ANNEX 7

REPORT OF THE WORKING GROUP FOR THE CCAMLR ECOSYSTEM MONITORING PROGRAM

(Mar del Plata, Argentina, 23 to 30 August 1989)

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The Fourth Meeting of the Working Group for the CCAMLR Ecosystem Monitoring Program (WG-CEMP) was held from 23–30 August in Mar del Plata, Argentina. Three previous meetings have taken place: Seattle in 1985; Hamburg in 1986; Dammarie-les-Lys in 1987. Reports of these meetings can be found in the relevant Reports of the Scientific Committee (SC-CAMLR-IV, V and VI, respectively).

2. The Convener of the WG-CEMP, Dr K. Kerry (Australia) thanked the Government of Argentina for inviting the Working Group to hold this meeting in Mar del Plata and expressed his gratitude to the Comisión de Investigaciones Científicas de la Provincia de Buenos Aires (CIC) for making the arrangements for the meeting. Dr Kerry then welcomed participants to the meeting. A list of participants is attached (Appendix 1).

3. The Convener described the work which had taken place since the last meeting. The following documents were prepared by the Convener and Secretariat and distributed to Members for comment:

- draft formats for reporting data on monitoring seabirds and seals (SC-CAMLR-VII, paragraph 5.10);

- draft formats for recording field data on monitoring seabirds and seals (SC-CAMLR-VII, paragraph 5.30);

- instructions for the preparation of sensitivity analyses (SC-CAMLR-VII, paragraph 5.31); and

- advice on guidelines for the submission, validation, storage, access and analyses of CEMP data.

The results of this work are incorporated in a series of documents presented at this meeting (WG-CEMP-89/12). A paper describing the objectives of CEMP as well as its development and implementation, was prepared by the Secretariat (WG-CEMP-89/5) for Working Group participants as well as other scientists involved in Antarctic research.

4. A provisional agenda and annotations to the provisional agenda for the meeting were circulated to participants in advance of the meeting (WG-CEMP-89/1 and 2). Several suggestions on the restructuring of the agenda were received; the agenda as finally adopted is attached as Appendix 2.

5. A list of the meeting documents is in Appendix 3.

6. The Report was prepared by Drs J. Bengtson (USA), J. Croxall (UK), I. Everson (UK) and E. Sabourenkov (Secretariat).

EVALUATION OF AGREED PREDATOR MONITORING PARAMETERS

Evaluation of Monitoring Sites

7. The lists of monitoring sites within the Integrated Study Regions (SC-CAMLR-VI, Annex 4, Tables 1 and 2) and in network areas were reviewed.

8. Dr Croxall introduced a document (WG-CEMP-89/24) from the SCAR Bird Biology Sub-Committee commenting on CEMP monitoring sites: matters raised therein are dealt with in paragraphs 9 to 15 below.

9. It was agreed to delete the entry for Adelie penguins at Elephant Island because only a few pairs nest there.

10. The suggestion to add Adelie penguins at Esperanza (Hope Bay) as a formal CEMP site was declined on the recommendation of E. Marschoff (Argentina). Since a major construction project (satellite antenna) was about to begin there, it would be inappropriate to add this site to CEMP at the present time. He indicated that research on Adelie penguins at Esperanza, which has been underway since 1985/86, will continue as part of the environmental assessment associated with the construction project. It was noted that both the construction project and the environmental assessment are being conducted jointly by Argentina and the Federal Republic of Germany.

11. For the Prydz Bay region, Magnetic Island in Princess Elizabeth Land was added as a CEMP site for Adelie penguin monitoring because it has been used since 1984 for monitoring some parameters now adopted by the CEMP.

12. References to Adelie penguin and Cape petrel monitoring activities at Pointe Geologie, Adelie Land, were deleted because the monitoring program at this site has stopped as a result of disturbance from construction activities.

13. The status of Budd Coast was changed from a selected to a suggested site for Adelie penguin monitoring.

14. The reference to monitoring of macaroni penguins at Marion and Crozet Islands was deleted because detailed dietary studies have shown that *Euphausia superba* does not form part of these species' diet there.

15. The Rauer Islands (near Davis Station) were added as suggested network monitoring sites for Cape petrels.

16. The suggestion to add monitoring of black-browed albatross at Kerguelen Island to the list was accepted, providing a review of diet data indicates that *E. superba* represents an important prey item for this species in that area. The Working Group agreed that the Convener should write to the Chairman of the SCAR Sub-Committee on Bird Biology to arrange such a review.

17. The changes listed in the preceding paragraphs are recorded in Tables 1 and 2.

18. Table 1 was modified further to include the following key predator species, for which standard methods for routine monitoring have not yet been developed: Cape petrel, Antarctic petrel and crabeater seal.

19. The Working Group reconfirmed that the sites listed in Tables 1 and 2, as amended, are desirable and appropriate for CEMP monitoring activities in the Integrated Study Regions and complementary network areas.

20. Land-based elements of CEMP depend on the long-term acquisition of annual data collected in standardised ways at sites where disturbance of the study species is minimal. Until the sites selected by CEMP for this work are accorded proper protection, there is a high risk of even accidental disturbance being sufficient to seriously affect the quality of the data being collected. This would compromise both the data obtained in any one year and the ability to make unbiased comparison between years.

21. Therefore, the Working Group again calls the attention of the Scientific Committee to the critical need to ensure that monitoring sites receive statutory conservation protection as a matter of priority (see also paragraph 110).

22. Recognising the importance of conducting monitoring studies in undisturbed areas, CEMP investigators are urged to follow research protocols that have been developed with the aim of minimising potential disturbance due to monitoring activities.

Evaluation of Methods

23. The standard methods for monitoring parameters of predatory species were reviewed in the light of Members' experiences in using the instructions, existing data from sensitivity analyses and results of sensitivity analyses conducted in response to the guidelines in WG-CEMP-89/13, (WG-CEMP-89/6, 89/7, 89/21). Argentina provided field data on floppy disk in MS-DOS as suggested in WG-CEMP-89/13. The Working Group agreed that it would be most valuable if these data could be analysed following the guidelines in WG-CEMP-89/13 and the results submitted to the Working Group's next meeting.

24. Based on Members' written comments and the Working Group's discussions, major revision and reorganisation was recommended for most standard methods. The nature of the more important changes is noted below in paragraphs 31 to 49. Because of the urgency of completing this task, it was agreed that a small drafting group (co-convened by Drs Bengtson and Croxall) should meet immediately before the meeting of the Scientific Committee to prepare revised draft methods for circulation to Members at the meeting of the Scientific Committee. The Co-Conveners were asked to consult in advance of this meeting with appropriate colleagues, especially members of the SCAR Group of Specialists on Seals and the Sub-Committee on Bird Biology, in order to clarify matters of detail.

25. It was agreed that each standard method should be presented in the same format. The following headings were suggested:

species
parameter
associated parameters
aim
data collection (separate sections for Methods A, B, etc.)
    mandatory data
    highly desirable data
    problems to be considered
    comments on the method
data processing and analysis
    analytical methods
    interpretation of results
    problems to be considered
data reporting
ancillary studies
references
background papers

26. It was suggested that it would be desirable to take into account the presence of predatory species preying on species being monitored. It was agreed that the presence of predators such as skuas, giant petrels, and leopard seals and their estimated impact on predators being monitored should be noted and reported where appropriate.

27. To facilitate comparison of data sets from various sites and years, it was agreed that the five-day sampling periods called for in several of the methods would be standardised. There are 73 five-day periods in each year, with the first of these beginning on 1 January. A schedule of the beginning dates for each of the standard five-day periods will be included in the Handbook of CEMP Standard Methods.

28. The various papers reporting results of sensitivity analyses also provide useful guidance on appropriate sample sizes. Because the variance of different parameters at different sites is unlikely to be identical, investigators should examine their own data to ensure that the recommended sample sizes are adequate at their site. A table (WG-CEMP-89/23) showing relationships between the coefficient of variation (standard error/mean), the statistical power ($1 - \beta$, where β is the probability of accepting a false null hypothesis), and the smallest difference between means to be detected, given a specific α level (where α is the probability of rejecting a true null hypothesis) is provided for general guidance. WG-CEMP-89/7 and especially WG-CEMP-89/6 treat this topic in further detail.

29. As an initial general guide, it was recommended that investigators attempt to design sampling at their sites to detect at least a 10% change in the measured parameter at a 90% confidence level (α and $\beta = 0.1$). These decisions reflected recognition of the difficulties of detecting change at the 95% level in biological monitoring data in general (WG-CEMP-89/8, 89/13). Specifying identical values for α and β reflects that, in a conservation context, a failure to detect a change that actually occurred (type II or β error) may be equally, or perhaps more, serious than detecting an apparent, but false, change (type I or α error).

30. It was noted that standard method sheets have not yet been developed for black-browed albatross breeding success and breeding population size, although there has been adequate evaluation of these parameters. Dr Croxall agreed to try to arrange the preparation of draft instructions as soon as possible.

