

ECOSYSTEM MONITORING AND MANAGEMENT

Advice from WG-EMM

General comments

3.1 Dr Hewitt, Convener of WG-EMM, reported that the 2005 meeting of WG-EMM was held from 4 to 15 July 2005, in Yokohama, Japan. Intersessional activities included the first meeting of SG-ASAM and work by correspondence groups on preparations for this year's workshop on the design of land-based krill predator surveys and on the subdivision of CCAMLR statistical areas into ecologically based harvesting units. During the meeting the following groups met:

- (i) Workshop on Management Procedures
- (ii) Advisory Subgroup on Protected Areas
- (iii) Subgroup on CEMP Methods
- (iv) correspondence group on predator surveys
- (v) subset of the Steering Group for the CCAMLR-IPY-2008 Survey.

3.2 These activities are summarised in three documents for consideration by the Scientific Committee:

- (i) report of WG-EMM-05 (Annex 4) containing a listing of 'Key Points for Consideration by the Scientific Committee' at the end of each major agenda item, as well as the report of the Workshop on Management Procedures (Annex 4, Appendix D);
- (ii) synopses of working papers (SC-CAMLR-XXIV/BG/9) considered at the meeting, each containing an abstract and a summary of the findings and/or conclusions as they relate to a particular agenda item;
- (iii) report of the Convener of WG-EMM-05 to SC-CAMLR-XXIV (SC-CAMLR-XXIV/BG/11) containing appropriate references to paragraphs in the report of WG-EMM-05.

3.3 As in recent years, the agenda of WG-EMM-05 was structured to consider the status and trends in the krill fishery (Annex 4, section 3), the status and trends in the krill-centric ecosystem (section 4), the status of management advice arising from these considerations (section 5) and future work (section 6).

3.4 In particular, the Working Group drew the attention of the Scientific Committee to:

- (i) plans for the CCAMLR-IPY-2008 Survey (Agenda Item 3);
- (ii) adoption of a new model for acoustic target strength of krill and its implications (Agenda Item 3);
- (iii) substantial progress in the use of ecosystem models for evaluating management procedures (Agenda Item 3);
- (iv) approvals for two ATCM Management Plans (Agenda Item 3);

- (v) CCAMLR Workshop on Marine Protected Areas (Agenda Item 3);
- (vi) recommendation to require reporting of monthly krill catch and effort data by SSMUs (Agenda Items 3 and 4);
- (vii) request for Scientific Committee communication with SCAR (Agenda Items 3 and 6);
- (viii) the need to select a new convener of WG-EMM (Agenda Item 3).

Status and trends in the krill-centric ecosystem

3.5 Following the recommendations of WG-EMM, the Secretariat reported progress in validating CEMP data and summarising and reporting these data using an ordination approach. The Secretariat also reported receipt of Antarctic shag diet data (1991–2005) and development of an index based on these data (Annex 4, paragraphs 4.1 and 4.2).

3.6 The Scientific Committee noted that key challenges in the future work of CCAMLR are:

- (i) the potential influences of long-term change in the physical environment that underpin biological processes;
- (ii) how to detect the consequential changes in biological systems in monitoring programs;
- (iii) how to incorporate these into management.

3.7 The Scientific Committee noted the following highlights from the papers reviewed by the Working Group:

- (i) aerial surveys of the abundance of pack-ice seals off east Antarctica produced population estimates of 0.7–1.4 million crabeater seals, 37 000–124 000 Ross seals and 1 300–17 000 leopard seals (Annex 4, paragraphs 4.3 and 4.4);
- (ii) the role of environmental forcing and climate-induced change on the population processes of Antarctic fur seals at South Georgia, over the period from 1984 to 2003, indicated that positive sea-surface temperature anomalies, showing significant lagged correlations with large-scale ENSO events in the Pacific, explained extreme reductions in pup production (Annex 4, paragraph 4.6);
- (iii) the continued decline in population size and reduced reproductive performance of chinstrap penguins at Cape Shirreff, Livingston Island (Annex 4, paragraph 4.7);
- (iv) an outbreak of avian cholera at Marion Island in November 2004 that killed about 2 000 macaroni penguins at one colony; other colonies and other seabird species were not affected (Annex 4, paragraph 4.12);

- (v) a new approach to modelling krill growth using a large dataset of observed instantaneous growth rates and a temperature dependent model of inter-moult periods suggested that the mean length for age 6+ krill is 53 mm in the Indian Ocean sector and 57 mm in the Atlantic Ocean sector (Annex 4, paragraphs 4.19 to 4.22);
- (vi) a study that summarised all available scientific net sampling involving krill in the Southern Ocean from 1926 to 2003 concluded that (Annex 4, paragraph 4.23):
 - (a) the southwest Atlantic sector contains >50% of the krill in the Southern Ocean;
 - (b) krill density in this sector has declined substantially since the 1970s;
 - (c) during the summer, krill density is correlated spatially with chlorophyll concentrations;
- (vii) preliminary results from a multi-disciplinary survey carried out in the Ross Sea that showed Antarctic krill occurred in the warmer waters north of the shelf slope while crystal krill occurred in the colder shelf waters (Annex 4, paragraphs 4.25 to 4.28).

