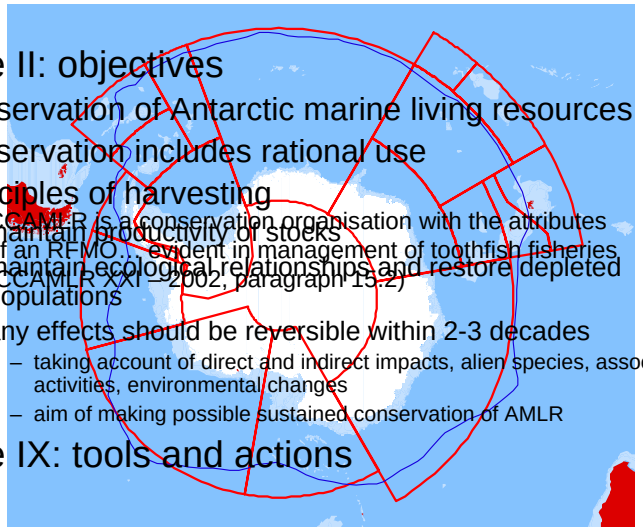
Lessons from CCAMLR

- 4 phases
  - Reactive management
  - Precautionary approach (handling uncertainty)
  - Ecosystem approach (monitoring; MSE)
  - Compliance and enforcement
- General lessons
  - Collaboration between policy and science
  - Balance between conservation and rational use
  - Regulatory framework governing high seas activities
  - A holistic management system for areas primarily beyond national jurisdiction and compatible with coastal States
  - Regional organisations need to have a global context
- Key lessons from CCAMLR for the high seas

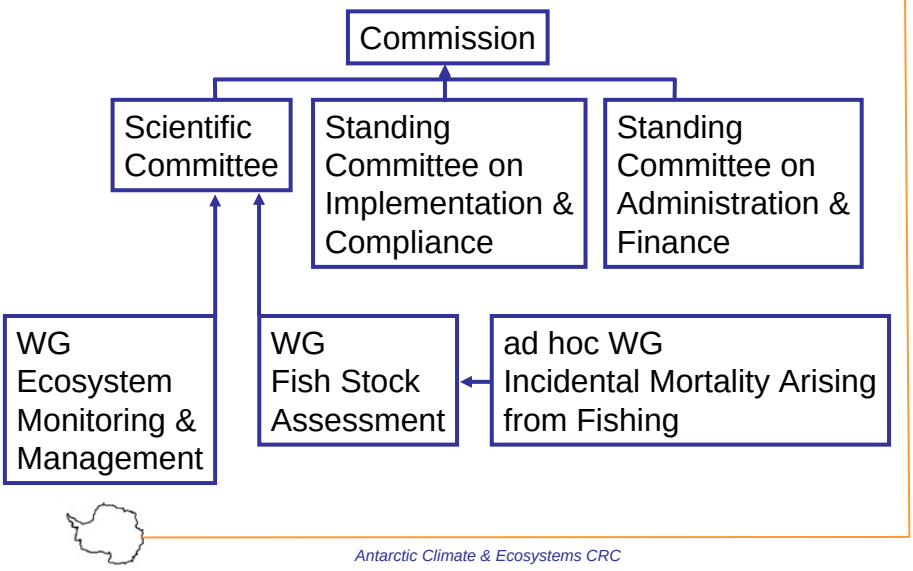
CCAMLR Convention



- Article II: objectives
  - conservation of Antarctic marine living resources
  - conservation includes rational use
  - principles of harvesting
    - maintain productivity of stocks
    - maintain ecological relationships and restore depleted populations
    - any effects should be reversible within 2-3 decades
      - taking account of direct and indirect impacts, alien species, associated activities, environmental changes
      - aim of making possible sustained conservation of AMLR
- Article IX: tools and actions

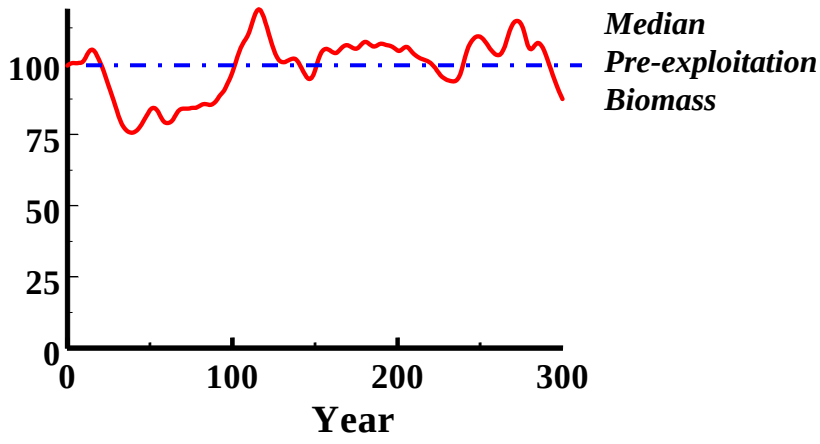
CCAMLR is a conservation organisation with the attributes of an RFMO... evident in management of toothfish fisheries (CCAMLR XXI – 2002, paragraph 15.2)

