2) Chile (12) UK (4,M) USA (2,C;11,A)	Australia (6,A) UK (4,M) USA (2,C;11,A)	Australia (6,A) UK (4,M) USA (2,C;11,A)	UK (4,M) USA (2,C;11,A)	UK (4,M) USA (2,C;11,A)
- Chick growth rate	2,11	USA(2,C;11,A)	USA (2,C;11,A)	UK (4,M) USA (2,C;11,A)	USA (2,C)		UK (4,M)
- Bioenergetics						USA (2,C,M)	USA (2,C,M)
Flighted seabirds							
Black-browed albatross							
- Breeding population size	4,9?,15	UK (4)	UK (4)		UK (4)		UK (4)
- Breeding success	4,9?,15		UK (4)		UK (4)		UK (4)
- Duration of foraging trips	4				UK (4)		
- Activity budget at sea	4		UK (4)		UK (4)		
- Prey characteristics/diet	4				UK (4)		

Table 2 (continued)

-1-	-2-	-3-	-4-	-5-	-6-	-7-	-8-
Flighted seabirds (continued)							
Antarctic/Cape petrel							
- Breeding success	3,6,8,11,2	UK (3,CP) Chile (11) Brazil (2)	Chile (11) Brazil (2)		UK (3,CP)		UK (3,CP)
- Chick weight at fledging	2,6,8,11	Brazil (2) Chile (11)	Brazil (2) Chile (11) USA (2)	Brazil (2) USA (2)	Brazil (2)	USA (2)	
- Prey characteristics/ diet	2,6,8,11	Australia (6) Brazil (2) Chile (11)	Australia (6) Brazil (2) Chile (11)	Brazil (2)	Brazil (2)		
Fur seals							
- Reproductive success	4,2		UK (4) USA (2)		UK (4) USA (2)		UK (4) USA (2)
- Prey characteristics/ diet	4,2		UK (4) USA (2)	USA (2)	UK (4) USA (2)	USA (2)	UK (4) USA (2)
- At-sea diving behaviour and activity pattern	2,4	USA (2)	UK (4) USA (2)	UK (4) USA (2)	UK (4) USA (2)	UK (4) USA (2)	UK (4) USA (2)
- Bioenergetics						USA (2)	USA (2)
- Indices of physiological condition	11	Chile (11)	Chile (11)		UK (4)		
- Fine structure of teeth	4		UK (4)	UK (4)	UK (4)		UK (4)
Crabeater seal							
- Reproductive rates	2,3,8,10-12		USA (11,12) Sweden (11,12)	USA (11,12)	USA (12)	USA (11,12)	
- Age at sexual maturity	2,3,8,10-12		USA (11,12) Sweden (11,12)	USA (10,11,12)	USA (12)	USA (11,12)	
- Cohort strength	2,3,8,10-12	USA (10,11,12)	USA (11,12) Sweden (11,12)	USA (10,11,12)	USA (12)	USA (11,12)	
- Indices of physiological condition	11,12		USA (11,12) Sweden (11,12)	USA (11,12)	USA (12)	USA (11,12)	
- Instantaneous growth rate	11,12				USA (12)		

Table 2 (continued)

-1-	-2-	-3-	-4-	-5-	-6-	-7-	-8-
Crabeater seal (continued)							
- Prey characteristics/ diet	11,12		USA (11, 12)	USA (11)	USA (11)	USA (11)	
- At-sea diving behaviour and activity pattern	11,12	USA (11,12)		USA (11,12)	USA (11,12)	USA (11,12)	
- Satellite telemetry			USA (11) Sweden (11)	USA (11,12)	USA (11,12)	USA (11,12)	
Minke whales							
- Reproductive rate	13,1	Japan	Japan				
- Age of sexual maturity	13,1						
- Cohort strength	13,1	Japan	Japan				
- Analyses of existing data:							
- stomach contents	13,1	Japan	Japan				
- blubber thickness	13,1	Japan	Japan				
- density/patchiness	13,1	Japan	Japan				
- school size	13,1	Japan	Japan				
- Feeding activity patterns	13,1	Japan	Japan				

(a) Areas:

- | | | | |
|----------------------|-------------------------|-------------------------|---|
| 1. Ross Sea | 5. Macquarie Island | 9. Crozet Island | 13. Mainly from the Indian Ocean (IWC Areas III and IV) |
| 2. South Shetland Is | 6. Davis Station | 10. Balleny Is | 14. Marion Is |
| 3. S. Orkney Is | 7. Syowa Station | 11. Antarctic Peninsula | 15. Kerguelen Is |
| 4. S. Georgia Is | 8. Dumont d'Urville Sea | 12. Weddell Sea | |

(b) Penguin species: A - Adélie, C - Chinstrap, M - Macaroni/Royal

(c) Petrel species: CP - Cape petrel, AP - Antarctic petrel

Table 3: Summary of Members' directed research on predator parameters required to provide essential background information needed to interpret changes in monitored predator parameters.

