

ECOSYSTEM MONITORING AND MANAGEMENT

6.1 Dr J. Bengtson (USA), Convener, presented the report of the Fifth Meeting of the Working Group for the CCAMLR Ecosystem Monitoring Program (WG-CEMP), held at Santa Cruz de Tenerife, Spain, 5 to 13 August 1991 (Annex 7). He summarised the main current and planned initiatives of WG-CEMP, which were then reviewed by the Scientific Committee.

6.2 The text below reports the endorsement of specific initiatives and the discussion of these and other points during the Scientific Committee's review of the report. The remainder of the WG-CEMP report was endorsed generally by the Scientific Committee.

6.3 The Scientific Committee thanked the Working Group for its work during the intersessional period and at the meeting, for which particular thanks for the quality of the facilities and working environment were expressed to the hosts.

6.4 It was noted that, despite the very active work of WG-CEMP, the attendance only comprised 19 scientists from 10 Members. The absence of scientists from Argentina, Brazil and Chile, which have active programs monitoring CEMP parameters and from France, Germany, New Zealand and South Africa, each of which has major programs of research directly relevant to CEMP, was particularly regretted.

Predator Monitoring

6.5 No proposals for new monitoring sites had been received. Deletion of the minke whale from the list of indicator species, pending a specific proposal for reinstatement including a definition of appropriate parameters for monitoring (Annex 7, paragraph 7.16) was approved by the Scientific Committee.

6.6 The gentoo penguin had been added to the list of selected CEMP indicator species in 1990; full details of the resulting modifications to the Standard Methods had been prepared intersessionally and were adopted subject to minor modifications. These have now been submitted to the Secretariat.

6.7 The Scientific Committee agreed that the Secretariat should produce and circulate addenda to the Standard Methods as necessary between full revisions of the complete document. In particular, the Secretariat would circulate annually, to all Members and all

CEMP field program investigators, additions to and comments and advice on existing sites, species, parameters and procedures.

6.8 The Scientific Committee endorsed the suggestion that henceforth proposals for the inclusion of new species, parameters, or sites in CEMP would only be considered if submitted in writing with full supporting evidence by 30 June.

6.9 In order to help develop standard methods on activity budgets of seabirds and seals at sea - a potentially very important index - WG-CEMP has been developing proposals for a workshop on methods to monitor the at-sea behaviour of penguins and pinnipeds (Annex 7, paragraphs 4.45 to 4.47). This would consider various aspects of the topic and prepare specific recommendations for CEMP.

6.10 The Scientific Committee agreed there was a need for such a workshop and approved the overall terms of reference of the workshop:

- (i) to review the current state of the art regarding the design and deployment techniques;
- (ii) to review the available information on the potential instrument effects on animals;
- (iii) to review the existing data collection, processing, and analytical methods and the compatibility of these within and between various devices and species;
- (iv) to identify appropriate procedures for analysing the data sets of at-sea behaviour produced by time/depth recorders and satellite-linked instruments; and
- (v) to assess whether indices of at-sea activity, suitably standardised for use in routine monitoring operations (e.g. as part of CEMP), can be derived from the data currently being collected on behaviour of seals and seabirds;

and those pertaining to the special component of the workshop which will address the needs of the CEMP Program:

- (i) to advise on the most suitable indices for monitoring the at-sea behaviour of pinnipeds and penguins; and

- (ii) to propose draft standard methods for collecting, processing, analysing and submitting summaries of such data to CCAMLR.

It noted that the workshop was unlikely to be held before late 1993 and approved the intersessional tasks (Annex 7, paragraph 4.52) for developing detailed implementation proposals.

6.11 Data submissions received on the standard reporting forms had generally been easy to understand. The Scientific Committee reiterated the request that Members should ensure that their data are reported on the current versions of the data submission forms; the Secretariat was recirculating these to all Members active in CEMP and can make additional sets available on request.

