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REPORT OF THE MEETING OF THE WORKING GROUP  
FOR THE DEVELOPMENT OF A CONSERVATION STRATEGY  
FOR ANTARCTIC MARINE LIVING RESOURCES

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FOR ANTARCTIC MARINE LIVING RESOURCES

1. The Working Group for the Development of a Conservation Strategy for Antarctic Marine Living Resources (WGDCS), chaired by Australia, met on 23 and 28 October. The Report of the Sixth Annual Meeting of the Commission lists the following terms of reference for the Working Group (paragraph 107) :

- "1. To develop a common understanding as to the management implications of Article II of the Convention;
2. To develop possible conservation approaches for achieving the objectives of Article II by means contained in Article IX;
3. To select and apply performance criteria for assessing each approach;
4. To identify, for preferred approaches, specific short and long term goals consistent with the objectives of the Convention;
5. To formulate the framework of a strategy for managing activities in order to achieve these goals;
6. To report to the Commission recommending appropriate action.

These are working terms of reference and may be altered as the Group progresses."

2. The Group considered the report submitted by a sub-group of technical experts which met on 20-22 October to formulate advice to the Group on the specification of performance criteria for the evaluation of conservation strategies and related matters (third term of reference). The

Convener of the technical sub-group, Dr G. Kirkwood (Australia) presented the sub-group's report. The Working Group welcomed the report as a useful contribution to its work.

3. In discussion of the technical sub-group's report and last year's consideration of this item, it was noted that the Commission may wish to accord status to paragraphs 114 & 115 of the 1987 Report, subject to refinement as approaches to conservation are developed. In this regard, the Working Group noted the technical sub-group's view that the primary objective of rational use entails harvesting in a manner which ensures that the potential for achieving the highest possible long term yield is preserved, subject to the agreed general principles of conservation.

4. The Working Group agreed, with regard to paragraph 13 of the technical sub-group's report that :

(a) The implementation of Article II 3)b) would be assisted by an operational definition for depletion and for target levels of recovery of depleted populations. In this regard, the Working Group believed that advice from the Scientific Committee on these matters, which would include consideration of the likely range for the level of greatest net annual increment for various major groups of species, would be useful.

(b) It would be useful to have the advice of the Scientific Committee on the ability of the ecosystem monitoring program to detect changes in relationships and also to recognise the effects of simple dependencies between species, including distinguishing between natural fluctuations and those induced by fisheries.

5. The Working Group agreed that it was not practical to assess alternative conservation approaches by using field trials because of the risk of failure to meet the objectives of the Convention, and that modelling will be the most effective way to proceed. It was understood that during the process of evaluating approaches, the development of objectives and performance criteria would continue to evolve.

6. It was recognised that conservation approaches had to consider both short and long time scales. It was noted that, in the short term, the Commission has begun to develop conservation approaches for the management of finfish stocks, with emphasis on those already subject to heavy exploitation; that the framework for assessing the effectiveness of these single species strategies is relatively straightforward; and that such matters are already being addressed by the Fish Stock Assessment Working Group.

7. In an ecosystem context, any approach to conservation needs to take into account the effects of fishing on not only the target species, but also dependent and related species. This makes the development and assessment of its effectiveness more complex. The group agreed that while there is a need to begin development of appropriate approaches to the conservation of ecosystems, the priority for completing this task is lower than that for the finfish stocks.

8. In this context it was agreed that the Antarctic should not be thought of as a single ecosystem, rather it comprises a number of different subsystems. These are subject to widely differing levels of exploitation. This means that while the effects of fisheries have to be considered within the local subsystem in which they take place, there is a need to consider their potential effects within related subsystems.

9. The Working Group discussed the value of obtaining an understanding of the fishing plans of member nations, as outlined in paragraph 28 of the Technical Sub-group's report. Representatives of Japan and the USSR expressed their difficulty in this regard due to some factors which affect long-term plans for harvesting activities. For example, the rate of expansion of Japanese fisheries can be governed by market conditions and the activities of individual fishing companies. In the case of the USSR fishery, even within a season, decisions are made to switch between finfish and krill depending on the fishing conditions within the area. Despite these uncertainties, information of the kind provided is of considerable value in developing, inter alia, predictive rather than reactive approaches to the conservation of krill.

