

DEVELOPMENT OF APPROACHES TO CONSERVATION OF ANTARCTIC MARINE LIVING RESOURCES

8.1 Last year, in response to specific questions raised by the Commission, the Scientific Committee identified two broad areas of work in relation to this item on which it intended to concentrate more effort (SC-CAMLR-VIII, paragraph 7.17):

- (a) actual work at assessment level in key areas involving coordination and integration of studies which would enable definition of appropriate management options. An example would be investigation of the krill flux in the South Shetlands/Peninsula area combined with determination of the impact of predators on stocks, leading to drawing up a budget of predator prey interactions; and
- (b) the wider task of evaluating the effectiveness of approaches to management adopted by the Commission in the light of the objectives of the Convention. It was suggested that the fundamental problem is how to deal with the uncertainty in the assessments.

8.2 Further, the Scientific Committee requested its working groups to continue to consider the Commission's questions from CCAMLR-VII (paragraphs 140 to 141), which were concerned with:

- (i) operational definitions of depletion and target levels for recovery of depleted species; and
- (ii) the ability of the CCAMLR Ecosystem Monitoring Program to detect changes in ecological relationships and to recognise the effects of simple dependencies between species, including distinguishing between [the effects of] natural fluctuations and those induced by fisheries.

8.3 The Scientific Committee also agreed to ask the Commission for more specific guidance on the strategic issues on which it would like the Scientific Committee to consider and provide advice (SC-CAMLR-VIII, paragraph 7.19). The Commission did not respond directly to this request, but questions on conservation approaches in relation to the management of krill and finfish stocks were referred back to the Scientific Committee (CCAMLR-VIII, paragraphs 74 to 75, 50 (krill) and 123 (finfish)).

8.4 The Conveners of WG-Krill, WG-CEMP and WG-FSA highlighted the aspects of their groups' reports relevant responses to these questions. These have been considered in the respective sections of the Scientific Committee Report.

8.5 The questions concerning krill, such as potential yield in Subarea 48.3 and possible management measures that would maintain ecological relationships in that area, and other issues in the wider context of approaches to conservation of krill stocks, such as operational definitions of the objectives in Article II, are addressed in paragraphs 2.18 to 2.20 and 2.53 to 2.56. The Scientific Committee has agreed that WG-Krill should investigate these questions further at its next meeting.

8.6 WG-CEMP has continued to make progress on assessing the relevance of CEMP to the work of the Commission (paragraphs 5.3 to 5.7). The Scientific Committee endorsed the conclusion that analysis and evaluation of submitted CEMP data and developments of recommendations based thereon did not require, and should not await, the determination of the precise quantitative nature of predator/prey/environmental relationships.

8.7 The questions that the Commission asked the Scientific Committee dealing with developing fisheries (CCAMLR-VIII, paragraph 123) are pertinent to the development of approaches to conservation in new fisheries. These questions were addressed by the WG-FSA (Annex 5, paragraphs 282 to 294) and the approach suggested by the Working Group was endorsed by the Scientific Committee as being necessary for the management of new and developing fisheries (paragraph 3.91). The Scientific Committee recommends that the Commission take account of this approach in its management of those fisheries.

8.8 An approach for obtaining 'operational definitions for depletion and target levels for recovery of depleted species' was also discussed on the basis of SC-CAMLR-IX/BG/14. This paper illustrated a possible approach that provides an objective basis for setting TACs (probably by-catch limits in practice) for depleted stocks so that there is a high probability of achieving the general objectives set out in Article II of the Convention, i.e., if the 'best' estimate of current stock level is substantially below the greatest net annual increment (GNAI) then a stock is deemed to be depleted and hence fishing mortality must be set at levels which should not preclude stock recovery to GNAI (or other target levels) within two or three decades. A 'best' estimate would be the mean or median of a probability density function which incorporates the uncertainty in the quantities estimated.

8.9 The paper illustrated, in principle, how these catch limits could be calculated such that they have specified levels of probability of achieving the requisite stock recovery. The paper

used three illustrative operational objectives to determine these fishing mortalities that may achieve the requirements in Article II:

- (i) the fishing mortality which results in a specified subjective probability that the stock will not have declined further in 20 years;
- (ii) the fishing mortality which results in a subjective probability that the stock is at or above GNAI (or other target level) in 20 years; and
- (iii) the fishing mortality which results in a specified subjective probability that the stock is above GNAI (or other target level) in 30 years.

8.10 In these examples, the fishing mortalities were calculated using a stock projection program with inputs on stock size, biological parameters and accounting for uncertainty in stock assessment. The by-catch would be set using whichever of these fishing mortalities was lowest. The assessments would be revised as new data become available. Once the procedure has been put into effect the target years for recovery become fixed at 20 and 30 years after that time when the procedure was first begun. Thus, the fishing mortalities specified above have to be calculated using shorter projections as time progresses. The fishing mortalities would also be revised as more information accrues about the status of the stock.

8.11 The Scientific Committee welcomed this type of study and agreed that this approach should be developed further. It was also agreed that such an approach, with modifications, may be useful for taking into account uncertainty when calculating fishing mortalities appropriate for exploitable stocks at all levels of development.

8.12 The USSR Delegation drew the attention of the Scientific Committee to the fact that Soviet scientists have been carrying out studies based on similar principles derived from Prof. Monastirskiy's theory (1928). The fundamental characteristics of these studies are described in SC-CAMLR-IX/BG/14.

8.13 The Scientific Committee noted that the selection of the probability levels in the operational objectives used in this approach (paragraph 8.9) is not purely a scientific question, and hence guidance from the Commission will be required. However, such guidance will be most easily obtained if further analyses on the properties of these definitions and procedures, or others that are suggested, can be carried out so that the Commission has an objective and quantitative basis for selecting management policy parameters.

8.14 The illustrative calculations showed that uncertainty in stock assessment and the relationship between stock-size and recruitment were both very important in determining by-catch limits. In particular, the Scientific Committee noted that:

- (i) the current policy of the Commission to apply $F_{0.1}$ when calculating fishing mortalities may not be appropriate for ensuring the recovery of depleted stocks to the levels envisaged by the Convention within the required time interval. Such a conclusion was also reached by WG-FSA, which considered that fishing mortality of $F_{0.1}$ was too high for depleted stocks of *N. squamifrons* at Ob Bank (Division 58.4.4) (Annex 5, paragraph 2.61), and *P. georgianus* and *C. aceratus* around South Georgia (Subarea 48.3) (Annex 5, paragraph 203); and
- (ii) the fishing mortality which ensures the recovery of a depleted stock becomes less as uncertainty in stock assessments increase.

8.15 The WG-DAC is also considering this year the ways in which scientific evidence is being used by the Commission to aid its decision making. A paper by Australia (WG-DAC-90/5) on this topic was drawn to the attention of the Scientific Committee for consideration.

8.16 The Scientific Committee recognised that one of the major problems it has been facing is how to deal with uncertainty when providing advice to the Commission. The Scientific Committee drew the attention of the Commission to its endorsement of the document by the WG-FSA (paragraph 3.6 of this Report), which analysed the problems of providing stock assessment advice (Annex 5, Appendix D). The main conclusions of this paper are set out in paragraph 3.7 of this Report.