

## ECOSYSTEM MONITORING AND MANAGEMENT

### Report of the 2007 meeting of WG-EMM

3.1 Dr Reid, WG-EMM Convener, reported on the results of the 13th meeting of WG-EMM which was held in Christchurch, New Zealand, from 17 to 26 July 2007 (Annex 4). In particular, the meeting included:

- (i) a workshop to review estimates of  $B_0$  and precautionary catch limits for krill (Annex 4, section 2 and Appendix D);
- (ii) further development of management procedures to evaluate options for subdividing the krill catch limit among SSMUs in Area 48 and consideration of the advice from WG-SAM (Annex 7, paragraphs 6.3 to 6.5);
- (iii) discussion of the core business of WG-EMM, which included:
  - status and trends in the krill fishery
  - status and trends in the krill-centric ecosystem
  - status of management advice
  - future work.

3.2 The Scientific Committee noted several key points in relation to the krill fishery which were highlighted in the report of WG-EMM:

- (i) There were inconsistencies in the reporting of catches and notification of intention to fish by Members and non-Members (Annex 4, paragraph 4.17). There was also a substantial increase in the number of notifications of intention to participate in the krill fishery in 2008/09, suggesting a potential catch in excess of 700 000 tonnes (Annex 4, paragraph 4.14).
- (ii) WG-EMM had adopted and implemented agreed protocols from SG-ASAM for the estimation of krill biomass based on acoustic surveys. The Working Group had used revised estimates of  $B_0$ , CV and  $\gamma$  to provide advice on the revision of the precautionary catch limits for krill in Area 48 and Division 58.4.2 (including an allocation of that yield into two subdivisions) (Annex 4, paragraphs 2.70 and 2.71).
- (iii) WG-EMM had agreed to a proposal for a staged development of the krill fishery based on available information, such that the fishery does not develop at a pace greater than that at which it can be managed, in a way that achieves the objectives of the Commission. The first stage of this process will be to deliver advice next year on a risk-based expansion of the fishery to a level consistent with the current level of uncertainty (Annex 4, paragraphs 6.35 to 6.38).
- (iv) The discussion of a number of suggestions for the collection of necessary data from the krill fishery, including options for the deployment of scientific observers. These discussions included consideration of the impact on data quality of the various options that might be adopted (Annex 4, paragraphs 4.85 to 4.88).

- (v) The important scientific and operational requirements for the orderly development of krill fisheries and the need to consider the data requirements with respect to existing conservation measures this year (Annex 4, paragraph 6.50).

#### Scientific observer program

3.3 The Scientific Committee agreed that the instructions in the *Scientific Observers Manual* be revised (Annex 4, paragraph 4.34), and the interim fish larvae by-catch protocol (WG-EMM-07/25) be included in the manual, so that the various types of information urgently needed by the Scientific Committee could be systematically collected (Annex 4, paragraphs 4.64 to 4.72).

3.4 The Scientific Committee agreed to consider issues relating to observer coverage.

3.5 The Scientific Committee noted with interest WG-EMM's deliberations on the issue of data collection by scientific observers which focused on previously agreed priorities (SC-CAMLR-XXV, paragraph 2.15).

3.6 The Scientific Committee endorsed WG-SAM's advice which identified a need for high-quality length-frequency data from the fishery from several years in advance of implementing an integrated assessment, and recommended that the fishery start providing length-frequency data now, given that the coverage by research surveys is not likely to be sufficient for all regions (Annex 7, paragraph 3.13).

3.7 The Scientific Committee based its deliberations on the following two strategic objectives for scientific observations of the krill fishery:

- (i) to understand the overall behaviour and impact of the fishery
- (ii) to undertake routine monitoring of the fishery to inform population and ecosystem models.

3.8 The rationale behind this two-stage approach is that fisheries monitoring effort does not necessarily have to have indefinite maximum coverage if a reduced observation effort is sufficient to fulfil management requirements. There is, however, an expectation that there will be a long-term need for systematic data collection from the fishery.

3.9 The Scientific Committee agreed that it will only be possible to design the spatial and temporal level of observer coverage required for objective (ii) once objective (i) has been completed. A full investigation of (i) would require systematic spatial and temporal coverage by scientific observers across SSMUs, seasons, vessels and fishing methods.

3.10 The Scientific Committee agreed that there are a number of ways to collect the required scientific data from the krill fishery. For example, for both first and second stages the most comprehensive coverage, and the most rapid way to achieve objective (i), could be either of the following alternatives:

- 100% coverage by international scientific observers
- 100% coverage by international scientific and/or national observers.

3.11 The Scientific Committee noted that reduced levels of observational effort could delay the achievement of objective (i) in paragraph 3.7, and may also introduce bias into the data if the observational effort is not reduced appropriately. This reduced effort could include:

- (i) systematic but <100% coverage by observers;
- (ii) different levels of coverage for different fleets, for example, 100% coverage for new vessels with unknown characteristics and a lesser level of coverage on established vessels for which data are already available;
- (iii) random systematic allocation of observers plus regular quality checks, and systematic coverage by scientific observers until the fishery is established to fulfil suitable data for management requirements.

