

**REPORT OF THE WORKING GROUP  
ON FISH STOCK ASSESSMENT**  
(Hobart, Australia, 11 to 22 October 2010)



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<sup>1</sup> Appendices E to T are published only in electronic format ([www.ccamlr.org/pu/e/e\\_pubs/fr/drt.htm](http://www.ccamlr.org/pu/e/e_pubs/fr/drt.htm)).

APPENDIX S: Fishery Report: *Champscephalus gunnari*  
South Georgia (Subarea 48.3)

APPENDIX T: Fishery Report: *Champscephalus gunnari*  
Heard Island (Division 58.5.2)





**REPORT OF THE WORKING GROUP  
ON FISH STOCK ASSESSMENT**  
(Hobart, Australia, 11 to 22 October 2010)

## OPENING OF THE MEETING

1.1 The meeting of WG-FSA was held in Hobart, Australia, from 11 to 22 October 2010. The Convener, Dr C. Jones (USA), opened the meeting and welcomed participants (Appendix A). Mr A. Wright (Executive Secretary) extended his welcome and wished the meeting success in its current round of deliberations.

## ORGANISATION OF THE MEETING AND ADOPTION OF THE AGENDA

2.1 The agenda of the meeting was discussed and adopted without change (Appendix B). It was agreed to focus discussions on bottom fishing activities and VMEs (subitem 9.1) during the first week of the meeting.

2.2 Documents submitted to the meeting are listed in Appendix C. While the report has few references to the contributions of individuals and co-authors, the Working Group thanked all the authors for their valuable contributions to the work presented to the meeting.

2.3 Paragraphs dealing with advice to the Scientific Committee and its working groups have been highlighted. A list of these paragraphs is provided in Item 13.

2.4 The report was prepared by the Working Group participants.

2.5 Selected components of WG-FSA's work were developed intersessionally and during the meeting by the following subgroups:

- Subgroup on Assessments (coordinator: Mr A. Dunn, New Zealand);
- Subgroup on New and Exploratory Fisheries (coordinator: Dr S. Hanchet, New Zealand);
- Subgroup on By-catch (coordinators: Mr J. Fenaughty, New Zealand, and Dr R. Mitchell, UK);
- Subgroup on Biology and Ecology (coordinators: Drs M. Belchier, UK and L. Pshenichnov, Ukraine);
- Subgroup on Tagging (coordinator: Dr D. Agnew, UK and Scientific Committee Chair);
- Subgroup on the Scientific Observer Program (coordinators: Dr R. Leslie, South Africa and Mr J. Roberts, UK);
- Subgroup on VMEs and Ecosystem Management (coordinators: Drs A. Constable Australia and B. Sharp, New Zealand).

2.6 The information used in developing the assessments is provided in the Fishery Reports (Appendices F to T). These reports will be published on the CCAMLR website ([www.ccamlr.org](http://www.ccamlr.org) – go to 'Publications', see 'Fishery Reports').

## REVIEW OF AVAILABLE INFORMATION

### Data requirements specified in 2009

3.1 Since WG-FSA-09 the Secretariat has further developed procedures, databases and data forms at the request of the Commission and the Scientific Committee and its working groups, including:

- (i) development of data forms and associated guidelines, including a new form for daily catch and effort reporting in exploratory fisheries (except krill), revision of the 'CCAMLR VME Taxa Classification Guide' and associated guidelines, species list and VME sections in the catch and effort reporting forms and the fine-scale data forms, and consequential updates to database tables and entry forms (WG-FSA-10/4 Rev. 1);
- (ii) processing of fishery and observer data from 2009/10, including data from the fisheries at Prince Edward and Marion Islands (South African EEZ in Subareas 58.6 and 58.7 and Area 51), Kerguelen Islands (French EEZ in Division 58.5.1) and Crozet Islands (French EEZ in Subarea 58.6) – these data have undergone limited and preliminary validation prior to the meeting, and further validation will be conducted in the forthcoming intersessional period;
- (iii) allocation of starting positions of research hauls in the exploratory fisheries in Subareas 48.6 and 58.4 (WG-SAM-10/4; see also Item 5.1);
- (iv) updating of fishery and observer information reported in the Fishery Reports (see Item 5);
- (v) developing a proposal to commission an independent review of the Secretariat's data management systems (CCAMLR-XXIX/13; see Item 12).

3.2 The Working Group acknowledged the important role of fishing crews, scientific observers and Members in collecting and processing CCAMLR data, and the Secretariat's work in managing these data (see also Item 12).

### Fisheries information

#### Catch and effort in 2009/10

3.3 The 2009/10 fishing season started on 1 December 2009 and will end on 30 November 2010, and fishing was still in progress in some areas. Members' fishing vessels operated in the fisheries targeting icefish (*Champsocephalus gunnari*), toothfish (*Dissostichus eleginoides* and/or *D. mawsoni*), krill (*Euphausia superba*) and crab (*Paralomis* spp.), and catches reported to 24 September 2010 are summarised in Table 1 (see also SC-CAMLR-XXIX/BG/1).

3.4 In 2009/10, the Secretariat monitored 153 catch limits for species groups (target and by-catch species) in SSRUs, SSRU groups, management areas, divisions and subareas (CCAMLR-XXIX/BG/10 Rev. 1). This included forecasting fishery closures once the catch

of a managed species exceeded 50% of its catch limit. As of 24 September 2010, 12 fishing areas and four fisheries had been closed by the Secretariat (CCAMLR-XXIX/BG/10 Rev. 1, Table 2), and all of these closures were triggered by catches of *Dissostichus* spp. approaching their respective catch limits.

3.5 Catch limit overruns (i.e. the catch exceeded the catch limit) occurred for *D. eleginoides* in Subarea 48.3 (Management Area B: overrun 3 tonnes, total catch 100.3% of the limit) and *Dissostichus* spp. in Division 58.4.1 (SSRU E: overrun 1 tonne, total catch 103% of the limit), Division 58.4.2 (SSRU A: overrun 23 tonnes, total catch 177% of the limit; whole fishery: overrun 23 tonnes, total catch 133% of the limit), and Subarea 88.1 (SSRUs H, I and K: overrun 38 tonnes; total catch 102% of the limit; whole fishery: overrun 20 tonnes, total catch 101% of the limit).

3.6 Scientific observers appointed under the CCAMLR Scheme of International Scientific Observation were deployed on all vessels targeting finfish in the Convention Area, and some vessels targeting krill, in 2009/10 (WG-FSA-10/5 Rev. 2 and 10/8; see also Items 5 and 10).

3.7 The incidental mortality of seabirds observed in fisheries in the Convention Area in 2009/10 is summarised in Tables 2 and 3.

3.8 There was no incidental mortality of marine mammals or entanglements observed in fisheries in the Convention Area in 2009/10 (WG-FSA-10/5 Rev. 2, Tables 9 and 14).

3.9 WG-FSA-10/P1 was referred to next year's meeting of WG-IMAF where it can be considered in full.

#### Estimates of catch and effort from IUU fishing

3.10 Estimates of IUU catches in the Convention Area were prepared by the Secretariat based on information submitted by 30 September 2010 (Table 4; see also WG-FSA-10/6 Rev. 1). The agreed deterministic method used to estimate IUU fishing effort was based on reports submitted by Members of sightings by surveillance operations and legal fishing vessels, and catch rates of licensed vessels. The IUU catch was allocated between *D. eleginoides* and *D. mawsoni* based on the known location of sightings of IUU activities and the proportion of each species reported in the CCAMLR database for the subareas and divisions where IUU fishing occurred (SC-CAMLR-XXVIII, Annex 5, paragraph 3.23).

3.11 The Working Group recommended that, to the extent possible (e.g. IUU fishing in Subarea 88.1 in 2007/08 which was known to have occurred in SSRU A), the allocation of IUU catch between *D. eleginoides* and *D. mawsoni* be based on the proportion of each species in the SSRUs where IUU fishing occurred.

3.12 The estimated catch history of *Dissostichus* spp. taken by IUU longlining and gillnetting activities in the Convention Area was updated using new information on estimated catch rates for gillnets (Tables 5 and 6).

3.13 The shift in IUU fishing activities, from high levels in Divisions 58.5.1 and 58.5.2 and Subareas 58.6 and 58.7 in the late 1990s and early 2000s, to Divisions 58.4.1, 58.4.2 and 58.4.3b in recent seasons was noted; IUU fishing activities appeared concentrated in Divisions 58.4.1 and 58.4.2 in 2009/10 (Table 5).

3.14 The Working Group reiterated its concern about IUU fishing and the use of gillnets in the Convention Area. The estimation of removals of toothfish and other species by gillnets is problematic and confounded by soak times and ghost fishing. Further information and approaches may be required to better document the extent of IUU fishing (see Item 7).

#### Catch and effort data for toothfish fisheries in waters adjacent to the Convention Area

3.15 Catches of *D. eleginoides* from fisheries outside the Convention Area, and reported in the CDS in 2008/09 and 2009/10, are summarised in Table 7. Most of the catch of *D. eleginoides* taken outside the Convention Area was from Areas 41 and 87.

#### Inputs for stock assessment

3.16 WG-FSA-10/12 reported on the *C. gunnari* survey in Division 58.5.2 (also referred herein as Heard and McDonald Islands) conducted during 2010. New parameters for a von Bertalanffy growth model were proposed, based on additional recent data relating age and length. This was further considered in Item 4, including whether growth rates could be changing with time.

3.17 WG-FSA-10/26 undertook a retrospective analysis of the fishing trips that would be selected for use in Subarea 88.1 and Subarea 88.2 SSRUs A and B (also referred herein as the Ross Sea) *D. mawsoni* assessment on the basis of data-quality metrics for individual trips (SC-CAMLR-XXVIII, Annex 5, paragraph 3.49). The paper examined if the same trips were selected when applying the method over successive years and concluded that application of the method resulted in a generally stable selection of trips over time. The final datasets are considered unlikely to be biased towards trips releasing tagged fish in areas most easily accessible to the fishery (and where tags might be more likely to be recovered).

3.18 WG-FSA-10/38 reported on an annual groundfish survey conducted in Subarea 48.3 in 2010. Survey design was similar to that employed for previous years, noting that sampling effort was allocated to five area and two depth strata based on respective strata CVs, but actual allocation also resulted to some degree from the logistical constraints of using a commercial survey platform. The mean biomass estimated for *C. gunnari* in 2010 increased relative to the 2009 survey estimate; a 3+ cohort remained dominant, but there was also an increase in the proportion of 1+ and 2+ age classes in the population. This increase in biomass was unexpected considering the low availability of krill to *C. gunnari* in the area in 2009 evidenced by dietary analysis. The survey also identified the first evidence since 2003/04 of toothfish recruitment at Shag Rocks, of fish 30–40 cm (putative age 2+ fish). The authors were uncertain why this cohort of fish was not evident during the 2009 survey.

3.19 WG-FSA-10/39 provided input information for the assessment of *D. eleginoides* in Subarea 48.4 North. Of particular note to the 2010 assessment, CASAL estimates a higher  $L_{\infty}$  (approximately 160 cm) than that currently assumed for the Subarea 48.3 population. This increased maximum size has flow-on effects to estimated productivity, however, yield estimates were quite similar to previous years.

3.20  $L_{\infty}$  in this instance is being estimated from length-frequency data, and should be validated using data from aged fish when practical. This would also address the question of whether multiple age classes might be contributing to the strong cohort recruited to the population in the early 1990s.

3.21 Catch distributions of *D. eleginoides* and *D. mawsoni* showed that *D. eleginoides* dominate catches in the northern part of Subarea 48.4 South and are likely to be part of a southern extension of the population present in Subarea 48.4 North. This split in the distributions was thought to coincide with a region of hydrographic change along the island chain. Given that two assessments are currently undertaken, one for each of the species, it would be desirable for the assessments to better account for the distributions of the species rather than adhere to the boundaries for the division as they are currently defined.

3.22 The Working Group recommended that an exploratory analysis on the extent to which separate assessments, based on the observed distributions of the species, would impact future advice to the Scientific Committee regarding the appropriateness of the location of the north-south boundary in Subarea 48.4.

3.23 WG-FSA-10/41 presented two estimation models for natural mortality ( $M$ ) from mark-recapture and age data in the Division 58.5.2 *D. eleginoides* fishery, using data from the main trawl ground and the methods described in WG-SAM-10/12. The Working Group agreed that simulations in WG-SAM-10/12 showed that the CCODE method was more robust than the BODE method, and concluded that the estimate of  $M = 0.155 \text{ y}^{-1}$  from the model for *D. eleginoides* in Division 58.5.2 was a credible estimate.

3.24 The Working Group agreed that the database framework to summarise bathymetric point data presented in WG-SAM-10/18 was useful for deriving bathymetric maps, depth data, and spatially explicit polygons of specified depth ranges in a GIS framework. The database and processing methods were demonstrated for the Ross Sea, but are broadly applicable to the entire Southern Ocean.

#### Deliberations on tagging

3.25 Stock assessments using mark-recapture data rely on good matching of tag recovery with release events. More than 90% of all recoveries can now be matched. Significant improvements to matching have been seen since the Secretariat started to manage the distribution of tags to vessels, as the Secretariat has developed its matching methods, and as interaction between data users, data providers and the Secretariat has improved.

3.26 The Working Group emphasised the importance of returning photos or physical tags to the Secretariat, and preferably both, to aid matching. Otoliths from tagged fish may also be returned to the Secretariat where they will be stored (see paragraph 8.24).

3.27 The Working Group noted that if otoliths from tagged fish could be photographed alongside the tag, this would allow for positive species identification.

3.28 Details of the tagging rates, cumulative tagging rates and tag overlap statistics for the new and exploratory fisheries for the 2009/10 season are discussed further in paragraphs 5.17 and 5.18.

3.29 All required tagging rates are currently expressed in terms of tags per tonne. Some vessels translate this into tags per number of fish, which generates very smooth cumulative tag-release plots and might generate better overlap between tag and catch length frequencies. The Working Group considered that for all current tagging programs, expressing the required rate in terms of tags per tonne should continue so as not to disturb current practices, but in future some fisheries might be better regulated in terms of tags per number of toothfish.

3.30 The Working Group reviewed the experiences with skate tagging in the second-year extension of the Year-of-the-Skate. Reports from observers indicate that application of the protocol in respect of CCAMLR-XXVII, paragraph 4.55: ‘all skates should be brought on board or alongside the hauler to be correctly identified, scanned for tags and for their condition to be assessed’ has been sporadic. The Working Group did not recommend a continuation of the Year-of-the-Skate, but noted that it is important to continue to scan all skates for tags. Consequently, the Working Group recommended some changes to the relevant CMs to take account of these recommendations (see paragraphs 6.26 to 6.28 for details):

CM 41-01, Annex C, paragraph 2(v). **All skates shall be brought on board or alongside the hauler to be correctly identified, scanned for tags and for their condition to be assessed. All toothfish shall be examined for the presence of tags.** Recaptured tagged fish (i.e. fish caught that have a previously inserted tag) shall not be re-released, even if at liberty for only a short period.

3.31 The Working Group recommended that the Secretariat translate existing signs and information about the tagging program into the languages commonly spoken by the crew on board vessels active in exploratory fisheries, in addition to the CCAMLR official languages.

3.32 In using tagging data in assessments, various tag-specific parameters must be determined, such as tag-induced growth retardation, immediate post-tag mortality and tag loss. The Working Group noted that these parameters had originally been determined early in the tagging programs. Since then, significant changes have occurred to the programs, including improvements in fish handling and the expertise of observers and crew, as well as the presence of many more tags and recapture years. The Working Group recommended periodic review of these parameters to establish whether they should be adjusted for more recent tagging events compared to early tagging events.