Standard Method A1.1: Adult Penguin Weight on Arrival at Colony

31. Due to the different arrival schedules and sizes of male and female penguins, it is desirable for investigators to be able to determine accurately the sex of penguins being weighed. Measurements of bill dimensions are the most practical way to accomplish this. A discriminant function analysis of bill measurement data from studies such as those conducted by Drs D. Vergani and Z. Stanganelli (Argentina) and Dr W. Trivelpiece (USA) would be helpful in identifying which bill measurements are most useful in determining a bird's sex. Dr Vergani informed the Working Group that he intended to undertake such an analysis and report the results at the next meeting of the Scientific Committee.

32. Although a geographical cline in penguin morphometrics may cause different results for discriminant function analyses of bill measurements among different areas, such analyses can provide a general guideline for the present time. Investigators should be encouraged to conduct the appropriate bill measurements and analyses for birds at their sites.

33. It was agreed that a set of instructions for determining a penguin's sex by bill measurements should be developed and included as an appendix to the Handbook of CEMP Standard Methods. These instructions should include a diagram of the specific locations on the bill where measurements should be taken.

34. The question of whether sampling weights need to be taken during several five-day periods or whether instantaneous samples taken during the time of peak arrival would suffice, was discussed. The nature of inter-relationships between sex, age, arrival data and arrival

weight are uncertain at present and need investigating in future analyses. For now, it is preferable to collect data over several five-day periods. Where birds are sexed, however, it may be sufficient to weigh a larger sample of birds on one or more days. In either case, data on the timing of arrival of the study population (in relation to the first or mean laying date) are highly desirable and a suggested method for monitoring this will be prepared.

Standard Method A2.1: Length of Penguin First Incubation Shift

35. The importance of making a distinction between successful and unsuccessful shift reliefs was emphasised. In addition, the departure and arrival dates for each adult should be determined and recorded separately.

Standard Method A3.1: Annual Trend in Size of Penguin Breeding Population

36. To improve accuracy and to make counting easier, the priority with this parameter should be on breeding groups that are discrete so that the whole group can be counted. For very large colonies, transect counts may be useful to sub-sample the area and the Working Group solicited information on appropriate methods.

37. For areas where there is reliable access to suitable aircraft, the ability to distinguish between breeding and non-breeding birds, and the opportunity to conduct appropriate ground-truth counts, aerial surveys may prove valuable. Members considering such surveys should consult BIOMASS Handbook No. 20 (1982) and are encouraged to develop a draft aerial survey protocol and to submit the proposal to the Working Group for consideration and possible adoption as an addition to this standard method.

38. Because a standard CEMP data collection and reporting format has been adopted, the ISAS Census Card and instructions were deleted from the revised standard method.

Standard Method A4.1: Age-Specific Annual Survival and Recruitment in Penguins

39. The Working Group agreed to change the title of this parameter from ‘Demography’ to ‘Age-Specific Annual Survival and Recruitment’. Because of the complexity and large number of approaches to the analysis of demographic data, it was agreed that standard data

processing, analysis, or reporting protocols would not be developed at this time. Members are requested to inform the Working Group of the recording and analytical protocols currently in use in their programs. These reports will be reviewed by the Working Group and may be used to help develop standard protocols for CEMP at a later date.

Standard Method A5.1: Duration of Penguin Foraging Trips

40. The factors affecting this parameter with penguins are more complex than for the same parameter for fur seals (see paragraph 49). Aspects such as whether there are one or two chicks being fed, whether one or both adults are feeding the chick, and whether attachment of a radio transmitter affects the behaviour of the bird need to be considered. Investigators should note and record the number and fate of chicks as well as the sex and identity of the parents at nests being monitored.

41. Although the general feeling among investigators at present is that models of small transmitters currently being used do not alter substantially penguin behaviour, Members are encouraged to conduct comparative studies of birds with and without instruments. If transmitters have no significant adverse effect on birds' behaviour, it would be desirable to deploy transmitters on both mates at each nest.

Standard Method A6.1: Penguin Breeding Success

42. The results of the sensitivity analyses conducted for this parameter, as well as Members' experiences in the field, indicated a need to revise instructions for this method. The revised data collection protocol for Method A is intended to be clearer, with an emphasis in Method B on identifying the chronology of breeding events within a season.

Standard Method A7.1: Penguin Chick Weight at Fledging

43. The extent and significance of differences in the weights of fledglings sampled in successive five-day periods needs further investigation to determine whether it would be sufficiently accurate to weigh a large sample of chicks on one or more days during the time of peak fledging. In either case, the chronology of fledging in the study population will need to be determined (see paragraphs 34 and 42).

Standard Method A8.1: Penguin Chick Diet

44. E. Marschoff summarised the results of an analysis of Adelie penguin diet (WG-CEMP-89/16), which indicated that a modified protocol is required if one is trying to interpret observed changes in the size-frequency of krill consumed. This standard method was therefore split into two separate parts. The aim of Method A is to characterise the gross composition of prey items in chick diet. Method B will provide a detailed description of prey items taken (e.g. sex, maturity stage and size). Because sensitivity analyses indicated that very large samples would be required to detect anything less than major changes in meal size, measurements of this parameter were accorded a lower priority than previously.

45. The desirability of having a central sorting facility to analyse diet samples (especially for Method B) was discussed. Such a facility might be particularly valuable in standardising analysis of samples taken by various investigators within CEMP. The Working Group recalled that Poland had extended an offer to the Scientific Committee to sort samples of this type (SC-CAMLR-VI, paragraph 16.5). As it becomes clearer to what extent investigators are collecting samples under the Method B protocol, the need and prospect for central processing will be considered further.

Standard Method C1.0: Fur Seal Pup Growth

46. The guidelines for sensitivity analyses indicated the need to test the assumption that pup growth is adequately described by a linear relationship with time. Although data presented to the meeting (WG-CEMP-89/12) and analysed previously (Doidge et al., 1984) support this assumption, Members were encouraged to verify this independently for each of their year's data. A critical comparison of the results of using Methods A and B at the same site would be desirable.

47. Under Method B, simulations of various sampling schedules (i.e. how many pups and frequency of weighing) would help refine existing sampling strategies. Dr Bengtson indicated that US scientists were planning to conduct such simulations.

Standard Method C2.0: Duration of Female Fur Seal Foraging Trips

48. As with many standard methods for penguins, for fur seals it is important to know the chronology of breeding season events. The most desirable chronological reference point for

this parameter is the date of parturition. The value of observations taken without knowing the parturition date for specific females is likely to be lower and requires further assessment to determine whether collection of such data is worth the effort.

49. Further analysis of existing data on foraging trip duration is required in order to develop the most appropriate analytical procedures for providing an overall index of this parameter (see WG-CEMP-89/21).

Data Recording and Analysis

50. The draft forms for recording field data and reporting summary data were reviewed. In many cases, the revisions of data collection methods outlined above required an alteration of the draft data reporting forms.

51. It was agreed that an example of each of the revised forms for reporting summary data would be included in the standard methods booklet (in a small format). These forms would also be available from the Secretariat in a standard format (e.g. A4 size) for the purpose of actually submitting data to the Secretariat.

52. The option of submitting CEMP data either by hard copy on paper or by soft copy on computer diskette or tape should be available. The CCAMLR Data Manager is requested to propose a specific data format for these computer files.

53. Separate reporting sheets or computer files should be used for each parameter of each breeding group of each species. For reporting forms that relate to a single monitoring site the descriptive header data need only be entered at the top of the first page. In this case, however, all succeeding sheets should specify clearly the breeding group, site and year to which the data refer.

54. The Working Group noted the draft forms for recording field data that had been prepared by the Secretariat in response to the request of the Scientific Committee. These provide an approach to the recording of field data which might help field workers in developing their own methods. The Working Group felt that it was not necessary to proceed further with these forms now. Instead, the emphasis should be placed on improving the sheets to report summary data.

Parameter Evaluation

55. Members were requested to undertake sensitivity analyses to permit critical evaluation of the limitations of the present approved parameters (SC-CAMLR-VII, paragraph 5.31). Results of such studies, following approved guidelines (WG-CEMP-89/13[1]) were provided in WG-CEMP-89/6, 89/7 and 89/21. Although these reports were used extensively in revising the standard methods, critical discussion and comparison of the parameters themselves had to be postponed until the next meeting of the Working Group. Members were urged to submit additional evaluations, using the same guidelines, in time for this meeting.

56. No proposals were received for consideration as new standard methods. Table 3 outlines Members' directed research being undertaken to assess the utility of potential predator parameters.

Implications of Existing Predator Monitoring
for Information Required for Prey Monitoring

57. The written comments received from Members (WG-CEMP-89/12, SC-CIRC 89/2) were discussed in the context of what prey data were needed for interpreting changes in predator parameters. R. Williams (Australia) had drawn the Working Group's attention to the fact that in some areas where predator breeding sites are at great distance from the margin of the continental shelf, *E. crystallorophias* and *Pleuragramma antarcticum* are more important prey items for predators than *E. superba.*

58. The Scientific Committee at its Seventh Meeting identified as a priority task the development of prey monitoring operations to aid interpretation of predator parameters (SC-CAMLR-VII, paragraph 5.40). The WG-CEMP was therefore asked to identify the characteristics of predators that needed to be taken into account in prey survey design and bring these to the attention of the Working Group on Krill (WG-Krill).