3.12 It was clarified that:

- (i) ‘systematic coverage’ means coverage that ensures data collection across all areas, seasons, vessels and fishing methods, which leads to the provision of consistent high-quality data for assessments in multi-vessel, multi-nation fisheries (Annex 7, paragraph 4.16);
- (ii) to obtain the required information, either international or national scientific observers would be acceptable, provided the data and reports are consistent with the CCAMLR Scheme of International Scientific Observation and are of a sufficiently high quality to be of use for the proposed analyses;
- (iii) levels of initial observation coverage to understand the overall behaviour and impact of the krill fishery might be higher than that of the eventual long-term observation coverage.

3.13 The Scientific Committee encouraged interested Parties to submit plans to achieve systematic and consistent collection of the required scientific data from the fishery to the next WG-EMM, WG-SAM and ad hoc WG-IMAF meetings for scrutiny. These plans would include those that proposed 100% observer coverage and those that could demonstrate adequate data collection using lower levels of coverage. This work is essential in order that Members can agree on the level of coverage that enables collection of the data necessary to achieve the stated objectives.

3.14 The Scientific Committee agreed that the working groups should carry out an assessment of the consequences to the data collection effort of the different approaches suggested, and recommend the required level of observer coverage to the Scientific Committee in 2008.

3.15 The Scientific Committee acknowledged that each of the options for obtaining the priority data required would have consequential issues of implementation and the timescale of delivery. Risks associated with reduced coverage need to be thoroughly addressed by relevant experts before agreeing on an observer coverage plan.

3.16 The Scientific Committee further urged Members and Contracting Parties fishing for krill to send their experts to WG-EMM and WG-SAM to be fully engaged in the process.

## Orderly development of the krill fishery

3.17 The Scientific Committee agreed that a strategic approach to the orderly development of the krill fishery would allow the Commission to better control and mitigate the level of impact by the krill fishery on the krill stocks and on predator populations (Annex 4, paragraphs 4.73 to 4.76). This approach would also make the krill fishery consistent with other CCAMLR-managed fisheries.

## Estimation of $B_0$ and precautionary catch limits for krill

3.18 The Scientific Committee noted the outcomes of the Workshop to Review Estimates of  $B_0$  and Precautionary Catch Limits for Krill (Annex 4, paragraphs 2.1 to 2.80), and concurred with the advice that the most appropriate method for estimating  $B_0$  from survey data was still the Jolly and Hampton (1990) method as has been used for all CCAMLR  $B_0$  surveys to date (Annex 4, paragraphs 2.13 and 2.67).

3.19 The Scientific Committee agreed that current CCAMLR protocols for the acoustic estimation of krill biomass and its variance should follow those of the CCAMLR-2000 Survey (Trathan et al., 2001; Hewitt et al., 2004), except with regards to target strength and species identification; for these procedures, the recommendations of SG-ASAM should be followed (SC-CAMLR-XXIV, Annex 6). To assist this process, all CCAMLR-adopted acoustic protocols and guidelines for krill surveys should be collated into a single document (Annex 4, paragraphs 2.31 and 5.97).

3.20 The Scientific Committee noted that no new formulations of the key parameters for krill such as growth, recruitment variability and mortality were produced at the workshop. A work program has been initiated to incorporate the most recent information into the assessment process (Annex 4, paragraphs 2.33 to 2.36 and 2.52 to 2.54).

3.21 The Scientific Committee agreed that the  $B_0$  estimate of 37.29 million tonnes and the CV estimate of 21.20%, presented in WG-EMM-07/30 Rev. 1, represents the best advice on the biomass estimate for krill in Area 48 during the CCAMLR-2000 Survey (Annex 4, paragraph 2.28) and that, using these values and the updated  $\gamma$  arising from the use of the GYM (0.093), compared to the KYM (0.091), the precautionary catch limit for Area 48 should be updated to 3.47 million tonnes (Annex 4, paragraphs 2.28, 2.39 and 2.41). The Scientific Committee recommended that Conservation Measure 51-01 be amended accordingly.

3.22 A new estimate of  $B_0$  for Division 58.4.2, produced using the new simplified SDWBA model for target strength and species identification, of 28.75 million tonnes with a CV of 16.18% was presented in SC-CAMLR-XXVI/7. This biomass was subdivided as agreed by WG-EMM (Annex 4, paragraphs 6.22 and 6.50) and precautionary catch limits were calculated for the entire survey area and for the two subdivisions.

Stratum	$B_0$ (million tonnes)	CV	Precautionary catch limit (million tonnes)
Entire survey (30–80°E)	28.75	16.18	2.645
Western subdivision (30–55°E)	16.17	18.36	1.448
Eastern subdivision (55–80°E)	11.61	29.82	1.080

3.23 The Scientific Committee agreed that the subdivision was appropriate and that Conservation Measure 51-03 should be re-written to reflect these changes in the precautionary catch limit and its subdivision.

