

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

(Dammarie-les-lys, France, 10–15 June, 1987)

(SC-CAMLR-VI/4)

TABLE OF CONTENTS

INTRODUCTION

MONITORING OF PREDATORS

- Background
- Objectives
- Review of Predator Species and Study Sites
- Review of Parameters
- Conclusions and Recommendations

MONITORING OF PREY

WORKSHOP ON TELEMETRY AND REMOTE SENSING

- Radio Telemetry
- Archival Tags and Recorders
- Satellite Linked Instruments
- Automatic Data Collection
- Automatic Sample Analysis
- Remote Sensing

THEORETICAL ASPECTS AND PILOT STUDIES IN ESTABLISHING PREDATOR–PREY RELATINSHIPS

IMPLEMENTATION AND CO-ORDINATION

- Protection of Monitoring Sites
- Next Meeting

CLOSE OF MEETING

REFERENCES

SUMMARY OF RECOMMENDATIONS

- Table 1. Sites within the integrated study areas at which land-based monitoring or predators has been or should be initiated now
- Table 2. Sites selected or suggested for monitoring studies to complement the programs in the three main integrated study regions
- Table 3. Predator parameters for which there have been adequate evaluations to allow preparation of standard method sheets and for which routine monitoring activities are recommended to begin immediately
- Table 4. Directed research programs required to assess the utility of potential predator monitoring parameters
- Table 5. Methods which could be utilised in monitoring rates of change in abundance and distribution of selected prey species

- Table 6. Environmental data requirements to interpret predator-prey interactions
- Table 7. Preliminary summary of CCAMLR net performance experiments and associated acoustic abundance estimates on krill scheduled for the 1987–1988 season
- Table 8. Directed research on predator parameters required to provide the essential background information needed to interpret changes in monitored predator parameters

APPENDIX 1 LIST OF PARTICIPANTS

APPENDIX 2 AGENDA FOR THE SECOND MEETING

APPENDIX 3 LIST OF DOCUMENTS

APPENDIX 4 CCAMLR STANDRAD MEHTODS FOR MONITORING
PARMETERS OF PENGUINS

REPORT OF THE WORKING GROUP FOR THE CCAMLR ECOSYSTEM MONITORING PROGRAM

Dammarie-les-Lys, France

10–15 June, 1987

INTRODUCTION

At its Fifth Annual Meeting in September 1986, the Scientific Committee of CCAMLR reaffirmed the urgent need to commence the practical implementation of the CCAMLR Ecosystem Monitoring Program (CEMP). The Committee agreed that an intersessional meeting of the Working Group for CEMP should be held during 1987. A draft annotated agenda was prepared and circulated.

2. The Scientific Committee accepted an invitation from the Republic of France to hold the meeting at Chateau des Vives Eaux, Dammarie-les-Lys, France.

3. The Meeting was held from 10–15 June, 1987.

4. Participants were welcomed by Prof. J.-C. Hureau, Muséum National d'Histoire Naturelle, Paris. A list of participants is attached (Appendix 1).

5. The Convener (Dr K. Kerry, Australia) opened the meeting and the agenda (Appendix 2) was adopted.

6. Mr D. Miller (South Africa) was appointed as Rapporteur for the Working Group. Drs J. Bengtson and D. Ainley, both of the USA, were responsible for the sections of the Meeting report dealing with remote sensing technology and predator species respectively.

7. A list of the documents tabled at the meeting is attached as Appendix 3.

8. The Convener tabled a paper prepared by the Secretariat (WG-CEMP-87/4) which outlines the development of the CEMP, and summarises the objectives of the program and agreements reached so far. He drew attention to the wording of the objectives of ecosystem monitoring as agreed at the 1985 meeting in Seattle of the Ad Hoc Working Group on Ecosystem Monitoring (SC-CAMLR-IV, Annex 7, paragraph 11) and subsequently adopted

by the Working Group for CEMP. The Group agreed that the words 'the monitoring system should be designed' were redundant and should be deleted. The objectives of Ecosystem Monitoring are now:

- to detect and record significant changes in critical components of the ecosystem, to serve as a basis for the conservation of Antarctic marine living resources;
- to distinguish between changes due to harvesting of commercial species and changes due to environmental variability, both physical and biological.