## PREPARATION FOR ASSESSMENTS AND ASSESSMENT TIMETABLE

### Report from WG-SAM

4.1 WG-SAM provided advice to WG-FSA on the following topics:

- (i) strategies for data-poor fisheries for *Dissostichus* spp. (Annex 4, paragraphs 3.6, 3.9 and 3.19 to 3.26);
- (ii) harvest control rules for *C. gunnari* (Annex 4, paragraphs 3.36 and 3.37);
- (iii) VME modelling and evaluation tools (Annex 4, paragraphs 4.6, 4.7, 4.9 and 4.11);
- (iv) VME impact assessment methods (Annex 4, paragraphs 4.14 to 4.16, 4.18 and 4.19).

4.2 The Working Group agreed to consider these issues under the respective agenda items. In particular, the Working Group took note of the need to review the data collected from research hauls in exploratory toothfish fisheries (see paragraph 5.27).

#### Review of preliminary stock assessments

4.3 The Working Group discussed preliminary assessment papers for *D. eleginoides* and *D. mawsoni* in Subarea 48.4, and *C. gunnari* in Subarea 48.3 and Division 58.5.2, in preparation for the assessments reported under Item 5.3.

##### *D. eleginoides* northern South Sandwich Islands (Subarea 48.4 North)

4.4 WG-FSA-10/39 reported an updated CASAL stock assessment for the northern area of the South Sandwich Islands stock of *D. eleginoides*. The catch limit of 41 tonnes had been obtained by mid-April with a total of 232 fish tagged, for an average of 5.8 fish tagged per tonne. There were 18 tag recaptures in the 2009/10 season, with a total of 72 tags recaptured over all seasons. Catch-at-length data indicated the vulnerable biomass was predominantly composed of one large cohort that recruited in or around 1992.

4.5 The Working Group recommended that the most recent year over which relative year-class strengths were estimated be changed to 2002 rather than 2010, because that was the most recent year for which information on relative recruitment was available to the model.

4.6 Options for assessing *D. eleginoides* around Saunders Island (at the northern end of Subarea 48.4 South) were discussed. The Working Group noted that, in future, it may be more appropriate to include it in the assessment of *D. eleginoides* in Subarea 48.4 North (paragraphs 3.19 to 3.22).

##### *Dissostichus* spp. southern South Sandwich Islands (Subarea 48.4 South)

4.7 WG-FSA-10/40 reported on a preliminary stock assessment for the southern area of the South Sandwich Islands based on CPUE depletion analyses, CPUE and area comparisons, and results from a tagging study. The Working Group noted that the results indicated localised stock depletions, and potentially a lower stock size of *Dissostichus* spp. in the southern area than previously assumed.

#### *C. gunnari* South Georgia (Subarea 48.3)

4.8 WG-FSA-10/37 reported on a length-based model as an alternative to the age-based model to estimate catch limits for *C. gunnari* in Subarea 48.3 (Annex 4, paragraphs 3.36 and 3.37). The assessment uses survey data on length densities and biomass density without the need to identify age-specific cohorts as required by the age-based model used in previous assessments.

4.9 The Working Group discussed whether using finer length bins might improve the match between length- and age-based assessments. It was agreed that changing the size of length bins might be considered in the future but would be unlikely to substantially change the model estimates.

4.10 The Working Group also agreed that boxplots of bootstrap samples of biomass estimates after a period of burn-in would be a useful method of summarising the uncertainty around these estimates.

4.11 The Working Group noted that the issue of bias in both age- and length-based assessments needs to be explored further and encouraged Members to undertake this work in the intersessional period.

#### *C. gunnari* Heard and McDonald Islands (Division 58.5.2)

4.12 WG-FSA-10/12 reported on a preliminary assessment of *C. gunnari* in the Heard and McDonald Islands, using both the current and a revised growth model. The density of fish in each age class was estimated using the CMIX procedure and the estimate of yield was obtained using the GYM. A new 2+ cohort was detected and the paper noted that it was expected that the 2010/11 fishery will focus on this cohort.

4.13 The Working Group discussed whether the parameter estimates from the revised growth model were tracking population change in response to the environment or were due to changes in the way the CMIX method identified cohorts. Showing the data used to calculate both the new and the current growth curves was recommended.

#### *D. eleginoides* Kerguelen Island (Division 58.5.1)

4.14 An outline of data available for the development of a formal stock assessment for the Kerguelen Plateau was considered. Data available include an estimate of biomass from a random stratified trawl survey in 2006, catch-at-length frequencies, CPUE time series from commercial fisheries, and tag-recapture data from 2006 to 2010.

4.15 Since 2006, 12 774 fish had been double-tagged (at a rate of one per tonne) by the fishery, and a total of 587 of these tagged fish have been recaptured. In addition, 102 tagged fish were recaptured that had been tagged in Division 58.5.2.



4.16 The Working Group encouraged the development of an integrated assessment model and recommended that a descriptive summary of the input data, the model stock and structural assumptions, and parameter values be submitted to WG-FSA.

4.17 The Working Group encouraged Members to collaborate on the development of a stock assessment for the area.

#### Assessments to be carried out and assessment timetable

4.18 Assessment approaches taken for the assessed fisheries were based on the preliminary assessment submissions, issues identified during the course of WG-FSA, as well as subgroup discussions. The Working Group agreed to undertake updated assessments for the following fisheries:

- (i) *Dissostichus* spp. in Subarea 48.4 (comprising *D. eleginoides* in Subarea 48.4 North and *Dissostichus* spp. in Subarea 48.4 South);
- (ii) *C. gunnari* in Subarea 48.3;
- (iii) *C. gunnari* in Division 58.5.2.

4.19 The Working Group agreed that the assessments for *D. eleginoides* in Subarea 48.4 North will use the CASAL framework, and for *C. gunnari* will use the short-term projection approach. Specific information on input data and assessment methodologies for each assessed fishery and the review of information for the *Dissostichus* spp. experimental fishery in Subarea 48.4 South are presented in Item 5.3.

4.20 The Working Group considered the preliminary assessments for the fisheries for *C. gunnari* in Subarea 48.3 (WG-FSA-10/37) and Division 58.5.2 (WG-FSA-10/12). It was agreed that these assessments would be reviewed during the meeting and the information used to develop the management advice for these fisheries.

4.21 The Working Group reviewed the fisheries for *Dissostichus* spp. in Subareas 48.3, 88.1 and 88.2 and Division 58.5.2, and agreed, under the current arrangement for multi-year management, that no new assessments for these fisheries were necessary this year.

4.22 The Working Group did not update assessments for *D. eleginoides* fisheries in Division 58.5.1, Subarea 58.6 (Crozet) and Subareas 58.6/58.7 (Prince Edward Island).

4.23 All assessment work was undertaken by primary authors of preliminary assessments, and reviewed independently. Tasks of independent reviewers are listed in WG-FSA-06/6, paragraph 6.3. The outcomes of the assessments were reported in the Fishery Reports (Appendices F to T).

## ASSESSMENTS AND ASSESSMENT ADVICE

### Development of a research framework for data-poor fisheries

5.1 The term ‘data-poor fisheries’ was considered by the Working Group as referring to a fishery for which a robust stock assessment that provides advice on catch limits according to CCAMLR decision rules has not been developed due to lack of information.

5.2 The Working Group recalled general principles and requirements for CCAMLR sponsored research (SC-CAMLR-XXVII, paragraphs 8.9 and 8.10), the characteristics of a well-designed research program (SC-CAMLR-XXVIII, Annex 6, paragraphs 2.34 to 2.40), and the recommendations of WG-SAM-10 for WG-FSA in assessing any research fishery design and the data requirements for a stock assessment (Annex 4, paragraphs 3.20 and 3.23).

5.3 The Working Group agreed that its objective for data-poor fisheries is to develop management advice on catch levels consistent with Article II of the CAMLR Convention. At present, robust assessments of stock status of toothfish are lacking in many areas (e.g. Subareas 48.6 and 58.4).

5.4 The Working Group identified that the system of SSRUs (open and closed areas) may need to be revised in order to improve the capacity for estimating stock status of *D. mawsoni*. This is further considered in developing research plans below when trying to identify areas of greatest importance to address specific research questions.

5.5 The Working Group recalled issues with the development of a tag-recapture-based assessment, including:

- (i) high levels of post-tagging mortality of tagged fish (e.g. the effect of depredation, or the health and condition of released fish);
- (ii) insufficient overlap in the length frequency of the tagged fish and the landed catch (i.e. the tag overlap statistic);
- (iii) insufficient overlap in the location of fish tagged and released and the location of the majority of the commercial catch;
- (iv) poor scanning (tag detection) rates;
- (v) the effect of IUU fishing on tag-based abundance estimation.

5.6 The Working Group recalled issues with the use of CPUE indices, including that:

- (i) a single point index or short time series of CPUE cannot be used to estimate abundance;
- (ii) a longer time series may reflect changes in fisher behaviour or experience rather than changes in abundance;
- (iii) CPUE can be highly variable in areas of low abundance;

- (iv) there has been insufficient overlap of vessels and types of gear (e.g. autoline, Spanish longline, or trotline), both spatially and temporally to enable standardisation of CPUE;
- (v) the performance of some types of gear (e.g. trotline) was not well understood.

5.7 The Working Group recalled that the characteristics of successful assessments included the use of well-designed experiments to develop an integrated tag-based assessment of *Dissostichus* spp. in Subarea 48.4 (SC-CAMLR-XXVIII, paragraph 4.87), and the use of a multi-national multi-year tag-based assessment for Subareas 88.1 and 88.2. In recalling these successful experiments, the Working Group agreed that concentrating tagging effort spatially was a key factor that led to the success of the tag-based assessment. Further, the Working Group noted that successful assessments in Subarea 48.3 and Division 58.5.2 have also included data collected from trawl surveys.

5.8 The Working Group noted the previous successful work to standardise survey requirements amongst CCAMLR Members, including developing standard methods for demersal fish trawl surveys (SC-CAMLR-XI, paragraph 3.20) and for acoustic surveys (SC-CAMLR-XVII, paragraphs 5.4 to 5.14).

5.9 The Working Group noted that both the ability of vessels to meet an appropriate research standard and the calibration between vessels' data would need to be considered in developing a research plan. For example, in a tagging program, the calibration would need to consider:

- (i) survivorship of fish as a result of the fishing method being used
- (ii) evaluation of the likelihood of released tagged fish being available for recapture.

5.10 The Working Group agreed that the development of a generalised work plan would assist Members in developing proposals, individually or in a multinational program, that would satisfy the CCAMLR-sponsored research principles above.

5.11 The Working Group agreed that the generalised work plan for implementing research in data-poor fisheries would be:

1. Define the objective and appropriate field and analytical methods. For example, sampling platforms may be longline or trawl and these may be fishery dependent or independent.
2. Review which areas are best candidates for spatially constrained research activity and evaluate how large the research areas need to be.
3. Review the best candidate designs for the spatial and temporal coverage of the research activity, including for example, areas of habitat and movement of *Dissostichus* spp.
4. Use the available data and information to evaluate nominated vessels and gear types for their appropriateness for use in these research activities, including for example, vessel and gear performance in producing tag-release and recapture data.

5. Develop standard research protocols and methods for calibrating vessels and observers that would participate in the research activities. For example, the requirements could include the number of tags to be released in nominated locations, and a suitable spatial plan for distributing effort.
6. An evaluation of the amount of catch necessary for the research, and its consequences for the stock.
7. Where the research is for more than one year, undertake an annual review of the research, including a review of the performance of the research program, preliminary analyses to evaluate how well the research will meet the research objectives, and determine if adjustments are required or whether the program should cease.

5.12 The Working Group recommended that some specific elements of the work plan be considered as a high-priority focus topic for WG-SAM in the coming intersessional period according to following terms of reference:

WG-SAM focus topic: work plan for implementing research proposals for data-poor fisheries. To consider:

- (i) methods for evaluating the capability of vessels and gear types to contribute to research outcomes and for calibrating vessels and gears, including specific case studies relevant to current exploratory fisheries such as in tag-recapture programs;
- (ii) proposed research designs and data collection protocols for estimating stock status in data-poor fisheries;
- (iii) methods for assessing stock status in data-poor fisheries.

#### New and exploratory fisheries

5.13 Seven exploratory longline fisheries for *Dissostichus* spp. were agreed for the 2009/10 season (CMs 41-04 to 41-07 and 41-09 to 41-11), an exploratory trawl fishery for *E. superba* in Subarea 48.6 (CM 51-05), and exploratory fisheries for crab in Subareas 48.2 and 48.4 (CMs 52-02 and 52-03 respectively). Activities in these fisheries are summarised in Table 1.

5.14 Nine Members notified for exploratory longline fisheries for *Dissostichus* spp. in Subareas 48.6, 88.1 and 88.2 and Divisions 58.4.1, 58.4.2, 58.4.3a and 58.4.3b for the 2010/11 season (Table 8). Another Member (France) withdrew its notifications in Subareas 88.1 and 88.2 prior to the meeting.

5.15 The Working Group did not attempt to determine whether the notifications for exploratory fisheries satisfied the requirements of the notification procedure (CM 21-02); this, it believed, should be done by SCIC. It did, however, note that many of the notifications provided very little information on the research to be undertaken as part of the exploratory fishery.

5.16 Unstandardised CPUE data for *Dissostichus* spp. caught in exploratory longline fisheries between 1996/97 and 2009/10 are summarised in Table 9.

5.17 Under CM 41-01, each longline vessel fishing in exploratory fisheries for *Dissostichus* spp. in 2009/10 was required to tag and release *Dissostichus* spp. at a specified rate per tonne (Table 10). All vessels achieved the required tagging rate. Consideration of the cumulative tag-releases prepared by the Secretariat showed that in exploratory fisheries all vessels released tags continuously, at or above the required rates, throughout their fishing trips.

5.18 Length-frequency overlap statistics calculated using the approach outlined in SC-CAMLR-XXVIII, Annex 5, paragraph 5.13, showed that in all subareas/divisions except Divisions 58.4.1 and 58.4.3b, at least one vessel had achieved a high ( $\geq 60\%$ ) overlap between tag-release length frequency and catch-weighted length frequency (Table 11). Many vessels have improved their performance over the last three years, some significantly (Table 12). For example, the *Tronio* improved from 20% in 2009 to 62% in 2010 and the *Hong Jin No. 707* from 26% in 2009 to 47% in 2010. There are still some vessels whose overlap statistic is low ( $< 30\%$ ) – *Insung No. 1* in Subarea 88.1, *Jung Woo No. 2* in Subarea 88.1 and *Jung Woo No. 3* in Subarea 88.2 – although it should be noted that the latter vessel achieved a medium overlap in the other statistical area in which it fished (Table 11). Furthermore, although *Insung No. 1* achieved a medium score for *D. eleginoides* in Subarea 48.6, it failed to tag any of the 2 404 much larger *D. mawsoni* caught in the same subarea, making it impossible to estimate a statistic. Examples of low, medium and high overlap statistics are given in Figure 1.

5.19 The Working Group recalled its advice last year (SC-CAMLR-XXVIII, Annex 5, paragraph 5.16) that tagging large numbers of small fish in these exploratory fisheries would have very limited use for the estimation of abundance. This is because it would take many years before these small fish are fully selected in the fishery. Consequently, it is extremely important that vessels strive to achieve as high an overlap as possible between length frequencies of captured and tagged fish, particularly where current overlap is low or medium (see discussion in paragraph 3.29). The marked improvement from last year is encouraging, and shows that further improvements could be made.

5.20 The Working Group agreed that some vessels showed a very low level of commitment to tagging larger toothfish and that this was having a serious impact on the efficacy of the tagging program. It also recalled that a paper had been submitted to WG-FSA in 2007 which outlined methods by which large toothfish could be tagged in good condition (WG-FSA-07/36). In noting the methods described in this paper, and paragraph 5.18 above, the Working Group agreed that there was no reason why all vessels should not be able to score a high overlap statistic in all subareas and divisions. The Working Group recommended that the issue of achieving compliance with the tagging requirements of CM 41-01, Annex C, be considered by SCIC.