3.24 The Scientific Committee thanked Australia for completing this survey and congratulated it on the timely submission of the revised results.

3.25 The Scientific Committee agreed that any future surveys intended to produce estimates of  $B_0$  should follow the agreed protocols and be first presented to WG-EMM for its consideration and approval (Annex 4, paragraph 2.30).

3.26 The Scientific Committee also noted that there are currently no SSMUs defined in areas other than Subareas 48.1, 48.2 and 48.3, and catch limits have not been set in Area 88 nor Subarea 48.6 (Annex 4, paragraph 2.55).

3.27 In noting that there is currently sufficient knowledge of where krill fishing might be possible, but insufficient knowledge about the impacts of such fisheries on krill and dependent predators for many areas, the Scientific Committee noted that as the krill fishery develops, it will be important to apply the ecosystem-based management principles developed in Area 48 to other areas (Annex 4, paragraph 2.79).

3.28 The Scientific Committee recommended that the development of krill fishing in Area 88 or Subarea 48.6 should be considered exploratory fisheries, since only limited information exists on the distribution and abundance of krill or predators.

3.29 WG-EMM should consider the information that would be required from exploratory krill fisheries. This could include consideration of stock sizes and definition, any subdivision of the statistical areas that might facilitate surveying or management, the requirement for SSMUs and trigger levels and the information available on krill, predators and the environment that could assist with management of exploratory fisheries (Annex 4, paragraph 2.79).

3.30 It was noted that some of the information required from an exploratory krill fishery might be provided from fishing vessels.

3.31 The Scientific Committee noted an aspect of uncertainty that is not currently incorporated in the assessment and decision rules – implementation uncertainty. Implementation uncertainty, caused by IUU fishing for krill or spatial/temporal misreporting, may also become important, and either minimised by putting appropriate control measures in place or explicitly represented in models (Annex 4, paragraph 2.64).

#### Status of predators, krill resource and environmental influences

3.32 The Scientific Committee noted WG-EMM's deliberations on the wider Antarctic ecosystem. It endorsed the comments on the importance of data collection to support CEMP indices (Annex 4, paragraph 5.6 and 5.73) and their analysis (Annex 4, paragraphs 5.75 and 5.76), encouraged regional studies in areas such as the Ross Sea (Annex 4, paragraphs 5.26 and 5.34) and the Scotia Sea (Annex 4, paragraph 5.58), encouraged

participants in IPY and CAML surveys to follow standard protocols (Annex 4, paragraphs 2.31 and 5.84) and agreed on the need for future data requirements from the fishery (Annex 4, paragraphs 5.5 and 5.51).

3.33 The importance of the long time series of krill density and recruitment indices collected as part of the BAS, US AMLR and LTER programs for the work of CCAMLR was strongly emphasised. There will be a continuing need to collect and submit these data to the working groups into the future (Annex 4, paragraphs 2.75 and 5.43).

3.34 The Commission was urged to encourage Members to develop (and maintain) long-term scientific monitoring programs studying the krill-based ecosystem, as these will provide the data that will allow the Scientific Committee to investigate the effects of climate change as well as the effects of the fishery. This work will be facilitated by coordination of future long-term research to develop the best sites and data.

3.35 In noting the request from WG-EMM for advice from the Scientific Committee on the methods to use for subdividing large statistical areas in the absence of sufficient information, the Scientific Committee encouraged further work be undertaken by the Working Group to examine the consequences of not subdividing large statistical areas, or the consequences of subdividing these areas using limited data (Annex 4, paragraphs 6.23 and 6.24).

#### Small-scale management units

3.36 The Scientific Committee endorsed the results of WG-EMM's continuing deliberations on SSMUs (Annex 4, paragraphs 6.25 to 6.47), noting also its discussion in paragraph 2.14, in particular:

- (i) its endorsement that 'structured fishing' is a useful elaboration of the meaning of Option 6 (Annex 4, paragraph 6.26);
- (ii) its endorsement of the process recommended by WG-SAM that the implementation of a subdivision of the Area 48 catch limit amongst SSMUs could be undertaken in stages based on the best scientific evidence available at each stage (Annex 4, paragraph 6.35);
- (iii) that Stage 1 advice can be delivered next year based on models and data currently available and would involve the provision of advice on a total catch limit in Area 48 combined with catch limits in each SSMU, and that the discussion surrounding this advice is provided in Annex 4, paragraphs 6.35 to 6.38;
- (iv) its endorsement of the model scenarios for delivering Stage 1 advice and the need to consider the implications for the fishery of potential differences in catch rates in shelf versus oceanic SSMUs (Annex 4, paragraphs 6.39 to 6.44);