10. The Working Group felt that any additional information concerning plans for fishery development, however uncertain, would be valuable. Furthermore, descriptions of the operational tactics applied to fishing activities would be important in the development and evaluation of conservation approaches. For example, detailed information on the day to day operations of krill trawlers has been found useful in modelling work to evaluate the potential role of catch and effort data in monitoring changes in abundance of krill.

11. There was agreement that work should continue to develop models for the evaluation of conservation approaches (both single and multi-species). This needs to be carried out by Members and by the various working groups of the Scientific Committee. At the same time, it was noted that the priority for this kind of work should be determined in relation to other important tasks such as determining the stock abundance and stock structures for key species in the ecosystem.

12. In reviewing the direction of its work, the Working Group emphasised that full account should be taken of, and duplication avoided with, other work being carried out in the Scientific Committee. It was agreed that the Working Group had an important and continuing role in the development of practical conservation approaches, in accordance with its terms of reference.

13. The report of the technical sub-group is attached.

REPORT OF THE MEETING OF THE TECHNICAL SUB-GROUP  
OF THE CCAMLR WORKING GROUP FOR THE DEVELOPMENT  
OF A CONSERVATION STRATEGY

(Hobart, Australia, 20-22 October, 1988)

The Meeting was held in the CCAMLR Secretariat on 20-22 October, 1988. A list of participants is attached at Appendix 1.

2. Dr Geoff Kirkwood was elected Convener of the Sub-group, and it was agreed that the rapporteurs duties would be assumed by members of the Australian delegation at the meeting.

3. The Convener expressed his understanding that the development of performance criteria involved developing a methodological framework for evaluation of potential conservation approaches. The Group accepted this definition of their task and adopted the agenda attached at Appendix 2.

4. Papers were submitted by technical experts from several CCAMLR Members for the Group's consideration (see list of documents at Appendix 3). It was agreed that these should be used to assist the Group through reference to them where they were relevant to the issues raised rather than considering them individually.

THE DEVELOPMENT OF A METHODOLOGICAL FRAMEWORK FOR EVALUATION  
OF POTENTIAL CONSERVATION APPROACHES

5. The Group accepted, as a working definition, that a conservation strategy incorporates procedures under which conservation measures (for example, catch limits, open and closed seasons) are established, removed or varied. It involves using the information available to assess the state of the resources, from which decisions are made as to what changes in conservation measures are necessary.

6. It was pointed out that the Antarctic should not be thought of as a single ecosystem; rather it comprises a number of different sub-systems. These are subject to widely differing levels of exploitation. This means that the potential effects of fisheries have to be considered in both local and broad geographical scales.

7. It was recognised that a methodological framework had to consider both short and long timescales. In the short term, the Commission has begun to develop conservation strategies for the management of finfish stocks, with emphasis on those already subject to heavy exploitation. The framework for assessing the effectiveness of these single species strategies is relatively straightforward. Such matters are already being addressed by the Fish Stock Assessment Working Group.

8. In an ecosystem context, a strategy has to take into account the effects of fishing on not only the target species, but also dependent and related species. This makes its assessment more complex. The Group agreed that while there is a need to begin development of appropriate strategies for conserving ecosystems, the priority for completing this task is lower than that for the finfish stocks.

#### Information Requirements for Specification of Conservation Strategies, Including Data Inputs and Monitoring

9. The specification of a conservation strategy involves the identification of operational objectives, data inputs and monitoring, assessment procedures and decision rules. For evaluation of a strategy, the decision rules need to be specified in terms of the information inputs and the range of decisions that are possible.

## Preliminary Objectives

10. At its 1987 Meeting, the Working Group for the Development of a Conservation Strategy for Antarctic Marine Living Resources had developed a set of principles of conservation based on Article II of the Convention, and an interpretation of the term "rational use" (CCAMLR-VI, paragraphs 114-115). These were :

"114. The Group noted that, under Article II, the term "conservation" includes rational use. Harvesting and associated activities are to be conducted in accordance with the following principles of conservation :

- (i) maintenance of ecological relationships
- (ii) maintenance of populations at levels close to those which ensure the greatest net annual increment
- (iii) restoration of depleted populations
- (iv) minimisation of the risk of irreverisble change in the marine ecosystem.