59. The Working Group reviewed each predator parameter discussed in paragraphs 31 to 49 and identified those features which should be taken into account by the WG-Krill when

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1 Please note there is a typographical error in equation [1] in WG-CEMP-89/13. The correct form of the equation is:

$$n \varepsilon 2 (S/\delta)^2 \{t_{\alpha,(v)} + t_{2(1-P),[v]}\}^2$$

designing surveys to monitor local distribution and abundance of krill in the Integrated Study Regions. The temporal and spatial scales relevant to monitoring land-based predators using approved standard methods are summarised in Table 4.

60. Table 5 provides detailed information on temporal and spatial scales of predator parameters for different species at sites within the three Integrated Study Regions. Members were requested to provide information specified in this table at the next meeting of the Scientific Committee.

Implications of Existing Predator Monitoring for Information Required from Environmental Monitoring

61. The information required from environmental monitoring as set out in Table 4 of WG-CEMP-89/5, was divided into two categories; environmental conditions that have a direct influence on predators and environmental conditions that have an indirect effect through their impact on the prey.

62. It was agreed that environmental features that have a direct influence on predators (e.g. sea ice, local weather) should be the emphasis at land-based monitoring sites. These features are listed in Table 6.

63. Environmental features that have an indirect effect on predators (e.g. water circulation, productivity) should be considered in association with the distribution and abundance of prey. With respect to *Euphausia superba*, the Working Group noted that these features would be taken into account by the WG-Krill.

PROGRESS AND ACHIEVEMENTS OF DIRECTED RESEARCH ON PREDATORS

Species and Parameters Which May Have Potential for Monitoring

64. A summary of directed research programs being undertaken by Members in the 1987/88 and 1988/89 seasons was included in WG-CEMP-89/5. This summary was updated to include programs for the 1989/90 season for those countries represented at the meeting (Table 7). Information from other Members participating in CEMP will be sought before the next meeting of the Scientific Committee.

65. Dr Bengtson informed the Working Group of a research project conducted jointly by the USA and Sweden during the 1988/89 season on satellite telemetry of crabeater seals. Although the technology is still in the developmental stage (the transmitter was capable of sending only location data), it is expected that new instruments will soon allow the transmission of data on seal diving behaviour and activity patterns.

66. Dr Croxall reported on the successful deployment on grey seals in the northern Atlantic of devices for transmitting via satellite data on location, diving behaviour and activity patterns. This system will also have application for seals in the Antarctic. This project is being carried out by the Sea Mammal Research Unit (UK), under a contract through UNEP to the SCAR Group of Specialists on Seals.

Analysis of Interdependence Between Monitored Predators and Prey

67. The Scientific Committee suggested that the WG-CEMP investigate the nature of relationships between the indices derived from predator monitoring and congruent data on prey abundance (SC-CAMLR-VII, 5.22 (iii)). Explicit questions on this topic were addressed to Members (SC-CAMLR-VII, 5.43). No responses were received. This was probably due to the fact that these requests were made before the Working Group had finished specifying precisely what data should be collected for monitoring prey and predators. Now that these requirements have been clarified, Members are urged to respond to the questions in SC-CAMLR-VII, paragraph 5.43 before the next meeting of the Working Group.

Background for Monitoring Studies

68. The summary table from WG-CEMP-89/5 on directed research on methods to interpret changes in monitored predator parameters was updated (Table 8). Further information on the other Members' activities in this area will be sought before the next meeting of the Scientific Committee.

69. Scientists from Chile and the United States are undertaking collaborative research at Seal Island (South Shetland Islands) to link the results of pelagic prey and environmental monitoring with data obtained from land-based monitoring of predators. These efforts are focussed on the foraging areas of Antarctic fur seals, chinstrap and macaroni penguins, and the biological and physical features with which they are associated. A pilot study was conducted in 1987/88, a

full scale program started in 1988/89 and work is planned to continue in 1989/90. A preliminary report of this collaborative study was presented at the meeting (WG-CEMP-89/22).

PREY

Consideration of Relevant Reports

Scientific Committee

70. At its Seventh Meeting the Scientific Committee had noted (SC-CAMLR-VII, paragraph 5.40):

'A priority task within CEMP should be to develop prey monitoring operations to aid interpretation of predator parameters. Bearing in mind earlier discussion, the Scientific Committee recommended the following procedure:

(i) the Working Group for CEMP should identify the characteristics of predators that need to be taken into account in prey survey design;

(ii) simulation studies are likely to be particularly useful in generating advice on survey design, frequency and duration. Work including modelling krill distribution and behaviour is being undertaken within the Krill CPUE Simulation Study. The Working Group for CEMP should consult with the Working Group on Krill to develop this, and other relevant studies, to provide appropriate advice;

(iii) the Working Group on Krill should arrange the production of standard method sheets for the technical aspects of prey surveys.'

These points had been raised in correspondence with the Convener of the WG-Krill by the Convener of the WG-CEMP (WG-CEMP-89/12).

71. The Reports of the Krill CPUE Simulation Workshop and WG-Krill were discussed.

Krill CPUE Simulation Study

72. The Report of the Workshop on the Krill CPUE Simulation Study (SC-CAMLR-VIII/89/3 Rev. 1) which was held from 7 to 13 June 1989 in La Jolla, USA was presented by Dr Everson. He drew attention to components which were of direct relevance to the CEMP.

73. The Workshop had demonstrated that fine-scale data derived from commercial fishing operations could be effectively used for plotting the distribution of fishable concentrations of krill. An example (WG-CEMP-89/10) of such a distribution map, prepared by Dr S. Nicol (Antarctic Division, Australia) is shown in Figure 1.

74. Examination, during the Workshop, of the distribution of fishable krill concentrations revealed two important points:

- they often occur in the same place for some time and that these locations show some year to year consistency; and

- they tend to occur close to the shelf break.

These points were discussed further by the WG-Krill (SC-CAMLR-VIII/4 Rev. 1, paragraphs 43 to 45).

75. The major outcome of the Krill CPUE Workshop was the development of a Composite Index of krill abundance. This combined an index of krill density within fishable concentrations, which had been derived from Japanese catch and effort data, with an index of the number of krill concentrations in an area, derived from USSR catch and effort data.

76. Additional information on the distribution and size of fishable krill concentrations may be obtained by examination of echosounder chart rolls from past and future commercial and research cruises.

Working Group on Krill (WG-Krill)

77. The First Meeting of the WG-Krill was held from 14 to 20 June 1989 in La Jolla, USA. Dr Everson presented the report of the meeting (SC-CAMLR-VII/89/4 Rev. 1).

78. Acoustics and net sampling were seen, by the WG-Krill, as being the best methods currently available for estimating krill distribution and abundance. The Working Group had considered these, and other methods, at length but had not proceeded as far as providing standard methods protocols.

79. The WG-Krill was unable to proceed with providing specifications for prey monitoring surveys as they relate to interpreting predator parameters being monitored because the WG-CEMP had not met subsequent to the Seventh Meeting of the Scientific Committee to define the important characteristics of predators that need to be addressed by such surveys.

80. Recognising that much information on krill distribution was potentially available from fishery data the WG-Krill assigned a high priority to analysis of fine-scale commercial catch and effort data.

81. WG-Krill had noted that historically about 90% of catches have been taken from particular locations in Statistical Area 48. WG-Krill agreed that the current total catch of krill was unlikely to be having much impact on the circumpolar krill population. However, WG-Krill was unable to say whether or not the present level of krill catch was having an adverse impact on local predators.

82. The WG-Krill also suggested that the simulation models used in the Krill CPUE Simulation Study might be adapted for use in identifying important parameters to study predator/prey interactions in the context of CEMP (SC-CAMLR-VIII-89/4 Rev. 1, paragraph 96).

Prey Monitoring

83. The location of commercial krill fishing activity can be readily derived from the fine-scale catch and effort data supplied to the Secretariat. This information is important in assessing the status of krill within the Integrated Study Regions and Subarea 48.2. The Working Group was unable to state what time and space scales would be the most appropriate for the collection of these data and therefore recommended that, for the time being, these data

should continue to be collected on a haul by haul basis and sent to the Secretariat according to the current system.

84. Dr Everson introduced his paper WG-CEMP-89/9 in which he made some analyses of fine-scale catch data for krill on a monthly basis. One of the important outcomes of these analyses was the demonstration that quite intensive krill fishing took place in the Antarctic Peninsula Integrated Study Region within the foraging range of predators at a time when they may be susceptible to the depletion of krill by the fishery (Figure 2, January-February graph).

85. Dr Vergani reported that Argentine scientists attempted to relate krill catches in CCAMLR Subarea 48.2 with fur seal abundance ashore during January to April at the South Orkney Islands (WG-CEMP-89/15). This analysis would be improved by using fine-scale catch data.

86. Although krill is a key prey component for CEMP, it was agreed that it is not the sole prey species to be incorporated into the program. However, at this stage it was felt best to concentrate activity towards krill and incorporate studies on other components such as *Euphausia crystallorophias* and *Pleuragramma antarcticum* in the future. There still remains the need for more information on these species and further research on aspects relevant to CEMP was encouraged.

87. The spatial and temporal scales within which information on prey is required have been specified in paragraphs 58 to 61. It was emphasised that, although prey monitoring would be concentrated within the time and space scales specified, further information was required from the vicinity of the predator foraging areas and also in advance of the critical period. The precise areas and times of interest will differ from site to site and should be set so as to provide general information on the dynamics of krill around a particular site and detailed information from within the critical foraging areas.