- (v) the importance of using field and other data in the models to establish that the relative differences amongst SSMUs in the models reflect reality and its endorsement of the process of using data outlined by WG-SAM (Annex 4, paragraph 6.45), including consideration of the benchmark data suggested by WG-SAM for validating the models noting:
  - (a) the strongest signals in empirical data are those for penguins and seals;
  - (b) variability in krill abundance can be documented from the AMLR, BAS and LTER survey series;
  - (c) changes in krill abundance prior to these survey series are less well supported by data, particularly when the errors in the estimates of abundance are considered;
  - (d) trends in whale populations are unclear and very much dependent on which species is considered;
- (vi) its endorsement of the approach of WG-SAM to the performance measures and risk assessments to be undertaken in Stage 1, noting that the ‘benchmark levels’ indicated by WG-SAM are really ‘reference levels’, which are quite distinct from the benchmark data used to validate the models (Annex 4, paragraph 6.46);
- (vii) its endorsement of the further development of feedback management approaches (Option 5) and structured fishing (Option 6) after the work for Stage 1 is completed, noting that structured fishing could provide useful results to assist, during the development of the fishery, the elaboration of a feedback management in the longer term (Annex 4, paragraph 6.47).

3.37 Dr H. Shin (Republic of Korea) questioned if structured fishing is fishing as instructed by a pre-set plan overriding fishers’ decisions with a view to generate artificial impacts. He doubted whether such fishing could detect any effects beyond natural variability when conducted at an ecologically safe level. He also observed it would be difficult to administer, particularly when applied in regular, assessed fisheries which have been in operation for a few decades.

3.38 The Scientific Committee acknowledged that the issue of variability in environmental parameters and in the krill population would have a major effect on the operation of SSMUs (Annex 4, paragraph 6.36) and noted that the models being developed incorporated such variability. There also needs to be an assessment of the various subdivision options on the krill fishery itself and how within-season reallocation of catches might be effected.

#### Lenfest Workshop

3.39 The Scientific Committee welcomed the discussion of the report of the Workshop on Identifying and Resolving Key Uncertainties in Management Models for Krill Fisheries organised at the request of the Lenfest Ocean Program in May 2007 in California, USA

(Annex 4, paragraphs 7.9 to 7.13). Such workshops provide an opportunity for people outside the CCAMLR community to contribute their experience, data and perspectives towards advancing the work of CCAMLR and to communicate that work to a wider audience.

#### Intersessional work

3.40 The Scientific Committee endorsed the priorities for the 2008 meeting of WG-EMM (Annex 4, paragraph 7.30):

- (i) the development and provision of advice on Stage 1 of the subdivision of the Area 48 krill catch amongst SSMUs;
- (ii) revision, as needed, of estimates of yield for krill;
- (iii) considering the outcomes of the work of the Subgroup on Status and Trend Assessment of Predator Populations (WG-EMM-STAPP).

#### Conservation measures on krill fishing

3.41 The Scientific Committee discussed a number of issues arising from the advice of WG-EMM. The background to its discussions is given below.

#### Precautionary yield for krill in Area 48

3.42 The Scientific Committee noted that in 2000 the Commission agreed that krill catches in Area 48 should not exceed a trigger level until a procedure for division of the overall catch limit into smaller management units had been established (CCAMLR-XIX, paragraph 10.11), and that in 2002 the Commission had defined these smaller management units as small-scale management units (CCAMLR-XXI, paragraph 4.5). It further noted that WG-EMM had advised that the current drafting of Conservation Measure 51-01 would not allow the Secretariat to implement the trigger level as intended, and consequently recommended its revision (Annex 4, paragraphs 2.77 and 6.50).

3.43 The Scientific Committee further noted that following a reanalysis of the CCAMLR-2000 survey data, WG-EMM had provided advice on a revised precautionary catch limit for krill in Area 48 (3.47 million tonnes), but had not provided advice on a subarea division of this catch limit. The Scientific Committee noted that subarea divisions were not necessary given the decision of the Commission to define the spatial delineation of SSMUs.

3.44 The Scientific Committee recommended that Conservation Measure 51-01 be revised accordingly.



### Notification of intent to participate in a krill fishery

3.45 The Scientific Committee endorsed the advice of WG-EMM of the need to clarify the notification procedure and include more detail in the notification form (Conservation Measure 21-03, Annex A). The large discrepancy between notifications for krill fishing and actual fishing effort creates a significant problem for the Scientific Committee in that it reduces its ability to plan its activities, particularly its work to determine appropriate catch limits for SSMUs.

3.46 The Scientific Committee agreed that one of the ways to reduce the number of notifications that were not followed by fishing would be to disallow future fishing for a number of years for those Contracting Parties which did not act on their notifications. It regretted the circumstance that might make this necessary.

3.47 The Scientific Committee recommended that Conservation Measure 21-03 be revised accordingly.

### Data reporting from the krill fishery

3.48 The Scientific Committee noted the advice of WG-EMM that, under current reporting requirements, the Secretariat would have to forecast krill catches 120 days in advance to effect a closure of a krill fishery. It concluded that a shorter catch reporting system would be required as the fishery approached the trigger level. It recommended that moving to a 10-day reporting system would be necessary once 80% of the trigger level in any krill fishery had been reached.