Future surveys

3.8 The Scientific Committee endorsed the plans for the Australian BROKE-West acoustic krill biomass survey of Division 58.4.2 from January to March 2006. The Scientific Committee suggested using the new SDWBA TS (Annex 4, paragraphs 4.55 and 4.56) as well as measuring the necessary data to parameterise the TS model. The Scientific Committee welcomed the proposed comparisons with ships surveying in adjacent areas (Germany and Japan). It was recognised that the value of such comparisons would be maximised if coordinated and common protocols for equipment settings and calibrations could be agreed and used (Annex 4, paragraphs 4.68 and 4.69).

3.9 The CCAMLR-IPY-2008 Survey initiative received formal recognition by the IPY Joint Committee and was listed as EoI 148; it has become the 'lead project' for the topic 'Natural Resources, Antarctic'. A close link has also been established with CAML EoI 83, the lead project for 'Biodiversity', which also has a strong pelagic component (Annex 4, paragraphs 4.72 to 4.75). Details of the plans for further work are provided in paragraphs 13.33 to 13.43.

Subgroup on Acoustic Survey and Analysis Methods (SG-ASAM)

3.10 SG-ASAM met in La Jolla, USA, from 31 May to 3 June 2005, to consider models of krill target strength and classification of volume backscattering strength.

3.11 The Scientific Committee recalled that although SG-ASAM was formed by the Scientific Committee, the subject matter of the first meeting was of particular importance to WG-EMM and therefore this year it had reported directly to that Working Group (Annex 4, paragraphs 4.39 to 4.60). The Scientific Committee agreed that the report of the first meeting of SG-ASAM should be appended to its report this year (Annex 6).

3.12 The Scientific Committee endorsed a change from the current empirical krill TS model towards the use of a ‘theoretically-derived, empirically-validated’ model and agreed that the most appropriate theoretical model for krill TS was currently the SDWBA model. The Scientific Committee therefore endorsed the WG-EMM recommendation that krill TS should be estimated using the SDWBA model and appropriate values of parameters in the model for surveys and, as appropriate, areas be applied as discussed in Annex 4, paragraphs 4.55 and 4.56.

3.13 The Scientific Committee recommended that measurement of the relevant parameter values be undertaken in all future surveys to minimise the uncertainty associated with the estimation of TS and that, where possible, parameters be estimated for past surveys and areas (Annex 4, paragraph 4.59).

3.14 In considering a request from Dr Siegel to develop a CEMP standard method for acoustic determination of krill biomass, the Scientific Committee recalled the existing recommendation for the CEMP standard method for the collection of acoustic data (SC-CAMLR-XX, Annex 4, paragraph 3.93). Furthermore, in welcoming the report of the first meeting of SG-ASAM, it encouraged Members conducting acoustic surveys for krill to follow the recommendations contained in the report.

3.15 The Scientific Committee considered the request of WG-FSA for advice on the conduct of acoustic surveys for *C. gunnari*. The plan and terms of reference for a second meeting of SG-ASAM are presented in paragraphs 13.27 to 13.31.

Workshop on Management Procedures

3.16 This was the fifth in a series of workshops held at the WG-EMM meeting designed to develop a revised management procedure for krill (Annex 4, section 2 and Appendix D). It was also the first in an anticipated future series with the intent of evaluating alternative management procedures. The specific intent of this workshop was to examine how well six candidate methods for subdividing the krill catch limit in Area 48 among SSMUs would meet the objectives of CCAMLR.

3.17 Performance measures were considered for krill, krill predators and the krill fishery. These included measures that described variability in krill spawning biomass, predator population sizes and rates of change, krill catch and fishing patterns. The intent was to use a model of the interactions between krill, their predators, and the fishery to generate frequency distributions of performance measures. These distributions would be wide or narrow depending on the uncertainty associated with assumptions about ecosystem structure and measures of critical parameters. Furthermore, performance measures could be used to evaluate trade-offs between alternative management procedures, as well as the risks associated with specific management decisions.