88. The Working Group requested the WG-Krill to consider questions of survey design as they would be better able to take account of sampling constraints in designing suitable surveys.

89. During the intersessional period, Dr K. Sherman (USA) had begun to coordinate studies of net sampling efficiency but was now unable to continue. The Working Group thanked Dr Sherman for his efforts in this study over several years. The Working Group agreed that the study should continue and noted that the WG-Krill had considered the topic. The problems of determining the sampling efficiency of nets are likely to be different for each

prey species. Dr R. Holt (USA) agreed to take over the coordination role and liaise with the Convener of the WG-Krill regarding studies on krill.

Implications for Predator Studies

90. The Working Group noted that a substantial proportion of recent krill harvesting had regularly occurred within the foraging ranges of breeding predators being monitored by CCAMLR, and particularly so within the Antarctic Peninsula and South Georgia Integrated Study Regions.

91. Members were therefore asked to give high priority to synthesising existing published and unpublished data on breeding population size, activity-specific energy budgets, diet and foraging range to provide preliminary estimates of the krill requirements of predators in each Integrated Study Region, at least during the predators' breeding seasons.

92. The Working Group also noted the importance of improving these estimates and encouraged Members to continue and/or initiate research programs aimed at improving current data on:

- population size and distribution, both ashore and at sea;
- activity and energy budgets ashore and especially at sea;
- delimitation of foraging ranges, including at different times of year;
- the characteristics of krill aggregations exploited by predators, including the size and reproductive status of krill eaten; and
- the feeding strategies and tactics employed by krill predators.

SPECIFICATION OF ENVIRONMENTAL DATA

93. As noted above in paragraph 61, environmental data was considered in two categories: environmental parameters which have a direct affect on the predators (these were set down in Table 6) and those which affect predators indirectly through their effects on the distribution and abundance of prey. This latter category is now being discussed in detail by the WG-Krill.

94. In 1987, the Scientific Committee agreed that remote sensing using satellites would play an increasing role in the acquisition of key environmental data. In particular, attention was drawn to the application of satellite imagery data on sea-ice distribution and its characteristics as well as to the possibility of production of global-scale maps of phytoplankton concentrations and distribution with data acquired by the Coastal Zone Colour Scanner (CZCS). Individual scientists who participated at the 1987 Meeting of the Working Group made arrangements to submit their data to Dr G. Feldman (NASA, Goddard Space Flight Centre, Washington, DC, USA) for comparison with relevant satellite-derived data sets.

95. In his reply to a letter from the Convener, Dr G. Feldman advised that data derived from the CZCS, amounting to some 70 000 individual images, are now available 'on-line'. In addition the system allows researchers to view the data on regional scales and to generate movie loops to monitor how ocean conditions changes over the time period of interest. The system will also have an ability to assess and display *in situ* observations such as temperature, salinity, nutrients and chlorophyll profiles that were obtained from the National Oceanographic Data Center. Members were invited to investigate the utility and value of these data for their CEMP national programs.

96. The members of the Working Group expressed their thanks to Dr Feldman for his advice on how to access the data.

97. It was noted that many of the environmental parameters identified (SC-CAMLR-VI, Annex 4, Table 6), particularly satellite derived data, will also be important for the interpretation of the predator parameters. The Working Group noted that standard methods for these parameters are likely to be available through such organisations as WMO, IMO, IOC. The Secretariat was therefore requested to compile a list of standard methods used by such international organisations as might be applicable to CEMP.

RELEVANCE OF CEMP TO CCAMLR MANAGEMENT STRATEGIES

98. The Scientific Committee had indicated a desire for advice from its Working Groups on how information from CEMP might be used in the management of fisheries in the Convention Area (SC-CAMLR-VII, paragraph 5.44).

99. More specifically, the Scientific Committee had also noted that as part of analyses investigating the statistical properties of parameters being modelled, their power to detect

differences and trends and their relationships with estimates of krill abundance/availability, it was also logical to consider the adequacy of the data and estimates to meet the requirements of CCAMLR in distinguishing between natural variations in prey abundance and those induced by fishery activity (SC-CAMLR-VII, paragraph 5.22). The Scientific Committee had commented that this would probably require evaluating how information from the Ecosystem Monitoring Program might be used by CCAMLR in the management of fisheries (SC-CAMLR-VII, paragraph 5.23).

100. The Working Group for the Development of Approaches to Conservation of Antarctic Marine Living Resources (WG-DAC) had requested advice from the Scientific Committee on the ability of the CEMP 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 (WG-CEMP-89/20).

101. This meeting of the WG-CEMP had already noted the considerable progress made in the definition of the accuracy and precision of estimates of predator parameters being monitored (reference to paragraphs 31 to 49 above). These are essential first steps in proceeding to address the questions posed in paragraphs 99 and 100 above.

102. It was thought helpful to state that the Working Group was giving particular consideration to the adequacy and application of its predator monitoring program in terms of:

(i) detecting changes in indices of the status and/or reproductive performance of seabirds and seals;

(ii) relating these changes to indices of prey abundance and availability (to predators);

(iii) using predator indices, on the basis of relationships between predators and prey developed above, as a measure of food availability (to the predators); and

(iv) distinguishing between changes in food availability that result from commercial harvesting and changes due to natural fluctuations in the biological and physical environment.

103. It was noted that the Working Group does not think that predator indices will provide a useful index of prey stock abundance, but does think they might give a useful index of prey availability to predators.

104. In responding to the request from WG-DAC, specifically addressing application (iv) above, the Working Group noted the complexity of this topic, including the possible need for modelling studies, which meant that advice could not be provided at present and that further work and discussion will be needed.

105. The Working Group noted that Members were already considering these broader questions (e.g. WG-CEMP-89/8). These developments were welcomed and it was agreed that more critical discussion of this topic would be undertaken at the next meeting of the Working Group.

COORDINATION OF RESEARCH IN INTEGRATED STUDY REGIONS

106. The Convener, in his report to the 1988 Meeting of the Scientific Committee, drew attention to the possible need for coordination of research between various groups conducting monitoring studies within the Antarctic Peninsula Study Region. The Convener subsequently drew this matter to the attention of the relevant Members and solicited suggestions on how best to proceed.

107. Based upon the replies from Argentina, Brazil and Chile it was agreed that the overlap between CEMP and other programs at a particular breeding site is a potentially serious problem. There is therefore a need for coordination among countries working in the same region.

108. Mr A. Mazzei (Chile) informed the Working Group that there is an overlap of scientific effort on Ardley Island (S. Shetlands) where scientists of three countries carry out research on the same penguin colonies. Chilean scientists conduct research in accordance with CEMP. The research of the other countries is apparently not related directly to CEMP objectives. It was agreed that the matter of coordination of the research effort on Ardley Island should be brought to the attention of the Scientific Committee.

109. These circumstances illustrate problems that would be resolved by the Commission's development of appropriate conservation and management procedures for its CEMP sites (see also paragraphs 20 and 21).

110. The Working Group noted the benefits of cooperative programs undertaken by Members in support of CEMP. Since the inception of the program there have been numerous productive collaborations between Members in the Integrated Study Regions. These

activities have included a variety of joint monitoring and directed research projects relating to aspects of prey, predators and environmental features.

CCAMLR/IWC SPONSORED WORKSHOP ON THE FEEDING ECOLOGY OF SOUTHERN BALEEN WHALES

111. The Executive Secretary informed the Working Group that the Scientific Committee of the IWC had decided not to proceed with the Workshop at this time because of the present heavy workload associated with the Comprehensive Assessment of Whale Stocks. The Secretary of the IWC has written to inform CCAMLR of this decision and the proposal from the IWC to consider holding the Workshop in 1991.

OTHER BUSINESS

112. The following items were considered under this agenda item:

- CEMP data reporting;
- interactions with the WG-Krill;
- information from the Convener of the BIOMASS Executive on a planned BIOMASS Colloquium;
- promotion of awareness of the CEMP program in the CCAMLR community and outside it; and
- next meeting of WG-CEMP.

CEMP Data Reporting

113. The Working Group considered the advice of the Secretariat and the Convener of the Working Group regarding submission, validation, storage, access and analyses of ecosystem monitoring data (WG-CEMP-89/14). The Group agreed with the following guidelines.

114. The Secretariat will circulate to the CCAMLR Members the appropriate reporting forms. The Data Manager of the CCAMLR Secretariat will specify the necessary protocols for the submission of data on computer compatible media should any Member wish to use this means of data submission.

115. The CCAMLR Data Manager will contact scientists in national laboratories to ascertain the precautions taken as data are collected and processed prior to their submission to CCAMLR and develop standard procedures to be employed by the CCAMLR Data Centre for checking and logical validation of the summarised data.

116. It was noted that the conditions under which fisheries data held by the Secretariat might be released to Members were outlined under SC-CAMLR-VII, paragraph 3.3. Because of the special value of long-term data sets derived from scientific studies, it was agreed that data access provisions pertaining to CEMP data needed to be strengthened in addition to the conditions described in SC-CAMLR-VII, paragraph 3.3.