3.49 Accordingly, the Scientific Committee recommended that Conservation Measure 23-06 be revised.

### Biological reporting for the krill fishery

3.50 In noting that the conservation measure for the data reporting system for the krill fishery (Conservation Measure 23-06) is the only conservation measure that does not require collection of biological information, the Scientific Committee recommended the data reporting requirements from the krill fishery should be consistent with the data required to manage the orderly development of the fisheries (Annex 4, paragraph 4.70 to 4.72).

3.51 In order to deliver this consistency in reporting, the Scientific Committee requested that WG-EMM consider the biological data reporting requirements for the krill fishery and to deliver advice next year in order that the biological data reporting requirements included in Conservation Measure 23-06 may be reviewed.

## Exploratory fisheries for krill

3.52 The Scientific Committee agreed that krill fisheries in areas without precautionary catch limits (e.g. Area 88 and Subarea 48.6) should be considered as exploratory fisheries and that the conditions applied to other exploratory fisheries (Conservation Measure 21-02) should apply.

3.53 The Scientific Committee requested that Members provide WG-EMM with details of appropriate approaches to determining the data requirements to evaluate the distribution, abundance and demography of krill to provide an estimate of precautionary catch limit and the potential yield of the fishery according to the CCAMLR decision rules.

### Precautionary catch limitation on *Euphausia superba* in Division 58.4.2

3.54 The Scientific Committee agreed that the precautionary catch limit for krill in Division 58.4.2 be revised to 2.645 million tonnes per year based on the results of a scientific survey using approved methodology and the CCAMLR decision rules (Annex 4, paragraphs 2.29 and 5.39). Noting that WG-EMM had agreed that the subdivision of this area along the 55°E line of longitude was appropriate (Annex 4, paragraph 6.22) precautionary catch limits of 1.448 million tonnes and 1.080 million tonnes for the regions west and east of 55°E for these subdivisions were also agreed.

3.55 Noting that WG-EMM had agreed that trigger levels should be developed for each krill fishing area to manage the orderly development of the fishery (Annex 4, paragraph 2.79(iii)), the Scientific Committee agreed that trigger levels for this division should be calculated in a manner consistent with the proportion of  $B_0$  used in Area 48, resulting in trigger levels of 260 000 and 192 000 tonnes west and east of 55°E in Division 58.4.2 respectively.

3.56 The Scientific Committee recognised that despite there being a recent assessment of krill biomass in Division 58.4.2, there is a relative paucity of ecological information in this division compared to Area 48. Furthermore, the krill fishery has not operated in Division 58.4.2 since the 1988/89 season and no observer reports have been submitted from the krill fishery in this division. Consequently, there is a need to collect scientific data from the fishery in this division to assist with management. Because of this lack of data, the Scientific Committee agreed it is prudent to apply some of the exploratory fisheries measures to Division 58.4.2 to ensure the orderly development of the fishery in this division, including the use of scientific observers to collect data on the fishing operations, by-catch and krill demographics.

3.57 The Scientific Committee recommended that Conservation Measure 51-03 be revised accordingly.

### Other conservation measures

3.58 The Scientific Committee agreed with the Working Group's recommendation to remove the Seal Islands CEMP site from Conservation Measure 91-03 (paragraph 3.60; Annex 4, paragraphs 6.3 and 6.4).

### Protected areas

3.59 Discussion of WG-EMM's deliberations on management of protected areas is reported in the next section.

### Management of protected areas

3.60 The Scientific Committee endorsed the advice from WG-EMM that management plans for the Cape Shirreff and Seal Islands CEMP sites, and the two relevant measures (Conservation Measures 91-02 and 91-03 respectively) would not need to be reviewed until 2009. It further endorsed the recommendation that the Seal Islands CEMP site under Conservation Measure 91-03 should be discontinued, since research was no longer being undertaken at this site (Annex 4, paragraphs 6.2 to 6.4).

3.61 The Scientific Committee noted the advice from WG-EMM regarding the proposed management plan submitted by the USA for ASMA No. X: Southwest Anvers Island and Palmer Basin, which contains a marine component (SC-CAMLR-XXVI/BG/3). The Working Group had noted that the site contains an area of long-term ecosystem research, which occurs in an area without harvesting and thus provides information that can be compared to adjacent harvested areas. The proposed ASMA has a small marine component (3 275 km<sup>2</sup>, representing approximately 0.5% of the total surface area in Subarea 48.1), and has not been subjected to sustained commercial harvesting (Annex 4, paragraph 6.13).

3.62 Dr Holt noted that this proposal was for a managed area, and not a protected area. He highlighted the reasons for the proposal of this area, and the need for the management of activities in order to protect long-term and future research interests. The proposed ASMA contains a small and shallow marine component, in an area that is considered very unlikely to support a krill fishery. The importance of providing scientific advice from the Scientific Committee to CEP was also emphasised, particularly in relation to the maintenance of a good working relationship between the Scientific Committee and CEP.

