ECOSYSTEM MONITORING AND MANAGEMENT

9.1   The Science Officer of the Commission introduced document SC-CAMLR-III/BG/4 which summarised points raised in a number of scientific papers on ecosystem monitoring and management, including the development of plans of action, that had been prepared by the Secretariat to facilitate discussions. It was agreed to consider the agenda item under the seven sub-headings listed in this document. At the same time it was emphasised that all national and observer submissions were major contributions in their own right (SC-CAMLR-III/7, BG/1, BG/3, BG/5, BG/7, BG/8, BG/9, BG/12, BG/13, BG/14, INF.6).

Interpretation of the Objectives of the Commission

9.2   It was agreed that there was a need to consider Article II of the Convention in its entirety.

General Concept of Antarctic Ecosystem

9.3   The question of whether the availability of food (and particularly krill – *Euphausia superba*) to higher trophic levels was the major limiting factor in the Antarctic marine ecosystem was considered. There was agreement that there was no simple answer to this question, and that the ecosystem should not be treated globally but rather as a set of smaller subsystems linked not only with each other but also with ecosystems neighbouring the Convention Area. The possibility that different limiting mechanisms might be dominant in these various smaller subsystems was recognised. It was noted that many of the top predators utilised species other than krill, and also that while the food chain might be simple with respect to the small number of species involved, it remained complex as far as their ecological relationships were concerned.

9.4   Three separate biological communities were recognised:

-   the community of the pack ice area;
-   the community of the shelf zone;
-   the community of the open water beyond the shelf zone.

The need to characterise these areas was recognised. It was stressed that a geographical definition for each habitat would not be appropriate, and flexibility should be retained in their

consideration. This in turn implied the need to furnish data on as fine a spatial and temporal scale as possible.

9.5   It was suggested that analysis of tag-recovery data be undertaken in an attempt to ascertain the extent to which top predators are localised in specific areas. The magnitude of migration rates could be important in the design and analysis of possible localised perturbation experiments.

9.6   The question of whether the revised FAO statistical areas (ref. paragraph 6.16) were also to be regarded as 'management areas' was raised. It was considered that the primary basis in specifying the statistical area boundaries had been to ensure recording of data in terms of natural divisions. These might also be considered as a first approximation to management areas, but management considerations had to remain cognisant of the linkages between adjacent statistical areas.

Present State and Existing Trends in the Ecosystem

9.7   The Committee <u>agreed</u> that

a)   as a result of reduced baleen whale stocks, krill availability to other organisms had almost certainly increased (although no direct evidence in this regard existed);

b)   there was little direct but some indirect evidence that non-exploited krill predators (e.g. crabeater seals, penguins) and minke whales may have responded functionally and numerically to this increased krill availability (i.e. the effective carrying capacity for these species might have increased); however the data concerned could be differently interpreted, and the existence of these responses should be considered an open question. Observed increases in the southern fur seal population will include a component due to recovery after previous depletion through exploitation and may not necessarily be related to increased krill availability to any substantial extent. It was noted, however, that some increase in fur seal population levels at South Georgia (and possibly at other Sub-Antarctic islands) could be attributed to enhanced krill availability.

9.8   Greater clarity on whether or not changes in the age-at-maturity of crabeater seals had occurred was recognised as an important need in determining how this species might have

responded to changed krill availability. It was suggested that more regular sampling should be attempted in future to try to resolve this question.

9.9   The potentially critical role of squid in understanding the dynamics of the ecosystem was emphasised. The proportion of krill in the diets of squid varied substantially between species and geographic areas. Recent research results by USSR scientists were summarised, and the hope was expressed that English translations of the relevant research publications would be available in the near future. The Committee noted the availability of a recent BIOMASS Working Party report on squid. In view of the paucity of knowledge on squid, further research in this respect was strongly recommended. It was agreed to include an item on the squid community in the agenda for the meetings of the Scientific Committee in 1985.

Management Approaches

9.10   There was some discussion on the possible approaches for the rational management of Antarctic marine living resources and on the criteria for selecting such management approaches. It was noted that some possible choices would be:

   a.   to prohibit all harvesting and related activities in the Convention Area with the aim of restoring the Antarctic marine ecosystem to a condition perceived to be similar to that which existed prior to human intervention;

   b.   to reduce the abundance of certain krill predators if they are found to be competing with depleted stocks of krill-eating whales, with the aim of facilitating the restoration of depleted whale stocks; or

   c.   to allow rational utilisation of resources that have not been over-exploited, within levels which will ensure that any potential detrimental effects are reversible over two or three decades.

It was agreed that option (c) was the most appropriate and that option (b) would be inappropriate without better information concerning the nature and extent of competition between various krill predators.

9.11   Criteria for selecting management approaches could be: practical possibilities of achievement, risks to the stability and diversity of the system, economic feasibility, and benefits to mankind.

9.12   It was noted that there are still several difficulties at present in developing specific management strategies

-    there are considerable uncertainties on various aspects of the basic structure of the ecosystem (e.g. the relative importance of krill in predator diets);

-    the current status of the ecosystem is unclear;

-    there is a lack of information on the current population trends of a number of species previously reduced by harvesting;

-    we are unable to predict the effects of a total moratorium or of different harvesting strategies on ecosystem dynamics.

9.13   The practicality of determining whether or not only one stable state exists for the unexploited Antarctic marine ecosystem was questioned. It was also suggested that determination of population trends of previously depleted and currently protected baleen whale species would provide information in this regard; possible management responses might need to be considered if such species are still declining.

9.14   It was suggested that an initial coarse management strategy for krill might be based on attempting to ensure that the level of predation on krill by natural predators and man will not exceed that by natural predators in the pristine ecosystem.