Structure of CCAMLR



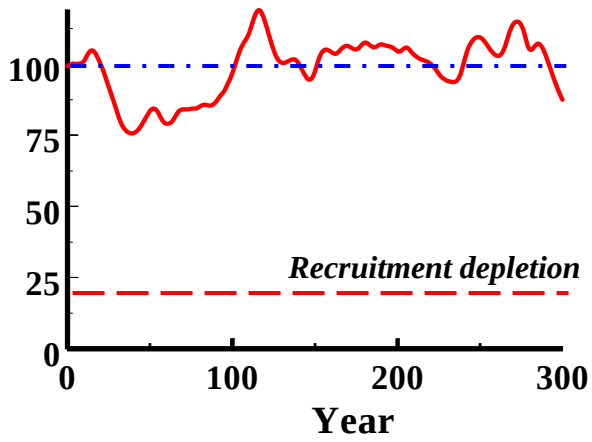
Making ecosystem objectives operational

Objective Reference Point

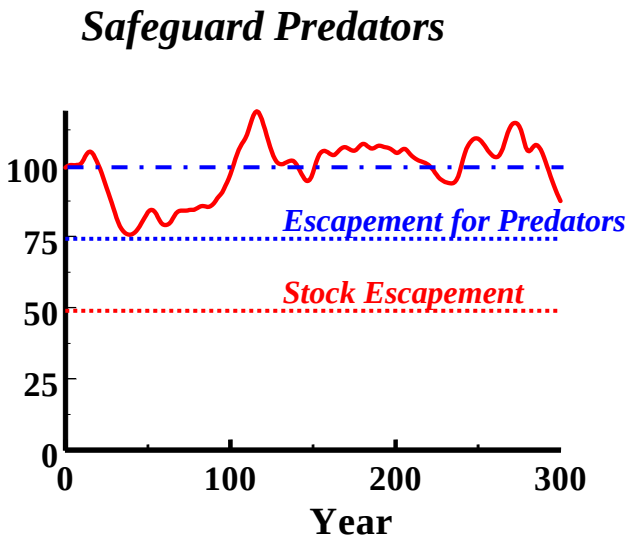


Making ecosystem objectives operational

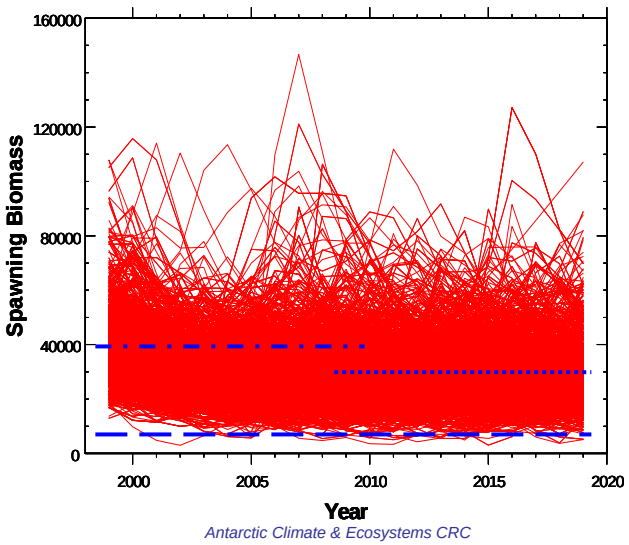
Safeguard recruitment



Making ecosystem objectives operational



Dealing with uncertainty

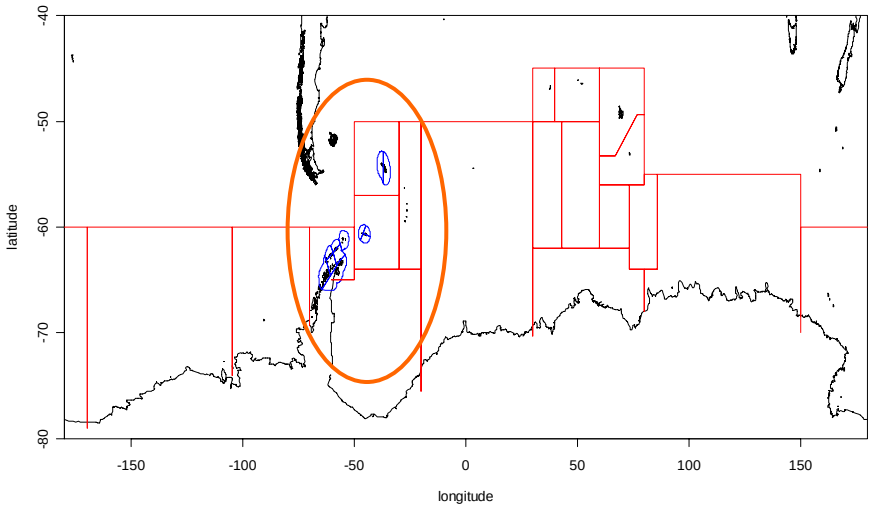


Antarctic Climate & Ecosystems CRC

Incorporating monitoring and feedbacks into management decisions

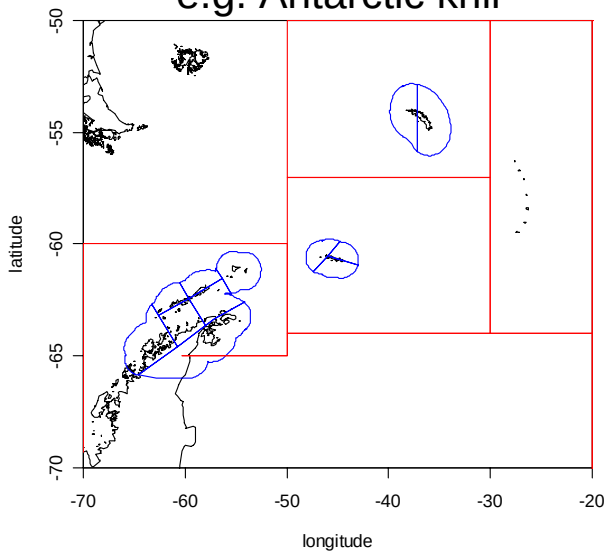
- CCAMLR Scheme of Scientific Observation
- CCAMLR Ecosystem Monitoring Program
  - ➢ detect effects of fishing
  - ➢ distinguish between effects of fishing and effects of environmental change

Evaluation of management strategies e.g. Antarctic krill



Antarctic Climate & Ecosystems CRC

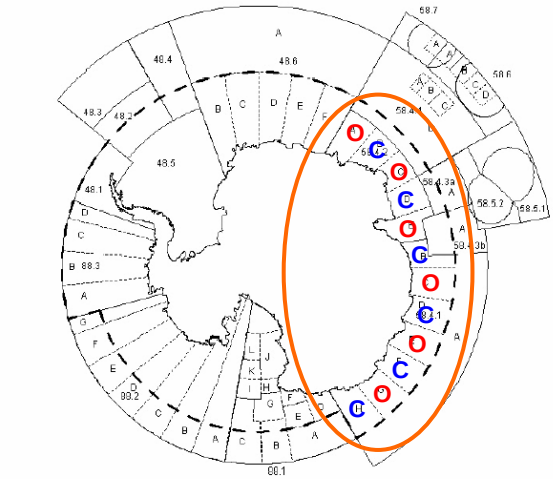
Evaluation of management strategies e.g. Antarctic krill



Developing fisheries in the absence of data

- Regulatory framework for new and exploratory fisheries
  - Notification
  - Evaluation
  - Limited access to explore commercial viability & data acquisition, leading to an assessment