3.18 The workshop considered three models that were relevant to evaluating options and decided to focus its attention on the KPFM described in Annex 4, Appendix D, section 3. The KPFM was developed specifically to address the issue of subdividing the krill catch limit in Area 48. The model and its interfaces were relatively mature and contained tools for integrating across alternative ecosystem assumptions and parameter uncertainty. These tools allowed users to examine model diagnostics and compare performance measures.

3.19 The KPFM is spatially resolved to the level of SSMUs and surrounding oceanic areas, and it includes the transport of krill between these areas. Krill and predator population dynamics (of up to four predators in each SSMU, typically a generic seal, whale, penguin and fish) are implemented in a way that accommodates various assumptions about the recruitment and predation processes. Monte Carlo simulations are used to integrate the effects of numerical uncertainty. Routines are available to compare and merge results from multiple simulations helping to assess structural uncertainty. Although the model necessarily simplifies a complex system, it provides a flexible framework for investigating the roles of transport, production, predation and harvesting in the operation of the krill–predator–fishery system.

3.20 The workshop agreed that future work should continue to examine the sensitivity of performance measures to plausible ranges of model parameters and structural hypotheses (i.e. robustness to uncertainty). The Working Group agreed that at least three key aspects should be given further attention in the models and their implementation:

- (i) incorporation of shorter time steps and/or seasonality
- (ii) incorporation of alternative movement hypotheses
- (iii) incorporation of a threshold krill density below which a fishery will not operate.

3.21 The Scientific Committee noted that a further year's work should allow the delivery of appropriate advice on the evaluation of options for the subdivision of the precautionary catch limit for krill in Area 48. The Scientific Committee also noted that the KPFM, with its extensive documentation, graphic outputs and diagnostics, had successfully engaged participants from a wide range of backgrounds, including those with and without modelling skills.

3.22 The Scientific Committee thanked the co-conveners of the workshop, the authors of the KPFM and all the contributors to the workshop who had succeeded in ensuring a high level of engagement and participation; furthermore the Scientific Committee recognised the need for this important work to continue, including the development and testing of the other two models presented at the workshop as well as additional models that might be produced, and looked forward to receiving advice from WG-EMM next year.

Status of management advice

3.23 The Scientific Committee agreed to transmit to the Commission approval of the recommendations for two ATCM management plans containing marine areas. These include the ASPA at Edmonson Point and a revised plan for the ASMA at Admiralty Bay (Annex 4, paragraph 5.5).

3.24 The Scientific Committee agreed that it was unable, at this time, to provide advice on the candidate options for subdividing the catch limit for krill in Area 48 amongst SSMUs. Nevertheless, it recognised the substantial progress in developing the tools and parameter sets required, and looked forward to receiving advice on a subdivision of the Area 48 catch limit in the near future (Annex 4, paragraph 5.18).

3.25 The Scientific Committee agreed that sufficient progress had been made with the KPFM development this year for it to believe that a further year's work should allow appropriate advice, based on runs with a revised version of the simulation model, to be provided to the Commission next year. The Scientific Committee also agreed that it would be valuable if results were also available from other models (Annex 4, paragraph 5.19).

3.26 In order to achieve monthly reporting of krill catch and effort at the resolution of SSMUs, WG-EMM recommended modification of paragraph 2 of Conservation Measure 23-06 to read:

‘Catches shall be reported in accordance with the monthly catch and effort reporting system set out in Conservation Measure 23-03. When fishing in SSMUs in Area 48, each Contracting Party shall report monthly catch and effort data by SSMU. When fishing in other areas, each Contracting Party shall report monthly catch and effort data by subarea/division.’

3.27 Dr Naganobu indicated that Conservation Measure 23-03 should be retained in its current form and that Japan was unwilling to submit monthly catches by SSMU.

3.28 Dr Naganobu suggested that, in order to allow the consideration of catches in each SSMU at an annual time scale, paragraph 3 of Conservation Measure 23-06 be modified to read:

‘At the end of each fishing season each Contracting Party shall obtain from each vessel the haul-by-haul data required to complete the CCAMLR fine-scale catch and effort data form (trawl fisheries Form C1). It shall transmit those data in the specified format to the Executive Secretary not later than 1 April of the following year.’

3.29 The Scientific Committee recalled that while most Contracting Parties fishing for krill reported monthly catch and effort by subarea, some Parties reported monthly catch and effort by area only. As a result, it is not possible for the Secretariat to estimate catches by subarea or SSMU in the current season.