117. The Working Group recognised two important points: (a) CEMP data submitted to the CCAMLR Data Centre should be freely available for analysis and preparation of papers for use within the CCAMLR Commission, Scientific Committee, and Working Groups; and (b) the originators/owners of the data should retain control over any use of their data outside of CCAMLR.

118. The Working Group expressed its understanding that papers prepared for meetings of the Commission, Scientific Committee, and Working Groups are not public documents that can be cited or used in the preparation of papers to be published outside of CCAMLR. Furthermore, because inclusion of papers in the 'Selected Scientific Papers' series or any other of the Commission's or Scientific Committee's publications constitutes formal publication, permission to publish papers prepared for meetings of the Commission, Scientific Committee and Working Groups must be obtained from the originators/owners of the data and authors of papers.

119. Subject to agreement on CEMP data access protocols (paragraph 118), it was recommended to start the submission of data to the CCAMLR Data Centre on those species and parameters for which standard methods and reporting forms had been approved by the WG-CEMP. Summarised data only will be reported at present. The Working Group emphasised that it was important for national agencies to retain all raw data in a readily accessible format for future reference if necessary.

120. It was agreed that data should be reported retrospectively for those periods in which Members had indicated that they were monitoring approved parameters using standard methods in the Integrated Study Regions or at network sites.

121. The Working Group agreed that, initially at least, 30 September would be a reasonable annual deadline for the submission of data.

Interactions with the Working Group on Krill (WG-Krill)

122. The Working Group noted the close links which had been established with the WG-Krill both through the instructions of the Scientific Committee in the establishment of the WG-Krill (SC-CAMLR-VII, paragraph 2.26) and by individual scientists participating in both groups. As a result, the WG-Krill has now taken over aspects of the monitoring of prey. The WG-CEMP emphasised the importance of continuing close contact between the groups to ensure that the needs of the CEMP program for prey monitoring were being met.

BIOMASS Colloquium

123. Dr Everson informed the Working Group that the BIOMASS Executive was planning a BIOMASS Colloquium to be held in September 1991. In preparation for this Colloquium a series of workshops is planned on various subjects, some of which are of interest to CCAMLR. Members are encouraged to submit proposals for analyses to the conveners of the workshops.

Promotion of the Awareness of the CEMP Program

124. Dr S.N. Dwivedi (India) suggested to the Working Group that awareness of the CEMP is possibly limited to countries whose experts have participated in its elaboration and whose scientists carry out research within CEMP. It was suggested that it would be very useful to promote awareness of the program among other CCAMLR Members and other countries.

125. This promotion may be undertaken by means of wider distribution of CCAMLR publications dealing with the CEMP development and implementation. In particular, the Secretariat had prepared a very useful summary on CEMP (WG-CEMP-89/5) which might be distributed outside the CCAMLR. The same might be done with the CEMP Standard

Methods and other documents. Some scientists might be also invited to give lectures in various countries.

126. Another direction for the activities of the Working Group might be by helping national programs in support of CEMP activities by advising on the status of ecosystem monitoring methodology, technology and equipment.

Next Meeting of WG-CEMP

127. 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 1990 would be desirable.

ADOPTION OF THE REPORT

128. The Report of the meeting was adopted.

CLOSE OF THE MEETING

129. Dr Kerry informed the Working Group that he felt it was time to step aside as Convener. The Working Group noted that Dr Kerry had been Convener for the past six years. During this period the Working Group had been established and had made good progress in developing the Monitoring Program. This had been a difficult task, breaking much new ground and requiring a great degree of cooperation among participating members. The Working Group placed on record its appreciation for the very significant part Dr Kerry had played in getting CEMP started.

130. The Convener thanked all participants and the Secretariat for their cooperation and efforts not only in making this meeting a success but in supporting him, through his period as Convener. He thanked the Argentine Government for hosting this meeting and Enrique Marschoff and Dr Daniel Vergani for making the detailed arrangements for it.

131. The Convener closed the meeting.

Table 1: Sites within the Integrated Study Regions at which monitoring of predators has been or should be initiated now.

	Site	Species	Critical Period
1.	ANTARCTIC PENINSULA REGION		
	Anvers Island (Palmer Archipelago)		
	(south coast)	Adelie penguin	Nov–Jan
	Livingston Island (S. Shetland Is)		
	(north coast)	Chinstrap penguin	Nov–Feb
	(north coast)	Antarctic fur seal	Dec–Mar
	King George Island (S. Shetland Is)		
	(north ? and south coasts)	Adelie penguin	Oct–Jan
	(north and south coasts)	Chinstrap penguin	Nov–Feb
	(north coast)	Antarctic fur seal	Dec–Mar
	Elephant Island (S. Shetland Is)		
	(west coast)	Chinstrap penguin	Nov–Feb
	(west coast)	Macaroni penguin	Dec–Feb
		Cape petrel*	Dec–Feb
	Seal Island (S. Shetland Is)	Chinstrap penguin	Nov–Feb
		Macaroni penguin	Dec–Feb
		Antarctic fur seal	Dec–Mar
		Cape petrel*	Dec–Feb
	Sea Ice areas	Crabeater seal*	Jan–Dec
2.	SOUTH GEORGIA REGION		
	Bird Island	Fur seal	Dec–Mar
		Macaroni penguin	Dec–Feb
		Black-browed albatross*	Oct–Apr
3.	PRYDZ BAY REGION		
	Mac. Robertson Land	Adelie penguin	Oct–Jan
		Antarctic petrel*	Nov–Feb
	Magnetic Island, Princess Elizabeth Land	Adelie penguin	Oct–Jan
		Antarctic petrel*	Nov–Feb
		Cape petrel*	Nov–Feb
	Sea Ice areas	Crabeater seal*	Jan–Dec

* Species for which standard methods have not yet been developed.

Table 2: Sites selected or suggested for monitoring studies to complement the programs in the three main Integrated Study Regions.

Species	Sites
Adelie penguin	NW Ross Sea (Cape Hallett and Cape Adare) Budd Coast* Ongul Islands (near Syowa Station) Shepard Island* Signy Island, South Orkney Islands Laurie Island, South Orkney Islands
Chinstrap penguin	Signy Island, South Orkney Islands South Sandwich Islands* Bouvet Island*
Macaroni penguin	Bouvet Island* Kerguelen Island*
Cape petrel	Signy Island, South Orkney Islands Rauer Islands (near Davis Station) Elephant Island (South Shetland Islands)
Antarctic fur seal	Bouvet Island * Kerguelen Island
Crabeater seal	Weddell Sea* Amundsen and Bellingshausen Seas*
Black-browed albatross**	Kerguelen Island

* Suggested sites
** Subject to diet data

Table 3: 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 1987/88		Undertaken 1988/89		Proposed for 1989/90	
		Analysis of existing data	Acquisition of new data	Analysis of existing data	Acquisition of new data	Analysis of existing data	Acquisition of new data
Penguins[b]							
- Macaroni incubation shift	4,5,11,14	UK(11)	UK(11)	UK(11)	Brazil (2)	Brazil (2)	Brazil (2)
- Macaroni weight prior to moult	2,15,14,4,5?	Brazil (2) UK(4)	Brazil (2)	Brazil (2)	Brazil (2)	Brazil (2)	Brazil (2)
- At-sea diving behaviour and activity patterns (A,C,M)	2,4,6	UK (3,C)(4,M)	Australia (6,A) USA (2,C,M)	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)
- 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)	Australia (6A) Brazil (2) Chile (12) UK (4,M)	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)
- Chick growth rate	2,11		USA(2,C;11,A)	USA(2,C;11,A)	USA(2,C;11,A)	UK (4,M) USA(2,C;11,A)	USA(2,C;11,A)
FLIGHTED SEABIRDS							
Black-browed albatross							
- Breeding population size	4,9?,15	UK (4)	UK (4)	UK (4)	UK (4)		UK (4)
- Breeding success	4,9?,15	UK (4)	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)
Antarctic/Cape petrel							
- Breeding success	3,6,8,11,2	Chile (11) Brazil (2)	Brazil (2) UK (3)	Chile (11) Brazil (2)	Chile (11) Brazil (2)		UK (3)
- Chick weight at fledging	2,6,8,11	Brazil (2) Chile (11)	Brazil (2) USA (2)	Brazil (2) Chile (11)	Brazil (2) Chile (11)	Brazil (2) USA (2)	Brazil (2)

Table 3 (continued)

Parameter	Areas[a] from which data are available for analysis/ evaluation	Members' Research Activity					
		Undertaken 1987/88		Undertaken 1988/89		Proposed for 1989/90	
		Analysis of existing data	Acquisition of new data	Analysis of existing data	Acquisition of new data	Analysis of existing data	Acquisition of new data
Antarctic/Cape petrel (continued)							
- Prey characteristics/ diet	2,6,8,11	Australia (6) Brazil (2)	Australia (6) Brazil (2)	Australia (6) Brazil (2) Chile (11)	Australia (6) Brazil (2) Chile (11)	Brazil (2)	Brazil (2)
Fur seals							
- Reproductive success	4,2	UK (4)	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	UK (4) USA (2)	USA (2)	USA (2)	UK (4) USA (2)	UK (4) USA (2)	UK (4) USA (2)
- Indices of physiological condition	11	Chile (11)		Chile (11)	Chile (11)		UK (4)
- Fine structure of teeth	4	UK (4) USA (4)			UK (4)	UK (4)	UK (4)
Crabeater seal							
- Reproductive rates	2,3,8,10-12				USA (11)	USA (11,12)	
- Age at sexual maturity	2,3,8,10-12				USA (11)	USA(10,11,12)	
- Cohort strength	2,3,8,10-12			USA(10,11,12)	USA (11)	USA(10,11,12)	
- Indices of physiological condition	11,12				USA (11)	USA (11,12)	
- Instantaneous growth rate	11,12						
- Prey characteristics/ diet	11,12				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)