115. With these principles in mind, the Working Group felt that rational use involved inter alia the following elements :

- (i) that the harvesting of resources is on a sustainable basis
- (ii) that harvesting on a sustainable basis means that harvesting activities are so conducted as to ensure that the highest possible long-term yield can be taken from a resource, subject to the general principles of conservation above
- (iii) that the cost effectiveness of harvesting activities and their management is given due weight."



11. The Group agreed to adopt as a set of preliminary objectives these general principles of conservation and elements of "rational use". It agreed that they were sufficient for the purpose of evaluating potential conservation strategies.

12. The Group noted that it was not possible to simultaneously satisfy each of the preliminary objectives. Conservation strategies must inevitably involve compromises between the objectives, and an important part of any examination of differing strategies would be a comparison of the extent to which they met the different objectives.

13. The Group then addressed the interpretation of these preliminary objectives in terms which admit assessment of the degree to which they are able to be met.

(i) Maintenance of ecological relationships

The Group agreed that it was difficult to see how to evaluate the extent to which this objective could be met because of the sheer number of species and interrelationships which might be monitored. It is only practical to monitor a small number of these. This matter has been considered by the Working Group for the CCAMLR Ecosystem Monitoring Program and they have drawn up a program for monitoring selected predators which, at this stage, is as comprehensive as practicable. There are plans for the monitoring of prey species and environmental parameters. There remains a need to examine the power of this monitoring program to detect changes in relationships and to recognise the effects of even simple inter-specific dependencies.

The question was raised as to the number of species which would need to be monitored to be reasonably certain that important ecological relationships were being maintained. While it was felt that this required further investigation it was suggested that the largest and smallest species in major groups should be considered.

- (ii) Maintenance of populations at levels close to those which ensure greatest net annual increment (GNAI)

There is a paradox in this objective in that the level of GNAI for a dependent species changes with the level of exploitation of prey species. This has been resolved by interpreting the predator population levels referred to as those which would exist if there were no exploitation of prey. In practical terms these levels can be best assessed from historical levels of abundance.

It was generally accepted that if this objective is achieved then objective (i) would also probably be achieved as a consequence.

The Group agreed that, in general, it is not possible to accurately predict the population level at which GNAI would be obtained, therefore arbitrary working values will need to be chosen for various types of species.

The Group agreed that there was a problem in separating what may be natural fluctuations in dependent populations from changes induced by fishing on their prey. This needs to be addressed.

- (iii) Restoration of depleted populations

The Group identified a number of considerations to be examined in relation to this objective. These were :

- (a) the need for an operational definition of depletion and of a target level for recovery
- (b) the likely timescale of the recovery
- (c) the compromise between the rate of recovery of a stock and the effects of any fishing activities permitted during the recovery period

- (d) the possibility that reducing the abundance of competitors or predators might assist in the recovery of depleted populations.

Assessing the achievement of this objective depends upon some form of monitoring of trends in the abundance of depleted species. It was suggested that in certain instances some level of fishery could assist in monitoring the recovery of a depleted stock.

- (iv) Minimisation of risk of irreversible change in the marine ecosystem

In the Convention, this principle is stated as "the prevention of changes or minimisation of the risk of changes in the marine ecosystem which are not potentially reversible over two or three decades". This suggests that the minimum levels of abundance for various species need to be tied to their dynamics. For example, slow growing populations will take the specified time to recover from levels which are not far below the target levels, while fast growing populations may recover from levels well below target levels over that time. However, in many circumstances, it will be difficult to predict that a population could recover from a given level in the required time.

#### Elements of "Rational Use"

14. The primary objective involving rational use is that of harvesting to ensure that the potential for achieving the highest possible long-term yield is preserved, subject to the above principles of conservation. The Group agreed that assessing the extent to which this objective was met by a proposed conservation strategy was straightforward.

15. With respect to the issue of cost-effectiveness, it was agreed that it was not appropriate to consider the economics of individual fishing operations. However, the costs of management and monitoring, including those related to observation and inspection, must be taken into account in any evaluation of a conservation strategy.

#### Evaluating Performance of Conservation Strategies in Meeting Objectives

16. The Group considered that it was not practical to evaluate conservation strategies by applying them in the field because of the risk of failure to meet the objective should they prove inadequate. The timescale involved could be long and the cost prohibitive. It was therefore agreed that a modelling approach to evaluation will be the most effective.