Developing fisheries in the absence of data



By-catch, habitats and conservation

- By-catch & habitat avoidance
  - Move-on rule to avoid by-catch hot spots
  - No bottom fishing on continental shelf in eastern Antarctica
  - Closed seasons during seabird breeding
- By-catch mitigation
- By-catch limitation
- Representative system of marine protected areas

Monitoring, control and surveillance

- Catch documentation scheme
- Centralised vessel monitoring system
- List of vessels engaged in IUU fishing
- Port and Flag State controls

CCAMLR as a management system

- Skills required: policy, natural and social sciences, law, economics, technology, MCS
- Attributes of the system
  - Participation (points 1-5)
  - Regulatory framework for new activities prior to development of a management strategy (point 6)
  - Management strategies (points 7-9,11)
  - Monitoring, control and surveillance (point 10)
  - Effective options to eliminate non-compliance (points 12-13)
  - Dispute resolution (point 14)

Key lessons from CCAMLR

- **Science-policy framework** for an ecosystem approach with binding conservation measures is tractable for high seas where little information is available
- **Evaluation of management strategies** in advance of issues arising reduces scientific and political conflict and identifies critical knowledge gaps
- **Observer program** (including non-fishery related research on fishing vessels) is centrally important to providing data and advice to manage fisheries on the high seas (routine independent research is too expensive)
- **Monitoring, control and surveillance** activities are essential with the aim of 100% coverage
- Mechanisms are needed to accommodate **new entrants**

Key lessons from CCAMLR (primary governance issues)

- **Obligations for new fisheries** ensures that the development of those fisheries does not outpace the development of the governance system to manage them
- A regional organisation such as CCAMLR will fail if it is not provided the **support globally**
  - to eliminate all potential for unregulated fishing in its waters, and
  - for species that primarily reside inside a convention area, to reduce sources of human-induced mortality of those species in high seas outside of that convention area.

Presentation to UNICPOLOS 7 – June 2006

International implementation of the ecosystem approach to achieve the conservation of Antarctic marine living resources

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ABSTRACT

The Commission for the Conservation of Antarctic Marine Living Resources (CCAMLR), which held its first meeting in 1982, was the first international organisation charged with achieving an ecosystem approach to the conservation of exploited stocks, notably krill, as well as the conservation of the wider ecosystem. Since its beginning, the Commission has evolved from (i) initially reacting to over-exploitation of stocks, a situation largely inherited from previously unregulated fisheries prior to the Convention, to (ii) establishing the precautionary approach for new and developing fisheries, as well as (iii) establishing a process for implementing an ecosystem-approach, including monitoring and assessments that take account of the ecosystem requirements. The evolution of the Commission and its Scientific Committee over its first twenty five years provides a strong lesson in what can and cannot be achieved using different management approaches both in terms of how a governing commission can effectively use the best scientific evidence available and what is diplomatically achievable in a regional commission.

CCAMLR has been successful in implementing its ecosystem approach because of the emphasis on the conservation of the marine ecosystem and only permitting rational utilisation of marine living resources in the region. Whales and seals are excluded from consideration by CCAMLR except as they may be impacted by fisheries.

In the first instance, CCAMLR only reacted to the need for management measures (conservation measures) once there was demonstrable proof, i.e. consensus in the Scientific Committee, that those measures were needed. This method was recognised to fail in the late 1980s following difficulties in curbing fishing activities until stocks were obviously depleted. A second phase began in the late 1980s with the introduction of the precautionary approach that achieves scientific consensus on conservation measures, notably catch limits, before problems arise. An important component of

this phase was to interpret the ecosystem objectives of the Convention in population and ecosystem quantities that could be defined and measured scientifically. In so doing, the new methods used to assess catch limits were designed to take account of scientific uncertainties and estimate the likelihood of achieving the population and ecosystem objectives of the Convention given a specific harvest strategy, which at present is total allowable catch. Approaches to new and exploratory fisheries were also developed that restrict harvesting until such time as sufficient data are available to properly assess whether a harvest strategy would be consistent with the objectives of CCAMLR. In most cases, the Commission has specified, in conservation measures, the data required to be collected from the fisheries to facilitate assessments in the future. This is achieved primarily through the annual submission of catch and effort data, and through the CCAMLR Scheme of Scientific Observation, which requires 100% coverage on finfish vessels to obtain suitable data.

The third phase has been the implementation of compliance and enforcement measures, such as vessel monitoring systems, catch documentation schemes and Port and Flag State controls. These developments have almost completed an internationally coordinated management system from data acquisition, assessments, and harvest controls to compliance and enforcement. Current work is adding to the means by which conservation objectives will be met for predators of krill as well as for investigating and implementing further compliance and enforcement activities, further reducing bycatch and examining the use of area management and other tools to minimise the impacts of fishing and to conserve biodiversity.

CCAMLR has established almost all the mechanisms necessary for the effective administration of fisheries and conservation activities. However, despite the strong will of the Members of CCAMLR to achieve the objectives of the Convention, the Commission will fall short of that goal if full international cooperation is not achieved. In terms of regional cooperation, CCAMLR needs complementary binding regional arrangements in areas to the north of CCAMLR in which Antarctic marine living resources are found in order to achieve the conservation objectives for those taxa, such as toothfish and especially seabirds, notably albatrosses. More importantly, cooperation from all States with an interest in conservation and utilisation of high seas resources needs to be achieved. At present, any State can choose not to become a party to CCAMLR but still allow their flag vessels to fish in CCAMLR waters as unregulated fishers; such activities are also often illegal and unreported. This common practice seriously threatens the CCAMLR's ability to achieve its conservation and rational use objectives. Mechanisms are needed to ensure that States are obliged to only allow their vessels to fish in the region if that State is a Party to CCAMLR and participates fully in the activities and obligations of the Commission, including contributing to the costs of managing fishing.

INTRODUCTION

The Commission for the Conservation of Antarctic Marine Living Resources (CCAMLR), which held its first meeting in 1982, was the first international organisation charged with achieving an ecosystem approach to the conservation of exploited stocks, notably krill, as well as the conservation of the wider ecosystem. Since its beginning, CCAMLR has evolved from initially reacting to over-exploitation of stocks, a situation inherited from previously unregulated fisheries prior to the Convention, to establishing the precautionary approach for new and developing fisheries as well as establishing a process for implementing an ecosystem-approach, including monitoring and assessments that take account of the ecosystem requirements.