5.21 Recalling its advice from last year, the Working Group again recommended that the method developed to evaluate the degree of mismatch between the length-frequency distribution of the tagged fish and that of the fish caught, as outlined in paragraphs 5.18 and 5.19, could be used to assess consistency with CM 41-01, Annex C, and referred this to SCIC for further consideration.

5.22 In the 2009/10 season, 5 289 *Dissostichus* spp. were reported to have been tagged and released in the exploratory longline fisheries (Table 13), and 305 tags were recovered

(Table 14). As in previous years, most tags have been recaptured from Subareas 88.1 and 88.2. Out of a total of 11 000 tags reported to have been released in Subareas 48.6 and 58.4, there have been only 56 (0.2%) recaptures. In contrast, recapture rates of 4.2% and 7.9% have been reported for Subareas 88.1 and 88.2 respectively.

5.23 To determine whether the spatial mismatch between tags and subsequent fishing effort was a possible reason for the lack of tag-recaptures in Divisions 58.4.1, 58.4.2, 58.4.3a and 58.4.3b, the Working Group reviewed the annual distribution of tags and subsequent fishing effort in these areas (Figure 2). The results suggested a moderate overlap of where the tags were released and where the effort was subsequently carried out, suggesting that spatial overlap was not the primary problem. Despite the low level of tags recaptured from Divisions 58.4.1, 58.4.2, 58.4.3a and 58.4.3b, the program continues to provide information on the movement of tagged fish throughout Subarea 58.4.

5.24 The Working Group also noted that there were various other possible reasons for the lack of recaptures, including depredation of the tagged fish by marine mammals, release of fish in poor condition due to the capture and subsequent handling methods, and removals through IUU fishing.

5.25 Each longline vessel fishing in exploratory fisheries for *Dissostichus* spp. in Subareas 48.6 and 58.4 in 2009/10 was required to complete 10 research hauls (each comprising 3 500–5 000 hooks and separated by a distance of at least 5 n miles) on entering an SSRU in the exploratory fishery. The Secretariat allocated starting positions for research sets in the exploratory fisheries in Subareas 48.6 and 58.4 (except in Division 58.4.3b where positions were specified in CM 41-07). For each of the 12 notifying vessels, up to eight starting positions were provided for each of two fishing strata in each SSRU notified, and vessels were required to complete five research hauls in each stratum (total of 10 research hauls per SSRU); 1 133 starting positions were allocated for 84 vessel–SSRU combinations.

5.26 Three vessels fished in these exploratory fisheries in 2009/10, and deployed a total of 129 research hauls in accordance with the conservation measures and allocated positions (WG-SAM-10/4). Overall the vessels adhered to the research fishing protocol, and it was noted that:

- (i) sea-ice along the Antarctic coastline had prevented some vessels from reaching allocated positions in the continental SSRUs (e.g. 486D, 5841C and 5841G); however, the vessels were able to deploy research hauls in alternative positions determined by vessels;
- (ii) the deployment of research hauls in alternative positions determined by vessels had resulted in some hauls being set in depths greater than 2 500 m;
- (iii) some vessels did not achieve the required five hauls per stratum.

5.27 The Working Group noted that the use and implementation of research hauls had been reviewed by WG-SAM (Annex 4, paragraphs 3.5 to 3.9) and that it had provided the following comments and recommendations:

- (i) Is there sufficient spatial and temporal overlap in research hauls such that a CPUE standardisation (accounting for, inter alia, the effect of vessel, gear type and line orientation to bathymetry) will be possible in the near future?
- (ii) Is there further stratification of research hauls (e.g. to account for areas where sea-ice may be a problem) required to ensure data collected during research hauls can be used to estimate abundance, distribution and population dynamics of toothfish in Subareas 48.6 and 58.4 in the near future?
- (iii) WG-SAM considered ways to alleviate fishing vessels' difficulties in reaching allocated research haul locations in ice-bound areas, and agreed that the current single allocation of starting positions could be augmented, in areas of sea-ice, by providing each vessel with up to three random lots of start positions for the required research hauls in a given SSRU.

5.28 Since 2002/03, a total of 1 654 research hauls had been made in the exploratory fisheries in Subareas 48.6 and 58.4 (Table 15), and the Working Group agreed there was likely to be sufficient data available by 2011 to review these data at its next meeting.

5.29 The issue of imposing additional fishing mortality due to research catch on a stock that may be depleted was investigated in WG-FSA-10/42 Rev. 1. The paper showed that in a simulated depleted population of *D. eleginoides*, it is possible for population status to remain depressed for several years after fishing ceases before beginning to recover, and that research catches can influence the probability of stock recovery within 20 years. The actual effects will depend on the population dynamics specified in the model, the population size, and the level of depletion assumed. The level of research catch that can influence the probability of recovery to the target biomass within 20 years can be very small (<1% of total pre-exploitation stock biomass), and may constrain the catch needed for some research survey designs.

5.30 Length-frequency data are frequently collected from fisheries where routine stock assessments are not available. WG-FSA-10/43 assessed the utility of using length-frequency data in isolation to make robust conclusions about stock status. The paper examined length-frequency data and several derived indices from length data, such as mean length, 75th percentile length, and the proportion of mature fish, and how variable the relationship was with stock status. The analysis showed that interpretation of trends in length-frequency data as indicators of stock status can be misleading and should be avoided.

5.31 WG-FSA-10/32 presented a method for determining and summarising data collection requirements. The paper summarised the data collection requirements (including catch and effort data, length, sex, gonad stage sampling, tagging and VME reporting requirements) from vessels and observers currently in place in Subareas 88.1 and 88.2.

5.32 The Working Group noted that these data are collected for use in scientific research, the results of which are used to inform the Commission in achieving its goals, and welcomed the approach used in the paper of using power analyses and other quantitative methods to evaluate the relative utility of different sampling levels for each data type. The Working Group noted that there were some refinements to the method that might be taken in determining an appropriate number of samples.

5.33 The Working Group agreed that the data collection requirements presented in Table 3 of WG-FSA-10/32 provided a useful summary of the data collection requirements in Subareas 88.1 and 88.2, and that such a table would be a useful summary to have for all CCAMLR fisheries.

5.34 The Working Group recommended that the Scientific Committee request the Secretariat to prepare a table of the data collection requirements for each new and exploratory fishery that summarises the data collected, frequency of data collection (i.e. samples per thousand hooks), and the rationale for that frequency, following the format outlined in Table 16. These tables would be used by WG-FSA in 2011 to review the data collection requirements in each fishery, and would be included within the fishery reports as a description of the data collection required.

Development of advice on catch limits for *Dissostichus* spp.

*Dissostichus* spp. Subarea 48.6

5.35 Two Members (Japan and the Republic of Korea) and three vessels fished in Subarea 48.6 SSRUs D and E in 2009/10. The precautionary catch limit for *Dissostichus* spp. was 200 tonnes north of 60°S (SSRUs A and G) and 200 tonnes south of 60°S (SSRUs B–F). Information on this fishery is summarised in Appendix F.

5.36 The combined SSRUs B, C, D, E and F were closed on 21 March 2010 (catch limit for *Dissostichus* spp.: 200 tonnes; final reported catch: 197 tonnes). The combined SSRUs A and G (catch limit for *Dissostichus* spp.: 200 tonnes; reported catch to date: 98 tonnes) are currently open and one vessel was fishing. There was no evidence of IUU fishing in 2009/10.

5.37 The number of tag-recaptures increased in Subarea 48.6 in 2009/10. However, the Working Group noted that there are still very few tag-recaptures from this subarea, and that no progress could be made on assessments of *D. eleginoides* in Subarea 48.6.

5.38 The Working Group noted that the overlap in size frequency of tagged fish with the overall size frequency of fish caught was medium for two vessels and high for one vessel which fished in 2009/10 (Table 12). It was also noted by the Working Group that one vessel which had fished in SSRUs A and G, where both species of *Dissostichus* occur, had not tagged any *D. mawsoni* (see Appendix F, Figure 3). The Working Group recommended that the issue of achieving compliance with the tagging requirements of CM 41-01, Annex C, be considered by SCIC.

5.39 Three Members (Japan, Republic of Korea and South Africa) and a total of six vessels notified their intention to fish for toothfish in Subarea 48.6 in 2010/11.

5.40 The Working Group recommended that all measures in the research and data collection plans, including the requirement to tag toothfish at the rate of three toothfish per tonne and the requirement for research hauls as used in 2009/10, be retained for the exploratory fisheries in Subarea 48.6.



5.41 The Working Group agreed that it could provide no new advice on catch limits for this subarea. It noted that a research plan was being developed which could provide advice in the future (paragraphs 5.1 to 5.12).

#### *Dissostichus* spp. Division 58.4.1

5.42 Two vessels from two Members (Japan and the Republic of Korea) fished in the exploratory fishery in Division 58.4.1 in 2009/10. The precautionary catch limit for toothfish was 210 tonnes in three SSRUs (C: 100 tonnes, E: 50 tonnes and G: 60 tonnes), of which 196 tonnes were taken between 1 December 2009 and 20 February 2010. Information on this fishery is summarised in Appendix G.

5.43 High levels of IUU fishing have been reported in 2005/06 and 2006/07 and an estimated IUU catch of 910 tonnes was taken in 2009/10.

5.44 Vessels were required to tag and release *Dissostichus* spp. at a rate of three fish per tonne of green weight caught and both vessels achieved the target rate. A total of 5 012 *D. mawsoni* and 314 *D. eleginoides* have been tagged and released in Division 58.4.1, and 20 *D. mawsoni* and one *D. eleginoides* have been recaptured in that division. In 2009/10, 615 *D. mawsoni* and 12 *D. eleginoides* were tagged with three *D. mawsoni* and one *D. eleginoides* recaptured.

5.45 The Working Group noted that vessels in Division 58.4.1 had a medium level of overlap in the size frequency of tagged fish with the overall size frequency of fish caught (Table 12). The Working Group recommended that the issue of achieving compliance with the tagging requirements of CM 41-01, Annex C, be considered by SCIC.

5.46 Five Members (Japan, Republic of Korea, New Zealand, South Africa and Spain) and a total of 11 vessels notified their intention to fish for toothfish in Division 58.4.1 in 2010/11.

5.47 The Working Group recommended that all measures in the research and data collection plans, including the requirement to tag toothfish at the rate of three toothfish per tonne and the requirement for research hauls as used in 2009/10, be retained for the exploratory fisheries in Division 58.4.1.

5.48 The Working Group agreed that it could provide no new advice on catch limits for this division. It noted that a research plan was being developed which could provide advice in the future (paragraphs 5.1 to 5.12).

5.49 In progressing a research plan to develop *D. mawsoni* assessments for Division 58.4.1, the Working Group encouraged Members to collaborate in the intersessional period to progress elements of the generalised work plan (paragraphs 5.1 to 5.12). Further, the Working Group also noted that a special research area that could be investigated in this process could be the combined SSRUs F and G in Division 58.4.1. Possible canyons and submarine features in this area could be investigated for their importance to *D. mawsoni*. Research in both these SSRUs may provide an opportunity to compare the characteristics of an area with a known history of fishing with an area that has been closed over the same period.

*Dissostichus* spp. Division 58.4.2

5.50 In 2009/10, the exploratory fishery for *Dissostichus* spp. in Division 58.4.2 was limited to Japanese, Korean, New Zealand, Spanish and Uruguayan vessels using longlines only. Only one Member (the Republic of Korea) fished in the division and reported a catch of 93 tonnes. SSRU E was closed on 17 February 2010 (SSRU E catch limit for *Dissostichus* spp.: 40 tonnes; final reported catch: 40 tonnes), and SSRU A and consequently the fishery was closed on 24 February 2010 (SSRU A catch limit for *Dissostichus* spp.: 30 tonnes; final reported catch: 53 tonnes). The other SSRUs (B, C and D) were closed to fishing. Information on this fishery is summarised in Appendix H.

5.51 The fishery targeted *D. mawsoni* and operated in SSRUs A and E in 2009/10. It was estimated that 432 tonnes of *D. mawsoni* were taken by IUU fishing in 2009/10.

5.52 A total of 291 toothfish were tagged and released in 2009/10 and no tagged toothfish were recaptured (Tables 13 and 14). The vessel in Division 58.4.2 achieved the target tagging rate of three tags per tonne of green weight with a high level of overlap in the size frequency of tagged fish with the overall size frequency of fish caught (Table 12).

5.53 Five Members (Japan, Republic of Korea, New Zealand, South Africa and Spain) and a total of eight vessels notified their intention to fish for toothfish in Division 58.4.2 in 2010/11.

5.54 The Working Group noted that the vessel in Division 58.4.2 achieved the target tagging rate of three tags per tonne of green weight with a high level of overlap in the size frequency of tagged fish with the overall size frequency of fish caught.

5.55 The Working Group agreed that measures in the research and data collection plans, including the requirement to tag toothfish at the rate of three toothfish per tonne and the requirement for research hauls as used in 2009/10, be retained for the exploratory fisheries in Division 58.4.2.

5.56 The Working Group agreed that it could provide no new advice on catch limits for this division. It noted that a research plan was being developed which could provide advice in the future (paragraphs 5.1 to 5.12).

5.57 In progressing a research plan to develop *D. mawsoni* assessments for Division 58.4.2, the Working Group encouraged Members to collaborate in the intersessional period to progress elements of the generalised work plan (paragraphs 5.1 to 5.12).

*Dissostichus* spp. Division 58.4.3a

5.58 In 2009/10, the exploratory fishery for *Dissostichus* spp. in Division 58.4.3a was limited to Japanese and Korean vessels using longlines only. The precautionary catch limit for toothfish was 86 tonnes, but no vessel participated in this fishery. Information on this fishery is summarised in Appendix I.

5.59 There was no evidence of IUU fishing in 2009/10.

5.60 No toothfish were tagged and released in 2009/10 and no tagged toothfish were recaptured during that season.

5.61 One Member (Japan) and one vessel notified their intention to fish for toothfish in Division 58.4.3a in 2010/11.

5.62 The Working Group agreed that measures in the research and data collection plans, including the requirement to tag toothfish at the rate of three toothfish per tonne and the requirement for research hauls as used in 2008/09, be retained for the exploratory fisheries in Division 58.4.3a.

5.63 The Working Group agreed that it could provide no new advice on catch limits for this division. It noted that a research plan was being developed which could provide advice in the future (paragraphs 5.1 to 5.12).

#### *Dissostichus* spp. Division 58.4.3b

5.64 In 2009/10, the exploratory fishery for *Dissostichus* spp. in Division 58.4.3b was limited to research fishing conducted by Japanese, Korean, South African and Uruguayan vessels using longlines only, and no more than one vessel per country was permitted to fish at any one time. In November 2007, the division was divided into two SSRUs: A north of 60°S and B south of 60°S. In November 2008 the area north of 60°S was further subdivided into four SSRUs (A, C, D and E). The precautionary catch limit for *Dissostichus* spp. in the fishery was set to zero tonnes in each SSRU. An additional limit of 72 tonnes was set for research fishing between 1 December 2009 and 31 March 2010 within four designated sampling sectors (CM 41-07, Annex A, Figure 1). Information on this fishery is summarised in Appendix J.

5.65 In 2009/10, one Member (Japan) and one vessel participated in research fishing. The vessel operated in the southeastern sampling sector and reported a total catch of 14 tonnes of *Dissostichus* spp. (*D. eleginoides*: 2 tonnes, *D. mawsoni*: 12 tonnes).

5.66 Information on IUU activities indicated that 171 tonnes of toothfish were taken in 2009/10.

5.67 The Working Group agreed that measures in the research and data collection plans, including the requirement to tag toothfish at the rate of three toothfish per tonne and the requirement for research hauls as used in 2008/09, be retained for the exploratory fisheries in Subareas 48.6 and 58.4.