3.30 Furthermore, the Scientific Committee recognised that while the Commission had set catch limits for each subarea in Area 48 in Conservation Measure 51-01, there was no requirement in Conservation Measure 23-03 to report monthly catches at the subarea scale and hence there was no mechanism by which to determine if catch limits had been exceeded.

3.31 Dr Constable advised the Scientific Committee that the spatial and temporal scale at which data reporting was required from the krill fishery would determine the scales at which the fishery can be managed. For example, one of the options for allocating krill catches to SSMUs, based on the assessment of spatially explicit indices of krill availability that may be monitored or estimated on a regular basis, may not be possible if krill catches are not reported

at the time for which the limit would apply. Such flexible catch arrangements require that the fishery be closed when the catch limit is reached in a given year in order to avoid over-runs that could impact on predators.

Future work of WG-EMM

Predator surveys

3.32 Following a review of the deliberations of the correspondence group on land-based predator surveys (Annex 4, paragraph 6.5), the Scientific Committee agreed that a workshop should be held to examine the utility of existing data for estimating predator abundance and associated uncertainty, to further develop estimation procedures and to identify any areas where data are absent or inadequate as priorities for future survey work. The Chair of the Scientific Committee agreed to write to SCAR informing them of the intention to hold such a workshop and to extend an invitation for SCAR representatives to attend.

3.33 The Scientific Committee recognised that one of the aims of the workshop would be to provide a much clearer definition of data requirements for its work with respect to estimates of abundance, with associated uncertainty, of land-based predators. Therefore the Scientific Committee agreed that, until these requirements are defined, no formal requests on the status and trends in marine mammal and seabird populations would be made to SCAR (see SC-CAMLR-XXIII, paragraphs 6.15 to 6.17).

3.34 The Scientific Committee drew the attention of the Commission to the potential delay that such a postponement in requesting new data from SCAR would have on the next review of the status and trends of predator populations. However, the Scientific Committee noted that such information on status and trends of some species is available from other specialist groups such as the Status and Trends group of ACAP.

3.35 The Scientific Committee agreed that the Antarctic Site Inventory (ASI) (WG-EMM-05/39) contained much information of great interest to CCAMLR, particularly with regard to counts of land-based predators and the Chair of the Scientific Committee agreed to communicate these findings to CEP at its next meeting (SC-CAMLR-XIII, paragraph 9.2(iii)).

Ecosystem models, assessments and approaches to management

3.36 In considering future work on ecosystem models, assessments and approaches to management, the Working Group noted that the main advances over the last year were in the development of operating models for evaluating management procedures. A future work program for further developing these models has been identified (Annex 4, paragraphs 6.13 to 6.19).

3.37 The Scientific Committee endorsed the establishment of a Subgroup on Development of Operating Models, according to the terms of reference in Annex 4, Appendix F, to facilitate the work program for further developing models identified in Annex 4, paragraphs 6.13 to 6.19. The Scientific Committee agreed that the primary initial function would be to establish

a newsgroup as part of the subgroup with the assistance of the Secretariat (SC-CAMLR-XXIV/9). Dr Constable undertook to assist the Secretariat in establishing the newsgroup and facilitating subgroup discussion.

3.38 The Scientific Committee noted the development of Antarctic ecosystem models for providing management advice in CCAMLR and the IWC (Annex 4, paragraphs 6.33 to 6.37). This is considered further in paragraphs 13.44 to 13.53.

Long-term work plan

3.39 The Scientific Committee endorsed the long-term work plan of WG-EMM (Annex 4, paragraphs 6.38 to 6.49) and noted that the following three actions should have priority status:

- (i) facilitate the continued evaluation of management procedures to allocate the precautionary krill catch limit in Area 48 among SSMUs (Annex 4, paragraphs 2.10 and 5.19);
- (ii) consider revising estimates of B_0 and γ in all areas taking account of recent developments in estimating parameters used in assessments, thereby revising estimates of precautionary yield (Annex 4, paragraph 4.60);
- (iii) develop SSMU-specific estimates of predator abundance and demand in Area 48 (Annex 4, paragraph 6.9).

3.40 The Scientific Committee agreed that a Second Workshop on Management Procedures, building on the work completed this year, should be held in 2006 and convened by Ms T. Akkers (South Africa) and Dr C. Reiss (USA) (Annex 4, paragraph 6.46).

3.41 The Scientific Committee agreed that provision of advice, should it be possible from work done at the Second Workshop on Management Procedures, would be consistent with CCAMLR's use of the best available scientific evidence. This does not preclude revisions in the future, as knowledge and methods improve (Annex 4, paragraph 6.43).