6.12 The WG-CEMP initiative on the processing and analysis of data on monitored predator parameters - to ensure standard indices for comparative purposes - was approved. This requires that the Secretariat:

- (i) use specified procedures in calculating the indices;
- (ii) prepare a document describing in detail the methods used (together with worked examples); and
- (iii) prepare annually a summary of calculated indices and trends in indices.

Prey Monitoring

6.13 The Scientific Committee noted that substantial progress had been made through the excellent work of WG-Krill's Subgroup on Survey Design. The current situation, therefore, was that agreed survey designs are now available for:

- (i) determining availability of krill within the foraging ranges of penguins and fur seals in respect of the parameters monitored by Standard Methods A5, A6, A7, C1 and C2;
- (ii) investigating meso-scale distribution and abundance of krill (i.e., at scales directly relevant to CEMP work in Integrated Study Regions (ISR)); and

- (iii) investigating interactions between macro-scale distribution and abundance of krill and major environmental factors in a fashion appropriate to helping WG-CEMP interpret predator and environmental monitoring data.

6.14 Members were encouraged to implement such surveys as soon as possible.

6.15 Concerning monitoring of prey species other than krill, Dr Shust stated that fine-scale catch and biological data on *Pleuragramma antarcticum* have been received by the Secretariat.

6.16 Dr Kock expressed concern about the appropriateness of using surveys of *Pleuragramma* larvae as an index of availability of this species in the Anvers Island area to predators which only consume post-larval and juvenile fish (Annex 7, paragraph 4.71). Clarification of this point would have to await the provision of detailed information on the United States long-term ecological research program at Palmer Station.

Environmental Monitoring

6.17 WG-CEMP had developed detailed proposals for acquiring data on characteristics of sea-ice within ISRs. In addition to site-based records it was regarded as essential to acquire data at a regional scale, which can only feasibly be done using remote sensing techniques.

6.18 The Secretariat had prepared a detailed review of this topic (WG-CEMP-91/9) suggesting a methodology for the acquisition of data on sea-ice distribution, involving use of JIC weekly ice charts and AVHRR data on sea-ice distribution in fully processed image form (Annex 7, paragraphs 4.77 to 4.91).

6.19 In order to evaluate further this approach, WG-CEMP recommended an initial pilot study be conducted for two CEMP sites over a two-month period. The aim of the study would be:

- (i) to establish the mechanism of extraction of data on sea-ice distribution from satellite imagery;
- (ii) to compute relevant parameters from these data, such as distance from the CEMP site to the ice edge, ice cover, etc.; and

- (iii) to compute indices from these data for use by CEMP.

The Secretariat had been asked to prepare a detailed estimate of the expected costs for consideration by the Scientific Committee. This was presented in SC-CAMLR-X/7.

6.20 The Scientific Committee reviewed this proposal in detail, seeking to confirm that:

- (i) the work required was not duplicating existing initiatives elsewhere; and
- (ii) the procedure for data acquisition was the most efficient and cost effective (especially in regard to acquiring data from cloud-free images).

6.21 The Data Manager was able to reassure the Scientific Committee on these points. Accordingly, the Scientific Committee endorsed the pilot study and noted the budgetary implications for consideration later. Members noted that this was the first formal proposal by WG-CEMP for acquiring data from satellite imagery, a topic on which the Working Group had commenced detailed evaluation (initially through invited experts) in 1987. The concept of a pilot evaluation study was also commended.

Ecosystem Assessment

6.22 The Scientific Committee noted that WG-CEMP had now largely completed arranging the structure and content of the system for acquiring and reporting relevant data on predators to the Secretariat. Therefore it was now entering a phase of evaluation of these data and of the provision of advice to the Scientific Committee.

6.23 Data from monitoring predator parameters held by the Secretariat are summarised in SC-CAMLR-X/BG/2. The instructions for analysis and presentation of these data have already been specified.

6.24 In order to formulate advice based on integrated evaluation of predator, prey and environmental data, WG-CEMP is requesting that all available data on:

- (i) fine-scale distribution of krill catches; and
- (ii) estimates of krill biomass and fluxes and movements of krill at relevant spatial scales;

be made available annually, together with summaries of sea-ice and relevant environmental data.