Table 3 (continued)

Parameter	Areas[a] from which data are available for analysis/ evaluation	Members' Research Activity					
		Undertaken 1987/88		Undertaken 1988/89		Proposed for 1989/90	
		Analysis of existing data	Acquisition of new data	Analysis of existing data	Acquisition of new data	Analysis of existing data	Acquisition of new data
Minke whales							
- Reproductive rate	13,1	Japan (completed)	Japan	Japan	Japan		
- Age of sexual maturity	13,1	(completed)					
- Cohort strength	13,1	(under way)	Japan	Japan	Japan		
- Analyses of existing data:							
- stomach contents	13,1	(almost (completed)	Japan	Japan	Japan		
- blubber thickness	13,1	(completed)	Japan	Japan	Japan		
- density/patchiness	13,1	(under way)	Japan	Japan	Japan		
- school size	13,1	(completed)	Japan	Japan	Japan		
- Feeding activity patterns	13,1	(under way)	Japan	Japan	Japan		

[a] Areas:

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

[b] Penguin species: A - Adelie, C - Chinstrap, M - Macaroni/Royal

Table 4: Approximate spatial scales relevant to monitoring approved predator parameters at land-based sites. These scales should be considered when designing prey surveys in the Integrated Study Regions.

Standard Method		Temporal Scale			Spatial Scale	
		Time of Year Measured	Duration of Observation Period	Parameter Integration Period[1]	Foraging Range/ Area	Depths of Predator Foraging[2]
A1	Arrival weight	Oct – Nov	20 days	May – October	CCAMLR Subarea	20 – 30 m (max 150 m)
A2	Shift length	Nov – Dec	5 – 15 days	First shift 30 + days Second shift 10 days	100 – 500 km 25 – 50 km	20 – 30 m (max 150 m) 20 – 30 m (max 150 m)
A3	Population size	Oct – Nov	1 day periods	Previous 12 months	CCAMLR Subarea	20 – 30 m (max 150 m)
A4	Demography	Oct – Mar	6 months	1 + years	CCAMLR Subarea (adults) CCAMLR Area (juveniles)	20 – 30 m (max 150 m)
A5	Foraging trips	Jan – Feb	Samples throughout field season	1 – 3 days*	25 – 50 km	20 – 30 m (max 150 m)
A6	Breeding success	Nov – Mar	Counts throughout field season	Nov – March	25 – 150 km	20 – 30 m (max 150 m)
A7	Fledging weight	Jan – Mar	20 days	Jan – March (chick rearing period)	25 – 50 km	20 – 30 m (max 150 m)
A8	Chick diet	Dec – Feb	Samples throughout field season	1 – 3 days	25 – 50 km	20 – 30 m (max 150 m)
C1	Pup growth	Dec – Mar	Samples throughout field season	Dec – Mar	50 – 100 km	Mean 30 m, max 150 m
C2	Foraging trips	Dec – Mar	Samples throughout field season	2 – 5 days*	50 – 100 km	Mean 30 m, max 150 m

[1] Timespan over which parameter potentially integrates prey abundance/availability

[2] Diurnal changes in the vertical diving depths of penguins and fur seals should be taken into account when designing prey surveys

Table 5: Summary of temporal and spatial scales relevant to monitoring of land-based predators, using approved standard methods in each of the Integrated Study Regions.

Parameter[1]	Integrated Study Region	Species	Time of Year of Measurement[2]	Duration of Measurement[3]	Integration Period[4]	Foraging Range/Area[5]	Foraging Depth Mean	Foraging Depth Max	Comments
	Prydz Bay	Adelie							
	Antarctic Peninsula	Adelie							
		Chinstrap							
		Macaroni							
		Fur seal							
	South Georgia	Macaroni							
		Fur seal							

1 Use separate sheet for each parameter
2 Calendar date of start and finish
3 In days, months etc
4 Timespan over which parameter potentially integrates prey abundance/availability
5 Range in km; area in terms of CCAMLR Area, Subarea etc while measuring parameter

Table 6: Environmental parameters which may have a direct effect on the predator parameters being monitored.

Feature	Parameter	Period
Sea ice cover viewed from the colony	Ice type and cover	2-3 weeks before arrival, until finish weighing of birds
Sea ice within Integrated Study Region	Ice type and cover	2-3 weeks before arrival, until finish weighing of birds
Local weather	Synoptic observations on temperature, precipitation, pressure Wind speed and direction	2-3 weeks before arrival to end of season
Snow cover in colony	Depth and extent	Throughout field season

Table 7: Summary of Members' CEMP activities on monitoring approved predator parameters.

Method Sheet Number	Parameter	Species: A-Adelie penguin M-Macaroni penguin C-Chinstrap penguin F-Fur seal				Country	Site name/ Integrated Study Region/ Network Site	Site Location	Year Started
		A	M	C	F				
A1.1	Weight on arrival at breeding colonies	X				Australia	Magnetic Is Davis Station/ Prydz Bay	68°33'S 77°54'E	1983/84
		X				Argentina	King George Is Stranger Point S. Shetland Is	62°14'S 58°30'W	1987/88
		X				Argentina	Laurie Is Mossman Peninsula S. Orkney Is	60°45'S 44°44'W	1987/88
			X	X		Brazil	Elephant Is S. Shetland Is Ant. Peninsula	61°04'S 55°21'W	1990/91
			X			UK	Bird Is/ South Georgia	52°00'S 38°02'W	1988/89
A2.1	Length of the first incubation shift	X				Australia	Magnetic Is Davis Station/ Prydz Bay	68°33'S 77°54'E	1983/84
		X				Argentina	King George Is Stranger Point S. Shetland Is	62°14'S 58°30'W	1987/88
			X	X		Brazil	Elephant Is S. Shetland Is Ant. Peninsula	61°04'S 55°21'W	1990/91
A3.1	Annual trends in breeding population size	X				Australia	Magnetic Is Davis Station/ Prydz Bay	68°33'S 77°54'E	1983/84
		X				Argentina	King George Is Stranger Point S. Shetland Is	62°14'S 58°30'W	1987/88
			X	X		Brazil	Elephant Is S. Shetland Is/ Ant. Peninsula	61°04'S 55°21'W	1986
		X		X		Chile	Ardley Is S. Shetland Is/ Ant. Peninsula	62°11'8"S 58°55'W	1982
		X				Japan	Syowa Station/ Network site	69°00'S 39°30'E	1970
			X			UK	Bird Is/ South Georgia	52°00'S 38°02'W	1975/76
			X		X	UK	Signy Is/ Network site	60°43'S 45°38'W	1978/79
			X	X		USA	Seal Is S. Shetland Is/ Ant. Peninsula	60°59.5'S 55°24.5'W	1987/88
		X				USA	Anvers Is. Palmer Station/ Ant. Peninsula	64°06'S 64°03'W	1987/88

Table 7 (continued)

Method Sheet Number	Parameter	Species: A-Adelie penguin M-Macaroni penguin C-Chinstrap penguin F-Fur seal				Country	Site name/ Integrated Study Region/ Network Site	Site Location	Year Started
		A	M	C	F				
A4.1	Demography			X		Chile	Ardley Is S. Shetland Is/ Ant. Peninsula	62°11'8"S 58°55'W	1982
			X	X		Brazil	Elephant Is S. Shetland Is/ Ant. Peninsula	61°04'S 55°21'W	1986
			X	X		USA	Seal Is S. Shetland Is/ Ant. Peninsula	60°59.5'S 55°24.5'W	1987/88
		X				USA	Anvers Is Palmer Station Ant. Peninsula	64°06'S 64°03'W	1987/88
A5.1	Duration of foraging trips	X				Australia	Magnetic Is Davis Station/ Prydz Bay	68°33'S 77°54'E	1983/84
				X		USA	Seal Is S. Shetland Is/ Ant. Peninsula	60°59.5'S 55°24.5'W	1987/88
A6.1	Breeding success success	X				Australia	Magnetic Is Davis Station/	68°33'S 77°54'E	1983/84
		X				Argentina	King George Is Stranger Point S. Shetland Is	62°14'S 58°30'W	1987/88
			X	X		Brazil	Elephant Is S. Shetland Is/ Ant. Peninsula	61°04'S 55°21'W	1986
				X		Chile	Ardley Is S. Shetland Is/ Ant. Peninsula	62°11'8"S 58°55'W	1982
			X			UK	Bird Is/ South Georgia	52°00'S 38°02'W	1975/76
		X		X		UK	Signy Is/ Network site	60°43'S 45°38'W	1978/79
			X	X		USA	Seal Is S. Shetland Is/ Ant. Peninsula	60°59.5'S 55°24.5'W	1987/88
		X				USA	Anvers Is Palmer Station/ Ant. Peninsula	64°06'S 64°03'W	1987/88
A7.1	Fledging weight	X				Australia	Magnetic Is Davis Station/ Prydz Bay	68°33'S 77°54'E	1983/84
		X				Argentina	King George Is Stranger Point S. Shetland Is	62°14'S 58°30'W	1987/88