3.63 Dr N. Gilbert (CEP Observer) endorsed previous comments on the status of the proposed ASMA as a managed area. He noted that under the provisions of Annex V to the Protocol on Environmental Protection to the Antarctic Treaty, any area including any marine area may be designated as an ASMA. ASMAs are not prohibited-access areas, and are intended to coordinate the range of activities occurring in an area. For clarification, he noted that the draft management plan for Southwest Anvers Island had been submitted to CEP X (New Delhi, India, 2007), and that it has now entered a process of intersessional review under CEP. In this regard, CEP's expectation is that the Scientific Committee can provide input to this review, according to the procedure nominated by the Commission (CCAMLR-XX, paragraph 11.17).

3.64 Dr K. Shust (Russia) indicated that the marine boundary of the proposed area does not follow geographic features. Other Members noted that the management plan states that the boundaries of the ASMA have been designed to include areas of high ecological value while also maintaining a practical configuration for ease of use and navigation. It was further noted that the substance of the management plan, including the area boundaries, had already been reviewed by CEP.

3.65 The Scientific Committee noted that, for this ASMA proposal, it needs to address two questions in order to provide advice to the Commission:

- (i) Could actual harvesting or the potential capability of harvesting of marine living resources be affected by site designation?
- (ii) Are there provisions specified in a draft management plan which might prevent or restrict CCAMLR-related activities?

3.66 The Scientific Committee agreed the following response to the respective questions:

- (i) the marine component contains a very small fraction of the krill population distributed throughout Area 48 (only comprising 0.5% of the total surface area of Subarea 48.1) and that, should fishing activities need to be undertaken, it would need to be carried out in such a way that it would not impact on research activities;
- (ii) the research being undertaken in the area proposed to be included in the ASMA:
  - (a) is important for considering ecosystem interactions related to krill and assists WG-EMM and, as such, enhances the work of CCAMLR;
  - (b) contributes to the cooperative research being undertaken as a foundation to the work of CEP, CCAMLR and the Antarctic Treaty System as a whole;
  - (c) could be compromised if activities occurring in the marine area are not appropriately managed to avoid interference with those programs.

3.67 The Scientific Committee agreed that there was a need for clarification in the management plan of whether fishing is permitted within the proposed ASMA. It was suggested that text could be inserted into the management plan to state that fishing activities are permitted within the ASMA, but that any fishing activities must be conducted in accordance with the provisions of the management plan, and in coordination with the research and other activities taking place in the area. This could include the development of a research plan for fishing in this area.

3.68 It was further noted that:

- (i) there are no restrictions on the navigation of any vessels through the area, with the exception of seasonal buffer zones extending 50 m from the shore of a small number of islands, to protect sensitive bird colonies during the breeding season;

- (ii) scientific research can be undertaken within the area by any CCAMLR Member or Party to the ATCM, in accordance with the general Code of Conduct and the Scientific and Environmental Guidelines contained within the management plan.

3.69 The Scientific Committee agreed that, in accordance with Annex V, Article 6.3 of the Protocol on Environmental Protection to the Antarctic Treaty, a review of this management plan would be initiated every five years, and the plan updated as necessary. This review would be conducted in full consultation with CCAMLR.

3.70 Taking into account the points agreed in paragraphs 3.67 to 3.69, the Scientific Committee expressed its support for the draft management plan, noting that the proposed ASMA would create an important coordination framework for activities such as scientific research and tourism. In particular, the area would enhance the ability of Members to undertake scientific research to further the objectives of CCAMLR and CEP. It was noted that the input provided by the Scientific Committee on this issue has provided a valuable example of the important cooperation between CCAMLR and CEP under the Antarctic Treaty System.

#### Workshop on Bioregionalisation

3.71 The Report of the Workshop on Bioregionalisation of the Southern Ocean (Annex 9) was introduced by the Workshop Co-convenor, Dr Grant. The Workshop on Bioregionalisation was held from 13 to 17 August 2007 in Brussels, Belgium. The Workshop report contains technical details on data, methods and results, as well as an Executive Summary compiled by the Workshop Co-convenors. The Scientific Committee thanked Belgium for the opportunity to progress this work and for hosting such an excellent meeting.

3.72 The primary aim of the Workshop was to advise on a bioregionalisation of the Southern Ocean, including, where possible, advice on fine-scale subdivision of biogeographic provinces (SC-CAMLR-XXV, paragraph 3.34) (Annex 9, paragraphs 10 and 11). The Workshop was organised around two subgroups considering the benthic and pelagic systems separately.

3.73 The Workshop considered available bathymetric, physical oceanographic and biological data for the pelagic bioregionalisation (Annex 9, paragraphs 39 to 64). Biological datasets considering spatial attributes of different areas were also considered, and it was determined that some of these datasets might be most appropriately used at the regional scale. Data from the Continuous Plankton Recorder (CPR) Survey, and SCAR-MarBIN were recognised as having particular value to bioregionalisation.