The Scientific Committee endorsed these requests.

6.25 Members noted that the formulation of advice based on interactions between predator, prey and environment was a complicated topic. Relationships between environmental conditions, krill abundance, krill availability to predators and predator responses in terms of measured parameters and calculated indices would inevitably require careful evaluation. Notwithstanding this, the attention of WG-Krill was drawn to the comments in Annex 7, paragraphs 5.9 to 5.11 which reported interpretations of predator-prey-environment interactions relevant to the FIBEX estimates of krill biomass.

6.26 Particular attention was given to the implications of the recent analysis of the fine-scale krill catch data (WG-CEMP-91/25 and SC-CAMLR-X/BG/7) for Subareas 48.1 and 48.2.

6.27 WG-CEMP had noted the extensive overlap between the krill harvest and the foraging ranges of penguins and fur seals during their breeding seasons and the significant potential for competition that this creates.

6.28 Within Subarea 48.1 over 50% of the krill harvest has been taken from within the breeding season foraging ranges of these predators in each of the three years for which data are available. In some years the catch was almost half the requirements of predators at this time.

6.29 The Scientific Committee noted that a situation, whereby a substantial krill fishery consistently operates within the foraging range of krill-dependent predators at a critical time of year (when the predators have dependent offspring), had long been identified as a most serious concern and one where close and urgent attention needs to be given to appropriate management action (see also paragraph 3.53).

6.30 The Scientific Committee endorsed the calls of WG-CEMP for:

- (i) urgent research into krill biomass, productivity and fluxes in Subarea 48.1 generally and in the area of the operation of the fishery in particular;

- (ii) obtaining accurate estimates of the requirements of land-based predators in these areas;
- (iii) noting the increased significance of existing CEMP activities in the area and of the need for enhanced activity wherever and whenever possible; and
- (iv) noting the urgency of examining precautionary management procedures such as restrictions on timing and location of the krill fishery (see also paragraph 3.60).

6.31 The Scientific Committee also noted the importance of comparative analyses of the predator monitoring data from sites both very close to the main area of krill fishing and from sites more distant from the main krill fishing areas.

6.32 Furthermore, the Scientific Committee noted that, although in Subarea 48.2 the fishery had overlapped with penguin and fur seal foraging ranges to an extent comparable to the situation in Subarea 48.1 only in two of the four years for which data are available, nevertheless the magnitude of the krill fishery in Subarea 48.2 (65% of the total historic catch in Statistical Area 48) was such that interactions between fishery and predators there were potentially equally, if not more, serious.

6.33 Accordingly, the Scientific Committee recommended that similar priority attention be given to undertaking the same initiatives in Subarea 48.2 as outlined for Subarea 48.1 in paragraph 6.30 above. At present CEMP monitoring activities in Subarea 48.2 are restricted to the network sites at Signy Island and Laurie Island and are considerably less extensive than similar activities in Subarea 48.1. Thus the CEMP Program in Subarea 48.2 is considerably less extensive than in Subarea 48.1 and enhanced activity is particularly needed.

6.34 A precautionary management procedure to provide protection for land-based predator populations at the critical time of year when they are breeding would be to prevent fishing within the foraging range of these predators (0 to 50 km for penguins; 0 to 80-100 km for fur seals) at the time when they are rearing offspring (December through February). The Scientific Committee agreed with WG-CEMP (Annex 7, paragraph 5.20) that it was important to investigate, with Members conducting fishing in these areas and in conjunction with WG-Krill, implications and consequences of such potential conservation measures.