Research Topic	Countries Proposing Directed Research	
	Programs Currently Underway	Programs Proposed to Commence (season of initiation)
PENGUINS		
- Foraging areas	Chile, Japan USA, South Africa	Australia (1990/91)
- Energy requirements		UK (1990/91) USA (1990/91)
- Seasonal movements	South Africa	
- Relationships between monitored parameters and physical environment (e.g. distribution and structure of sea ice and frontal systems)	Chile UK (Frontal systems) USA South Africa (Frontal systems)	Australia (1990/91) UK (1992/93)
FUR SEALS		
- Local abundance/population structure	Argentina, Chile, UK, USA	Brazil Chile (1990/91)
- Energy requirements/life history	UK	Sweden (1990/91, with UK)
- Foraging areas	Chile, USA	UK (1992/93) Japan (1990/91, with USA)
- Relationships between monitored parameters and physical environment (e.g. distribution and structure of sea-ice and frontal systems)	Chile (partial), USA	
CRABEATER SEALS		
- Foraging areas	USA	Sweden (1990/91, with USA)
- Energy requirements/life history		Sweden (1990/91, with Australia)
- Stock discreteness/seasonal movements	USA	Sweden (1990/91, with USA)
- Relationships between monitored parameters and physical environment (e.g. distribution and structure of sea-ice and frontal systems)	USA	
MINKE WHALES		
- Survey abundance (IWC/IDCR ^a)		
- Relationships between monitored parameters and physical environment (e.g. distribution and structure of sea ice and frontal systems)		

^a International Whaling Commission/International Decade of Cetacean Research

AGENDA

Working Group for the
CCAMLR Ecosystem Monitoring Program
(Stockholm, Sweden, 6 to 13 September 1990)

1. Opening of the Meeting
2. Adoption of the Agenda
3. Review of Members' Activities
 - 3.1 Monitoring
 - 3.2 Directed Research
4. Relevance of CEMP to the Work of the Commission
5. Predator Monitoring
 - 5.1 Sites and Species
 - 5.2 Data Collection Methods
 - 5.2.1 Revised Methods Sheets
 - 5.2.2 New Information
 - 5.3 Processing/Analysis Methods
 - 5.4 Reporting Formats and Requirements
 - 5.5 Evaluation of Proposed Methods
6. Prey Monitoring
 - 6.1 Review of WG-Krill Report
 - 6.2 Other Species
7. Environmental Monitoring
 - 7.1 Methods at Land-Based Sites
 - 7.2 Remote Sensing
8. Review of Submitted Data
9. Estimates of Prey Requirements for Krill Predators
 - 9.1 Review of Current Information
 - 9.2 Action Needed for Further Progress

10. General Matters
 - 10.1 Interdependence Between Predator/Prey/Environmental Monitoring
 - 10.2 Approaches to Integrated Analyses of Predator/Prey/Environmental Data

11. Designation and Protection of Sites
 - 11.1 Review of Proposed Management Plans
 - 11.2 Other Actions Required

12. Awareness of CEMP

13. Future Work of WG-CEMP

14. Other Business

15. Adoption of the Report

16. Close of the Meeting.

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(Stockholm, Sweden, 6 to 13 September 1990)

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LIST OF DOCUMENTS

Working Group for the
CCAMLR Ecosystem Monitoring Program
(Stockholm, Sweden, 6 to 13 September 1990)

WG-CEMP-90/1	PROVISIONAL AGENDA
WG-CEMP-90/2	LIST OF PARTICIPANTS
WG-CEMP-90/3	LIST OF DOCUMENTS
WG-CEMP-90/4	AN APPROACH TO INTEGRATED ANALYSES OF PREDATOR/PREY/ENVIRONMENTAL DATA Stephanie N. Sexton and Jane E. Rosenberg (USA)
WG-CEMP-90/5	DRAFT STANDARD METHODS FOR MONITORING OF ENVIRONMENTAL PARAMETERS (METHODS F1 TO F4) Secretariat
WG-CEMP-90/6	DEVELOPMENT OF THE CCAMLR ECOSYSTEM MONITORING PROGRAM 1982 TO 1990 Secretariat
WG-CEMP-90/7	SEXING OF ADULT ADELIE PENGUINS BY DISCRIMINANT ANALYSIS OF MORPHOMETRIC MEASUREMENTS J.A. Scolaro <i>et al.</i> (Argentina)
WG-CEMP-90/7 DISCRIMINANT Rev. 1	SEXING OF ADULT ADELIE PENGUINS BY ANALYSIS OF MORPHOMETRIC MEASUREMENTS J.A. Scolaro <i>et al.</i> (Argentina)
WG-CEMP-90/8	RAW DATA AND DEVELOPMENT OF AN ANNUAL INDEX FOR PARAMETER A1, ADULT WEIGHT ON ARRIVAL AT BREEDING COLONY Z.B. Stanganelli <i>et al.</i> (Argentina)
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