The evolution of CCAMLR and its advisory bodies over its first twenty five years provides a strong lesson in what can and cannot be achieved using different management approaches both in terms of how a governing commission can effectively use the best scientific evidence available and what is diplomatically achievable in a regional commission.

CCAMLR has been successful in implementing its ecosystem approach because of the emphasis on the conservation of the marine ecosystem and only permitting rational utilisation of marine living resources in the region. Whales and seals are excluded from consideration by CCAMLR except as they may be impacted by fisheries.

This paper summarises the evolution of the precautionary and ecosystem approaches of CCAMLR[1] and how it developed operational objectives, data collection programs and methods for dealing with uncertainty in knowledge to provide a scientific basis for regulating fisheries, including new fisheries, while conserving the marine ecosystem. It also summarises some of the compliance and enforcement activities being undertaken to provide for effective implementation of the harvest regulations. Lastly, the experience of CCAMLR in its first 25 years is used to describe the important elements required for CCAMLR to be an effective regional management system governing the conservation, including rational use, of marine living resources.

[1] reviewed in Constable, A.J. *et al*. (2000) Managing fisheries to conserve the Antarctic marine ecosystem: practical implementation of the Convention on the Conservation of Antarctic Marine Living Resources (CCAMLR). *ICES J. Mar. Sci.* 57, 778-791;
Miller, D.G.M. *et al.* (2005) CCAMLR's approach to managing Antarctic marine living resources. In: Deep Sea 2003: conference on the governance and management of deep-sea fisheries. Part 1:Conference Reports. Ed. R. Shotton. FAO, Rome. FAO proceedings 3/1, pp. 433-481.

THE CCAMLR CONVENTION

The Convention on the Conservation of Antarctic Marine Living Resources (1980)[2] (hereafter referred to as the Convention) applies to the area south of the Antarctic Polar Front (formerly known as the Antarctic Convergence). Within this zone, CCAMLR endeavours to enable rational use of marine species, excluding whales and seals, while ensuring principles of conservation are maintained. These principles aim to ensure the maintenance of stable recruitment in target species, the maintenance of the ecology of the system, particularly in relation to predators of those target species, and that the ecosystem effects of fishing must be reversible over a fixed period. These principles are contained in paragraph 3 of Article II of the Convention, such that:

> 3. *Any harvesting and associated activities in the area to which this Convention applies shall be conducted in accordance with the provisions of this Convention and with the following principles of conservation:*
>
> *(a) prevention of decrease in the size of any harvested population to levels below those which ensure its stable recruitment. For this purpose its size shall not be allowed to fall below a level close to that which ensures the greatest net annual increment;*
>
> *(b) maintenance of the ecological relationships between harvested, dependent and related populations of Antarctic marine resources and the restoration of depleted populations to the levels defined in sub-paragraph (a) above; and*
>
> *(c) prevention of changes or minimization of the risk of change in the marine ecosystem which are not potentially reversible over two or three decades, taking into account the state of available knowledge of the direct and indirect impact of harvesting, the effect of the introduction of alien species, the effects of associated activities on the marine ecosystem and of the effects of environmental changes, with the aim of making possible the sustained conservation of Antarctic marine living resources.*

Article IX provides the means by which CCAMLR can manage fisheries. It includes that CCAMLR must base decisions on the best scientific evidence available, which means that CCAMLR does not need to wait until all science is concluded before making a decision. Decisions pertaining to controls on fisheries are embodied in "conservation measures". States agree to be legally bound by

[2] English text of the Convention is available at http://www.ccamlr.org/pu/e/e_pubs/bd/toc.htm (the website is also accessible in French, Russian and Spanish)

these measures when they become Parties to the Convention. Non-binding but agreed principles are often embodied in resolutions. Decisions are made by consensus.

CCAMLR now comprises 24 members and 9 parties; a member is a Party that is active in harvesting or research, contributes financially to CCAMLR and has voting rights. CCAMLR receives advice from a Scientific Committee (SC-CAMLR) and a Standing Committees on Implementation and Compliance, and Administration and Finance. A Working Group on Developing Approaches to Conservation (1987-1990) began the task of interpreting the Convention's objectives and providing mechanisms for making ecosystem-oriented decisions rather than concentrating on individual species. Working groups of the Scientific Committee include Fish Stock Assessment (WG-FSA), Ecosystem Monitoring and Management (formerly the Working Groups on Krill and on the CCAMLR Ecosystem Monitoring Program) and Incidental Mortality Arising from Fishing (currently part of WG-FSA).

THE EARLY YEARS: REACTIVE MANAGEMENT

In the first instance, CCAMLR only reacted to the need for conservation measures once there was demonstrable proof, i.e. consensus in the Scientific Committee, that those measures were needed. This approach was recognised to fail in the late 1980s-early 1990s following difficulties in curbing fishing activities until stocks were obviously depleted.

During this period, the management of finfisheries relied on then existing standard methods for stock assessment and yield predictions based on the principles of the time regarding maximum sustainable yield. Most attention was given to the status of marbled rockcod around South Georgia. Despite the incomplete data set and lack of detailed analyses, there was sufficient evidence to recommend a closure of 12 nautical miles around the main fishing ground in Subarea 48.3, mesh size regulations and a reduction in catches to below the levels caught in the early 1980s. While the first two recommendations were adopted by the Scientific Committee and set into conservation measures by CCAMLR, the recommendation to restrict catches was opposed in the Scientific Committee[3] on the basis that the information and the analyses were incomplete. Although a prohibition of directed fishing for marbled rockcod was established in the following year, this impasse set the tone of discussions for the remainder of the 1980s with the implementation of important measures to protect depleted stocks often lagging behind the majority scientific advice by one to two years. These difficulties in finding scientific unanimity increasingly raised the question: 'How should the Commission deal with uncertainty in assessments and advice from the Scientific

[3] SC-CAMLR. 1984. Report of the Third Meeting of the Scientific Committee. CCAMLR, Hobart. 237 pp.

Committee?' Uncertainties arose from natural variation in stock abundance and large statistical errors in stock assessment, uncertainty in estimates of model parameters, incomplete historical catch records and imprecise submission of recent data. They also arose in the decision-making process generally because of the assessment methodologies available at the time.

The problem manifested itself when the mostly non-scientific Commissioners had to choose between different assessments and their consequences, without detailed knowledge of why the differences arose[4]. Within CCAMLR, the implementation of catch limits, as with any conservation measures, required consensus and often resulted in majority advice from the Scientific Committee for lower catch limits being rejected.