3.42 The Scientific Committee also agreed that a workshop to consider reviewing and revising precautionary catch limits for krill be held no later than 2007 (Annex 4, paragraph 6.48).

Advice to the Commission

3.43 The Scientific Committee called to the attention of the Commission the following items arising from WG-EMM:

- (i) Plans for the Australian BROKE-West acoustic krill biomass survey of Division 58.4.2 from January to March 2006 that will provide an updated estimate of B_0 for Division 58.4.2.

- (ii) The CCAMLR-IPY-2008 Survey initiative has received formal recognition by the IPY Joint Committee and has become the 'lead project' for the topic 'Natural Resources, Antarctic'.
- (iii) A change from the current empirical model towards the use of a 'theoretically-derived, empirically-validated' model for estimating krill target strength and that a workshop to consider reviewing and revising precautionary catch limits for krill be held no later than 2007.
- (iv) A second Workshop on Management Procedures is to be held in 2006 and convened by Ms Akkers and Dr Reiss and that this should provide appropriate advice on the evaluation of options for the subdivision of the precautionary catch limit for krill in Area 48.
- (v) In order to allow the consideration of catches in each SSMU at an annual time-scale, paragraph 3 of Conservation Measure 23-06 should be modified to read:

'At the end of each fishing season each Contracting Party shall obtain from each vessel the haul-by-haul data required to complete the CCAMLR fine-scale catch and effort data form (trawl fisheries Form C1). It shall transmit those data in the specified format to the Executive Secretary not later than 1 April of the following year.'
- (vi) While the Commission has set catch limits for each subarea in Area 48 in Conservation Measure 51-01, there is no requirement in Conservation Measure 23-03 to report catches at the subarea scale and hence there was no mechanism by which to determine if a catch limit had been exceeded (paragraph 3.30).
- (vii) A proposed workshop to examine the existing data to provide abundance estimates and associated uncertainty of land-based predator populations would provide a definition of data requirements. Therefore, no formal requests for information on the status and trends of marine mammal and seabird populations would be made to SCAR at this time and such a postponement would delay the next review of the status and trends of predator populations (paragraphs 3.32 to 3.34).
- (viii) The Scientific Committee also agreed that a workshop to consider reviewing and revising precautionary catch limits for krill be held no later than 2007 (paragraph 3.42).

Marine Protected Areas

3.44 At CCAMLR-XXIII, the Commission urged the Scientific Committee to proceed with work addressing the topic of MPAs as a matter of priority and reaffirmed the need to develop advice consistent with Articles II and IX of the Convention (CCAMLR-XXIII, paragraph 4.13).

3.45 A Workshop on Marine Protected Areas, endorsed by the Scientific Committee and convened by Dr Penhale, was held from 29 August to 1 September 2005 at the NOAA National Marine Fisheries Service, Silver Spring, MD, USA.

3.46 The terms of reference for the workshop (SC-CAMLR-XXIII, paragraph 3.52) were:

- (i) to review current principles and practices related to the establishment of Marine Protected Areas;
- (ii) to discuss how the use of Marine Protected Areas could be used to contribute to furthering the objectives of CCAMLR;
- (iii) to consider proposals that are currently under development or in a conceptual phase that relate to Marine Protected Areas in the Convention Area;
- (iv) to discuss the types of scientific information that may be required for the development of Marine Protected Areas to further the objectives of CCAMLR, including the identification of biophysical regions across the Convention Area.

3.47 The Scientific Committee endorsed in full the report of the workshop (Annex 7), subject to comments below. It reviewed in detail the workshop's advice to the Scientific Committee, under each of the specific terms of reference.

3.48 The Scientific Committee regretted that the relatively short notice of the workshop had created difficulties for attendance of CCAMLR Members, especially those with particular logistic or financial constraints.

3.49 Nevertheless, it welcomed the very substantial progress made on this topic at the workshop and thanked the hosts, convener, steering committee and participants for the work that made this possible.

General

3.50 The Scientific Committee noted:

- (i) that MPAs were considered in relation to a definition as 'any area of intertidal or subtidal terrain, together with its overlying water and associated flora, fauna, historical and cultural features, which has been reserved by law or other effective means to protect part or all of the enclosed environment' (Annex 7, paragraph 1);
- (ii) that the discussion on MPAs was facilitated by a series of excellent contributions by CCAMLR Members and invited experts. These papers focused on MPAs in the conceptual sense, as well as in practice, both worldwide and within the CCAMLR Convention Area;

- (iii) specific commendation for the framework used to establish the Australian national representative system of MPAs, which underpinned the establishment in the Convention Area of the Heard Island and McDonald Islands Marine Reserve (Annex 7, paragraph 122).