9. When necessary the meeting divided into a subgroup on predators (Chairman, Dr J. Bengtson) and a subgroup on prey and environment (Chairman, Dr I. Everson). A workshop on telemetry and remote sensing was convened on 11 June and discussion was led by three invited experts, Drs G. Feldman (satellite remote sensing), R. Hill (systems design) and L. Kuechle (telemetry and tracking). The results of the work of these subgroups and the workshop is presented in the main body of this report.

MONITORING OF PREDATORS

Background

10. A suite of life history and behavioural parameters of predators which potentially could be monitored to provide indices of change in important aspects of structure and processes in the Antarctic marine ecosystem were identified at the 1985 Seattle meeting of the CCAMLR Ad Hoc Working Group on Ecosystem Monitoring (SC-CAMLR-IV, Annex 7). This meeting also received input from the SCAR Group of Specialists on Seals, the BIOMASS Working Party on Bird Ecology (now the Sub-Committee on Bird Biology of the SCAR Working Group on Biology), and the Scientific Committee of the International Whaling Commission.

11. At its 1986 meeting in Hamburg, the Working Group for CEMP defined a number of parameters of potential use in monitoring programs (SC-CAMLR-V, Annex 6, Table 2) and various programs of directed research required to assess the utility of potential monitoring parameters (SC-CAMLR-V, Annex 6, Table 3).

12. Following that meeting, the Scientific Committee requested the SCAR Group of Specialists on Seals and the Subcommittee on Bird Biology to provide advice on the precise

sampling methodology and sample sizes required for the effective monitoring of the identified parameters, including information on the timing of investigations and the minimum time required to establish adequate base-lines of the parameters.

13. Detailed advice including sampling methodology, was provided by the Sub-Committee on Bird Biology (WG-CEMP-87/5). Members of the SCAR Group of Specialists on Seals who attended this meeting provided information on parameters relating to the Antarctic fur seal, *Arctocephalus gazella*. In addition it was noted that during the past year further evaluations had been carried out on some of the predator parameters identified for monitoring in the 1986 Report of the Working Group for CEMP (SC-CAMLR-V, Annex 6, Tables 2 and 3). Relevant papers were tabled at the present meeting regarding seabirds (WG-CEMP-87/13), fur seals (WG-CEMP-87/14) and minke whales (WG-CEMP-87/18).

Objectives

14. The main objectives of the discussion on predators were:

- (a) to undertake a critical review of the parameters for which data have been presented and/or analysed and for which standard method sheets have been prepared, and
- (b) to make specific recommendations for monitoring activities which could be started now.

Review of Predator Species and Study Sites

15. The species and sites already recommended by the Working Group for monitoring studies were reviewed. The only change to the recommended predator species for monitoring was the addition of the Cape petrel *Daption capense*, a species which is accessible for study on the Antarctic Peninsula and which appears to have a similar ecological role to the Antarctic petrel, *Thalassoica antarctica*, in the Prydz Bay region.

16. The Working Group accepted the monitoring sites identified at the 1986 meeting of the Working Group with some slight modification. Recent information (e.g. WG-CEMP-87/6 and WG-CEMP-87/7) warranted inclusion of additional land-based sites for predator

monitoring within integrated study areas (see Table 1), and accessory network sites (see Table 2).

Review of Parameters

17. In conducting its review of predator parameters, the subgroup felt that in order to recommend that routine monitoring of specific parameters could and should start now, the following criteria had to be satisfied:

- (a) existing (and available) data on intra- and inter-annual variation are adequate to demonstrate that the parameter has appropriate sensitivity for detecting significant changes, at least in the medium term (i.e. 5–10 years) and to allow specification of appropriate sample sizes,
- (b) appropriate methods already exist for implementing monitoring at recommended filed sites, using the specified sample sizes, and
- (c) an agreed, specific, methodology has been (or can be) prepared to ensure that data collected at different sites and between seasons are comparable.