Table 7 (continued)

Method Sheet Number	Parameter	Species: A-Adelie penguin M-Macaroni penguin C-Chinstrap penguin F-Fur seal				Country	Site name/ Integrated Study Region/ Network Site	Site Location	Year Started
		A	M	C	F				
A7.1	(continued)	X				Argentina	Laurie Is Mossman Peninsula S. Orkney Is	60°45'S 44°44'W	1987/88
			X	X		Brazil	Elephant Is S. Shetland Is/ Ant. Peninsula	61°04'S 55°21'W	1986
			X			UK	Bird Is/ South Georgia	52°00'S 38°02'W	1988/89
				X		USA	Seal Is S. Shetland Is/ Ant. Peninsula	60°59.5'S 55°24.5'W	1987/88
		X				USA	Anvers Is Palmer Station/ Ant. Peninsula	64°06'S 64°03'W	1987/88
A8.1	Diet	X				Australia	Magnetic Is Davis Station/ Prydz Bay	68°33'S 77°54'E	1983/84
		X				Argentina	King George Is Stranger Point S. Shetland Is	62°14'S 58°30'W	1987/88
		X				Argentina	Laurie Is Mossman Peninsula S. Orkney Is	60°45'S 44°44'W	1987/88
			X	X		Brazil	Elephant Is S. Shetland Is/ Ant. Peninsula	61°04'S 55°21'W	1986
				X		Chile	Ardley Is S. Shetland Is Ant. Peninsula	62°11'8"S 58°55'W	1982
			X			UK	Bird Is/ South Georgia	52°00'S 38°02'W	1985/86
				X		USA	Seal Is S. Shetland Is/ Ant. Peninsula	60°59.5'S 55°24.5"W	1987/88
		X				USA	Anvers Is Palmer Station/ Ant. Peninsula	64°06'S 64°03'W	1987/88
C1.0	Pup Growth				X	Chile	Cape Shirreff/ Ant. Peninsula	62°28'S 60°47"W	1984/85
					X	UK	Bird Is/ South Georgia	52°00'S 38°02'W	1972/73 1977/78
					X	USA	Seal Is S. Shetland Is Ant. Peninsula	60°59.5'S 55°24.5'W	1987/88

Table 7 (continued)

Method Sheet Number	Parameter	Species: A-Adelie penguin M-Macaroni penguin C-Chinstrap penguin F-Fur seal				Country	Site name/ Integrated Study Region/ Network Site	Site Location	Year Started
		A	M	C	F				
C2.0	Cow foraging/ attendance cycles				X	Chile	Cape Shirreff/ Ant. Peninsula	62°27'S 60°47'W	1987/88
					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°24.5W	1987/88

Table 8: 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 (1988/89) USA	Australia (1989/90)
- Energy requirements		
- Seasonal movements		
- Relationships between monitored parameters and physical environment (e.g. distribution and structure of sea ice and frontal systems)	Chile UK (Frontal systems) USA	Australia (1989/90) UK (1992/93)
FUR SEALS		
- Local abundance/population structure	Argentina, Chile, UK, USA	Brazil
- Energy requirements	UK	
- Foraging areas	Chile, USA	UK (1992/93)
- 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	
- Energy requirements		
- Stock discreteness/seasonal movements	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])	Japan	
- Relationships between monitored parameters and physical environment (e.g. distribution and structure of sea ice and frontal systems)	Japan	

[a] International Whaling Commission/International Decade of Cetacean Research

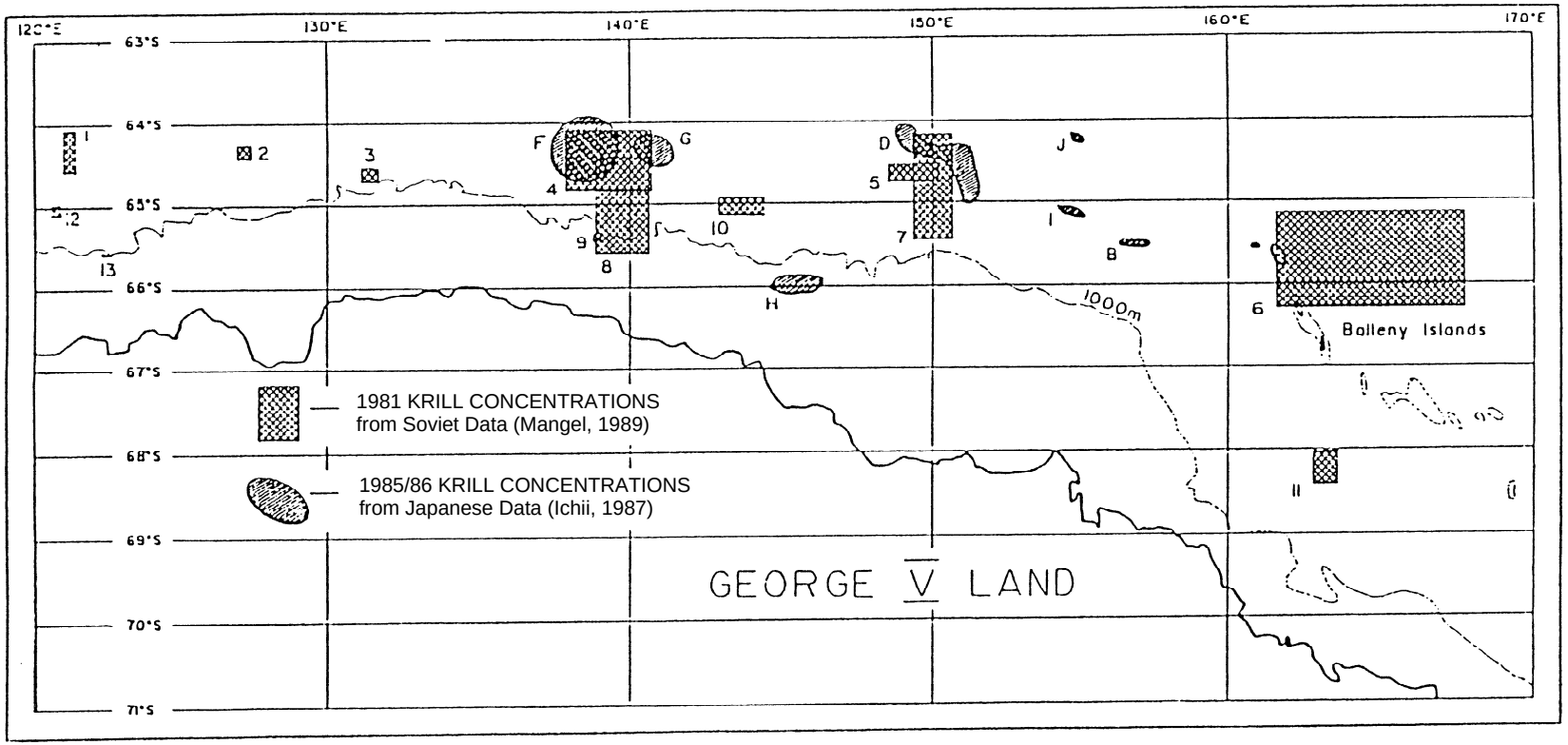

Figure 1: Distributions of krill concentrations based on USSR and Japanese fisheries data (WG-CEMP-89/10).