5.68 The vessel in Division 58.4.3b had only a medium level of overlap in the size frequency of tagged fish with the overall size frequency of fish caught (Table 12). The Working Group recommended that the issue of achieving compliance with the tagging requirements of CM 41-01, Annex C, be considered by SCIC.

5.69 The Working Group considered a research fishing proposal tabled by Japan during WG-FSA-10. Under the plan, research fishing is proposed to occur over a lattice of 88 equi-spaced grid points (7.5 n mile<sup>2</sup> cell size), centred on the four research areas (NW, NE, SW and SE) defined for the 2009/10 fishing season in Division 58.4.3b (also referred herein

as BANZARE Bank). A total catch limit of 71 tonnes was calculated using a comparative CPUE method with point parameter estimates for biomass and CPUE determined from the north of Subarea 48.4, longline CPUE rates for different fishing gears used in Division 58.4.3b and Subarea 48.4, and the assumption that the current spawning biomass is 20% of the virgin spawning biomass.

5.70 The Working Group recalled that previous analyses of fishery data, and a research longline survey undertaken across the division by Australia in 2008, have shown that the stock seems comprised of predominantly older, larger fish. The Working Group also recalled that the rapid depletion of the southern area of the division had resulted in it being closed to fishing three years after the fishery commenced, and that no smaller size classes have so far been observed in the fishery, indicating there is unlikely to be recruitment to the area. The longline survey also noted very low catch rates across the northern area of the division. The Working Group also recalled its discussion in 2009 regarding catch rates and stock status (SC-CAMLR-XXVIII, Annex 5, paragraphs 5.56 to 5.64) and the advice provided by WG-SAM-10 (Annex 4, paragraphs 3.19 to 3.26) in relation to a similar research proposal using the comparative CPUE method for Divisions 58.4.4a and 58.4.4b (also referred herein as Ob and Lena Banks) (WG-SAM-10/15). In particular, this advice notes that calculation of biomass estimates by comparative CPUE methods is underpinned by several assumptions, including similar catchability of different gear types between target and reference areas, similar size distributions of stocks between areas, and similar proportions of total biomass that are mature in both areas. The Working Group noted that some of these assumptions are known to be violated in the case of Division 58.4.3b and Subarea 48.4. For example, BANZARE Bank seems to be dominated by larger mature fish compared with Subarea 48.4, and the relationship between different longline gear types and selectivity and catch rates remains poorly understood.

5.71 The Working Group concurred with the general advice provided by WG-SAM-10 in relation to using the comparative CPUE method for estimating biomass, and provided some specific advice in the case of the 2011 research proposal by Japan to conduct research fishing on BANZARE Bank. This advice included:

- (i) The assumptions used in the calculation of available biomass, and the uncertainties associated with them, should be investigated using simulation methods (e.g. bootstrap or Monte Carlo) in order to determine credible estimates of the distribution of biomass. Such an evaluation should incorporate known variation in catch rates for different gear types within and between areas, and variation in biomass estimates from the reference area.
- (ii) Known differences in stock structure between reference and target areas should be incorporated by stratifying the calculation of available biomass by species (both *D. eleginoides* and *D. mawsoni* are found at BANZARE Bank) and by length class to account for these differences.
- (iii) The proposal currently assumes a target area of fishable seabed shallower than 1 500 m for the purposes of estimating available biomass, however, the area to be fished comprises only about half of this area. The latter area should be used for the purposes of this calculation, or the survey should be spread out to cover the entire area used to estimate biomass.

- (iv) The biomass estimate determined for Subarea 48.4 arose from fishing in areas including depths greater than 1 500 m. Using this biomass for the purposes of estimating available biomass in Division 58.4.3b should account for this difference in depth structure of the fishery. For example, the biomass estimate for Subarea 48.4 could be scaled by a factor equal to the area <1 500 m divided by total area, or the biomass estimated for Division 58.4.3b should be extended to include similar fishable depth as experienced in Subarea 48.4 (with survey positions adjusted accordingly).
- (v) There is merit in repeat sampling of the same survey points over multiple time points to provide a time series of catch rate data for this area. Research fishing of the same sample points in the southeastern sector on BANZARE Bank by Japan would provide a time series of catch rate data collected by the same vessel using identical methods.
- (vi) The distribution and abundance of *Dissostichus* spp. were surveyed only in the southeastern sector by a Japanese vessel and were not clarified in the other three sectors in the 2009/10 survey. Dr K. Taki (Japan) noted the need of the consecutive survey for all four sectors.

5.72 The Working Group recalled previous advice provided by the Scientific Committee (SC-CAMLR-XXVIII, paragraph 4.165) noting the need for research plans to deliver data that would lead to stock assessments. The proposal by Japan acknowledged the need to move toward tag-based assessments, and suggested that the proposed research fishing for 2011 will lead to this objective. However, in reviewing a similar plan for Divisions 58.4.4a and 58.4.4.b (WG-SAM-10/15), Annex 4, paragraph 3.25, noted that without a minimum estimate of biomass it is very difficult to determine the total number of tags required to be released, or subsequent tagging rates for proposed removals to achieve biomass estimates with target CVs as recommended previously (SC-CAMLR-XXVIII, Annex 6, paragraph 2.35(ii)). Applying the simulation methods noted above (paragraph 5.71(i)) would help to resolve this issue. It was also noted that research proposals should ideally summarise known information about the status of a stock in an area proposed for research fishing, including fishing history and stock structure (e.g. length–weight relationships, age/length-at-maturity, age structure).

5.73 The Working Group concluded that further analyses, as described above, should be undertaken to determine a plausible distribution of available biomass, thereby accounting for the considerable uncertainties inherent in applying the comparative CPUE method. Notwithstanding this analysis, the Working Group concurred with the advice of WG-SAM (Annex 4, paragraph 3.26) for research proposals to consider the possibility of conducting trawl surveys as an alternative method to using longline methods for establishing initial biomass estimates that could be used to inform the design of longer-term tagging programs.

5.74 The Working Group noted that good progress had been made in developing a research framework for data-poor fisheries (paragraphs 5.1 to 5.12). With respect to the Japanese research proposal, the Working Group drew the attention of the Scientific Committee to paragraphs 5.71(i)–(vi) above.

5.75 A total of 60 toothfish were tagged and released in 2009/10, including eight *D. eleginoides* and 52 *D. mawsoni*. One tagged toothfish (*D. eleginoides*) was recaptured during the 2009/10 season.

5.76 One Member (Japan) and one vessel notified their intention to fish for toothfish in Division 58.4.3b in 2010/11.

5.77 WG-FSA-10/45 updated WG-SAM-10/13 to describe a survey undertaken in accordance with CM 41-07 in order to determine the stock status and biological characteristics of toothfish populations on BANZARE Bank. Scientific fishing was undertaken by Japan in the southeastern sector during 2009, and results indicated that CPUE was lower than for previous seasons' catch rates from the northwestern sector. CPUE rates observed in the survey were lower than those observed for commercial fishing. The Working Group noted that this indicated that the abundance of fish in the survey area was low, and that higher CPUE observed in previous seasons may be a reflection of the aggregated nature of commercial fishing, whereby fishers aggregate to areas where catch rates are highest, but that other factors, such as removals by IUU fishing, could also be contributing to these results.

5.78 The Working Group noted that the sampling design undertaken for the proposed research in Division 58.4.3b was not submitted for review by any SC-CAMLR working group, and recommended that future research plans be reviewed by WG-FSA.

5.79 WG-FSA-10/47 reported on the distribution and population structure of *Dissostichus* spp. on BANZARE Bank, determined from data arising from exploratory longline fishing during 2007 to 2009. Results indicated *D. eleginoides* was typically found in shallower waters than *D. mawsoni*, and that larger fish (predominantly female) were found deeper. Based on the size distribution of catches, the study concluded that recruitment to BANZARE Bank is unlikely and that the population may consist primarily of adults migrating from other areas. The Working Group noted that this study only used data from a single vessel. However, the conclusions of the paper seemed consistent with previous work on the biology and ecology of toothfish in this area, such as that described in WG-FSA-08/57. The Working Group recommended that authors of such reviews should consider collaborating to synthesise current knowledge.

5.80 The Working Group recommended that the catch limits for Division 58.4.3b be retained for 2010/11. The Working Group could not reach consensus on advice for additional catch for research fishing.

5.81 The Working Group noted that a research plan was being developed which could provide advice in the future (paragraphs 5.1 to 5.12).

#### *Dissostichus* spp. Subareas 88.1 and 88.2

5.82 Five Members (Argentina, Republic of Korea, New Zealand, Spain and the UK) and 12 vessels fished in the exploratory fishery in Subarea 88.1. The fishery was closed on 9 February 2010 and the total reported catch of *Dissostichus* spp. (excluding research fishing) was 2 870 tonnes (101% of the limit) (Appendix K, Table 3). The following SSRUs were closed during the course of fishing:

- SSRUs B, C and G closed on 23 December 2009, triggered by the catch of *Dissostichus* spp. (total catch 370 tonnes; 100% of the catch limit);

- SSRUs J and L closed on 29 January 2010, triggered by the catch of *Dissostichus* spp. (total catch 358 tonnes; 96% of the catch limit);
- SSRUs H, I and K closed on 9 February 2010, triggered by the catch of *Dissostichus* spp. (total catch 2 142 tonnes; 102% of the catch limit).

The IUU catch for the 2009/10 season was estimated to be 0 tonnes.

5.83 Eight Members (Argentina, Japan, Republic of Korea, New Zealand, Russia, Spain, UK and Uruguay) and a total of 20 vessels notified their intention to fish for *Dissostichus* spp. in Subarea 88.1 in 2010/11.

5.84 Four Members (Argentina, Republic of Korea, Spain and the UK) and five vessels fished in the exploratory fishery in Subarea 88.2. The fishery closed on 31 August 2010 and the total reported catch of *Dissostichus* spp. was 314 tonnes (55% of the limit) (Appendix K). The IUU catch for the 2009/10 season was estimated to be 0 tonnes.

5.85 Seven Members (Argentina, Republic of Korea, New Zealand, Russia, Spain, UK and Uruguay) and a total of 18 vessels notified their intention to fish for *Dissostichus* spp. in Subarea 88.2 in 2010/11.

5.86 The Fishery Report for *Dissostichus* spp. in Subareas 88.1 and 88.2 is in Appendix K. In 2005, the Working Group recommended that Subareas 88.1 and 88.2 be split into two areas for stock assessment purposes: (i) the Ross Sea, and (ii) SSRU 882E.

5.87 Vessels were required to tag and release *Dissostichus* spp. at a rate of one fish per tonne of green weight caught and all vessels achieved the required target rate. However, the tagging overlap statistic varied widely between vessels ranging from 20% to 87% (Table 12). The Working Group recommended that the issue of achieving compliance with the tagging requirements of CM 41-01, Annex C, be considered by SCIC.

5.88 WG-FSA-10/23 summarised catches of *D. mawsoni*, *D. eleginoides* and by-catch species from the Ross Sea, including data from the most recent 2009/10 season. Catches were mainly taken from SSRUs 881C in the north, 881H, 881I on the slope, and 881J on the shelf. Unstandardised catch per hook showed no trend over the course of the fishery.

5.89 A more detailed characterisation of *D. eleginoides* catches in the north of the Ross Sea fishery was carried out for the first time. Catches of *D. eleginoides* have mainly come from the northwest of the Ross Sea (WG-FSA-10/23). Catches were quite high in the early part of the fishery, particularly in 2001, but have been relatively low since then. The catch rates for *D. eleginoides* have been much higher in SSRU 881A than the other SSRUs.

5.90 The paper noted that there may have been problems in distinguishing between the two toothfish species in both observer and C2 data in SSRUs 881A, 881B and 881C. In particular, a number of fish smaller than 100 cm had been identified as *D. mawsoni*, but investigations of otoliths from these fish would probably suggest that they were *D. eleginoides*. The Working Group suggested analysts who find substantial anomalies in reported locations of catches of *Dissostichus* spp. report these to the Secretariat. It noted that there were several mechanisms by which the identity could be independently verified, including length–weight relationships, length–frequency distributions, GSI indices and appearance of the otoliths.

5.91 *Dissostichus eleginoides* in Subarea 88.1 are clearly at the southern edge of their range, only extending into the northwest corner of Subarea 88.1 in any significant numbers. The fishery catches very few fish less than 50 cm, therefore the origin of *D. eleginoides* in this area is unclear. It is possible that these fish may be related to *D. eleginoides* around Macquarie Island as one *D. eleginoides* tagged at Macquarie Island was caught in SSRU 881B in 2007.

5.92 WG-FSA-10/23 also raised the possibility of developing a time series of relative abundance of recruitment using a longline research survey. It noted that the main objectives would be to (i) detect changes in relative abundance of recruitment over time, (ii) determine the level of recruitment variability, and (iii) determine autocorrelation in recruitment. The paper identified several areas where such a survey could be carried out, and suggested it could be carried out periodically using a standardised method and gear.

5.93 The Working Group agreed that such a time series of relative recruitments from a well-designed survey could be a useful input into the Ross Sea stock assessment model. The Working Group requested that Members develop a survey design to meet these objectives and submit it to WG-SAM and/or WG-FSA for evaluation. They also requested that the Scientific Committee consider how such a survey might be carried out, without compromising fishing activities, in the austral summer fishing season.

5.94 WG-FSA-10/32 proposed medium-term research objectives, the associated data collection requirements, and the development of a preliminary data collection plan for the toothfish fishery in Subareas 88.1 and 88.2. The paper focused on the data collection requirements (including catch and effort data, length, sex, gonad stage sampling, tagging and VME reporting requirements) from vessels and observers currently in place. The preliminary plan is presented in Table 16.

5.95 The Working Group agreed that measures in the research and data collection plans, including the requirement to tag toothfish at the rate of one toothfish per tonne, be retained for the exploratory fisheries in Subareas 88.1 and 88.2. It also encouraged the further development of the data collection plan for these fisheries.

5.96 In accordance with the advice of the Scientific Committee in 2009, the assessment for Subareas 88.1 and 88.2 was not updated. The Working Group agreed that the management advice on catch limits for Subareas 88.1 and 88.2 could be carried forward from last year.

#### Management advice to the Scientific Committee

5.97 The Working Group recommended that some specific elements of the work plan be considered as a high-priority focus topic for WG-SAM in the coming intersessional period (paragraph 5.12).

5.98 The Working Group agreed that some vessels showed a very low level of commitment to tagging larger toothfish and that this was having a serious impact on the efficacy of the tagging program. It also recalled that a paper had been submitted to WG-FSA in 2007 which outlined methods by which large toothfish could be tagged in good condition (WG-FSA-07/36). In noting the methods described in this paper, and paragraph 5.18 above, the Working Group agreed that there was no reason why all vessels should not be able to score a high



overlap statistic in all subareas and divisions. The Working Group recommended that the Scientific Committee once again strongly urge Members to request their vessels to fully comply with all aspects of CM 41-01, Annex C, in particular with respect to the size and species of toothfish being tagged.

5.99 The Working Group recommended that the Scientific Committee request the Secretariat to prepare a table of the data collection requirements for each new and exploratory fishery that summarises the data collected, frequency of data collection (i.e. samples per thousand hooks), and the rationale for that frequency following the format outlined in Table 16. These tables would be used by WG-FSA in 2011 to review the data collection requirements in each fishery, and would be included within the fishery reports as a description of the data collection required.

5.100 The Working Group recommended that all measures in the research and data collection plans, including the requirement to tag toothfish at the rate of three toothfish per tonne and the requirement for research hauls as used in 2009/10, be retained for the exploratory fisheries in Subarea 48.6 and Divisions 58.4.1, 58.4.2 and 58.4.3a.