18. Parameters meeting these criteria are presented in Table 3; those requiring further evaluation (directed research) are presented in Table 4. Additional directed research projects needed to provide background information to enable interpretation of variability in monitoring parameters are presented in Table 8. Instances where technological developments are essential to, or would improve, data collection are indicated in Tables 3, 4 and 5. Further comments on the need for automatic data gathering and analysis, telemetry, satellite-linked instrumentation, and remote sensing are reported elsewhere in this report (see paragraphs 40–50). Further consultations with the SCAR Group of Specialists on Seals, Sub-Committee on Bird Biology and Scientific Committee of the International Whaling Commission may be appropriate for some parameters.

19. A number of parameters identified at the 1986 Meeting of the Working Group for potential immediate use in monitoring programs (SC-CAMLR-V, Annex 6, Table 2) failed to meet the criteria for recommending them for routine monitoring at this time. The situation arose because:

- (a) existing data were inadequate for critical evaluation, or

- (b) adequate data exist but they have not been evaluated, or
- (c) vital technological and/or methodological developments are required.

20. The following parameters have now been re-assessed as requiring further evaluation before they can be recommended for routine monitoring:

- (a) Demographic parameters for penguins (e.g. adult survival, age of first breeding, cohort strength). Some adequate data exist but they require further analysis to assess their sensitivity and utility for routine monitoring operations;
- (b) Penguin weight at fledging and the weight of macaroni penguins before moult. Insufficient data currently exist to evaluate these parameters adequately.
- (c) Demographic parameters for crabeater seals (e.g. reproductive rate, age at sexual maturity, and cohort strength). These parameters require further analysis to assess their sensitivity and utility for routine monitoring operations.
- (d) Body condition (blubber thickness) of crabeater seals. The potential utility of this parameter requires additional evaluation, particularly in respect of data recently collected on crabeater seals from the Balleny Islands area (as reported by the USSR representative).
- (e) Minke whale parameters. The utility and desirability of routinely monitoring these parameters needs to be clarified. To resolve these questions, analyses of existing and possibly new data should be carried out. It was agreed that the Working Group would await the results of further analyses and advice from the IWC Scientific Committee before considering further action.

It was emphasised that directed research on the parameters listed in Table 4 has high priority and should accompany the routine monitoring activities recommended in Table 3.

Conclusions and Recommendations

21. The parameters now meeting the criteria for recommendation for routine monitoring activities are summarised in Table 3; detailed standard method sheets are provided for each of these parameters in Appendix 4. The Working Group noted that where resources and/or

logistics were limiting, priority should be given to monitoring penguins and Antarctic fur seals before flying birds. In addition, certain parameters (indicated in Table 3) should be given priority. Land-based sites within the CCAMLR integrated study areas should be given priority over network sites in the establishment of monitoring programs in the near future. The above priorities reflect the Working Group's desire to initiate integrated predator/prey/environment studies of comparable time series.

22. The Working Group noted the importance of standardising the collection of predator monitoring data by following the approved methodologies. Members must be aware that it is essential for their monitoring activities to address the specified parameters in the manner outlined in the CEMP standard method sheets. It was recognised that some modification of the methodologies may be necessary to adapt them to special circumstances and new developments at certain localities; however, national scientists should not modify the methodologies until the Working Group has been consulted.

23. The Working Group recommended that:

- (a) monitoring of the predator parameters listed in Table 3 should start now at as many sites as possible in the three integrated study areas and associated network sites,
- (b) this work should be carried out as specified in the standard method sheets, particularly with respect to sample sizes. It was stressed that programs which did not meet these criteria could not be recognised as part of routine monitoring activities of the CEMP, and
- (c) in order to determine how much of this work is currently taking place, or is proposed to commence in the future, all Members should be requested, as a matter of the highest priority, to report to the CCAMLR Scientific Committee prior to the 1987 annual meeting on existing monitoring activities (including the dates when activities started) and planned activities (including the proposed commencement dates).

