ECOSYSTEM MONITORING AND MANAGEMENT

6.1 The sixth meeting of WG-EMM was held at the Hotel Caparena, Taormina, Sicily, Italy, from 17 to 28 July 2000, the second time a SC-CAMLR working group had met in Italy. The Scientific Committee thanked the host of the meeting, Prof. L. Guglielmo, for an efficient and friendly meeting, and the Convener, Dr Hewitt, for chairing the meeting.

Environmental Variables

6.2 The Scientific Committee noted the observations of WG-EMM on spatial and temporal variations of the physical environment (Annex 4, paragraphs 3.27 to 3.44) and encouraged further work to quantify environmental variability. It looked forward to seeing further results on how the environment changes on different time scales.

Ecosystem Analysis

6.3 The Scientific Committee noted the continuing work of WG-EMM to develop Combined Standardised Indices (CSIs) with the objective of combining various CEMP indices (Annex 4, paragraphs 3.45 to 3.47, 3.50 and 3.51). The Scientific Committee endorsed the workplan of WG-EMM in the further development of CSIs (Annex 4, paragraph 3.51).

6.4 The Scientific Committee welcomed the method for assessing krill consumption by predators (Annex 4, paragraphs 3.48, 3.49 and 4.30 to 4.32) and noted that, inter alia, such assessments are sensitive to the estimates of abundance of predators and metabolic rates.

Ecosystem Assessment

Krill-centred Interactions

6.5 The Scientific Committee noted the work of WG-EMM to organise its review and discussion of the working papers available to it around the following questions:

- What is the interaction between krill distribution and oceanography? What are the implications of geographical distribution for assessing which sections of the krill population are being exploited by the fishery and predators? (Annex 4, paragraphs 4.2 to 4.9).
- What are the implications of apparent lack of krill recruitment at the Antarctic Peninsula for predators and the fishery? (Annex 4, paragraphs 4.10 to 4.13).
- Is there evidence of long- or short-term changes in the diets of krill predators that might suggest changes in the ecosystem or in krill availability? (Annex 4, paragraphs 4.14 to 4.22).
- Is there evidence of long- or short-term changes in the populations of krill predators that suggest changes in the ecosystem? (Annex 4, paragraphs 4.23 to 4.28).
- What are the impacts of predators on krill populations? (Annex 4, paragraphs 4.29 to 4.32).
- What is the distribution of predators relative to krill? (Annex 4, paragraphs 4.33 to 4.36).

- Can data from *C. gunnari* be incorporated into the CEMP time series to be used in ecosystem assessments? (Annex 4, paragraphs 4.38 to 4.40).

- How can empirical functional relationships between krill and predators be used to provide advice and what actions need to be taken with respect to the fishery? (Annex 4, paragraphs 4.41 to 4.44).

6.6 The Scientific Committee recognised that these questions are broad and some of the responses and conclusions preliminary, and requested WG-EMM to consider how to tackle these questions in a way that assists the work of CCAMLR.

6.7 Dr Everson elaborated on the report of WG-EMM regarding the status of *Notothenia rossii* in the Convention Area (Annex 4, paragraph 4.26). He indicated that the stocks of this species have been depleted in Subareas 48.1 and 48.3 and in Division 58.5.1. The overfishing that led to this decline occurred prior to CCAMLR and a lack of recovery of this species should not be construed as a failure of CCAMLR.

6.8 The Scientific Committee considered that the example of *N. rossii* indicates that the depletion of longer-lived Antarctic fish species to low levels may result in species being unable to recover to pre-exploitation levels in two to three decades as indicated in Article II of the Convention. Such a situation needs to be avoided in current fisheries in order to meet the objectives of the Convention.

6.9 The Scientific Committee endorsed the work to develop the *C. gunnari* condition index (Annex 4, paragraph 4.40), including addressing the questions:

(i) What is the linkage between *C. gunnari* and krill?
(ii) What density of krill is optimal for feeding *C. gunnari*?
(iii) How can data be collected regularly from both *C. gunnari* and krill to address the above questions using fish surveys and the fishery?

6.10 The Scientific Committee agreed that this work should be integrated into other ecosystem work of WG-EMM. Such questions are important and should be addressed for other krill predators in integrated study regions. It would also be of value to explore these issues in relation to the functional relationships between predators and krill.

Fish and Squid-centred Interactions

6.11 The Scientific Committee noted the issue that krill-centred interactions cannot be viewed in isolation from interactions with other components of the ecosystem. The issues raised about *C. gunnari* as a predator of krill also raised the issue that *C. gunnari* are themselves prey for land-based predators such as fur seals. This complexity needs to be considered in the future development of management procedures for these fisheries (Annex 4, paragraph 4.45).

6.12 The Scientific Committee noted discussion on fish and squid-centred interactions including:

- the role of myctophids as alternative prey to krill (Annex 4, paragraph 4.46);

- the implications of studies of the diet of squid and fish predators for ecosystem assessment (Annex 4, paragraphs 4.47 to 4.51); and

- status and trends of squid and fish predators (Annex 4, paragraphs 4.52 to 4.61).