In 1990, CCAMLR endorsed the need for the Scientific Committee to develop a method of assessments that would achieve scientific consensus, such that uncertainty could be unambiguously and unanimously dealt with in the management of Antarctic fisheries. This signalled a change towards a precautionary approach by CCAMLR. In the following year, the debate on how to manage the krill fishery to protect the pivotal importance of krill in the Antarctic marine ecosystem ended with CCAMLR endorsing the advice of the Scientific Committee "that reactive management - the practice of taking management action when the need for it has become apparent – is not a viable long-term strategy for the krill fishery. Some form of feedback management, which involves the continuous adjustment of management measures in response to information, is to be preferred as a long-term strategy. In the interim, a precautionary approach is desirable and in particular, a precautionary limit on annual catches should be considered."[5] This resulted in the first precautionary catch limit for krill being set in 1991 and the first explicit recognition of the need for precautionary measures prior to the development of feedback management procedures[6].

MAKING ECOSYSTEM OBJECTIVES OPERATIONAL AND ACHIEVABLE

Discussions on how to embrace the objectives set out in Article II arose during early meetings of the Scientific Committee[7]. In 1985, CCAMLR was presented with a framework for evaluating management procedures (or strategies) based on simulations that tested whether management

[4] a typical example is the 1987 assessment of mackerel icefish in Subarea 48.3 where the estimates of yield varied by a factor of 3, in SC-CAMLR. 1987. Report of the Sixth Meeting of the Scientific Committee. CCAMLR, Hobart. 263 pp.

[5] CCAMLR (1991) Report of the Tenth Meeting of the Commission. CCAMLR, Hobart, paragraph 6.13.

[6] Nicol, S., and de la Mare, W. (1993) Ecosystem management and the Antarctic krill. American Scientist, 81: 36-47.

[7] Australia (1985). An approach to a management strategy for the Antarctic marine ecosystem. SC-CAMLR Selected Scientific Papers 1982-1984, Part II: 1-14;
Beddington, J. R., and de la Mare, W. K. (1985). Marine mammal fishery interactions: modelling and the Southern Ocean. SC-CAMLR Selected Scientific Papers 1982-1984, Part II: 155-178;
Butterworth, D. S. (1985). Antarctic ecosystem management. SC-CAMLR Selected Scientific Papers 1982-1984, Part II: 15-42.

measures are highly likely to meet the objectives they are set to achieve[8]. This formed the precursor of discussions in the Commission Working Group on the Development of Approaches to Conservation[9] in which the need to specify the objectives in scientifically measurable terms, known as operational objectives, was discussed, forming the basis for setting objectives for the krill fishery.

A notable consideration in this discussion was that the ecosystem objectives for a given activity are restricted to the potential consequent effects of that activity on the ecosystem rather than endeavouring to specify objectives for the ecosystem as a whole[10].

Operational objectives were initially specified for krill stocks. There are two parts to the objective that need to be met simultaneously. The first part relates to the abundance of krill remaining after the introduction of the harvest strategy (catch limit in this case). The reference point prior to fishing was considered to be the median abundance of krill in the absence of fishing, which is the abundance about which the population would fluctuate such that the population would be above that level half the time and below it for the other half. In a single stock context, the usual "target level" after fishing is fully developed is for the median abundance to be 50% that of the unexploited median abundance. CCAMLR agreed that this did not provide for predators of krill and the maintenance of the ecosystem. In the absence of further information, CCAMLR agreed that an appropriate target would be a median abundance of 75% of the pre-exploitation median, half way between not taking account of predators (50%) to taking full account of predators (100% - no fishing).

The second part of the objective relates to a limit reference point below which the abundance of the population should not be reduced. This was set by CCAMLR at 20% of the pre-exploitation median. The aim of this limit is to help ensure that the productivity of the stock is not reduced to a point that the stock cannot sustain itself or recover to pre-exploitation levels.

Since then, CCAMLR has specified objectives for toothfish and mackerel icefish consistent with these criteria. CCAMLR has recognised that the objectives for mackerel icefish may need to be refined in the future in order to take account of the naturally large variations in stock abundance.

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[8] de la Mare, W. K. (1987). Some principles for fisheries regulation from an ecosystem perspective. SC-CAMLR Selected Scientific Papers, 3: 323-340.

[9] CCAMLR (1988) Report of the Seventh Meeting of the Commission, CCAMLR, Hobart. Addendum: Report of the meeting of the Working Group for the Development of a Conservation Strategy for Antarctic Marine Living Resources. 18 pp.

[10] Constable, A.J. (2004) Managing fisheries effects on marine food webs in Antarctica: trade-offs among harvest strategies, monitoring, and assessment in achieving conservation objectives. *Bull. Mar. Sci.* 74, 583-605; Constable, A.J. (2006) Setting management goals using information from predators. *In*: Top Predators in Marine Ecosystems:Their Role in Monitoring and Management. Edited by I. L. Boyd, S. Wanless, C. J. Camphuysen. Cambridge University Press, Cambridge.

Over the last decade, there have been a number of investigations into explicit objectives for predators of krill, largely determined by the amount of krill needed to be left to sustain the productivity of predators in the long term. The SC-CAMLR has identified that productivity of predators needs to be considered over the life time of the predators as the dependence of predators on krill may vary from one year to the next as well as between locations in the Southern Ocean.

SC-CAMLR is currently in the process of specifying objectives for the krill fishery in small-scale management units in the southwest Atlantic. In originally establishing the precautionary catch limit for krill, CCAMLR agreed to the smaller scale subdivision of Area 48 to accommodate the specific needs of krill predators. This recognised that land-based predator colonies, or other populations of krill predators dependent on small-scale areas of krill, might be impacted if the entire catch for Area 48 was taken out of a single small area. In 2002, CCAMLR agreed to a system of small-scale management units that would provide an ecological foundation for such a subdivision, thereby accounting for the small-scale dependencies in the Antarctic marine ecosystem, even though the krill stock in the southwest Atlantic extends from the Antarctic Peninsula throughout Area 48. The ultimate aim is to subdivide the krill catch for Area 48 to ensure that the ecosystem objectives of CCAMLR can be met on scales consistent with all elements of the marine ecosystem and not just the scale of the target species.