24. The Working Group identified a number of important topics for directed research which would provide essential background information to the interpretation of changes in predator parameters being monitored. These research topics are summarised in Table 8.

25. The Working Group recommended:

- (a) that appropriate directed research should be carried out as a matter of priority within national programs to further evaluate the potential utility of identified monitoring parameters,
- (b) that Members already undertaking or planning to start such directed research should be requested to report their activities and plans to the CCAMLR Scientific Committee, giving details of the nature, areas, and time-scale of these operations, and
- (c) that the results of further evaluations and technological developments should be presented to the Working Group for CEMP as soon as possible and, where appropriate, with draft method sheets.

26. It was noted that rapid technological advances in the electronics and remote sensing fields are likely to provide major benefits to studies of Antarctic predators and their interactions with prey and other environmental features (paragraphs 34–53).

27. Therefore, the Working Group recommended that Members be encouraged to incorporate technological developments (e.g. telemetry, satellite-linked instruments, archival tags, individual identification methods) into their directed research programs (Table 4 and 8) wherever possible, and into routine monitoring activities (Table 3) as recommended in the standard method sheets.

MONITORING OF PREY

28. Taking account of the criteria for selection of parameters outlined in the Report of the Working Group's first meeting in Hamburg (SC-CAMLR-V Annex 6, Paragraphs 28–35), the Group reviewed the various methods and parameters which had been identified at that meeting as being useful for monitoring prey variables, particularly krill (see SC-CAMLR-V Annex 6, Table 5).

29. Some changes were made and the revised table of methods and parameters which could be utilised in monitoring rates of change in abundance and distribution of selected prey species is presented as Table 5. The following important additions were made to the studies that can be implemented immediately:

- (a) The inclusion of an additional spatial category to encompass problems associated with the global (greater than 1000 km) distribution of krill. This was considered to be important more for reflecting gross changes in krill distribution than the relative changes in krill abundance.
- (b) A separate consideration of relative and absolute changes in krill abundance. For the former, additional estimation methods which could be utilised include monitoring certain properties of predators feeding on krill (e.g. seabirds, WG-CEMP-87/9) and the deployment of moored systems (including sediment traps to monitor faecal pellet and moult fall-out from krill).
- (c) The methods which could be utilised in monitoring rates of change in abundance and distribution of *Pleuragramma antarcticum* and early life-history stages of other fish species. Given the relatively poor state of knowledge concerning these groups, it was agreed that all the methods outlined in Table 5 should be considered as requiring further research. Current efforts to relate size to age in *P. antarcticum* should be encouraged.

Studies included in the table but not highlighted for immediate implementation were recognised as requiring further research before effective implementation of field monitoring activities could be undertaken.

30. Net haul and acoustic techniques have been developed to an extent where they could be used in studies monitoring krill. Further research, however, needs to be undertaken on survey design before routine monitoring should commence. Further research is also required on all other techniques of krill sampling before implementation of other field monitoring activities should be considered (see paragraphs 62 and 63).

31. It was agreed that detailed definition and standardisation of methods is essential before any of the methods outlined in Table 5 are implemented.

32. The Group recognised that modelling of important aspects of prey distribution and behaviour may facilitate the definition and standardisation of methods and could be useful in the definition of ecosystem functioning in future.

33. The Group reviewed the environmental variables thought to be important in assessing predator-prey interactions as well as predator and prey dynamics separately (SC-CAMLR-V

Annex 6, Table 6). A revised list of important environmental variables for which monitoring should be commenced as soon as possible is presented in Table 6.