5.101 The Working Group recommended that it could provide no new advice on catch limits for Subarea 48.6 and Divisions 58.4.1, 58.4.2 and 58.4.3a. It noted that a research plan was being developed which could provide advice in the future (paragraphs 5.1 to 5.12).

5.102 In progressing a research plan to develop *D. mawsoni* assessments for Division 58.4.1, the Working Group encouraged Members to collaborate in the intersessional period to progress elements of the generalised work plan (paragraphs 5.1 to 5.12). Further, the Working Group noted that a special research area that could be investigated in this process could be the combined SSRUs F and G in Division 58.4.1. Possible canyons and submarine features in this area could be investigated for their importance to *D. mawsoni*. Research in both these SSRUs may provide an opportunity to compare the characteristics of an area with a known history of fishing with an area that has been closed over the same period.

5.103 In progressing a research plan to develop *D. mawsoni* assessments for Division 58.4.2, the Working Group encouraged Members to collaborate in the intersessional period to progress elements of the generalised work plan (paragraphs 5.1 to 5.12).

5.104 The Working Group noted that the sampling design undertaken for the proposed research in Division 58.4.3b was not submitted for review by any SC-CAMLR working group, and recommended that future research plans be reviewed by WG-FSA.

5.105 WG-FSA-10/47 reported on the distribution and population structure of *Dissostichus* spp. on BANZARE Bank, determined from data arising from exploratory longline fishing during 2007 to 2009. The Working Group recommended that authors of such reviews should consider collaborating to synthesise current knowledge.

5.106 The Working Group recommended that the catch limits for Division 58.4.3b be retained for 2010/11. The Working Group could not reach consensus on advice for additional catch for research fishing, and noted that a research plan was being developed which could provide advice in the future (paragraphs 5.1 to 5.12).

5.107 The Working Group agreed that measures in the research and data collection plans, including the requirement to tag toothfish at the rate of one toothfish per tonne, be retained for the exploratory fisheries in Subareas 88.1 and 88.2. It also encouraged the further development of the data collection plan for these fisheries.

5.108 In accordance with the advice of the Scientific Committee in 2009, the assessment for Subareas 88.1 and 88.2 was not updated. The Working Group agreed that the management advice on catch limits for Subareas 88.1 and 88.2 could be carried forward from last year.

#### Management advice to SCIC

5.109 Recalling its advice from last year, the Working Group again recommended that the method developed to evaluate the degree of mismatch between the length-frequency distribution of the tagged fish and that of the fish caught, as outlined in paragraphs 5.18 and 5.19, could be used to assess consistency with CM 41-01, Annex C, and referred this to SCIC for further consideration.

#### Closed Fishery – Ob and Lena Banks Division 58.4.4

5.110 The longline fishery for *Dissostichus* spp. in Divisions 58.4.4a and 58.4.4b began as a new fishery in 1997/98 (CM 138/XVI) (Appendix L). These divisions were managed as a single area and a catch limit for *Dissostichus* spp. applied to fishing north of 60°S, and in waters outside areas of national jurisdiction. In 1999 the divisions were subdivided into SSRUs A, B, C and D.

5.111 In 2002, the Commission expressed concern regarding the low levels of stocks of *Dissostichus* spp. in Divisions 58.4.4a and 58.4.4b and the high levels of IUU fishing in that region (CCAMLR-XXI, paragraph 11.36). Consequently, the Commission prohibited directed fishing for *Dissostichus* spp. in these divisions and the fishery for *Dissostichus* spp. was closed (CM 32-10). The Commission agreed that such prohibition shall apply at least until further scientific information is gathered and reviewed by the Scientific Committee and WG-FSA.

5.112 In 2007/08 and 2009/10, a Japanese-flagged longliner conducted research fishing in accordance with a research plan submitted under CM 24-01. The vessel caught 77 tonnes of *D. eleginoides* and <1 tonne of *D. mawsoni* in 2007/08, and 59 tonnes of *D. eleginoides* in 2009/10.

5.113 Individual *D. eleginoides* were tagged and released by a Japanese-flagged vessel conducting research fishing in Divisions 58.4.4a and 58.4.4b in 2007/08 and 2009/10 (Table 2). A total of 639 *D. eleginoides* have been tagged and released, and one fish has been recaptured. Fish were tagged at a rate of 3.6 fish per tonne of green weight caught. CPUE in 2009/10 was 0.139 kg/hook compared with 0.108 kg/hook as described in WG-FSA-10/46. The allowable catch of 60 tonnes was taken in 94 hauls, leaving 17% of survey sites unfished.

5.114 A revised research proposal was reviewed by WG-SAM (Annex 4, paragraphs 3.23 to 3.25). During the WG-FSA-10 meeting, Japan further revised the research proposal

(WG-FSA-10/49) to survey *Dissostichus* spp. in 2010/11 as part of a 3–5 year tagging experiment. To accommodate a lower catch level and to maximise the number of tags recaptured, the spatial extent of the survey was reduced to two SSRUs, the number of sets reduced to 71 sets in a higher-density grid (7.5' latitude × 15' longitude), and the estimated catch reduced to 53 tonnes. A tagging rate of five fish per tonne would be used.

5.115 When seeking to develop a survey series to collect the data needed for an assessment of stock status, a design that generates the most robust index of stock status while minimising the risk to the stock is desired. This is paramount for stocks which may already be depleted. The Working Group discussed several logistical and scientific constraints of the survey design, including:

- (i) It is important to maximise the number of tagged fish released. Instead of tagging five fish per tonne, tagging every 'Nth' fish could both increase the tagging rate and maximise the tag overlap statistic.
- (ii) In areas where depredation may occur, the survey design needs to be flexible, to allow the vessel to move to avoid interactions with marine mammals, and the total mortality due to the survey should include the biomass removed through depredation.
- (iii) The area surveyed needs to be commensurate with the level of catch permissible given the best available information on stock status. Concentrating effort in small areas may provide a higher probability of subsequent recovery of tags. However, this may have other effects, such as:
  - (a) influencing the probability of recovering tags deployed elsewhere
  - (b) causing local depletion of a small area through intensive survey catch
  - (c) influencing the ability to extrapolate catch rates to the entire stock area
  - (d) constraining the ability of the vessel to move to avoid depredation.
- (iv) The procedure of estimating spawning stock biomass using the relative CPUE of a reference area was reviewed and considered inappropriate because the equation requires assuming similar productivity and selectivity in the two areas, that CPUE is actually indexing abundance in each area, and that the areas are representing the same habitat type (e.g. depth zone). In addition, error associated with each term would need to be included in the resulting estimate. These issues were summarised by WG-SAM-10 (Annex 4, paragraphs 3.23 to 3.25), and are also described in the advice regarding the proposed research plan for Division 58.4.3b (paragraphs 5.64 to 5.81).
- (v) The level of catch allowed can be the most constraining factor on the resulting survey design, and if too low in a mark-recapture experiment, could result in the failure to release or recapture an adequate number of tags to estimate biomass.

#### Management advice

5.116 An alternative method of estimating a precautionary research survey catch was described in WG-FSA-09/44, and developed further in WG-FSA-10/42 Rev. 1. At the

meeting, the estimated  $B_0$  value and the current stock biomass were calculated using this method for two stock status scenarios. Population status in each case was projected forward using the GYM (configured using stock parameters from WG-FSA-10/48, and the mean age of first and full selection by the research catch, as 8 and 11 years).

- (i) Scenario 1 used the estimated total catch history (legal and IUU) and assumed the biomass in 2010 to be 20% of  $B_0$ . An estimate of  $B_0$  was then calculated at 7 900 tonnes. Using the relationship in Figure 3 of WG-FSA-10/42 Rev. 1, representing a precautionary research catch, 0.62% of  $B_0$  is 49 tonnes.
- (ii) Scenario 2 used the same catch history and assumed the status at the end of the bulk of IUU fishing (in 2002) was 20% of  $B_0$ .  $B_0$  was then back-calculated to be 9 200 tonnes. This scenario then assumes some recovery through a forward projection, estimating the biomass in 2010 to be 33% of  $B_0$ . A precautionary catch limit (as for scenario 1) is then 1.05% of  $B_0$ , or 97 tonnes.

5.117 These scenarios assume that the actual level of stock depletion is due to IUU fishing in each scenario, the level of stock depletion did not impact the stock-recruit dynamics, the IUU catch history is correct, and the growth function is the same as that used for the *D. eleginoides* stock in Division 58.5.2. The Working Group agreed that these estimates are very uncertain and should be treated with caution. The knowledge of stock dynamics at low population sizes is very limited, and previous experience with recovery of depleted notothenioid fishes suggests recovery can be a very slow process.

5.118 Several other recommendations were made to improve the proposed survey design and to maximise the value of the scientific information resulting from the survey:

- (i) It is important to continue comparative trials of trotline and Spanish longline gear configurations. A single vessel deploying both gears provides an optimal comparison of the physical condition of fish captured using each gear configuration.
- (ii) Further, the condition of toothfish should be recorded when the fish is brought on board (as for skates). These data will allow the relative condition of fish captured with trotline and Spanish longline to be assessed, and also will allow the condition of tagged fish to be analysed.
- (iii) Vessel operators should record any observations of depredatory marine mammals to understand influences of depredation on catch rates and also the survival of the released toothfish.
- (iv) The allocated catch should be divided between the two SSRUs to be surveyed. The Working Group recommended that fishing effort be concentrated in SSRUs B and C because these SSRUs contain the most deployed tags, maximising the probability of tag recovery.
- (v) The Working Group encouraged Japan to continue the ageing work conducted on otoliths collected as part of this research.
- (vi) The research proposal details the collection of data concerning toothfish age, maturity, and stomach contents, length-frequency distributions of by-catch

species, VME indicator taxa identification, temperature-depth profiles, and detailed bathymetry. The Working Group encouraged these data to be analysed and presented at future WG-FSA meetings.

#### Research plans notified under CM 24-01

5.119 Mr T. Jung (Republic of Korea) presented a research plan proposed to be undertaken in the closed SSRUs 883A–C (WG-FSA-10/9), and noted that the proposal includes a plan by two longline vessels to conduct 190 hauls catching up to a total 190 tonnes of toothfish, and collect data on the size, catch rates and diet of toothfish, fish by-catch and VMEs, as well as tagging toothfish at a rate of five per tonne. Russia had also proposed to conduct research fishing in closed SSRUs 882A and 883A–C, using a single longline vessel. Russia proposed to conduct 10 hauls and take up to 10 tonnes of toothfish in SSRU 882A, and to conduct 20 hauls and take up to 65 tonnes of toothfish in Subarea 88.3. The proposed research would collect data on size, age, diet, reproduction and genetics of toothfish, as well as on fish and benthic invertebrate by-catch, tag toothfish at a rate of three per tonne, and tag skates.

5.120 The Working Group recalled the advice of the Scientific Committee for evaluating CCAMLR-sponsored research (SC-CAMLR-XXVII, paragraphs 8.9 to 8.11), and the advice of WG-SAM on estimating stock size in data-poor fisheries (Annex 4, paragraphs 3.19 to 3.26). It noted that it was unclear how the current proposals would address the need for an assessment in Subarea 88.3, in particular as the analyses in WG-FSA-10/43 and experience from exploratory and research fishing in Subareas 48.6 and 58.4 indicated the length distribution and catch rate data were unlikely to contribute to an assessment in the next three to four years. It further agreed that research on benthic communities may be more effectively conducted by camera work and research trawls.

5.121 The Working Group recalled that Chilean and New Zealand vessels had previously conducted research fishing in the closed SSRUs in Subarea 88.3. The results of both surveys indicated that the toothfish population in this area was dominated by juvenile fish <100 cm in length (WG-FSA-05/53; Arana and Vega, 1999). It was also noted that in the Chilean survey, catch rates were very low, with 302 kg of toothfish caught from over 50 000 hooks set, indicating the density of toothfish across the area is very low, across a depth range of 600–2 550 m.

5.122 The Working Group recalled its previous advice that the best way to develop an assessment in data-poor areas was to carry out a tagging program (SC-CAMLR-XXVIII, Annex 6, paragraph 2.34). It also noted that as Subarea 88.3 was very large, any tagging program would be most successful where the tagging was initially concentrated in a small area. It also noted that fishing in a smaller area would require a smaller catch allocation.

5.123 The Working Group recalled that the tag-recapture programs in Subareas 48.6 and 58.4 had been unsuccessful, and noted that many vessels showed low overlap between the size of fish tagged and the catch. It agreed that the vessels conducting a tag-recapture program in a closed area should have a proven record of successful participation in tag-recapture programs in open areas.

5.124 It was also noted that toothfish captured from the trotline method may have lower survivorship when tagged and released if they receive multiple hook wounds. The Working Group agreed that experiments to determine post-capture mortality rates from trotlines could be pursued in open areas where such vessels already operate.

5.125 The Working Group noted that the Russian proposal included reference to developing an assessment using the TISVPA. The Working Group reiterated its advice for the TISVPA to be evaluated by WG-SAM (SC-CAMLR-XXVIII, Annex 5, paragraph 4.16).

5.126 The Working Group agreed that the research proposed was unlikely to lead to an assessment for these areas. The Working Group agreed that future proposals for research to develop assessments in the closed areas of SSRU 882A and Subarea 88.3 would benefit from consideration of the generalised approach to conducting research for data-poor fisheries (paragraphs 5.1 to 5.12).

#### Assessed fisheries

##### *Dissostichus eleginoides* South Georgia (Subarea 48.3)

5.127 The Fishery Report for *D. eleginoides* in Subarea 48.3 is contained in Appendix M.

5.128 Following the advice of the Scientific Committee (SC-CAMLR-XXVIII, paragraph 4.82), the assessment was not updated in 2010.

#### Management advice

5.129 In the 2009/10 fishing season, five vessels fished within the five-day early extension (26–30 April). One vessel caught two birds. The average catch is therefore 0.4 birds per vessel. The Working Group advised therefore that, according to CM 41-02, paragraph 6(i), the 2010/11 fishery could start on 21 April 2011.

5.130 The Working Group did not undertake an assessment of this stock in 2010, and had no additional management advice. It therefore recommended that CM 41-02 be carried forward in its entirety for the 2010/11 fishing season.

##### *Dissostichus* spp. South Sandwich Islands (Subarea 48.4)

5.131 A tagging experiment has been conducted in Subarea 48.4 North over the last five years. This experiment was extended to Subarea 48.4 South in the 2008/09 fishing season.

5.132 The catch limits for *D. eleginoides* and *D. mawsoni* in Subarea 48.4 North in the 2009/10 season were 41 tonnes and 0 tonnes (except for scientific purposes) respectively, with recorded catches of 40 tonnes and 0 tonnes respectively. The northern fishery was closed when the catch limit was reached. The catch limit for *Dissostichus* spp. in Subarea 48.4 South in the 2009/10 season was 75 tonnes, with a recorded catch of 74 tonnes. The fishery report for *D. eleginoides* in Subarea 48.4 is contained in Appendix N.

5.133 Subarea 48.4 South is in the second year of a three-year experiment. No full assessment is currently available. There was some evidence of localised depletion around particular islands and seamounts close to the northern boundary of Subarea 48.4 South (WG-FSA-10/40). A preliminary assessment using the limited number of tag-recaptures to date and CPUE/area comparisons with Subarea 48.4 North suggest a vulnerable population of between 600 and 1 500 tonnes. This is about half the size of the estimate that was made in 2009, after the first season of fishing, which was based only on CPUE/area comparison (WG-FSA-09/18).

5.134 Taking into account the revised preliminary population assessment, the Working Group recommended a reduced 30 tonne catch limit during the third year of the experiment.

#### Management advice

5.135 The Working Group recommended the following limits for toothfish and by-catch in Subarea 48.4:

##### Subarea 48.4 North –

- (i) a catch limit of 40 tonnes for *D. eleginoides*;
- (ii) the continued prohibition of the taking of *D. mawsoni* other than for scientific research purposes;
- (iii) maintenance of catch limits for by-catch species, with a limit for macrourids of 6.5 tonnes (16% of the catch limit for *D. eleginoides*) and a limit for rajids of 2 tonnes (5% of the catch limit for *D. eleginoides*).