Modelling

9.15   Three classes of models were noted:

-    theoretical models, that give insight into the general behaviour of the system, but not quantitative predictions about certain aspects;

-    estimation models that provide quantitative estimates;

-    strategic simulation models that can be used to evaluate strategies for optimal acquisition of information relevant to management decisions.

9.16   Some members considered whole system estimation models might provide useful predictions, but others felt realistic quantitative models of this type would not be available for some considerable time. It was suggested that the manner in which predator dynamics was described in theoretical models merited attention. Strategic simulation model evaluations have emphasised the necessity for strong data 'contrasts' for effective model parameter estimation. This should be borne in mind in considering and developing proposals for experiments under controlled conditions. The relation of reproductive success of shore-based predators to food availability was seen as a likely area of promise for future use of modelling techniques.

9.17   In response to enquiry on what data was most needed for modelling activities, members suggested

-       population sizes and krill consumption rates for the major krill predators;
-       intrinsic growth rate and carrying capacity values for krill.

Indicator Species and Plan of Action

9.18   A strong association was recognised between the need to monitor krill directly and to monitor the status of dependent and related species. The final two agenda sub-items outlined in SC-CAMLR-III/BG/4 were therefore combined for the purpose of discussion.

9.19   The need to focus scientific research objectives on the impact of commercial harvesting (especially of krill) on the Antarctic marine ecosystem as a whole was noted. Documents SC-CAMLR-III/7, SC-CAMLR-III/BG/9 and SC-CAMLR-III/BG/12 were discussed. It was stressed that there was a need to focus attention on assessing variability in the ecosystem and for identifying cause and effect relationships.

9.20   Support was given to the concept of undertaking co-ordinated fishing and scientific research at selected sites in Antarctica. In particular the need for baseline data to assess and monitor the impact of fisheries on krill dependent and related species was stressed. The identification and study of 'indicator' species to monitor ecosystem changes was emphasised.

9.21   Indicator species may be defined as dependent and related species that are likely to reflect changes in the availability of harvested species, especially krill. Dependent and related species were defined as competitors, direct predators, and species indirectly dependent on target species.

9.22   Implementation of a co-ordinated effort to monitor the Antarctic marine ecosystem, both directly and through indicator species studies, was seen as a logical extension of the BIOMASS programme, due to be completed in 1986. It was also considered an imperative pre-requisite to defining interaction effects and hence pre-specifying management conditions.

9.23   It was proposed that an *ad hoc* working group be formed to assist the Scientific Committee in considering, designing and encouraging co-ordinated research of the type outlined in 9.20.

9.24   It was suggested that the terms of reference of the working group should be relatively narrow so as to deal specifically with ecosystem monitoring, assessing the natural variation in the ecosystem and investigating species related to, and dependent on krill. In accordance with the views expressed in 9.20, information accrued on dependent and related species would be complementary to more direct estimations of the effects of exploitation of krill and fish resources.

9.25   It was noted that, in addition to considering matters relating to target species, it is important for the Scientific Committee to address issues concerning non-target species as embodied in Article II of the Convention.

9.26   Unlike harvested species, for which data will be forthcoming from fisheries activities, information on non-target species will require studies specifically designed to provide needed data. Studies of dependent and related species should be considered and recommended to provide an indirect assessment of target species and to monitor the ecological status of non-target components of the marine community.

9.27   An *Ad Hoc* Working Group on Ecosystem Monitoring was formed under the convenership of Dr K. Kerry (Australia). The following objectives and terms of reference were agreed upon:

a)   Review the objectives of ecosystem monitoring and review the life history characteristics of indicator species that are potentially suitable for monitoring studies, bearing in mind potential relationships between selected indicator species and harvested resources (especially krill).

b)   Consider sampling and data collection procedures, including the collection of baseline data, required to detect any effect of fisheries activities on components of the Antarctic marine ecosystem.

c)   Describe the types of studies that would be necessary to evaluate natural variation of relevant variables.

d)   Evaluate and recommend potential monitoring sites and areas.

e)   Consider the utility, feasibility, and design of controlled experiments undertaken in collaboration with fisheries activities to test hypotheses concerning cause/effect relationships and the possible effects of different methods and intensities of fisheries activities on components of the Antarctic marine ecosystem.

f)   Formulate and recommend specific actions for planning and implementing multi-national ecosystem monitoring programs to establish data baselines, monitor indicator species, and undertake controlled experiments.

9.28   It was <u>recommended</u> that the *ad hoc* working group should report back to the next regular meeting of the Scientific Committee. In order to facilitate the working group's task, it was noted that considerable data is available on certain krill-dependent species, some of which could assume indicator status with respect to potential change in the ecosystem. In particular, attention was drawn to the responses of the 'BIOMASS Working Party on Bird Ecology' and the 'SCAR Group of Specialists on Seals' to the questions of the Scientific Committee on indicator species. On behalf of the Scientific Committee the Chairman expressed appreciation for the good cooperation received from both groups.

9.29   It was <u>agreed</u> that an inter-sessional meeting of the *ad hoc* working group would be useful to consolidate its position prior to the 1985 meeting of the Commission. The meeting is scheduled for the week of 6 May 1985. It was gratefully acknowledged that the National Marine Mammal Laboratory of the National Marine Fisheries Service had offered to host the meeting in Seattle (USA). In accordance with sentiments expressed in 9.20 and 9.25, it was agreed that to supplement discussions that will focus on dependent and related species (e.g., pinnipeds and seabirds) it was urged that expert advice on both krill and whales be available at the meeting. The agenda for this meeting was prepared by the Convenor and is attached in Annex 9.