34. Discussion of elements contained in both Table 5 and Table 6 focused on attempts to resolve major questions on monitoring which have been addressed since the Group's last meeting. The Group's attention was drawn to documents WG-CEMP-87/5 (Data and methodological requirements for CEMP: seabird parameters) and WG-CEMP-87/17 (Initiation of United States participation in the CCAMLR Ecosystem Monitoring Program). At the request of the meeting, a further paper was submitted by Dr Sherman entitled 'Some observations on logistics associated with the United States contribution to the CCAMLR Ecosystem Monitoring Program' (WG-CEMP-87/22).

35. Discussion of the USA program drew attention to the importance of ensuring adequate co-ordination and integration of various monitoring programs for prey species in the integrated study areas, and it was agreed that the Group should review such programs annually. Reporting of such activities should be included in the Reports of Members' Activities in the Convention Area.

36. Following the presentation of Dr Feldman's paper in the Workshop on Remote Sensing and Telemetry (see paragraphs 51 to 54) the Group recognised that there exists a vast amount of imagery and data derived from various satellite missions. These could provide valuable information on environmental variability in the Southern Ocean and particularly in the integrated study areas and network sites (see Table 8). It was agreed that the Convener should write to NASA thanking them for Dr Feldman's participation in the Meeting. The letter should also indicate that individual scientists within the group had made arrangements to submit data to Dr Feldman for comparison with relevant satellite derived data sets. The results of this work would be reviewed at the next meeting of the Working Group to further assess the potential contribution of satellite derived data to the CEMP.

WORKSHOP ON TELEMETRY AND REMOTE SENSING

37. The principal objective of the workshop was to obtain a detailed appraisal of currently available techniques as well as pertinent future developments in the field of telemetry and remote sensing.

38. The presentations of Dr R. Hill and L. Kuechle focused on various systems currently being used or being developed for remote monitoring of various animal species. The two

detailed papers (WG-CEMP-87/15 and WG-CEMP-87/16 respectively) were discussed at some length.

39. The Group agreed that the monitoring of several predator parameters identified as key elements and/or potentially valuable elements in the CEMP will require the utilisation of telemetry or other technology. In some cases, the technology will facilitate the collection of data (which could be collected manually if necessary) while in other cases the technology is essential for data collection. Other technological systems will facilitate sample analysis.

Radio Telemetry

40. Radio frequency transmitters used with scanning receivers and data loggers will be necessary to gather information on the duration of foraging trips and attendance cycles of penguins. It would be logistically difficult to gather sufficient data accurately in any other way. These parameters/species have been identified as particularly important in the CEMP (Table 3). The necessary technology for such monitoring has been developed and has been satisfactorily field tested.

41. Telemetry will greatly facilitate and improve the accuracy of measuring the duration of penguin incubation shifts and of fur seal foraging trips and attendance cycles - parameters which otherwise could only be monitored with difficulty. Another parameter - survival of fur seal pups (which requires further research to evaluate its utility) - will likely be greatly facilitated by telemetry. Radio telemetry is also essential for studies of seals' and penguins' foraging areas if this work is carried out from ships. Automatic direction-finding equipment would greatly enhance such tracking studies. Recent developments in programmable transmitters that transmit during specific periods of the season in one or several years (thus saving battery-capacity) may be useful in long term studies of foraging ranges, especially for smaller species.

Archival Tags* and Recorders

42. Time/depth recorders will enhance the ability to investigate the at-sea diving behaviour and activity patterns of predators. Various instruments have been used in the past on seals and penguins, and newly improved and miniaturised units may open new options for

* An archival tag is any recorder which has to be physically retrieved from the animal in order to get the recorded data.

monitoring activities and for directed research. Further development and refinement of digital instruments for use on Antarctic seals and penguins are currently underway.

43. An archival tag currently being developed for tuna in the eastern tropical Pacific Ocean will reportedly be able to record the geographic location of individual fish. Such tags may be useful in studies of Antarctic predators.