6.35 To start this process an *ad hoc* group held discussions and made the following report to the Scientific Committee.

6.36 Questions of relevance to developing the exact formulation of future conservation measures might include:

- (i) Within Subareas 48.1 and 48.2, does the consistent concentration of the krill fishery in particular parts of these subareas, reflect that:
 - (a) these are the only parts of these subareas where economic krill fishing is consistently possible;
 - and/or
 - (b) these are consistently the best parts of the subareas for krill fishing?
- (ii) What is known about krill concentrations in the parts of these subareas further from land than 100 km?
- (iii) How critical is the December through February period to the efficient operation of the krill fisheries in parts of Subareas 48.1 and 48.2 to which they are currently restricted?
- (iv) How does the abundance and distribution of krill in areas, currently the focus of the fishery, change throughout the fishing season? In particular, what are the abundance and distribution characteristics immediately before and after the breeding seasons of penguins and fur seals (i.e., prior to December and after February)?

6.37 It was recognised that complete answers to these, and other similar, questions were unlikely to be readily available. However, this situation should not preclude further dialogue and attempts to answer these questions with the best information presently available.

6.38 Furthermore, it was noted that it was impossible now and likely to be so for a considerable time in the future, to define the functional relationships between krill abundance, krill availability to the fishery and to predators, and reproductive performance and survival of predators.

6.39 It was, therefore, impossible now to determine accurately the escapement rates from these krill fisheries which would be adequate to meet the reasonable needs of predators during their breeding seasons.

6.40 Last year, concern over the rapid development of fisheries on myctophids led the Scientific Committee to request Members to submit data to WG-CEMP on the significance of myctophids, and especially *E. carlsbergi*, as prey for predators in the Convention Area (SC-CAMLR-IX, paragraph 5.20).

6.41 To assist in this process the Secretariat had prepared a review of the published literature (WG-CEMP-91/17 revised as SC-CAMLR-X/BG/6).

6.42 The Scientific Committee noted the conclusions arising from the WG-CEMP evaluation of this excellent and comprehensive review. These were that:

- (i) myctophids are important prey for a wide range of vertebrate predators; and
- (ii) *E. carlsbergi* and *Electrona antarctica* are of particular importance and thus there is a need for more and better data on their quantitative importance in predator diets.

6.43 The Scientific Committee further noted that the report of WG-FSA (Annex 6, paragraph 7.130) indicates that the catches of *E. carlsbergi* in the two years for which fine-scale data are available (1988 and 1990) were concentrated close to Shag Rocks and South Georgia, well within the foraging ranges of the main myctophid-eating seabird predators (e.g. king penguins and white-chinned petrels) at a time of year when they have dependent offspring.

6.44 Dr Croxall noted that a paper on the food consumption of predators in Statistical Area 48 (WG-CEMP-90/31) estimated that seabird and seal predators consume about 250 000 tonnes of myctophids annually. The main prey species are *E. carlsbergi* and *Krefflichthys anderssoni*, which are frequently found together in diet samples from predators.

6.45 The Scientific Committee recognised that in Subarea 48.3 a situation exists where there is a real likelihood of significant potential competition between the myctophid fishery and species significantly dependent on myctophids.

6.46 Furthermore, the tripling of the myctophid catch in this area in the last year raises additional concerns about the unregulated continuation of a fishery for which there are significant risks of competition between predators and fishery.

6.47 In response to questions concerning the identity of the myctophids caught by the fishery, Dr Shust stated that in the early years of experimental fishery on myctophids it was established that the catches were mainly *E. carlsbergi*, although *K. anderssoni* was present in small quantities.

6.48 Confusion existed as to whether fishing for myctophids had been undertaken in Subarea 48.2 (see paragraph 4.17). If this were the case it was pointed out that the target species was most likely to be *E. carlsbergi* and it would therefore represent the start of a new fishery. Dr Shust undertook to investigate further.

6.49 The Scientific Committee noted progress in evaluating the use of GIS and VS systems for use in CCAMLR data management and analysis initiatives. It was particularly encouraging to see the plans for collaborative pilot studies involving specific research tasks. Members stressed the importance of using these systems to analyse high quality data collected to address well-defined hypothesis.

6.50 Dr Croxall reported the existence of the Antarctica Digital Database project (SC-CAMLR-X/BG/17), a multi-national program coordinated by the SCAR Working Group on Geodesy and Geographic Information, developing a digital topographic database of Antarctica. To date the project has successfully validated and incorporated data on coastline, ice-fronts and inland rock and glacial features.