Review of advice from MPA Workshop

ToR (i) to review current principles and practices related to the establishment of MPAs

3.51 The Scientific Committee endorsed the advice that:

- (i) there was a need to develop a strategic approach to MPA design and implementation throughout the Southern Ocean, notably in relation to a system of protected areas (Annex 7, paragraph 124);
- (ii) there was a strong need for collaboration at technical and policy levels to further develop the MPA concept in the Southern Ocean. Relevant bodies in such a dialogue would include key elements of the Antarctic Treaty System (ATS) (CEP and the ATCM) as well as SCAR, SCOR, Observers to CCAMLR, intergovernmental organisations and non-governmental organisations (Annex 7, paragraph 124).

3.52 The Scientific Committee agreed that the primary aim is to establish a harmonised regime for the protection of the Antarctic marine environment across the ATS. This may require clarification of the roles and responsibilities of the ATCM and CCAMLR in respect of the management of different human activities in the region (Annex 7, paragraph 125).

ToR (ii) to discuss how MPAs could be used to contribute to furthering the objectives of CCAMLR

3.53 The Scientific Committee noted that:

- (i) Article II establishes the basic objective of CCAMLR as the conservation of Antarctic marine living resources (where conservation includes rational use) and sets out the principles by which harvesting and associated activities shall be carried out (Annex 7, paragraph 28);
- (ii) Article IX further specifies the ways to give effect to the objective and principles of Article II. This article relates particularly to the development and use of conservation measures, specifically including the opening and closing of areas, regions or sub-regions for purposes of scientific study or conservation, including special areas for protection and scientific study (Annex 7, paragraph 29).

3.54 The Scientific Committee endorsed advice that:

- (i) MPAs had considerable potential for furthering CCAMLR's objectives in applications ranging from protection of ecosystem processes, habitats and biodiversity, and protection of species (including population and life history stages) (Annex 7, paragraph 126);
- (ii) overall, when viewed in relation to the IUCN categories of protected areas, that the Convention Area as a whole would qualify as Category IV (Habitat/Species Management Area: protected area managed mainly for conservation through management intervention). This is defined as an area of land and/or sea, subject to active intervention for management purposes so as to ensure the maintenance of habitats and/or to meet the requirements of specific species (Annex 7, paragraph 127);
- (iii) conservation outcomes appropriate for achieving the objectives of Article II would include the maintenance of biological diversity as well as the maintenance of ecosystem processes (Annex 7, paragraph 129).
- (iv) attention may need to be given to the need for, *inter alia*, protection of:
 - (a) representative areas – a system of representative areas would aim to provide a comprehensive, adequate and representative system of MPAs to contribute to the long-term ecological viability of marine systems, to maintain ecological processes and systems, and to protect the Antarctic marine biological diversity at all levels;
 - (b) scientific areas to assist with distinguishing between the effects of harvesting and other activities from natural ecosystem changes as well as providing opportunities for understanding the Antarctic marine ecosystem without interference;
 - (c) areas potentially vulnerable to impacts by human activities, to mitigate those impacts and/or ensure the sustainability of the rational use of marine living resources (Annex 7, paragraph 130);
- (v) the process for establishing a system of protected areas will need to have regard for the objective of the Commission to achieve satisfactory fishery outcomes in terms of sustainable rational use (Annex 7, paragraph 132).

3.55 The Scientific Committee noted workshop views on the potential importance of making provision in protected area systems for the protection of spatially predictable features (such as upwellings and fronts) that are critical to the function of local ecosystems (Annex 7, paragraph 131).

3.56 Some Members expressed concern that such features and processes would need very careful definition in order to be relevant to, and applicable in, the approaches under consideration.

3.57 The Scientific Committee agreed to work toward developing a system of protected areas as set out in Annex 7, paragraphs 61 to 70, and summarised above. The general

objectives for which protected areas may be established and the types of protection that could be given in accordance with Article IX are illustrated in Table 1. These types of areas could be applied anywhere within the Convention Area (Annex 7, paragraph 133).

3.58 The Scientific Committee noted that the terms used for these areas have meanings in other fora that differ from those used here. Further discussion is needed to consider the terms to be used for different types of protected areas (Annex 7, paragraph 135).

3.59 The Scientific Committee also noted that the 'Fisheries Closed Areas' are already considered by the Scientific Committee and Commission according to advice from working groups on individual fisheries.