DEALING WITH UNCERTAINTY: CCAMLR'S PRECAUTIONARY APPROACH

The advantage of defining agreed operational objectives is demonstrated in their application in assessing catch limits and other harvest controls. CCAMLR's precautionary approach was developed initially for the krill fishery and later extended to the toothfish and mackerel icefish fisheries.

This approach seeks to determine the long term annual catch limit that is highly likely to be sustainable despite uncertainties in stock dynamics and key population parameters. It is envisaged that this approach is used in the interim of developing longer term feedback management procedures. This approach uses simulation methods to project a stock forward using possible sets of population and fishery parameters. Given the uncertainties in these parameters then many simulated projections are undertaken with the variety of combinations of those parameters. The long-term annual catch limit is set at the catch level that satisfies the decision rule based on the objective. These rules are specified as the greatest catch that results in both a median expectation that the stock is greater than or equal to the target level at the end of 20 years or one generation period of the stock (whichever is greater) and there being only a 10% chance or less that the stock will become depleted (below the limit reference point) over that time.

This approach shows the utility of simulation methods for undertaking assessments and for evaluating whether harvest strategies, in this case catch limits for krill, are likely to meet the objectives of the Convention.

INCORPORATING MONITORING AND FEEDBACKS INTO MANAGEMENT DECISIONS

CCAMLR has adopted a number of strategies for acquiring the data and information necessary for conserving the Antarctic marine ecosystem. In terms of targetted species, CCAMLR routinely receives fishery-independent survey and other research data from Members to assist with assessments of krill, toothfish and mackerel icefish. In addition, SC-CAMLR coordinated a multinational survey of krill stocks in the southwest Atlantic in 2000 to assist with setting catch limits for that region[11]. Other research programs are undertaken through the fisheries activities themselves, as specified in conservation measures, including mark-recapture (tagging) programs and the collection of fisheries related data. In the case of the latter, these are coordinated and undertaken by the CCAMLR Observer Program, which has a 100% coverage of finfish fishing vessels. This program has been found to be essential in providing necessary data for assessments on target and by-catch species, including by-catch of seabirds and elasmobranchs (primarily skates and rays). The observer program remains to be applied to the krill fleet.

An important development early in CCAMLR was the establishment of the CCAMLR Ecosystem Monitoring Program (CEMP), which aims to monitor, using agreed methods, important land-based predators of krill in order to detect the effects of the krill fishery on the ecosystem[12]. Several parameters are monitored for each predator species. The temporal and geographic scales over which these parameters are expected to integrate changes in the status of the ecosystem varies from several weeks and local (reflecting the duration of foraging trips: chick diets and growth) to annual/semi-annual, and region-wide (the weight of birds arriving to breed, breeding success, population size). Aspects of sea-ice and hydrographic conditions are monitored because of their importance in governing the distribution, abundance, movements and recruitment of krill as well as the distribution, winter survival and timing and access to breeding colonies of its predators.

Field work and data acquisition are carried out voluntarily by member states. Data collected are submitted to the CCAMLR Secretariat, which generates summaries of trends in the monitored parameters, including the identification of anomalous years. Currently, there is no formal mechanism for including these data in a feedback management procedure for krill. The CEMP is

[11] Trathan *et al.* (2001) The CCAMLR-2000 krill synoptic survey: a description of the rationale and design. CCAMLR Science, 8:1-24.
[12] Agnew, D. (1997). Review: the CCAMLR Ecosystem Monitoring Programme. Antarctic Science, 9: 235-242.

currently under review with the aim of refining and including its outputs in such a management procedure. One of the challenges facing CEMP is to have sufficient spatial coverage to monitor the impacts of fishing at relevant spatial scales and for predators feeding in areas where fishing may be concentrated[13].

The SC-CAMLR has embarked on evaluating feedback management procedures for krill[14]. To do this, it is using ecosystem models in the evaluation framework[15]. This process will explore how the conservation of krill stocks and their predators will be conserved under different fishing scenarios, given different approaches to field monitoring. In the first instance, these models are being used to provide advice on subdividing the krill catch limit for the southwest Atlantic[16].

DEVELOPING FISHERIES IN THE ABSENCE OF DATA

In establishing its precautionary approach, CCAMLR also agreed that the development of any fishery should not occur at a rate faster than CCAMLR is able to evaluate its potential consequences and whether the objectives in Article II would be met[17]. To this end, CCAMLR adopted measures requiring Members to notify their intention to undertake a new fishery in the Convention Area[18] and their intention to undertake further exploration following the initiation of a fishery[19]. These measures provide the opportunity to authorise fishing activities in the Convention Area, ensuring that these activities remain sustainable. This important requirement for fisheries management has been identified by FAO[20] in relation to the precautionary approach.

These requirements enable the Scientific Committee to evaluate the types of limitations to fishing operations that may be required in the early stages to satisfy conservation objectives while enabling reasonable prospecting within the new fishery. In the exploratory phase, the Scientific Committee will specify the types of information to be submitted that will facilitate assessments of the fishery,

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[13] Constable A.J. (2001) The ecosystem approach to managing fisheries: achieving conservation objectives for predators of fished species. *CCAMLR Science* 8: 37-64;
Constable, A.J. (2004) Managing fisheries effects on marine food webs in Antarctica: trade-offs among harvest strategies, monitoring, and assessment in achieving conservation objectives. *Bull. Mar. Sci.* 74, 583-605.

[14] SC-CAMLR (2004) Report of the Twenty Third Meeting of the Scientific Committee, CCAMLR Hobart. Annex 4 Report of the Working Group on Ecosystem Monitoring and Management;
for background examples of management procedures see Constable, A.J. (2002) CCAMLR ecosystem monitoring and management: future work. *CCAMLR Science* 9:233-253.

[15] SC-CAMLR (2004) Report of the Twenty Third Meeting of the Scientific Committee, CCAMLR Hobart. Annex 4, Appendix D, Report of the Workshop on Plausible Ecosystem Models for testing approaches to krill management.

[16] SC-CAMLR (2005) Report of the Twenty Fourth Meeting of the Scientific Committee, CCAMLR Hobart. Annex 4, Appendix D, Report of the Workshop on Management Procedures.

[17] CCAMLR. (1989). Report of the Eighth Meeting of the Commission. CCAMLR, Hobart. 133 pp.; CCAMLR. (1990). Report of the Ninth Meeting of the Commission. CCAMLR, Hobart. 123 pp

[18] CCAMLR. (1991). Report of the Tenth Meeting of the Commission. CCAMLR, Hobart. 101 pp.