Satellite Linked Instruments

44. The use of satellites will likely make it feasible to determine seasonal changes in predator movements, foraging areas and diving/feeding behaviour. Such knowledge will be essential for interpreting patterns in monitored parameters, and for relating these patterns to data on prey availability. At present, studies using prototype satellite-linked instruments on crabeater seals are underway. These studies have indicated promise for this technology. However, additional developmental work is needed, particularly with regard to size, durability and attachment of such instruments to the animals before potential monitoring parameters can be identified and evaluated. It was noted that the size of these instruments may preclude their use on penguins in the foreseeable future.

45. The use of satellite platforms to store and repeat data from transmitters in nearby (20-30 km) areas may be an alternative to direct location by satellite for smaller species. This technique may also be combined with the use of archival tags.

Automatic Data Collection

46. A device to gather and log data automatically would greatly facilitate monitoring three important parameters of penguins - adult weight at arrival, fledging weight and, for macaroni penguins, adult weight at moult. These parameters can currently be measured only through a major field program. The desired automated device will require simultaneous photo-identification of individuals to allow the accurate interpretation of arrival and fledging weight in mixed-species colonies. The required separate pieces of hardware for such an automated device are available but have not been assembled or field tested as a unit.

Automatic Sample Analysis

47. Automatic image analysis may facilitate the sorting and characterisation of prey collected from predators and net-hauls.

48. A digital image analyser may facilitate and increase the accuracy of reading growth layers in whale ear plugs. An accurate evaluation of these samples is critical to interpreting the apparent trends in age at sexual maturity of whales over past decades as indicated by analyses of ear plugs.

Remote Sensing

49. The interpretation of several predator parameters will require information on the location, characteristics and density of pack ice, the location of oceanographic fronts, and shifts in relative productivity of waters within and between years. Data should be made available for areas within 300 km of study sites during the period when predator monitoring and directed research activities are underway (Table 8). Satellite imagery may be able to provide much of this information. The utility of images integrated over a variety of time-scales should be evaluated. It was acknowledged that images integrated over weekly time-scales may be sufficient.

50. The assessment of long-term trends in the size of penguin colonies on a regional scale may be feasible using satellite imagery. Further work is required, and is underway, to evaluate the feasibility of this technique. Regional trends in population size would assist the interpretation of changes in monitored parameters.

51. Dr G. Feldman (NASA, Goddard Space Flight Center, Washington D.C., USA) presented a review of the goals and objectives of NASA's Oceanic Processes Program with specific emphasis on the remote sensing component of the Program (WG-CEMP-87/20). In addition, a summary of the status of current and proposed satellite remote sensing missions by the United States and other nations was given. Several background documents (see Appendix 3) were presented to the Working Group to serve as technical reviews of the methods and applications of satellite remote sensing techniques. Attention was drawn to the applicability of satellite observed sea-ice distribution and characteristics (see background documents 11–13, 15 and 20). Particular emphasis was given to the current efforts to produce global-scale maps of phytoplankton concentration and distribution with data acquired by the

Coastal Zone Colour Scanner (CZCS). The opportunity for using these satellite ocean colour estimates in the proposed Ecosystem Monitoring Program was discussed.

52. It has been demonstrated that near-surface phytoplankton pigment concentrations can be derived from CZCS data with an overall accuracy of 35–50%. Effort to relate these fields to primary productivity of areas are very promising.

53. A full description of the global CZCS processing program and the archiving and availability of this data set is given in background document 28.

54. The potential for fine-scale resolution work in the Southern Ocean using the above technique was highlighted. Dr Feldman stressed that if this was to be effectively achieved, an interactive association between the Working Group and the Goddard Space Flight Center should be developed (see paragraph 36).

THEORETICAL ASPECTS AND PILOT STUDIES IN ESTABLISHING PREDATOR–PREY RELATIONSHIPS

55. Discussions were held to identify problems associated with interpreting the cause of any significant changes detected in parameters of predators. The nature of these problems was illustrated schematically in WG-CEMP-87/21. This scheme concentrates on krill-predator interactions because krill are the only harvested or harvestable prey species for which there are at present predator species suitable for monitoring.