ToR (iii) to consider proposals that are currently under development or in a conceptual phase that relate to MPAs in the Convention Area

3.60 The Scientific Committee noted that the workshop had received information on progress, relating to MPAs in the Convention Area currently under development or consideration, in respect of:

- (i) Prince Edward Islands (WS-MPA-05/15)
- (ii) Anvers Island, Antarctic Peninsula (WS-MPA-05/10)
- (iii) Balleny Islands (WS-MPA-05/11, SC-CAMLR-XXIV/BG/25).

It noted the extensive discussion in respect of these topics (Annex 7, paragraphs 72 to 89 and 93 to 106).

3.61 Mr Pshenichnov informed the Scientific Committee that Ukraine is initiating research designed to identify the potential scope and extent of an MPA in the Argentine Islands (Antarctic Peninsula) (CCAMLR-XXIV/BG/19).

3.62 The Scientific Committee noted advice concerning elaboration of ATCM Decision 9 (2005) relating to guidelines for determining if an MPA will be of interest to CCAMLR (Annex 7, paragraphs 136 and 137).

3.63 It agreed that two approaches might assist in this:

- (i) to request WG-EMM and WG-FSA to develop guidelines to indicate what percentage of the range of a known harvestable resource could be covered by protected areas within a statistical unit before CCAMLR would need to determine if a proposed protected area might impact on rational use;
- (ii) to request each Member of CCAMLR to indicate which of the recent proposals from ATCM concerning protected areas with marine components should, in retrospect, have been required to be submitted to CCAMLR according to the criteria in ATCM Decision 9 (2005).

ToR (iv) to discuss the types of scientific information that may be required for the development of MPAs to further the objectives of CCAMLR, including the identification of biophysical regions across the Convention Area

3.64 The Scientific Committee endorsed advice that:

- (i) key tasks needed to consider a system of protected areas to assist CCAMLR in achieving its broader conservation objectives are:
 - (a) a broad-scale bioregionalisation of the Southern Ocean;
 - (b) a fine-scale subdivision of biogeographic provinces, which may include hierarchies of spatial characteristics and features within regions, giving particular attention to areas identified in the bioregionalisation;
 - (c) identification of areas that might be used to achieve the conservation objectives;
 - (d) determination of areas requiring interim protection;
- (ii) these tasks should involve an initial desktop study;
- (iii) the types of data listed in Annex 7, Table 2, are those appropriate for this process (Annex 7, paragraphs 138 and 139).

3.65 The Scientific Committee endorsed the need for this process to be implemented:

- (i) via a work program comprising the elements specified in Annex 7, paragraph 107 and in paragraph 3.66(3) below;
- (ii) complemented by a workshop to advise on a bioregionalisation of the Southern Ocean, including, where possible, advice on smaller-scale delineation of provinces and potential areas for protection to further the conservation objectives of CCAMLR;
- (iii) by establishing a Steering Committee, including members of the Scientific Committee and CEP. An important role of the Steering Committee will be to involve appropriate experts from outside the Scientific Committee and CEP with appropriate data or expertise (Annex 7, paragraphs 141 and 142).

3.66 The Scientific Committee endorsed the following terms of reference for the Steering Committee:

1. To facilitate collaboration between the CCAMLR Scientific Committee and CEP in this work.
2. To facilitate the involvement of appropriate experts in this work.
3. To coordinate and facilitate:

- (i) collating existing data on coastal provinces, including benthic and pelagic features and processes;
 - (ii) collating existing data on oceanic provinces, including benthic and pelagic features and processes;
 - (iii) determining the analyses required to facilitate a bioregionalisation, including the use of empirical, model and expert data;
 - (iv) developing a broad-scale bioregionalisation based on existing datasets and other datasets possibly available prior to the workshop;
 - (v) delineating fine-scale provinces within regions, where possible;
 - (vi) establishing a procedure for identifying areas for protection to further the conservation objectives of CCAMLR.
4. To organise a workshop to establish a bioregionalisation for the CCAMLR Convention Area and to consolidate advice on a system of protected areas (Annex 7, paragraph 144).

3.67 It also endorsed the suggestion that CEP be invited to undertake the initial work necessary to develop a bioregionalisation of the coastal provinces, as an extension of its terrestrial bioregionalisation work, while the Scientific Committee undertakes the initial work needed to delineate the oceanic provinces. Such work would involve examination of both the benthic and pelagic systems in the respective areas (Annex 7, paragraph 143).

3.68 Notwithstanding this general agreement, Dr K. Shust (Russia) suggested that caution should be exercised in inviting outside experts and groups to attend CCAMLR workshops on this topic, believing that it would be more appropriate for these to be involved only in the intersessional correspondence and preparations for workshops and meetings.