[19] CCAMLR. (1993). Report of the Twelfth Meeting of the Commission. CCAMLR, Hobart. 133 pp.

[20] FAO. (1995). Technical Consultation on the Precautionary Approach to Capture Fisheries and Species Introductions. FAO, Rome. 54 pp.

including research activities that may be required. This is exemplified by the experimental designs applied in the crab fishery at in Subarea 48.3 and for examining the potential impacts of trawling on the Antarctic continental shelf in Division 58.4.2 for which there remains a prohibition of bottom trawling in waters shallower than 550m pending further experimental work.

Measures so far imposed on new fisheries have included conservative catch limits for different management areas combined with local catch limits to avoid over-exploitation of localised stocks. For fisheries on Antarctic toothfish, areas have been defined for research purposes, small scale research units, to facilitate the acquisition of information for stock assessments. Catch limits vary between these areas in an attempt to concentrate fishing activity in some areas while total allowable catches are only small in order to improve the prospects of obtaining sufficient data for assessments and for ascertaining the possible effects of fishing. Other small-scale areas have lower catch limits, some being zero, as a precaution so as to reduce fishing activity while management approaches are developed for the region based on data from nearby areas.

BY-CATCH AND HABITATS

CCAMLR has adopted a number of measures to minimise by-catch of species in both longline and trawl fisheries. The by-catch strategy aims to avoid by-catch wherever possible. If this cannot be achieved then mitigation measures and, if needed, by-catch limits are employed. The main by-catch groups receiving special attention are seabirds and elasmobranchs. In the case of seabirds, a successful combination of avoidance and mitigation strategies has almost entirely eliminated seabird by-catch in licensed longline fishing operations in the CCAMLR area by Parties' vessels. The main tactics have included restricting the setting of lines to the least vulnerable times for seabirds (night time in winter), implementation of bird scaring devices (tori poles) and the adoption of a line weighting regime to accelerate sinking during the main vulnerable setting operation (baited hooks floating on or near the surface). For high latitude fisheries in summer, a stricter regime of line weighting and bird by-catch limits are in force. Research is continuing to improve these strategies in order to help improve the conditions for fishers. A remaining great concern to CCAMLR is that seabirds that breed in the CCAMLR Area continue to be killed needlessly and in large numbers in longline fisheries to the north of the CCAMLR Area, because of inadequate bycatch mitigation measures in those fisheries. Such mortality has brought several albatross populations to the brink of extinction.

For elasmobranchs, strategies are in place in longline fisheries to release skates and rays before being hauled, thereby minimising their mortality. Catch limits are also in place for each of the

management units. In addition, vessels are required to "move on" from areas where by-catch catch rates are higher than acceptable levels. This aims to avoid localised depletion of by-catch species.

Catch limits and move-on rules are generally applied across all by-catch finfish species.

CONSERVATION

To date, CCAMLR has focussed its attention on managing fisheries within the Convention area. However, it has broadened its focus in recent years to consider the conservation of biodiversity within the Convention area. In 2005, the SC-CAMLR organised a workshop on marine protected areas and will hold a workshop on bioregionalisation probably in 2007 to further consider these issues[21]. A longer standing conservation issue has been an increasing recognition that successful conservation of seabirds requires coordinated management across a number of fora. As described above, CCAMLR has largely controlled the impacts of legitimate fishing operations on seabirds through eliminating fishing practices that are detrimental to seabird populations. However, Antarctic and Southern Ocean seabirds are still being killed at alarmingly high rates by IUU fishing operations within the CCAMLR area, which do not implement the CCAMLR mitigation and avoidance measures, and in fishing operations outside of the CCAMLR area. In order for these seabirds to be conserved, a coordinated effort across many jurisdictions will be required. CCAMLR has demonstrated a number of suitable methods for reducing and eliminating seabird by-catch. In the absence of other methods, it would be useful to have the CCAMLR methods adopted across the relevant jurisdictions.

COMPLIANCE AND ENFORCEMENT

From the late 1990s, CCAMLR has endeavoured to eliminate illegal, unreported and unregulated (IUU) fishing by elaborating and implementing a wide range of innovative compliance and enforcement measures, such as a catch documentation scheme for toothfish, a centralised vessel monitoring system, lists of vessels engaged in IUU fishing in the CCAMLR Area, and several Port and Flag State controls. Further work is needed to harness wider international support amongst non-Parties for such measures and to develop an internationally-capable enforcement capacity, including a robust boarding and inspection regime.

[21] SC-CAMLR (2005) Report of the Twenty Fourth Meeting of the Scientific Committee. CCAMLR, Hobart.

CCAMLR AS A MANAGEMENT SYSTEM

The developments described above have almost completed an internationally coordinated management system from data acquisition, assessments, harvest controls and compliance and enforcement (Figure 1). CCAMLR is continuing this work using expertise in international policy, law and diplomacy, science, technology, economics, compliance and enforcement (Figure 2).

Figure 1: Components of a marine management system, such as CCAMLR (this example is for fisheries but could be modified to reflect other activities).

Investment is used to establish fisheries which accrue benefits that may lead to more investment. A population is exploited by a fishery. Management objectives will include consideration of the costs to the target species, the ecosystem and fishery as well as the need to maintain amenity value (conservation and economy) for the future. Data from the fishery, the exploited population and the environment will be used in assessments to determine whether the objectives are being met and, according to decision rules in a management procedure that indicate what regulations will be made in response to the assessments, regulations governing the fishery will be set or relaxed. Regulations only directly impact on human activities (fisheries or research) and are intended to indirectly affect the maintenance of the target species and the ecosystem. The large grey box represents the Antarctic marine ecosystem.