6.51 It was noted that the second phase, which might include the incorporation of bathymetric data, could be of particular interest to CCAMLR. Furthermore, the project as a whole had numerous aspects of potential relevance to CCAMLR.

6.52 The Scientific Committee agreed that the Data Manager should contact the manager of the Antarctica Digital Database Project to discuss existing and potential developments of mutual interest.

Prey Requirements for Krill Predators

6.53 The Scientific Committee noted the considerable progress towards estimating krill consumption by predators in Integrated Study Regions and the potential relevance of these towards assessing interactions in the main areas of operation of the krill fishery. They endorsed the proposed program of future work (Annex 7, paragraphs 6.8 to 6.24).

6.54 It was noted that there had been little progress towards assessing escapement levels adequate to predator needs and WG-CEMP was asked to provide at least preliminary advice at its next meeting.

6.55 WG-FSA had suggested that krill predation by fish might be incorporated into the WG-CEMP initiatives outlined in paragraph 6.53 (Annex 6, paragraph 5.12).

6.56 It was felt that before WG-FSA commenced work on this topic (e.g. Annex 6, paragraph 5.13) it would be helpful to discuss the whole matter with WG-CEMP in order to clarify the precise objectives of such work.

6.57 WG-FSA had also noted that CEMP data and advice might be valuable in interpreting changes in abundance and distribution of certain fish stocks, especially *C. gunnari*. WG-CEMP will consult with WG-FSA to ensure that the latter received appropriate documents and advice.

Other Matters

Collaboration and Awareness of CEMP

6.58 Publication by CCAMLR of the brochure describing the aims of CEMP was a welcome development in publicising the activities of the program.

6.59 The Scientific Committee endorsed the efforts to improve participation in the activities of CEMP (Annex 7, paragraph 7.12). Members noted that it was important to correct some apparently widespread misconceptions that the CEMP Program was restricted to krill-related matters in a few geographically restricted areas.

6.60 Collaborative work would also be enhanced by closer collaboration between the Working Groups of the Scientific Committee; in particular, broader participation of members of one Working Group in the work of others was required. This would be assisted by holding the meetings in close conjunction.

CCAMLR/IWC Workshop on the Feeding Ecology of Southern Baleen Whales

6.61 The Scientific Committee noted the current status of this initiative (Annex 7, paragraph 7.13 to 7.16). It agreed that because the original reasons for interest in this Workshop no longer apply, it would be inappropriate for CCAMLR to continue as a co-sponsor of current IWC initiatives for a Workshop on the Feeding Ecology of Southern Baleen Whales.

6.62 However, it reiterated CCAMLR's interest in this topic and welcomed further consultations when IWC had produced some detailed proposals.

6.63 The Executive Secretary was asked to inform the Secretary of IWC and Dr Reilly (the new IWC Convener of any future Workshop on Feeding Ecology of Southern Baleen Whales) of the CCAMLR position.

CCAMLR System of Observation

6.64 The Scientific Committee noted the comments of WG-CEMP pertaining to this topic, which had acknowledged the importance of such a system in ensuring that reliable biological data were collected from commercial operations (Annex 7, paragraphs 7.25 to 7.31).

New and Developing Fisheries

6.65 The Scientific Committee endorsed the points agreed by WG-CEMP in its discussion of new and developing fisheries (Annex 7, paragraphs 7.32 to 7.36). The Scientific Committee noted that WG-CEMP agreed that predictive management was the logical basis for the implementation of Article II. It was clarified that this applied to the establishment of new fisheries, and that as a fishery progressed, a transition to some form of feedback management would be the preferred approach.

Future Work of WG-CEMP

6.66 The Scientific Committee endorsed the program of future work (Annex 7, paragraph 9.1). It was felt that greater emphasis should be placed on management issues, including those which would arise out of the formulation of advice to the Scientific

Committee (Annex 7, paragraph 9.1(viii) and (ix)). WG-CEMP was asked to give this attention during the intersessional period.