##### Subarea 48.4 South –

- (i) a catch limit of 30 tonnes for *Dissostichus* spp. (*D. eleginoides* and *D. mawsoni* combined);
- (ii) maintenance of a move-on rule for by-catch species, with a macrourid trigger of 150 kg and 16% of the catch of *Dissostichus* spp., and a trigger for rajids set at 5% of the catch of *Dissostichus* spp.

5.136 The Working Group recommended that the mark-recapture experiment in Subarea 48.4 South be continued for the 2010/11 season with a reduced catch limit of 30 tonnes. Further, the Working Group noted that it would be desirable to discourage any possible concentration of effort on the northern islands in Subarea 48.4 South.

5.137 The Working Group recommended that where *D. mawsoni* and *D. eleginoides* are caught on the same line in Subarea 48.4 South, the majority of the tags released within the required tagging rate should be on *D. mawsoni*.

*Dissostichus eleginoides* Kerguelen Islands (Division 58.5.1)

5.138 The Fishery Report for *D. eleginoides* in Division 58.5.1 is contained in Appendix O.

5.139 The catch of *D. eleginoides* reported for this division to 31 August 2010 was 2 977 tonnes. Only longlining is currently permitted in the fishery. The estimated IUU catch for the 2009/10 season was zero inside the French EEZ. Some IUU fishing may occur outside the EEZ as reported in WG-FSA-08/10 Rev. 2.

5.140 During the 2006 survey, 639 fish were tagged and 12 135 fish were tagged from the longline fishery, 587 fish were recaptured from French tagging and 102 fish from Division 58.5.2 tagging so far. During the 2009/10 season, 194 tagged fish were caught on longlines, 177 French tags and 17 Australian tags. A cooperative work between France and Australia has been conducted (May 2009, Paris) on analyses of catch, effort and other data to be used to progress understanding of fish stocks and fishery dynamics for Divisions 58.5.1 and 58.5.2.

5.141 The CPUE standardisation for Division 58.5.1 was not updated by the Working Group.

5.142 The Working Group noted that France has made progress on a stock assessment of the area using CASAL. The development of a stock assessment model is ongoing, and France intends to present the model to a future meeting of WG-FSA. The Working Group encouraged other Members to assist France in undertaking the stock assessment of *D. eleginoides* in this division, including consideration of metapopulation structure in the Indian Ocean (SC-CAMLR-XXII, paragraphs 7.11 to 7.13). In addition, it also encouraged cooperative work in the intersessional period between French and Australian scientists on analyses of catch and effort data and other data that could be used to progress understanding of fish stocks and fishery dynamics for Divisions 58.5.1 and 58.5.2 and Subarea 58.6.

Management advice

5.143 The Working Group encouraged the estimation of biological parameters for *D. eleginoides* in Division 58.5.1 and the development of a stock assessment for this area. The Working Group also encouraged France to continue its tagging program in Division 58.5.1.

5.144 The Working Group recommended that avoidance of fishing in zones of specific high rates of abundance in by-catch should also be considered.

5.145 No new information was available on the state of fish stocks in Division 58.5.1 outside areas of national jurisdiction. The Working Group therefore recommended that the prohibition of directed fishing for *D. eleginoides*, described in CM 32-13, remain in force.

*Dissostichus eleginoides* Heard Island (Division 58.5.2)

5.146 The Fishery Report for *D. eleginoides* in Division 58.5.2 is contained in Appendix P.



5.147 Following the recommendation by the Scientific Committee, the toothfish assessment for *D. eleginoides* in Division 58.5.2 was not updated. The Working Group noted that the *D. eleginoides* stock assessment in this division will be updated in 2011.

#### Management advice

5.148 The Working Group did not undertake an assessment of this stock in 2010, and had no additional management advice. It therefore recommended that CM 41-08 be carried forward in its entirety for the 2010/11 fishing season.

#### *Dissostichus eleginoides* Crozet Islands (Subarea 58.6)

5.149 The Fishery Report for *D. eleginoides* in Subarea 58.6 (French EEZ) is contained in Appendix Q.

5.150 The catch of *D. eleginoides* reported for this subarea to October 2010 was 512 tonnes. Only longlining is currently permitted in the fishery. The estimated IUU catch for the 2009/10 season was zero inside Subarea 58.6.

5.151 The CPUE series for this fishery was not updated by the Working Group.

#### Management advice

5.152 The Working Group encouraged the estimation of biological parameters for *D. eleginoides* in Subarea 58.6 (French EEZ), and the development of a stock assessment for this area. The Working Group encouraged France to continue its tagging program in Subarea 58.6.

5.153 The Working Group recommended that avoidance of zones of specific high by-catch abundance should also be considered.

5.154 No new information was available on the state of fish stocks in Subarea 58.6 outside areas of national jurisdiction. The Working Group therefore recommended that the prohibition of directed fishing for *D. eleginoides*, described in CM 32-11, remain in force.

#### *Dissostichus eleginoides* Prince Edward and Marion Islands (Subareas 58.6 and 58.7)

5.155 The Fishery Report for *D. eleginoides* in Subareas 58.6 and 58.7 inside the South African EEZ is contained in Appendix R.

5.156 The catch limit of *D. eleginoides* in the South African EEZ for the 2009/10 season was 450 tonnes for the period from 1 December 2009 to 30 November 2010. The catch reported for Subareas 58.6 and 58.7 as of 5 October 2010 was 84 tonnes, all of which was taken by longlines. There was no evidence of IUU catch in 2009/10.

5.157 The CPUE series was not updated by the Working Group.

Management advice for *D. eleginoides* at Prince Edward and Marion Islands (Subareas 58.6 and 58.7) inside the EEZ

5.158 Dr Leslie noted that South Africa is considering the adoption of an operational management procedure (SC-CAMLR-XXVII, Annex 7, paragraphs 6.1 to 6.3) approach as a basis for provision of management advice, and a catch limit for 2010 has not been set as yet, but it is likely to be in the range of 250–450 tonnes. Details are provided in Appendix R.

5.159 In 2005, the Scientific Committee noted that the advice on the appropriate levels of future catch provided in WG-FSA-05/58 (see also WG-FSA-06/58 and 07/34 Rev. 1) was not based on the CCAMLR decision rules. Therefore, the Working Group was unable to provide management advice for the fishery in the South African EEZ at the Prince Edward Islands. The Working Group recommended that CCAMLR decision rules also be used in estimating yields for this fishery. The proposed operational management procedure addresses the concerns over the sensitivity of the ASPM to weightings used for different data sources and the estimation of recruitment levels for forward projections.

Management advice for *D. eleginoides* at Prince Edward Islands (Subareas 58.6 and 58.7 and Division 58.4.4) outside the EEZ

5.160 No new information was available on the state of fish stocks in Subareas 58.6 and 58.7 and Division 58.4.4 outside areas of national jurisdiction. The Working Group therefore recommended that the prohibition of directed fishing for *D. eleginoides*, described in CMs 32-10, 32-11 and 32-12, remain in force.

*Champsocephalus gunnari* South Georgia (Subarea 48.3)

5.161 The Fishery Report for *C. gunnari* at South Georgia (Subarea 48.3) is contained in Appendix S.

5.162 In the 2009/10 fishing season, the catch limit set for *C. gunnari* in Subarea 48.3 was 1 548 tonnes. During the 2009/10 season, the fishery caught 12 tonnes by the end of October 2010.

5.163 In January 2010, the UK undertook a random stratified bottom trawl survey of the South Georgia and Shag Rocks shelves (WG-FSA-10/38) (see also paragraph 3.18). The survey employed the same trawl gear and survey design as previous UK surveys in Subarea 48.3.

5.164 The Working Group agreed that a short-term assessment should be implemented using the length-based method described in WG-FSA-10/37 to calculate future catch limits in accordance with the CCAMLR decision rules for icefish.

5.165 The fixed parameters for the assessment remained unchanged from 2009.

#### Management advice

5.166 The Working Group recommended that the catch limit for *C. gunnari* should be set at 2 305 tonnes in 2010/11 and 1 535 tonnes in 2011/12 based on the outcome of the short-term assessment.

#### *Champscephalus gunnari* Heard Island (Division 58.5.2)

5.167 The Fishery Report for *C. gunnari* in Division 58.5.2 is contained in Appendix T.

5.168 The catch limit of *C. gunnari* in Division 58.5.2 for the 2009/10 season was 1 658 tonnes for the period from 1 December 2009 to 30 November 2010. The catch reported for this division as of 5 October 2010 was 365 tonnes.

5.169 A large 3+ year class, probably the result of spawning by the 4+ year class dominant in 2006, was observed to dominate the population in the survey undertaken in April 2009.

5.170 The short-term assessment was implemented in the GYM, using the one-sided bootstrap lower 95% confidence bound of total biomass from the 2010 survey, using the revised growth parameters described in WG-FSA-10/12. All other parameters were the same as in previous years.

5.171 The Working Group recalled its advice to the Scientific Committee last year that the catch limit for *C. gunnari* in Division 58.5.2 for 2010/11 be zero (SC-CAMLR-XXVIII, Annex 5, paragraph 5.178). It also noted that the trawl survey conducted in March–April 2010 (WG-FSA-10/12) detected an incoming 2+ year class, and that the short-term projection model was properly applied to generate precautionary yields for the following two seasons based on CCAMLR decision rules. However, the biomass from the survey was very low relative to historic levels, and the short-term projection model as applied will always yield a precautionary yield, no matter what the fishable biomass. The Working Group noted that work remains outstanding from the ‘Workshop on Assessment Methods for Icefish’ (SC-CAMLR-XX, Annex 5, Appendix D) to evaluate whether this strategy will be problematic for stocks of highly variable abundance (de la Mare et al., 1998). The Working Group also noted that this work will contribute to addressing the CCAMLR PRP recommendation whether a rebuilding strategy needs to be employed for such stocks when they have low levels of biomass.

#### Management advice

5.172 The Working Group recommended that the Scientific Committee consider a catch limit for *C. gunnari* in 2010/11 of no more than 78 tonnes.

5.173 The Working Group recommended that other measures in the conservation measure be retained.

#### Other fisheries

Antarctic Peninsula (Subarea 48.1) and  
South Orkney Islands (Subarea 48.2)

5.174 The Working Group noted that WG-FSA-09/31 reported the recovery of *Notothenia rossii* populations in Potter Cover, South Shetland Islands, to levels close to that of the early 1980s, however, it cautioned that extrapolation of these findings to a subarea scale was premature.

5.175 On the basis of the results of a multi-species research survey in Subarea 48.2 (WG-FSA-09/19), the Working Group agreed that the populations of previously exploited species, including *C. gunnari* and *N. rossii*, show little sign of recovery despite the closure of the fishery after the 1989/90 season (see SC-CAMLR-XXVIII, Annex 5, paragraph 3.41).

5.176 There was no new information available to the Working Group for the 2009/10 season for these subareas.

#### Management advice

5.177 The Working Group recommended that the existing CMs 32-02 and 32-04 on the prohibition of finfishing in Subareas 48.1 and 48.2 respectively, remain in force.

Crabs (*Paralomis* spp. Subarea 48.3)

5.178 Most fishing for crabs in Subarea 48.3 has proven not to be economically viable due to the large numbers of undersized crabs caught. For example, although the *Kinpo Maru No. 58* caught 112 tonnes of crab in 2002, it also discarded 511 tonnes of undersized crab.

5.179 Toothfish by-catch levels were high in 1995 and 1996 (7 tonnes and nearly 8 tonnes respectively) but were much lower in 2002 (695 kg plus 40 kg discarded toothfish by-catch).

5.180 The fishery for crabs in Subarea 48.3 is subject to CM 52-01 with a catch limit of 1 600 tonnes. On entering the fishery, vessels must undertake an experimental harvest regime, including deploying their first 200 000 pot hours fishing in set areas in an attempt to gather data on abundance.

5.181 In 2009 one vessel notified to fish. However, the vessel only started fishing in August, and stopped fishing only on 15 October. Vessel and observer data have yet to be submitted and could not be analysed by the Working Group.

5.182 For the 2009/10 fishing season, data on catches made before 30 June were required to be submitted for analysis by WG-FSA. The Working Group strongly encouraged Russia to provide a full analysis of the data collected for the 2011 meeting of WG-FSA.

#### Management advice

5.183 The Working Group had no new advice to present to the Scientific Committee on stock status of crabs or the conduct of the fishery in Subarea 48.3.

#### Crabs (*Paralomis* spp. Subarea 48.2)

5.184 An exploratory fishery for crabs was carried out for the first time in Subarea 48.2 during the 2009/10 season. The fishery was prosecuted in accordance with the requirements of CM 52-02, and a total of 79 140 pot hours and 17 sets were completed. Only three *P. formosa* were captured, and the Working Group concluded that the crab fishery in Subarea 48.2 was not likely to be viable.

#### Management advice

5.185 The Working Group recommended that CM 52-02 be allowed to lapse.

#### Progressing scientific issues identified in the PRP Report

5.186 The Working Group considered the requests of the Scientific Committee (SC-CAMLR-XXVIII, paragraphs 10.8 and 10.10).

5.187 In regard to Task 2, the Working Group agreed that it will be able to comment when WG-EMM has developed, through the analysis of observer sampling data, an understanding of the species of larval fish affected and the seasons and areas in which they are caught in krill trawls.

5.188 In regard to Task 3, in particular how to present information on the status of fish stocks, particularly those considered depleted, catch histories could be used in this task but the lack of current fishing may not be an indicator of depletion. In many cases, cessation of fishing has been due to closure of the fisheries by CCAMLR which has generally been because of a lack of information on stock status, or information that stock status was low and that fishing should cease. However, in some cases, e.g. myctophids, the lack of fishing is because the fishing industry has ceased to be interested in the stock.

5.189 The Working Group agreed that a tabulation of available information, including catch history (by decade), the history of surveys (year, location and type), the time series of assessment results (year, type) and the current conservation measure along with appropriate cross-references to management advice, could assist with interpreting stock trajectories.

5.190 With respect to determinations of whether a stock would be considered depleted, the Working Group recalled the terminology now typically used in these discussions elsewhere is whether or not a stock is overfished (its status relative to a target state) combined with whether the current harvest rate would be considered to be too high (termed overfishing and takes account of the productivity of the stock). This is often presented in graphical form with status on one axis and harvest rate on the other.

5.191 Presentations of stock status will need to consider the relationship of the stock to the target and depleted levels in the CCAMLR decision rules. Similarly, current harvest rate will need to be considered with respect to the productivity of the stock. The classification of the harvest rate may need to be further subdivided to account for the need for recovery when a stock is considered overfished.

5.192 An important issue identified by the Working Group is that the target status may change over time as a result of ecosystem change. This is an important consideration in determining current stock status and may be an important issue to consider for managing current fisheries in CCAMLR.

5.193 Acknowledging that the classification of the status of stocks may be difficult to agree, the Working Group requested the Scientific Committee to consider whether levels of certainty could be assigned to classifications in the same way that levels of certainty are ascribed to statements by the Intergovernmental Panel on Climate Change. In this way, statements can be made about the status of stocks and harvest rates and a level of certainty assigned to them.

5.194 The Working Group did not consider Tasks 1 and 5 at its current meeting.

## FISH AND INVERTEBRATE BY-CATCH

6.1 The Working Group discussed the following:

- (i) by-catch in trawl and longline fisheries in the CAMLR Convention Area;
- (ii) the 2009/10 Year-of-the-Skate in new and exploratory fisheries, including –
  - (a) numbers of skates tagged and tag rates
  - (b) biological data collection rates
  - (c) recommendations for a future skate data collection program;
- (iii) focused data collection on macrourids;
- (iv) by-catch mitigation –
  - (a) review of move-on rules in new and exploratory fisheries
  - (b) review of move-on rule in Subarea 48.4;
- (v) papers submitted to WG-FSA-10 with relevance to by-catch;
- (vi) implications of an increase in IUU gillnetting on by-catch.