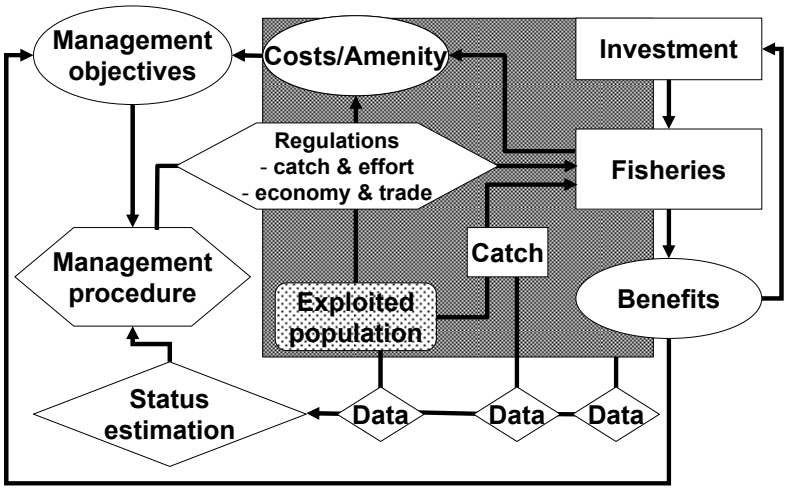
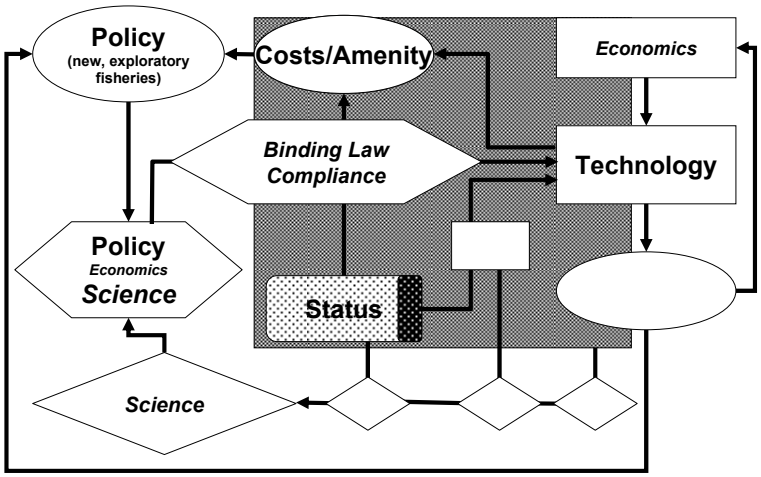


Figure 2: Work required in CCAMLR to establish regulated fisheries in a complete management system.

Expertise required for the different elements in Figure 1 are indicated in the respective symbols. Italicised text represents areas that need attention within the CCAMLR framework (smaller text requires more attention). This includes consideration of economic issues governing investment and the maintained value of fisheries into the future, the need for improved forms of regulation, compliance and enforcement, including methods for managing activities outside the Convention area that impact on CCAMLR values (indicated by difference in shading of Status), and further scientific research to underpin ecosystem-based management procedures and the precautionary approach.



The experience of CCAMLR has shown that, in order to be effective, CCAMLR needs, *inter alia*,

1. to achieve participation in the Commission by all Parties with a direct or genuine interest[22] in conservation and rational use of the Antarctic marine ecosystem,

2. to ensure that Parties with a direct or genuine interest in the Antarctic marine ecosystem embrace CCAMLR as the governing regional body and are given an opportunity to observe and have their views and potential interests taken account of in the current activities of the Commission,

3. to facilitate cooperation and support of CCAMLR by non-Parties that do not have a direct or genuine interest[23], including the opportunity to observe the current activities of the Commission,

4. to maintain transparency and accountability that will ensure CCAMLR remains internationally recognised as the competent body governing activities in the Antarctic marine ecosystem,

[22] States that actively undertake a research program in the Convention Area or participate directly in exploitation of AMLR (Flag States).

[23] Such States would include Port and Trade States, who would not be regarded as having a direct or genuine interest in the conservation and rational use of AMLR but may wish to be observers in order to facilitate cooperation with and support of CCAMLR.

5. to have effective influence on limiting activities that might impact on CCAMLR's ecological and conservation values,
6. to maintain orderly development of fisheries (new and exploratory as well as established) so that exploitation does not outpace the ability for CCAMLR to achieve its objectives,
7. to develop a suite of management tools, based on the best scientific research, that has been evaluated for effectiveness prior to implementation,
8. to identify appropriate regulations for harvesting marine species that will enable CCAMLR to meet its objectives,
9. to ensure that actions and activities are implemented in a timely fashion, such that the ability to achieve the objectives of the Convention are not undermined by inertia in the management system,
10. to maintain an appropriate and effective monitoring, control and surveillance regime, including monitoring, inspection and verification, of Parties' vessels and controls to prevent IUU fishing by non-Parties'vessels,
11. as appropriate, to manage fishing and research activities so that the cost of both management (including assessment, compliance and enforcement) are integrated into decisions about exploitation,
12. to maintain an appropriate and effective enforcement regime, including powers to terminate fishing operations,
13. to have a recognised and effective suite of disincentives and sanctions for non-compliance, and
14. to provide a dispute resolution process.

To a large extent, CCAMLR is achieving these requirements or, at least, has recognised the areas that need additional attention. A number of its recent initiatives in developing feedback management procedures for krill and in compliance and enforcement will help it achieve its ecosystem objectives. However, a limitation of CCAMLR remains the degree to which it is recognised and actively supported, including by non-Parties, as the international body responsible for managing fisheries and conservation of Antarctic marine living resources in the Southern Ocean.

CONCLUDING REMARKS

CCAMLR is widely recognised as a progressive international Commission with the responsibility for the conservation of the Southern Ocean marine ecosystem. In its convention and established practice, it

- has the attributes of a regional fisheries management organisation while also having wider conservation responsibilities,
- has been able to deliver a precautionary approach to fisheries management, and
- is a leading organisation in the development of benchmarks for best-practice in the ecosystem approach to managing activities in waters outside national jurisdiction.

CCAMLR has notably achieved these advances in the international arena and without precedent, only guided by the principles of Article II.

Despite the strong will of the Parties of CCAMLR to achieve the objectives of the Convention, it will fall short of that goal if greater international cooperation and support are not achieved. In terms of regional cooperation, CCAMLR needs complementary binding regional arrangements in the areas to the north of CCAMLR in which Antarctic marine living resources might be found in order to achieve the conservation objectives for those taxa, such as seabirds and toothfish. More importantly, cooperation from all States with an interest in conservation and utilisation of high seas resources needs to be achieved. At present, any State can choose not to become a party to CCAMLR but still allow their flag vessels to fish in CCAMLR waters as unregulated fishers; such activities are also often illegal and unreported. This common practice seriously threatens the CCAMLR's ability to achieve its conservation and rational use objectives. Mechanisms are needed to ensure that States are obliged to only allow their vessels to fish in the region if that State is a Party to CCAMLR and participates fully in the activities and obligations of the Commission, including contributing to the costs of managing fishing.