3.74 For the benthic bioregionalisation, the Workshop agreed that data on bathymetry, seafloor temperature and currents, geomorphology, sediments and sea-ice concentration are important. Regarding biological datasets available for the benthic bioregionalisation, the Workshop noted that for the most part, biological data are restricted to shelf areas. Data considered for inclusion in the analysis included data on benthic invertebrates from the SCAR-MarBIN network, as well as presence/absence data on demersal finfish from SCAR-MarBIN and the CCAMLR database (Annex 9, paragraphs 69 to 80).

3.75 The Workshop endorsed the general methodology used to provide a broad-scale pelagic regionalisation from the 2006 Hobart Workshop (SC-CAMLR-XXV, paragraphs 3.44 to 3.49). It was agreed that, at the broad scale, the primary bioregionalisation result from the 2006 Hobart Workshop was a good working product that could be used to inform spatial management of the Convention Area (Annex 9, paragraphs 94 and 95).

3.76 The Workshop agreed that the broad-scale pelagic regionalisation could potentially be enhanced (Annex 9, paragraph 96). Five methods of how biological data could be used to enhance the bioregionalisation were discussed (Annex 9, paragraphs 97 to 121). These included Species Habitat Modelling and the Boosted Regression Trees (BRT) method for modelling single-response variables using several environmental predictors.

3.77 The approach to a benthic bioregionalisation consisted of a three-step process, by which physical regions were first defined using the process employed by the 2006 Hobart Workshop. The biological data were then overlaid, and the classification evaluated. Further work on this classification was undertaken after the Workshop by workshop participants, using the methods described above, and incorporating additional data that was not available at the Workshop. The results of this work are described in SC-CAMLR-XXVI/BG/28.

3.78 The Workshop endorsed the broad-scale primary regionalisation result produced by the 2006 Hobart Workshop.

3.79 The Workshop was supportive of the potential for the BRT method to produce biological data layers for broad-scale and fine-scale bioregionalisation, and it was suggested that the method be submitted for technical review by WG-SAM. It was also suggested that WG-EMM and WG-FSA could be asked to review the appropriateness of the datasets to be included as response variables (biological data) and those for inclusion as environmental layers (Annex 9, paragraphs 140 to 144).

3.80 The results of the benthic bioregionalisation (Annex 9, paragraphs 145 and 146) were updated after the Workshop, to include additional physical data unavailable at the Workshop, and further evaluation of biological data layers (SC-CAMLR-XXVI/BG/28). These results show that there will be a greater heterogeneity in benthic biodiversity and ecosystem structure and function at finer scales.

3.81 A geomorphic map of the East Antarctic margin showed some key features relevant to benthic bioregionalisation, including shelf banks, depressions, steep slope areas, canyons, sediment mounds, seamounts, fracture zones and abyssal plain areas (Annex 9, paragraphs 149 to 156). Further work to extend this geomorphic classification to other areas is presented in SC-CAMLR-XXVI/BG/27.

3.82 The Workshop noted that in providing a framework for understanding spatial structure and function of ecosystems it is important to consider both biodiversity pattern information and spatially defined ecological processes (Annex 9, paragraphs 157 to 164). This can be of assistance to a spatial decision-making framework, which was used in developing the conservation plan for the Prince Edward Islands. The Workshop endorsed the approach to develop maps representing ecological processes and other features that cannot easily be incorporated into an analysis of spatial patterns.

3.83 It was noted that ecological processes can be mapped spatially in two ways:

- (i) flexible processes can be mapped using spatial probability data (e.g. kernels)
- (ii) fixed processes can be mapped using fixed features that define the process (e.g. geomorphic features).

3.84 The Scientific Committee endorsed the outcomes of the Workshop, as well as the follow-up work described in SC-CAMLR-XXVI/BG/27 and BG/28. It welcomed this work noting it can be used to inform spatial management, and is a primary foundation for understanding the biological and physical heterogeneity in the Southern Ocean.

3.85 The Scientific Committee endorsed the recommendations of the Workshop for further work on this topic (Annex 9, paragraphs 165 to 168):

- (i) The primary regionalisation for the pelagic environment can be regarded as useful for application by CCAMLR and CEP. It was agreed that the initial regionalisation for the benthic environment should be reviewed and optimised for use by CCAMLR and CEP.
- (ii) Refinements to this bioregionalisation could be made in the future as methods are improved and data acquired and analysed. Further finer-scale bioregionalisation work could be undertaken in a number of areas based on existing data.
- (iii) Future work could include efforts to delineate fine-scale provinces, where possible. It was recommended that participants should submit papers to the Scientific Committee on approaches to fine-scale regionalisation, including on statistical methods and potential data sources. It was further recommended that WG-SAM should be requested to consider the statistical methods presented in Annex 9, paragraphs 140 and 141.
- (iv) The inclusion of process and species information could also be considered further, particularly in the context of systematic conservation planning, and in developing a spatial decision-making framework (Annex 9, paragraph 157). This may be particularly applicable at finer scales.