## By-catch in trawl fisheries

6.2 By-catch in trawl fisheries for icefish and toothfish derived from fine-scale (C1) data are shown in Table 17.

6.3 In Division 58.5.2 trawl fisheries, the by-catch of *Channichthys rhinoceratus* was 55 tonnes (37% of the catch limit), 17 tonnes for rajids (14% of the catch limit), 11 tonnes for *Lepidonotothen squamifrons* (14% of the catch limit), and 3 tonnes *Macrourus* spp. (less than 1% of the catch limit). The combined catch for all other by-catch species was 6 tonnes, indicating that all were individually less than 12% of their catch limit.

## By-catch in longline fisheries

6.4 Total removals of by-catch species reported in fine-scale (C2) data from longline fisheries within the CAMLR Convention Area during the 2009/10 season are summarised in Table 18.

### Rajids

6.5 In 2009/10, reported rajid by-catch was <4% of *Dissostichus* spp. catch and <9.3% as a percentage of the rajid catch limit in most longline fisheries within the Convention Area. However, in those areas where a high proportion of rajids caught are retained and processed (French EEZs: Division 58.5.1 and Subarea 58.6) catches were 10% of *Dissostichus* spp.

### Macrourids

6.6 By-catch rates for macrourids ranged from 0 to 16.9% of the *Dissostichus* spp. catch for the 2009/10 fishing season and were broadly similar to those observed in 2008/09. The highest were in the French EEZs (Division 58.5.1 and Subarea 58.6), and in Subareas 48.4 and 88.2. In Subarea 88.2, macrourid by-catch reached >50% of the by-catch limits; in Subarea 48.4 North, the macrourid catches decreased from 100% of the limit in 2008/09 to 35% of the limit in 2009/10 (see paragraph 6.42).

### Other species

6.7 By-catch of other species in 2009/10 was generally low; <1% *Dissostichus* spp. catch in all areas except Subareas 48.4 South (1.1%) and 88.2 (4.8%). The 16 tonnes attributed to other species in Subarea 48.3 was comprised of *Antimora rostrata*. Other species comprised 0.5% of the toothfish catch in Subarea 88.1, and 4.8% of the toothfish catch in Subarea 88.2 was mainly *A. rostrata*, *Chionobathyscus dewitti* and *Muraenolepis* spp.

## Data reporting for by-catch species

6.8 Comparison of fine-scale (C2) data reported for rajids amongst different subareas and divisions (Table 19) and with scientific observer data (Table 20) highlighted a number of reporting inconsistencies. The most significant of these was the reporting in C2 and observer data of rajids (as well as other by-catch species) as 'Discarded Dead' in areas south of 60°S, where this activity is prohibited (CMs 26-01, 41-04 and 41-11).

6.9 Through more detailed exploration of the data on a vessel-by-vessel basis, discussion with respective Members and examination of observer reports, it was determined that reporting of discards of by-catch species by the vessels and observers concerned was due to misinterpretation of reporting requirements for by-catch that is retained when caught south of 60°S and later discarded as offal when the vessel is north of 60°S.

6.10 The Working Group recommended that further guidance on reporting requirements be provided to both vessels and observers by way of additional detail in the instructions on the relevant data reporting forms as follows:

- C2 Retained: Individuals landed and retained on board the vessel. Some retained product may be disposed at sea at a later date in accordance with conservation measures in force for the relevant subarea or division.
- C2 Discarded: Individuals landed on board the vessel and immediately discarded overboard. This excludes individuals released alive. 'Discards' are defined as whole fish or other organisms returned to the sea dead or with low expectation of survival. Discards are prohibited south of 60°S (see CM 26-01).
- The above changes should also be made to the other relevant C forms (e.g. C1, C3, C5).
- L5 Observed number discarded dead: Observed number caught, landed on board then discarded (including factory discards) during the hauling period. This DOES NOT include individuals released alive or lost, or those individuals which are retained for processing and discarded at a later date.

6.11 The Working Group also recommended that a laminated guide that had been developed for observers and vessel crews in 2009/10 to clarify reporting requirements for skates caught in different conditions, be further developed into a poster specifically directed at new and exploratory fisheries and other areas south of 60°S. This poster could then be distributed with toothfish tag orders. It was noted that there would be budget implications for the Secretariat associated with production of these posters at approximately A\$1 000.

6.12 The other inconsistency in by-catch data noted by the Working Group was greater numbers of by-catch species reported by observers when compared with vessel numbers. It is unclear why such inconsistencies might have arisen. The Secretariat was tasked to investigate these inconsistencies.

6.13 Despite the by-catch reporting issues evident in the 2009/10 data, the Working Group agreed that generally, improvements had been made in reporting of by-catch data, particularly of skates, by both vessels and observers across all areas in the last few years.



## Year-of-the-Skate

6.14 In 2009, it was agreed by the Scientific Committee (SC-CAMLR-XXVIII, paragraph 4.230) that application of protocols for the CCAMLR Year-of-the-Skate should be continued through 2009/10, in order to allow for sufficient data to be collected for preliminary assessments to be made in the future.

6.15 The Year-of-the-Skate included a tagging program for new and exploratory fisheries (CM 41-01, Annex C) in which skate were to be double-tagged at a rate of one skate in every five skates caught, up to a maximum of 500 skates per vessel.

6.16 In order to review whether skate tag rates had been met in 2009/10 or had improved since 2008/09 within new and exploratory fisheries, fine-scale (C2) data for numbers of skate caught were used to generate total numbers of skate hauled (i.e. combining numbers retained, discarded and released) from which a tag rate could be estimated using scientific observer data on numbers of skates tagged.

6.17 During the initial year of the program in 2008/09, an overall tagging rate of 0.23 was achieved, rising to 0.29 in 2009/10 indicating better performance by vessels (see Table 19).

6.18 Individual vessel tag rates, detailed in Table 21, illustrate that the tag rate set by CM 41-01, Annex C, was met for all vessels except one vessel which fished in Division 58.4.3b.

6.19 WG-FSA-10/25 characterised skate catches by vessels fishing in the Ross Sea since 1996/97 and included summaries of tag and other data collected during the two Year-of-the-Skate fishing seasons in 2008/09 and 2009/10. The results of this paper provided very useful feedback on the success of the Year-of-the-Skate.

6.20 WG-FSA-10/25 concluded that centralisation of skate tag management, and databases through the Secretariat, have improved the ability to match tag releases and recaptures and improved the quality of the tagging data available for skate species. The paper also presented findings indicating that tagging skates on board with T-bar tags resulted in lower tag-loss rates than the previous technique of tagging skates in the water with dart tags.

6.21 The Working Group recommended that any further skate tagging should be carried out on board vessels with T-bar tags using protocols developed for the Year-of-the-Skate.

## Biological data collection

6.22 WG-FSA-10/25 also reviewed skate biological data collected between 1996/97 and 2009/10 by vessels fishing within the Ross Sea. The authors concluded that the focused data collection during this two-year period had been instrumental in providing further data for the Ross Sea, particularly length (see also WG-FSA-10/27 for updated length–weight and length–length relationships for *Amblyraja georgiana* and *Bathyraja cf. eatonii*), and tagging data and recommended that similar such data collection programs be repeated in five-year cycles for skates (see paragraph 6.31 and 6.32).

6.23 Comparison of morphometric data in WG-FSA-10/25 collected by observers demonstrated that there remained some inconsistencies in this data. The Working Group recommended that total length, pelvic length and disc width should all be recorded for all skates biologically sampled to aid species identification and to enable retrospective corrections to historical length data for which it was not clear which measurement had been recorded.

6.24 WG-FSA-10/25 also explored skate condition data spanning the period over which a change in hauling protocol was made, so that all skates caught are brought on board or alongside the hauler, in order to increase the ability of crew and observers to identify skate condition and to effectively scan for tags. The results indicated that skate damage had not increased relative to the years prior to implementation of this new handling procedure (i.e. in 2008/09 and 2009/10).

#### Future work program for skates

6.25 The Working Group agreed that the Year-of-the-Skate had been successful in meeting its initial objectives of enhancing data collection and improving tagging performance in order to develop assessments (SC-CAMLR-XXVI, Annex 5, paragraphs 6.34 and 6.35). It was also agreed that such focused data collection programs could be useful for different by-catch species (see paragraphs 6.31 to 6.34 for more discussion).

6.26 The Working Group recommended that the handling procedure implemented in 2008/09 to be made mandatory in new and exploratory fisheries in 2010/11, and sought advice from the Scientific Committee on the following proposal to replace existing text in CM 33-03, paragraph 4:

On all vessels, all skates must to be brought on board or alongside the hauler to be scanned for tags and for their condition to be assessed.

6.27 The Working Group also recommended that the mandatory requirement for tagging skates at a rate of one in every five skates in new and exploratory fisheries should be removed from paragraph 2(iii) in CM 41-01, Annex C; paragraph 13 in CMs 41-04, 41-09 and 41-10; paragraph 11 in CM 41-05; and paragraph 14 in CMs 41-06 and 41-07.

6.28 Although skate tagging would no longer be mandatory in exploratory fisheries, where Members wished to tag skates, the Working Group recommended that protocols already developed during the Year-of-the-Skate be followed. The Working Group requested advice from the Scientific Committee on the following proposal for paragraph 2(vi) to be replaced with the following paragraphs:

(vi) recaptured tagged toothfish should be biologically sampled (length(s), weight, sex, gonad stage), an electronic time-stamped photograph should be taken of the tag removed along with recovered otoliths, detailing the number and colour of the tag;

- (vii) recaptured tagged skates should be biologically sampled (all length(s), weight, sex, gonad stage), two electronic time-stamped photographs should be taken; one of the whole skate with tag attached, and one close-up of the tag detailing the number and colour of the tag.

6.29 The topic of incentives to encourage crew to continue scanning for skate tags in future seasons, such as tag lotteries or rewards on a tag-return basis, was also discussed during the meeting. Difficulties in implementing such schemes within exploratory fisheries where a number of different Member States and fishing companies are involved were considered. These included the means by which an individual crew member might receive the reward, and setting an appropriate reward level to one which would provide an incentive for crew likely to be working under varying salary schemes on different vessels.

6.30 The Working Group also recognised that there were financial implications for the Secretariat in implementing such an incentive scheme, and requested that the Scientific Committee consider the merits of such a scheme and on how best it might be carried out successfully.

#### Focused data collection for macrourids across the Convention Area

6.31 The Working Group discussed WG-FSA-10/32 which detailed plans to develop a Ross Sea medium-term data collection plan and proposed a targeted approach for by-catch species, whereby a particular year is focused on a specific species group. During such focus years which might recur in a cyclical manner (every four to five years), a particular by-catch species would be subjected to a more substantive sampling regime in order to improve knowledge on the distribution, biology and ecology of by-catch species, and to monitor potential longer-term changes in the ecosystem due to fishing, climate change or any other cause. The Working Group concluded that the Year-of-the-Skate program has illustrated the utility of such focused data collection programs (WG-FSA-10/25).

6.32 The Working Group agreed that the principle of focused data collection for particular by-catch species was worth considering when this is seen as important to advance work not currently done and is needed to address unresolved management issues.

6.33 A summary of existing biological data previously collected by scientific observers on macrourids was reviewed during the meeting. The Working Group noted that a considerable amount of data has already been collected on *Macrourus* species across subareas, including over 40 000 records of snout–anal length for *M. whitsoni* for the Ross Sea. WG-FSA-10/33 described *Macrourus* specimens from the Ross Sea originally as *M. whitsoni*. It was noted that potential confusion with species identification remains within the Ross Sea and possibly other high-latitude areas; for example, over 1 000 records listed as *M. carinatus* in Subareas 88.1 and 88.2 are more likely to be *M. whitsoni* based on more recent data (WG-FSA-10/33).

6.34 Dr Hanchet noted that New Zealand is proposing to update the identification guide for fish in the Ross Sea to reflect the identifying features of the two sympatric macrourid species. He also noted that tissue samples will be collected from a subsample of the macrourids identified by observers across the Ross Sea during the 2010/11 season so that observers'

identification can be confirmed. The Working Group encouraged other Members to take a similar approach where possible and noted that a Restriction Fragment Length Polymorphism (RFLP) test had been developed which was a rapid and low-cost way of distinguishing between the two species and could be provided to other laboratories working on these two species in the Convention Area.

6.35 The Working Group proposed that during 2010/11, observers be asked to focus on correctly identifying macrourids to species. The Working Group recommended that consideration be given in 2011 as to whether a fully focused data collection program in 2011/12 on macrourids could be useful across all subareas within the Convention Area. Members were requested to analyse available data to determine key gaps not currently being addressed by observers.

6.36 The Working Group also requested that current data on macrourids in new and exploratory areas (except Subareas 88.1 and 88.2) be characterised to the extent possible by the Secretariat in advance of WG-FSA-11 to illustrate whether or where further data is required. Such a characterisation could include the location of collected otoliths, geographical location of samples collected, and biological parameter analyses. The Working Group also encouraged Members with national research programs to submit similar characterisations of macrourids. It was suggested that this process would clarify whether, or where, focused data collection for macrourids was needed in the future.

6.37 The Working Group requested advice from WG-SAM in 2011 as to assessment methods and data collection required for such assessments on *Macrourus* spp. to aid development of a data collection framework for macrourids in 2011/12.

#### Review of mitigation measures

##### Move-on rules in exploratory fisheries (CM 33-02)

6.38 There were no triggers of the move-on rule in Division 58.5.2.

##### Move-on rules in exploratory fisheries (CM 33-03)

6.39 There were seven instances in Subarea 88.1 and five in Subarea 88.2 during 2009/10 where CM 33-03, paragraph 5, had applied, forcing vessels to move 5 n miles for five days, where the by-catch weight exceeded 1 tonne (Table 22). Review of C2 fine-scale data by the Secretariat indicated that all vessels noted in the table complied with the measure.

6.40 A similar review was also carried out for paragraph 6 (CM 33-03) which excludes a vessel from an SSRU in the event of the *Macrourus* spp. catch exceeding 16% of the catch of *Dissostichus* spp. for any two 10-day periods. Three vessels triggered the exclusion, and all were found to have subsequently moved from the affected SSRU (Table 23).

## Move-on rule in Subarea 48.4 (CM 41-03)

6.41 By-catch limits and move-on rules are included in the annual conservation measure established for Subarea 48.4 (CM 41-03).

6.42 As a result of recommendations at CCAMLR-XXVII, the move-on rule for macrourids in Subarea 48.4 South was modified so that the 16% of toothfish catch trigger would only operate on lines where at least 150 kg of macrourids were caught. In 2009/10, the total catch of macrourids was lower than that in the previous season (11.6 tonnes compared to 14.1 tonnes in the previous season) and the proportion of macrourid move-on trigger sets was considerably lower than would have occurred with the 2008/09 move-on rule (8% sets compared to 70%). The rajid by-catch was 0.9 tonnes, 1.3% of the toothfish catch, and the 5% of toothfish catch move-on rule was triggered on 15% of sets. The Working Group recommended that the move-on rules for macrourids and rajids should remain unchanged in 2010/11.

## Papers submitted to WG-FSA-10 with relevance to by-catch

6.43 WG-FSA-10/34 summarised the spatial and bathymetric distribution of the proportion of different by-catch fish species caught within the French EEZ in longline fisheries. The paper demonstrated the relationship between toothfish CPUE and by-catch; in many areas high by-catch was associated with low CPUE of toothfish.