17. Models appropriate for evaluating conservation strategies for single species fisheries not involving substantial levels of ecological interactions (as currently being applied to fin fisheries in the CCAMLR area) are already in wide use in fisheries science.

18. The types of model required to evaluate conservation strategies for the management of fisheries involving substantial levels of interactions (e.g. krill) are more complex, because of the need to consider dependent and related species from an ecosystem perspective.

19. In any evaluation sub-models are needed to describe :

- the dynamics of the ecosystem or the species;
- the management procedure;
- the fishery; and
- the monitoring process and its results.

20. Most of the discussion focussed on the sub-model dealing with the dynamics of the ecosystem or the species. It was agreed that initial testing on simple models would define the range of potential strategies

suitable for further development. These models can then be made more complex to give more rigorous evaluation. The aim would be to use a diverse range of models to try to develop conservation strategies which are robust, in the sense that they would still meet their objectives when applied to model ecosystems that are radically different. As it will not be known which model best captures the dynamic features of real ecosystems or populations, potential strategies should be tested in as many hypothetical situations as possible.

21. The Group therefore decided that it is now appropriate to continue to the develop specific models for use in the evaluation of potential conservation strategies.

22. For performance criteria, two papers presented to the meeting (WG-CSD-88/6,8) contained suggestions suitable for application to evaluations aimed at refining the range of potential conservation strategies. The Group recognised that performance criteria would need to evolve in step with both the conservation strategies and the complexity of the hypothetical ecosystems to be managed.

#### Protocols for Conducting Evaluations

23. A protocol is a uniform set of evaluation procedures which allow the performance of different potential conservation strategies to be compared. It was agreed that protocols which might be employed in this process should now be developed. Further work by individual members is required in order to develop protocols for consideration by a technical group at a further meeting.

#### EXAMPLES OF PERFORMANCE CRITERIA AND EVALUATIONS

24. Paper WG-CSD-88/8 included examples in which a simple predator-prey system is simulated, with exploitation occurring only on the prey. Catch limits are set according to two different conservation strategies. One strategy uses a standard Schaeffer model to obtain annual estimates of MSY

from CPUE data and harvested at 90% of the estimated MSY. The second strategy uses a simple feedback procedure to adjust catches up or down depending on whether the prey abundance is estimated to be above or below a target level (55% of unexploited). On face value, any differences in the results of applying the two strategies should be slight.

25. In WG-CSD-88/8, a number of performance criteria were defined which relate to the objectives of management identified by the Working Group. Three examples of these objectives and the corresponding performance criteria are :

(a) Maintenance of ecological relationships :

Probability of the predator population being reduced to less than 30% of its initial abundance.

(b) Maintaining highest long-term yield :

Cumulative catch over 70 years.

(c) Risk of irreversible change :

Probability of the prey population being reduced to levels from which recovery to the target level takes more than 30 years.

26. Applying the conservation strategy to the simulated predatory-prey system led to the following estimates of performance criteria under the two strategies :

Performance criterion	Strategy 1	Strategy 2
(a)	0.94	0.33
(b)	1.14	4.51
(c)	0.93	0.08

27. Despite expectations, the two strategies differ considerably in their ability to achieve the three objectives illustrated. Strategy 1 is markedly inferior in all three criteria, and would be rejected as a conservation strategy in this example.

#### OTHER MATTERS

28. The Group recognised the importance of obtaining an understanding of the plans of member nations for the development of krill fisheries, and similar information on squid and fin fisheries would be useful. This information would help identify types of conservation strategy that are broadly consistent with the planned exploitation of the resource. Also, slight differences in the way in which development plans are implemented can sometimes provide substantially different opportunities to learn about the resource dynamics (e.g. the interactions between prey and dependent species and the separation of natural from fishery-induced fluctuations in abundance). Early notification of fishery development plans would allow examination of these opportunities.

#### CONCLUDING REMARKS

29. The Group recognised that further work is needed to develop models and protocols for the evaluation of potential conservation strategies. It noted that some related work useful for the examination of methodology and elements of conservation strategies has been and will be carried out under the auspices of the Scientific Committee.

30. The Group noted that some of the papers that it had received were pertinent to the development of conservation strategies. These might be considered by the Working Group.