6.13 The Scientific Committee noted that studies on the Antarctic shag detailed in the report of WG-EMM (Annex 4, paragraphs 4.48 to 4.50) are not new but have been going on for a number of years. Studies on the diet of this species have included a standard method implemented by WG-EMM in 1997 for a testing period of five years.

Status of the Krill-centred Ecosystem

6.14 The Scientific Committee noted the assessment of the krill-centred ecosystem by WG-EMM (Annex 4, paragraphs 4.67 to 4.85). The current year was not particularly unusual. It also noted that updated CSIs for several land-breeding krill predators at Bird Island were reviewed by WG-EMM. These indices did not vary significantly from the average values during 1999 or 2000. However, the indices did not reflect low breeding population sizes observed in 2000, which were likely to have been influenced by conditions prevailing during the previous winter. The indices presented are most likely to reflect the food supply during the summer concurrent with the breeding season. This latest analysis shows that 1984 and 1994 were years with particularly low predator performance in Area 48 followed by 1991 and 1978.

6.15 Prof. Croxall clarified Annex 4, paragraph 4.74, that while there may be no indications at present that low krill abundance may be affecting predators in Subarea 48.1, there is evidence from elsewhere that reproductive success in predators can be affected by periods of low krill availability.

Further Approaches to Ecosystem Assessment

6.16 The Scientific Committee noted the extensive discussions on advancing the ecosystem approach to management through the development of management procedures for krill, elaboration of objectives for predators and the consideration of how to implement management measures at spatial scales smaller than statistical units (Annex 4, paragraphs 4.86 to 4.117). It welcomed the progress made in determining key issues to be pursued in the near future and noted that it will take another five to 10 years to develop a management procedure for krill fisheries.

6.17 The Scientific Committee endorsed the use of Figure 1 of the report of WG-EMM (Annex 4, paragraph 4.102) as a conceptual framework for considering the development of a management procedure by WG-EMM. This is included in this report as Figure 1 and shows the relationships between the different types of information and assessments that are pertinent to the different spatial scales of conservation measures. The Scientific Committee encouraged further development of elements of this framework in WG-EMM.

Future Work

6.18 The Scientific Committee noted the future work identified by WG-EMM (Annex 4, paragraphs 4.118 to 4.137). In so doing, it noted the importance of interactions with other scientific organisations and resource managers.

6.19 The Scientific Committee noted the request by the University of British Columbia (UBC), Canada, for the CCAMLR Data Manager to participate in training and a scoping study of an ECOPATH-based model of the Southern Ocean ecosystem in November 2000 (Annex 4, paragraphs 4.130 to 4.135). Correspondence between the Chairman of the Scientific Committee, Dr Miller, and Prof. Pitcher from UBC was presented in SC-CAMLR-XIX/BG/22.

6.20 The Scientific Committee welcomed the development of ecosystem models of the Antarctic region. It noted that an area of major interest at this time is the consumption of krill on various regional and temporal scales in the South Atlantic region.

6.21 The Scientific Committee endorsed two criteria for examining such proposals in relation to work undertaken by the Secretariat in the future:

(i) Can the work be undertaken effectively by Members at home or in collaboration? and
(ii) Given resource limitations, will the work lead directly to the development of conservation measures?

6.22 The following views were expressed:

(i) The development of an ECOPATH model may help understand the relationships between species and the fishery but is unlikely to facilitate the direct development of conservation measures inside CCAMLR.

(ii) Consideration of these issues and providing for a better understanding of these models would be useful in WG-EMM.

(iii) Members are developing expertise within their countries to use the ECOPATH models.

(iv) The workload of the Data Management section of the Secretariat will be large in the coming year without this additional workload.

6.23 It was indicated that Canada should be encouraged to participate more formally in CCAMLR and bring its expertise with ECOPATH to WG-EMM. It was considered that the development of this expertise within the Secretariat may be beneficial to CCAMLR but for a number of Members it was a low priority at this stage and should follow the initial development of the models by Members. As a result of these differences of view, the Scientific Committee could not agree on supporting the participation of the Data Manager in the training program in November 2000.

Survey of Land-based Marine Predators

6.24 In response to a request of WG-EMM (Annex 4, paragraphs 3.56 to 3.59), Dr Constable reported to the Scientific Committee on correspondence amongst members of WG-EMM and the Scientific Committee on regional surveys of land-based predators, and a future potential synoptic survey of land-based predators (SC-CAMLR-XIX/6). This paper details the nature of the correspondence, the responses of Members to the request, a draft proposal for a survey, issues for consideration in the planning and implementation of a synoptic survey.

6.25 The Scientific Committee noted that a number of Members are currently planning surveys of land-based predators in the Convention Area and that Members supported the development of survey methodologies that would help achieve circum-Antarctic estimates of abundance of land-based marine predators.

6.26 The Scientific Committee agreed that it may be premature at this stage to identify the 2005/06 season as an appropriate time to undertake a synoptic survey. It agreed that a workshop needs to be held in 2002 to review the feasibility of a synoptic survey, survey methodologies and to review the overall requirements for estimating the circum-Antarctic abundances of land-based marine predators. To that end, the Scientific Committee requested that WG-EMM review SC-CAMLR-XIX/6 and develop terms of reference and organisation for an appropriate workshop in 2002.