6.67 In reviewing the program of work as outlined, the Scientific Committee noted that there was no explicit reference to the need to give priority attention to the topic of coincidence of krill catches and predator consumption in restricted areas at critical times of year. Members were therefore requested to consider the implications of the situation as a matter of priority. WG-CEMP was asked to collaborate with WG-Krill in work on this topic.

6.68 It also noted that the prompt submission of due and outstanding data was essential for the success of the meeting and urged Members to make this a high priority.

Management Plans for CEMP Sites

6.69 At its last meeting, the Commission adopted Conservation Measure 18/IX to afford protection to CEMP sites, scientific investigations and Antarctic marine living resources therein (CCAMLR-IX, paragraph 6.5). This conservation measure requires the provision of a management plan for any CEMP site for which protection is desired and its consideration by WG-CEMP, Scientific Committee and Commission.

6.70 The United States had drafted and submitted to the Secretariat a draft management plan for protection of the CEMP site at Seal Islands (WG-CEMP-91/7) following the procedure outlined in Conservation Measure 18/IX. This document was distributed to Members the required three months in advance of the WG-CEMP meeting. The Working Group agreed that, with minor revisions, the proposal adequately provided the information required, and should be passed along to the Scientific Committee.

6.71 The Scientific Committee reviewed the revised management plan for the Seal Islands (SC-CAMLR-X/11), which incorporated the suggestions of WG-CEMP.

6.72 The Scientific Committee approved the revised draft management plan and recommended that the Commission should adopt this management plan and take appropriate action to implement its observance.

6.73 Dr Marín noted that Chile had forwarded a draft management plan for Cape Shirreff, Livingston Island, South Shetland Islands to the Secretariat but that this had arrived late for

consideration by WG-CEMP. It would therefore be considered at the next meeting of this Working Group.

Advice to the Commission

6.74 The Commission is requested to encourage Members with active programs of research directly and indirectly contributing to CEMP, to participate in the meetings of WG-CEMP (paragraphs 6.4, 6.11 and 6.68).

6.75 Most Members recognised the potentially serious situation of substantial krill fisheries consistently located near seal and seabird colonies, (paragraphs 6.28 and 6.31), the current lack of data adequate for any precise assessment of the magnitude and consequences of these problems (paragraph 6.30(i) and (ii), paragraph 6.36) and the advice on precautionary management procedures available to mitigate these problems (paragraph 6.34). Most Members felt that it was highly desirable to implement now a conservation measure to provide adequate protection for predators in appropriate parts of Subareas 48.1 and 48.2 until such time that sufficient data are available to assess the situation more precisely.

6.76 Dr Naganobu felt that there is no scientific evidence that the fishery is having any marked effect on seal and penguin colonies.

6.77 In view of concerns last year over the development of the *E. carlsbergi* fishery, WG-CEMP had reviewed data on the significance of myctophids and especially *E. carlsbergi* as food of predators in the Convention Area. The Scientific Committee considered this review in the light of the current data on the *E. carlsbergi* fishery (paragraph 6.42 to 6.44) and concluded that there is likelihood of significant potential competition between the myctophid fishery and species significantly dependent on myctophids (paragraph 6.42). The Commission's attention is drawn to this advice, which may be relevant to the formulation of conservation measures.

6.78 The Scientific Committee draws the Commission's attention to progress made by WG-CEMP in preparing estimates of krill consumption by seabirds and seals in Integrated Study Regions (Annex 7, paragraphs 6.8 to 6.24). The Commission was advised that detailed proposals for future activities had been prepared and approved by the Scientific Committee (paragraph 6.53).

6.79 The Scientific Committee recommended that a meeting of WG-CEMP be held during 1992 (paragraph 6.66).

6.80 The Scientific Committee approved WG-CEMP's draft management plan for the CEMP site at Seal Islands, South Shetland Islands, and forwarded it for consideration by the Commission (paragraph 6.72).