3.69 Overall, the Scientific Committee recognised that the process summarised in paragraphs 3.64 to 3.67 has important implications in respect of budget, timetable, procedures and management.

3.70 It noted the advice of the MPA Workshop that the next workshop should be held in 2008 (Annex 7, paragraph 117). However, several Members felt that it was essential to make more rapid progress on such an important issue.

3.71 The Scientific Committee agreed that the workshop would be held independently from the working group meetings and a report provided directly to the Scientific Committee. It also agreed that the work of the Steering Committee be afforded a high priority. The Scientific Committee advised that, should the Steering Committee require preparatory meetings, it would be best for these meetings to occur in conjunction with other meetings that members of the Steering Committee may be attending, such as the meetings of the Scientific Committee or its working groups.

3.72 The Chair of the Scientific Committee was requested to consult with the Convener of the Subgroup on Protected Areas, and others as appropriate, to develop suggestions for membership of a Steering Committee and to circulate these to the Scientific Committee for

approval. The Chair of the Scientific Committee was also requested to invite CEP to participate in the work of the Steering Committee and for it to nominate appropriate members.

3.73 The Commission was requested to endorse the work program, workshop and Steering Committee terms of reference outlined above. Advice was also requested on the priority (including timing) to be accorded to these undertakings (and specifically to the proposed workshop).

Interactions between WG-FSA and WG-EMM

3.74 The Scientific Committee considered the ecological interactions arising with respect to fisheries and considered papers that addressed fish by-catch in the krill fishery (Annex 4, paragraph 3.13), the fish diet of Antarctic shags (Casaux and Barrera-Oro, 2005), benthos by-catch from the trawl survey (Annex 5, paragraph 3.32), and cetacean–fisheries interactions (Kock et al., 2005) (Annex 5, Appendix R).

3.75 With respect to the possible link of a decline of certain prey species and their predators, Antarctic shags and South Georgia shags (Annex 5, Appendix R, paragraph 8), Dr E. Barrera-Oro (Argentina) further elaborated that:

- (i) the monitoring of the status of these shag species in the South Shetland and South Orkney Islands started in the mid-1990s, well after the depletion of two of their main inshore fish prey species, *Notothenia rossii* and *Gobionotothen gibberifrons*. The shags' declining trend could have started earlier, closer in time to the fishery-induced decline of some of their prey species;
- (ii) although almost 25 years have passed since fishing has impacted on some fish stocks, and 15 years have passed since the closure of Subareas 48.1 and 48.2 for finfishing, a recovery of the inshore populations of the mentioned fish species has not been observed;
- (iii) a decrease in colony size has recently been reported for the sub-Antarctic Crozet shags at Marion Island, as being caused by an altered availability of food, which was reflected by a changed dominance in nototheniid prey in the diet (Crawford et al., 2003).

3.76 Dr Barrera-Oro added that some of these interactions may constitute cases of the potential impact of the commercial fishery on ecological interactions of components of the Antarctic ecosystem, which need to be monitored.

3.77 The Scientific Committee suggested that a system to quantify the interactions between marine mammals and the longline fishery in a systematic fashion be developed in the intersessional period. This should include direct observations of fish being removed from the line and indirect observations of depredated fish, lost hooks and broken gear, as well as systematic reporting of the presence of killer whales and sperm whales.

Dependent species and ecosystem considerations

3.78 The Scientific Committee considered the broader ecosystem approach to fisheries and in particular consideration of the effects of fisheries on non-target species, through both direct effects, such as incidental mortality, and through trophodynamic changes brought about by fishing. With respect to the ecosystem approach, the Scientific Committee considered that the management of fisheries as two complementary components would be useful:

- (i) firstly, the setting of catch limits for the target species in a fishery
- (ii) secondly, the implementation and conduct of that fishery.

3.79 The Scientific Committee agreed that CCAMLR had made progress on both of these components, including implementing the precautionary approach for assessing catch limits. However, beyond adopting escapement levels that endeavour to take account of dependent species, there are currently no adopted tools or assessment procedures used by the Scientific Committee to advise on catch limits according to the requirements of predators on small or large scales. Nor are there adopted tools and assessment procedures for assessing the impacts of existing harvest strategies on dependent species.

3.80 The Scientific Committee encouraged Members to participate in the work of the Subgroup on the Development of Operating Models (paragraphs 3.36 to 3.38) and for the conveners of WG-EMM and WG-FSA to work with the subgroup to provide opportunities for the development of models for use by both working groups.