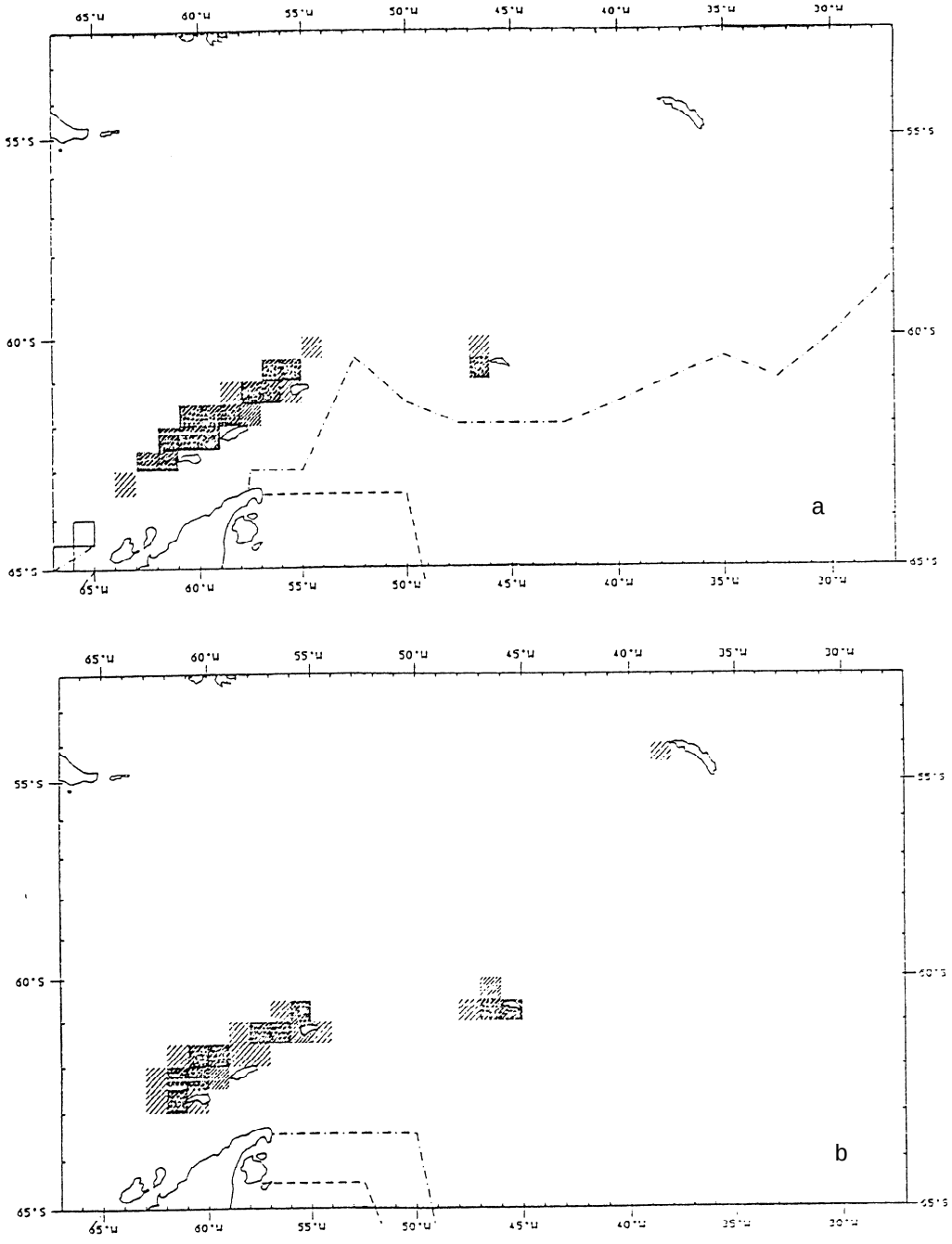

Figure 2: Distribution of commercial catches of krill in the South-West Atlantic in (a) January and (b) February 1988 (WG-CEMP-89/9).

APPENDIX 1

LIST OF PARTICPANTS

Working Group for the
CCAMLR Ecosystem Monitoring Program (WG-CEMP)
(Mar del Plata, Argentina, 23-30 August 1989)

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APPENDIX 2

AGENDA

Working Group for the
CCAMLR Ecosystem Monitoring Program (WG-CEMP)
(Mar del Plata, Argentina, 23 –30 August 1989)

1. Opening of the meeting

2. Adoption of agenda

3. Evaluation of agreed predator monitoring parameters
   - (i) Evaluation of sites, 5.29 (i)*
   - (ii) Evaluation of methods, 5.29 (iii and iv)
   - (iii) Data recording and analyses, 5.30 (i-iii)
   - (iv) Parameter evaluation, 5.31
   - (v) Implications of existing predator monitoring for information required for prey monitoring
   - (vi) Implications of existing predator monitoring for information required from environmental monitoring

4. Progress and achievements of directed research on predators
   - (i) Species and parameters which may have potential for monitoring as indicated in SC-CAMLR-VI, Annex 4, Table 4
   - (ii)
     - Analysis of interdependence between sampling method and results of monitoring and changes of krill abundance
     - Evaluation of availability of data and information supplied under requests set out in paragraph 5.43 (i-iv)
   - (iii) Directed research which provide background for monitoring studies, (SC-CAMLR-VI, Annex 4, Table 8).

* Numbers after each agenda item refer to the paragraphs in the 1988 Report of the Scientific Committee (SC-CAMLR-VII)

5. Prey monitoring
   (i) Methods of estimating prey parameters
   (ii) Spatial and temporal scales on which the prey parameters need to be monitored
   (iii) Survey design

6. Specification of environmental data
   (i) Data as set out in SC-CAMLR-VI, Annex 4, Table 6
   (ii) Imagery data, 5.38
   (iii) Standard method sheets, 5.36

7. Relevance of CEMP to CCAMLR management strategies, 5.44

8. General
   (i) Coordination of research in Integrated Study Regions, 5.41
   (ii) Review of relevant sections of reports of other intersessional meetings:
      - Krill CPUE Simulation Study
      - Working Group on Krill
      - CCAMLR/IWC Sponsored Workshop on the Feeding Ecology of Southern Baleen Whales

9. Other business

10. Adoption of the report

11. Closing of the meeting.

APPENDIX 3

LIST OF DOCUMENTS

Working Group for the
CCAMLR Ecosystem Monitoring Program (WG-CEMP)
(Mar del Plata, Argentina, 23-30 August 1989)

Meeting Documents:

WG-CEMP-89/1	Provisional Agenda
WG-CEMP-89/2	Annotated Provisional Agenda
WG-CEMP-89/3	List of Participants
WG-CEMP-89/4	List of Documents
WG-CEMP-89/4 Rev. 1	List of Documents (Revised 23 August 1989)
WG-CEMP-89/5	Development of the CCAMLR Ecosystem Monitoring Program 1982–1989 (Secretariat)
WG-CEMP-89/6	On the Power to Detect Changes Using the Standard Methods for Monitoring Parameters of Predatory Species (Boveng and Bengtson, USA)
WG-CEMP-89/7	Sensitivity Analysis for Predatory Parameters. CCAMLR Ecosystem Program in response to SC-CAMLR-VII, Paragraph 5.22 (i) and (ii) (Whitehead, Australia)
WG-CEMP-89/8	Use of Indices of Predator Status and Performance in CCAMLR Fishery Management Strategies (Croxall, UK)

WG-CEMP-89/9	Krill fishing: An Analysis of Fine-Scale Data Reported to CCAMLR (Everson and Mitchell, UK)
WG-CEMP-89/10	Map of Distribution of Krill Concentrations Off George V Land (Nicol, Australia)
WG-CEMP-89/11	Sensitivity Analyses for Monitoring Parameters of Predatory Species (Sander, Brazil)
WG-CEMP-89/12	Member's Responses to Various Topics Addressed by the Convener and the Secretariat During the Preparation of the WG-CEMP Meeting
WG-CEMP-89/13	Instructions for the Preparation of Sensitivity Analyses (Secretariat and the Convener of the Working Group on CEMP)
WG-CEMP-89/14	Advice Regarding Submission, Validation, Storage, Access and Analysis of Ecosystem Monitoring Data (Secretariat and the Convener of the Working Group on CEMP)
WG-CEMP-89/15	Activities of Argentina into the Ecosystem Monitoring Program - CEMP (Stanganelli, Vergani, Aguire and Coria, Argentina)
WG-CEMP-89/16	The Use of Penguin Stomachal Contents for the Simultaneous Study of Prey and Predator Parameters (Marschoff and González, Argentina)
WG-CEMP-89/17	Discrimination Between Larval and Juvenile Specimens of *Euphausia superba* from Gut Contents (Marschoff and Ravaglia, Argentina)
WG-CEMP-89/18	An Experimental Approach to the Analysis of Zooplankton Escape Reactions and Patchiness (Marschoff, Díaz and Schloss, Argentina)

WG-CEMP-89/19	Replaced by document SC-CAMLR-VIII/4 Rev. 1
WG-CEMP-89/20	Letter from the Convener of WG-DAC to the Chairman, Scientific Committee
WG-CEMP-89/21	Methods for Detecting Annual Changes in Fur Seal Foraging Trip Duration (Boveng and Bengtson, USA)
WG-CEMP-89/22	Foraging Areas for Fur Seals and Penguins in the Vicinity of Seal Island, Antarctica (Bengtson and Eberhardt, USA and Chile)
WG-CEMP-89/23	Reference tables for the CEMP Sensitivity Analysis (Croxall, UK)
WG-CEMP-89/24	Comments on CEMP Monitoring Sites (Scientific Committee on Antarctic Research Working Group on Biology, Bird Biology Subcommittee, 22 and 28 August 1988, Hobart, Australia)

Reference Documents:

DOIDGE, D.W., J.P. CROXALL and C. RICKETTS. 1984. Growth rate of Antarctic fur seal *Arctocephalus gazella* pups at South Georgia. J. Zool. Lond. 203: 87-93.

WALTERS, C.J. and J.S. COLLIE. 1988. Is research of environmental factors useful to fisheries management? Can. J. Fish. Aquat. Sci. 45: 1848-1854.

SC-CAMLR-VIII/3 Rev. 1. Report of the Workshop on the Krill CPUE Simulation Study, Southwest Fisheries Centre, La Jolla, USA, 7–13 June 1989.

SC-CAMLR-VIII/4 Rev. 1. Report of the First Meeting of the Working Group on Krill, Southwest Fisheries Centre, La Jolla, California, 14–20 June 1989.

SC-CAMLR-VII/5. CCAMLR Ecosystem Monitoring Program. Monitoring Prey. I. Everson (UK).