56. It was recognised that from a theoretical point of view, a comprehensive study of the various selected systems should evaluate all their constituent elements. However, for practical reasons, the Group agreed that the CEMP would have to be restricted to trophic interactions in which krill predominates.

57. The steps involved in investigating the key interactions in WG-CEMP-87/21 were discussed. One requirement was to undertake sensitivity analyses of predator parameters both in respect of sample size and in relation to detecting responses to various types and levels of environmental change, including harvesting. Possible data sets for such an investigation include those used to prepare the papers WG-CEMP-87/13, WG-CEMP-87/14 and WG-CEMP-87/18.

58. It was agreed that prior to defining the specific goals of such sensitivity analyses, further detailed discussions were necessary. Members were urged to give consideration to this matter with a view to making further progress at the next meeting of the Scientific Committee.

59. With respect to the initiation of case history studies of suitable existing data sets, the Group noted recent progress in the effective categorisation of other large marine ecosystems. While recognising the potential utility of identifying critical forcing mechanisms to typify certain Antarctic systems, the Group appreciated that this would be difficult because of the present scarcity of data. For this reason, case-history studies in small defined regions may provide useful information. The Group agreed to keep the matter under review.

IMPLEMENTATION AND CO-ORDINATION

60. The Group re-emphasised the importance of standardising methods and procedures used in monitoring. In addition, the Group noted that there would be benefit in co-ordinating the activities of Members monitoring predator-prey interactions in the same integrated study areas or sites. With regard to prey monitoring, it was agreed that little progress would be made unless surveys were undertaken as multi-nation co-ordinated activities. It was noted that progress had been made in the implementation and co-ordination of routine predator monitoring activities by the development of standard methodologies.

61. A variety of sampling techniques for assessing krill distribution and abundance are currently in use, and despite considerable effort in the BIOMASS program towards developing standard techniques, and acknowledgment of their importance by Members, little progress in this area has been achieved.

62. The Group agreed that standardising krill methods for use in the integrated study areas was essential. Dr Everson agreed to co-ordinate the preparation of suitable survey designs focusing on the three integrated study areas with the aim of making drafts available for discussion at the 1987 meeting of the Scientific Committee. The methodologies should then be further developed to include standardisation of net, hydrographic and hydroacoustic sampling techniques so as to form the basis for discussion on the standardisation of data collection as a priority item at the next meeting of the Working Group. In this connection, the Group noted the importance of studies being planned for the forthcoming Antarctic summer in which problems of effective intercalibration of different net types were being addressed.

63. Consideration was given by the Group to experiments designed to identify a suitable sampling system for the standardised monitoring of krill abundance. Several Members have expressed interest in pooling their efforts to conduct experiments quantifying the effect of avoidance and selectivity of different net systems towed at various speeds and under a variety of environmental conditions. The Group reviewed the results of recent studies (BIOMASS 1981; Czubeck 1981; Everson and Bone 1986; Klages and Nast 1981; and Siegel 1986) and concluded that it would be inappropriate to designate an interim standard system. It was agreed, however, to encourage the rapid progress of studies on developing a standardised methodology to measure changes in krill abundance and availability to predators. These studies should be based on an integrated sampling strategy using acoustics, nets and predators. A summary of planned national activities in the forthcoming season is given in Table 1. The Group agreed that this summary should be updated as additional information is received by Members not represented at the Working Group meeting. In an effort to obtain maximum benefit from net sampling efficiency studies, it was agreed that K. Sherman (USA) would co-ordinate such studies through correspondence with the principal scientists identified in Table 7 prior to the implementation of the field operations. Draft plans of net sampling efficiency experiments will be distributed to members of the Working Group for CEMP for review and comment. Appropriate adjustments to sampling schedules will then be made.

64. The Group agreed that an effective system of control and review of monitoring activities will be necessary. In the early stages of the Monitoring Program, such a system would function more in the development of suitable methods and data analysis techniques. As the Program develops, the emphasis would shift to the interpretation of the data accrued as a result of field monitoring activities. It was therefore agreed that the Group will annually review monitoring and directed research activities carried out by Members.