3.86 It was also noted that the final term of reference agreed for the Workshop Steering Committee (to establish a procedure for identifying areas for protection to further the conservation objectives of CCAMLR) (Annex 9, Appendix A) had not been addressed in detail at the Workshop, and it was agreed that this should therefore be taken forward as an outstanding topic for consideration in further work.

3.87 The Scientific Committee agreed that the further work described in paragraphs 3.85 and 3.86 should be undertaken within the context of WG-EMM, given the existing focus within that Working Group on issues relating to Southern Ocean ecosystems and spatial management. It was recommended that Members should submit papers to WG-EMM on these topics listed in paragraphs 3.85 and 3.86, and that a new WG-EMM agenda item should be created to facilitate consideration of this work. This new agenda item should maintain flexibility in order to respond to future requests for work on this topic and other related issues.

3.88 Dr Gilbert warmly welcomed the achievements of the Workshop, and informed the Scientific Committee that he would circulate the full Workshop report to CEP Members. As a point of interest, he further noted that the Environmental Domains Analysis undertaken by CEP as a biogeographic classification system for terrestrial Antarctica had provided a useful framework for the development of a terrestrial protected area system, as well as having broader benefits for research, monitoring and reporting.

3.89 Prof. Fernholm noted the relevance of the Workshop outcomes to the recent CBD Experts Workshop on ecological criteria and biogeographic classification systems for marine areas in need of protection, and asked whether there had been any input from CCAMLR to this process. Dr Constable confirmed that some of the discussion points from both the 2007 Workshop on Bioregionalisation and the 2006 Hobart Workshop had been conveyed to the CBD meeting, and that the outcomes of this meeting, when available, may be of interest to the Scientific Committee.

#### Advice to the Commission

3.90 The Scientific Committee endorsed the advice from WG-EMM on management plans for the Cape Shirreff and Seal Islands CEMP sites as set out in paragraph 3.60 (Annex 4, paragraphs 6.2 to 6.4).

3.91 The Scientific Committee expressed its support for the draft management plan for ASMA No. X: Southwest Anvers Island and Palmer Basin, noting that the proposed ASMA would create an important coordination framework for activities such as scientific research and tourism.

3.92 The Scientific Committee endorsed the outcomes of the Workshop on Bioregionalisation of the Southern Ocean (Brussels, Belgium, 13 to 17 August 2007) (paragraph 3.84), and recommended that the Commission should endorse the further work outlined in paragraphs 3.85 and 3.86.

3.93 The Scientific Committee agreed that this further work should be undertaken within the context of WG-EMM, and that a new WG-EMM agenda item should be created to facilitate its consideration.

#### Interactions between WG-EMM and WG-FSA

3.94 In order to address some of the issues regarding interactions between WG-EMM and WG-FSA which had been identified by the working groups, the Scientific Committee, at its 2006 meeting, agreed that the conveners of those working groups would lead a one-day workshop in 2007 to address these issues. The aim of the workshop was to consider the development of ecosystem models to examine the effects of fisheries in fish-based ecosystems.

3.95 The workshop was held on 16 July 2007 in Christchurch, New Zealand. It was co-convened by Drs Reid and Hanchet. It was agreed to use an ecological risk assessment as a framework for considering an ecosystem approach to CCAMLR finfish fisheries.



3.96 The main focus of the workshop was to identify potential risks from some CCAMLR fisheries and to review progress on work being undertaken that might contribute to assessing those risks.

3.97 Presentations were made on approaches to developing ecosystem models for CCAMLR fisheries which target:

- *E. superba* in the South Atlantic
- *C. gunnari* at South Georgia
- *C. gunnari* and *D. eleginoides* at Heard Island
- *D. mawsoni* in the Ross Sea.

3.98 The Scientific Committee agreed with the conclusion reached by workshop participants that the one-day meeting provided a good opportunity to review progress on ecosystem modelling for some CCAMLR finfish fisheries. The Scientific Committee noted the need for further development of ecosystems models which could take into account the complex interactions between predators, target species, prey and other fisheries.

3.99 The Scientific Committee agreed that:

- (i) the results of ecosystem/multi-species models would need to be evaluated by WG-SAM;
- (ii) results of ecosystem/multi-species models could be discussed under the WG-FSA agenda item 'Considerations of ecosystem management';
- (iii) interactions of the target fish species with top predators, and with krill and the krill fishery, may best be considered by WG-EMM under its agenda item 'Status and trends in the krill-centric ecosystem'.

3.100 The Scientific Committee agreed that further work on ecosystem modelling for finfish fisheries would benefit from holding another workshop. The Scientific Committee requested that during 2008, the WG-FSA and WG-EMM conveners develop terms of reference for a workshop to be held in 2009.