65. It was also agreed that Members will provide data reports and summaries of monitoring activities in advance of the next meeting of the Working Group for CEMP. The development of suitable reporting formats and the effective archiving of such information will have to be developed as activities increase. At present, the format of the Report of Members' Activities in the Convention Area and individual detailed papers on specialist topics appear to be sufficient.

66. In all respects, the Group recognised that reporting of monitoring activities and the submission of field data should be separate. With respect to the submission of field data, a need to develop standardised formats for the presentation of new data may be necessary. The Group did not envisage that such data would have to be archived in one central database. An

informal discussion will be held during the next meeting of the Scientific Committee to advise the CCAMLR Data Manager of requirements of centralised data storage.

67. It was recommended that Members' reports on monitoring activities should contain adequate descriptions, summaries of available data and where such data are housed or can be accessed. This information would be archived by the Secretariat.

Protection of Monitoring Sites

68. The need to provide protection from human interference at monitoring sites was discussed. The Group noted that the CCAMLR Convention (Article IX paragraph 2 subparagraph (g)) provides for the establishment of protected areas for scientific research purposes and conservation and that the Antarctic treaty has established a system for protecting particular sites. The Scientific Committee's attention is drawn to this matter.

Next Meeting

69. It was agreed that the Working Group would need to meet at approximately the same time next year. In addition to reviewing reports of monitoring activities undertaken in the 1987/88 season, matters to be discussed include the following which have been raised at the present meeting:

- review of monitoring programs (paragraph 35) and directed research carried out by Members with emphasis on methods (paragraph 22) and data analysis (paragraphs 64 and 66);
- co-ordination and integration of programs (paragraphs 35 and 60);
- review of utility of case-history studies (paragraph 59).

CLOSE OF MEETING

70. The report was adopted and the meeting concluded at 1730 hours on 15 June, 1987.

71. The Convener thanked the invited experts, the Chairmen of the Sub-Groups and especially the Rapporteurs for their efforts. He also expressed the Group's appreciation to Prof. J.-C. Hureau for hosting the meeting and to the staff of the Muséum National d'Histoire Naturelle for their assistance.

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SUMMARY OF RECOMMENDATIONS

The Working Group for the CCAMLR Ecosystem Monitoring Program recommended:

Paragraph 23

(a) monitoring of the predator parameters listed in Table 3 should start now at as many sites as possible in the three integrated study areas and associated network sites, Rec. 1

(b) this work should be carried out as specified in the standard method sheets, particularly with respect to sample sizes. It was stressed that programs which did not meet these criteria could not be recognised as part of routine monitoring activities of the CEMP, Rec. 2

and

(c) in order to determine how much of this work is currently taking place, or is proposed to commence in the future, all Members should be requested, as a matter of the highest priority, to report to the CCAMLR Scientific Committee prior to the 1987 annual meeting on existing monitoring activities (including the dates when activities started) and planned activities (including the proposed commencement dates). Rec. 3

Paragraph 25

(a) that appropriate directed research should be carried out as a matter of priority within national programs to further evaluate the potential utility of identified monitoring parameters, Rec. 4

(b) that Members already undertaking or planning to start such directed research should be requested to report their activities and plans to the CCAMLR Scientific Committee, giving details of the nature, areas, and timescale of these operations,

Rec. 5

and

- (c) that the results of further evaluations and technological developments should be presented to the Working Group for CEMP as soon as possible and, where appropriate, with draft methodological protocols.

Rec. 6

Paragraph 27

Members be encouraged to incorporate technological developments (e.g. telemetry, satellite-linked instruments, archival tags, individual identification methods) into their directed research programs (Tables 4 and 8) wherever possible, and into routine monitoring activities (Table 3) as recommended in the standard method sheets Rec. 7

Paragraph 67

Member reports on monitoring activities should contain adequate descriptions, summaries of available data and where such data are housed or can be accessed. This information would be archived by the Secretariat.

Rec. 8