## IUU gillnetting

6.44 The Working Group noted advice from WG-FSA-10/6 Rev. 1 stating that all IUU vessels sighted in 2009/10 were thought to be using gillnets. In the absence of any qualitative information on the levels and type of by-catch from gillnet fishing, the Working Group could not assess this and urged collection of any information that can reduce the uncertainty and which could inform future deliberations.

## EVALUATION OF THREATS ARISING FROM IUU ACTIVITIES

7.1 The Secretariat provided an estimate of IUU catches of *Dissostichus* spp. for the 2009/10 season to 30 September 2010 (WG-FSA-10/6 Rev. 1). The estimated IUU catch of *Dissostichus* spp. of 1 615 tonnes from the Convention Area was based on information from 11 sightings of seven IUU gillnet vessels in the Convention Area, as well as a review of available information from ports and markets. All IUU vessels reported to be active were believed to be gillnet vessels. There is considerable uncertainty surrounding estimates of IUU catches by gillnet vessels, and the Secretariat had consulted extensively with compliance officers with experience in the Convention Area, as well as officers with experience in gillnet operations in other fisheries (see also paragraph 3.14).

7.2 The active IUU fleet in 2009/10 consisted of a minimum of seven vessels, and was unlikely to consist of more than 10 vessels. These vessels were sighted operating in waters where sea-ice conditions were likely to preclude year-round fishing. The level of surveillance in these areas appears to be at similar levels to previous years.

7.3 The Secretariat advised that it had received no additional information to indicate that IUU catches of toothfish might be significantly in excess of its estimate of 1 615 tonnes. The Working Group expressed its appreciation for the detailed work by the Secretariat in collecting information regarding gillnet fishing.

7.4 The Working Group requested that the Secretariat continue to provide an estimate of IUU removals of *D. eleginoides* and *D. mawsoni*. The Secretariat was also requested to continue to review the index of local vessel density but to report this information to WG-FSA in future only if changes were observed to occur.

7.5 Noting that gillnetting is an indiscriminate and destructive fishing practice and that its impacts remain largely unknown, the Working Group reiterated its deep concern at the use of gillnets in the Convention Area.

## BIOLOGY, ECOLOGY AND DEMOGRAPHY OF TARGET AND BY-CATCH SPECIES

### Review of information available to the meeting

8.1 The Working Group considered 26 papers containing information relevant to this agenda item: WG-FSA-10/11, 10/13, 10/15, 10/17 to 10/22, 10/24, 10/25, 10/27, 10/33 to 10/36, 10/38, 10/44, 10/47, 10/48, 10/50 to 10/52, 10/P2, 10/P3 and 10/P5.

#### Target species

##### *Champscephalus gunnari*

8.2 Feeding rate (WG-FSA-10/18) and diet composition (WG-FSA-10/38) data were presented for the southern Scotia Arc and South Georgia respectively.

##### *Dissostichus eleginoides*

8.3 WG-FSA-10/35 documented an increase in CPUE in closed Management Area A in Subarea 48.3, between 2004 and 2008, which was attributed to an increase in average individual fish weight in the catch. WG-FSA-10/47 provided a characterisation of the catch in Division 58.4.3b. Preliminary estimates of age and growth for fish caught in Divisions 58.4.4a and 58.4.4b were given in WG-FSA-10/48.

### *Dissostichus mawsoni*

8.4 Ageing data derived from scale and otolith reading of historical collections from the Indian Ocean sector were provided in WG-FSA-10/13. WG-FSA-10/22 provided a detailed diet analysis of *D. mawsoni* from the Ross Sea. Results are compared with an earlier study in 2003. WG-FSA-10/36 detailed length-frequency distributions of *D. mawsoni* from Subareas 88.1 and 88.2 and Divisions 58.4.1 and 58.4.2. WG-FSA-10/47 provided a characterisation of the catch in Division 58.4.3b. The results of a histological investigation of gonad maturation in *D. mawsoni* from the Amundsen Sea (Subarea 88.2) were presented in WG-FSA-10/50 and suggest a spawning time in March.

### By-catch and non-target species

8.5 WG-FSA-10/11 presented the results of a study on the diet of *C. dewitti* obtained from toothfish stomachs. The Working Group recognised that this is a valuable method that may prove useful for assessing diets of species with swim bladders that usually evert stomach contents when brought to the surface. WG-FSA-10/17 detailed a preliminary investigation of the feasibility of lead/radium dating in *Chaenocephalus aceratus*. Feeding rates of six species of icefish from the southern Scotia Arc and Antarctic Peninsula were investigated in WG-FSA-10/18. Preliminary estimates of age and growth of *Muraenolepis* spp. and *A. rostrata* from the Ross Sea were presented in WG-FSA-10/19, and a preliminary assessment of age and growth in *Pleuragramma antarcticum* was provided in WG-FSA-10/20.

8.6 Biological information for skates in the Ross Sea, including the data collected in the two Years-of-the-Skate, was summarised in WG-FSA-10/25. Revised estimates of weight-length and length-length regression parameters and length-at-maturity were provided for *A. georgiana* and *B. cf. eatonii* from the Ross Sea in WG-FSA-10/27.

8.7 WG-FSA-10/33 reported on the discovery using molecular methods of a cryptic macrourid species in the Ross Sea.

8.8 WG-FSA-10/34 provided a description of the distribution and catch rates of by-catch species in the French EEZ at Kerguelen Islands (Division 58.5.1). Updated information on the distribution and size structure of demersal fish populations at South Georgia were reported in WG-FSA-10/38. WG-FSA-10/44 provided biological data on the very limited crab catch taken in the exploratory crab fishery in Subarea 48.2. New information on spawning and oogenesis of three by-catch species from the Pacific and Indian Ocean sectors of the Southern Ocean was given in WG-FSA-10/51.

### Published papers

8.9 WG-FSA-10/P2 examined connectivity between populations of *C. aceratus* in the Atlantic sector of the Southern Ocean using otolith microchemistry. WG-FSA-10/P3 analysed data from two trawl surveys to characterise the demersal fish assemblages in the Ross Sea.

## General discussion

8.10 The large increase in biology, ecology and demography papers covering a wide range of species and topics meant it was not possible to fully review all the information they contained at the meeting. The Working Group discussed whether WG-FSA represented the best forum in which to discuss the merits of papers containing information on species of less immediate relevance to the work of WG-FSA. It was agreed that the majority of expertise to assess the content of these papers lay within WG-FSA and this remains the best place to address these papers.

8.11 It was noted that WG-EMM plans to convene a session on trophic interactions in relation to krill at its meeting in 2011, and that papers on dietary ecology of relevant fish species could also be tabled for discussion at that meeting.

8.12 Several papers only provided descriptive geographic references of the location of research and fishing activities. The Working Group urged Members to ensure that future contributions included a reference to CCAMLR statistical area, subarea, division nomenclature. Where descriptive geographic names are used, they should be consistent with the SCAR Composite Gazetteer of Antarctica (<http://data.aad.gov.au/aadc/gaz/scar/>).

8.13 It was recognised that data collected in the CCAMLR fisheries process generate a considerable body of new information on the biology and ecology of target, by-catch and related species, and this should be further encouraged.

8.14 Ad hoc TASO requested advice on whether it was useful for observers to continue collecting macroscopic gonad staging information. The Working Group agreed that these data provide only qualitative information and, where possible, it would be more appropriate to collect gonad weight information using accurate marine scales and record macroscopic stage using a reduced three-point scale. If accurate scales are not available, macroscopic staging, using a multipoint scale, should be continued.

## Species profiles

8.15 The development of species profiles for by-catch species (particularly grenadiers and rajids) and potential resource species (*Pleuragramma*, grenadiers, myctophids) could provide a focus for the submission of biology and ecology papers and identify areas in which further research effort could be targeted. It was agreed that the compilation of species profiles is a major task and should not be left to individuals. The Secretariat was requested to develop outlines for such species profiles and Members were encouraged to submit to WG-FSA contributions to those profiles.

8.16 It is anticipated that the updated species profile for *D. mawsoni* (WG-FSA-10/24) will be available publicly following the upgrade of the CCAMLR website, however, copyright issues could preclude the addition of the species profile for *D. eleginoides* (WG-FSA-10/P5) to the public website in its current published format.

8.17 The role and target audience of the species profiles were discussed and it was noted that they should provide a broad overview and introduction to the biology and ecology of the



species. In conjunction with the development of a web-based, publicly accessible, archive of abstracts of SC-CAMLR working group papers, they should provide a comprehensive resource to highlight the current state of knowledge of the target species.

#### CCAMLR Otolith Network (CON)

8.18 Detailed otolith preparation manuals for the CQFE, USA (WG-FSA-10/15) and NIWA, New Zealand (WG-FSA-10/21) were provided.

8.19 The Working Group welcomed the provision of detailed and comprehensive otolith reading manuals (see paragraph 8.18) from two laboratories that are routinely involved in age determination of *Dissostichus* spp. otoliths. It was noted that there are major differences in otolith preparation and reading methods between laboratories which may restrict the ability to carry out easy inter-laboratory comparisons, although access to paired otoliths could enable comparisons between methods.

8.20 The requirement to validate age readings was re-emphasised and the use of calcium binding markers, such as OTC, on tagged specimens was highlighted as a method by which this could be improved.

8.21 The Working Group noted that the request for Members to submit a detailed inventory of otolith holdings (SC-CAMLR-XXVIII, Annex 5, paragraph 9.5) had been unsuccessful, and urged Members, in particular those operating in new and exploratory fisheries, to submit details of their otolith holdings to the Secretariat, including details of the intended processing of those otoliths.

8.22 The need to obtain reliable and validated age data from Members participating in new and exploratory fisheries was highlighted. The Working Group recalled that it is a requirement of research plans for new and exploratory fisheries to include details of fish ageing to be undertaken.

8.23 It was recognised that Members with no current otolith preparation or reading capacity could develop their own otolith preparation and reading protocols in association with an experienced otolith laboratory. However, it was suggested that for those Members, the use of a single central otolith reading facility to carry out all otolith preparation and age reading would eliminate variability in age data that could arise if many different facilities were used. The Working Group recommended that finances could be made available in the short term, possibly through the General Science Capacity Special Fund, to ensure that sufficient age data were available from new and exploratory fisheries in order to facilitate the development of assessments in these areas.

8.24 It was recommended that the Secretariat assist Members with the selection of appropriate samples for age determination to ensure that the composition of aged fish reflects the composition of the fished stock. It was recommended that Members without otolith reading facilities could store otoliths collected from new and exploratory fisheries at the CCAMLR Secretariat.

## CONSIDERATION OF ECOSYSTEM MANAGEMENT

### Bottom fishing activities and VMEs

9.1 The Working Group agreed that the sections in the template for the ‘Report on Bottom Fisheries and Vulnerable Marine Ecosystems’ formed the plan for consolidating its work this year. The Subgroup on VMEs had progressed the template for the report (Annex 6, paragraph 3.1). The Working Group agreed with WG-EMM (Annex 6, paragraph 3.58) that a document on the status of knowledge on the ecology of VMEs in the CAMLR Convention Area should be developed separately to the bottom fisheries report.

### Glossary

9.2 In 2009, the Scientific Committee identified the need for a glossary of terms relevant to the consideration and management of VMEs in the CCAMLR area (SC-CAMLR-XXVIII, paragraph 4.251(iii)).

9.3 WG-FSA-10/28 proposed a VME glossary and a diagram illustrating the conceptual relationships between the various terms, consistent with terms agreed by WG-EMM in 2010 (Annex 6, paragraphs 3.2 and 3.3) and with previously agreed CCAMLR text, to facilitate clarity and ensure consistency in subsequent CCAMLR discourse regarding VMEs. In particular, to facilitate clarity regarding the quantitative assessment of impacts on VMEs, the paper disaggregated the agreed ‘vulnerability’ term to consider the physical susceptibility of a VME taxon to damage (‘fragility’) separate from other spatio-temporal and ecological factors affecting recovery (‘resilience’). The paper also proposed a definition of ‘risk’ following the advice of WG-EMM (Annex 6, paragraph 3.5).

9.4 The Working Group recommended the following VME-related terms for the glossary. These include slight modifications to the terms already agreed by WG-EMM, for purposes of clarity and to avoid redundancy with the new agreed terms. The proposed changes do not alter the intent or conceptual meaning of the terms agreed by WG-EMM.

**Fragility** – The susceptibility of a taxon or habitat to impact (physical damage or mortality) arising from a particular interaction with a particular type of threat, e.g. bottom trawls or longlines. Fragility refers to an intrinsic physical property of the organism and the nature of the threat, without reference to the actual presence or intensity of the threat.

Example: Tall, brittle organisms would be more fragile as a result of shearing forces exerted by lateral longline movement than low profile or flexible organisms.

**Resilience** – The ability of a species or habitat to recover from impact over time, incorporating longevity, productivity/growth rate, dispersal and colonisation, rarity, patch size and spatial distribution, and ecological succession.

**Vulnerability** – The susceptibility of a taxon or habitat to impact by a particular type of threat over time, without reference to the actual presence or intensity of the threat. Vulnerability incorporates fragility and resilience.

Example: A species with high fragility but, as a population, also high resilience (i.e. rapid growth, reliable and abundant recruitment) would have lower vulnerability than a species with comparable fragility and slower growth, or with comparable fragility and infrequent or lagged recruitment.

**Threat** – An anthropogenic activity (e.g. bottom fishing) that may exert an impact on vulnerable organisms or habitats. The level of threat reflects factors extrinsic to the organism or habitat (e.g. intensity of fishing effort).

**Instantaneous impact** – Change in status to a particular taxon, habitat or other component of an ecosystem, arising from a threat over a period within which recovery is unlikely to occur. Conceptually, instantaneous impact is the product of fragility and threat.

**Cumulative impact** – The accumulated impact over time, including recovery.

**Fishing footprint** – The area of the seafloor within which fishing gear interacts with benthic organisms. Fishing footprint may be expressed per unit of fishing effort for a particular gear configuration (e.g. for longlines, km<sup>2</sup> seabed contacted per km of longline deployed), or as a cumulative footprint when calculated and summed for all fishing gear deployments in a defined period and area. This areal measure does not incorporate the level of impact within the footprint.

**Ecological consequence** – The magnitude of ecological effects likely to arise from a particular level of cumulative impact. For example, impacts to VMEs may affect benthic-pelagic coupling, the availability of three-dimensional structural habitat for associated species, reproductive output of benthic organisms, succession in the benthic assemblage or the viability of the affected population. Ecological consequence is a function of the level of cumulative impact and the ecological attributes of the benthic ecosystem.

**Risk** – The probability that an activity will have an unacceptable ecological consequence under a particular management strategy and in a specified timeframe, taking account of uncertainty. With specific reference to the management of bottom fishing impacts on VMEs, risk may be calculated as the probability that the ecological consequence associated with an impact will exceed the ‘significant adverse ecological consequence’ (SAEC) threshold as shown in Figure 3, consistent with the limits of acceptable impact expressed in the CAMLR Convention, Article II. Risk may be expressed with reference to activities to date, or in association with a future management strategy.

9.5 The Working Group agreed that the diagram in Figure 3 provides a useful illustration of the conceptual relationships between the terms, and recommended that the diagram should accompany the VME glossary.

9.6 The graph in the diagram illustrating the relationship between cumulative impact and ecological consequence is as recommended by WG-EMM (Annex 6, paragraphs 3.3 to 3.6 and Figure 5) and provides the conceptual link to the agreed definition of risk.

9.7 The Working Group considered a definition of ‘Vulnerable Marine Ecosystem’. It was agreed that it was important in the definition of VME to distinguish between a biological entity and a term used in the designation or management of those entities.

9.8 WG-FSA-10/28 proposed that the term VME refers to a biological entity, and that an alternate term, for example, ‘registered VME’ be used to denote particular areas that have been identified and, for example, added to the Registry of Vulnerable Areas (WG-EMM-10/7).

9.9 Some members felt that the definition of VME included in WG-FSA-10/28 was appropriate and broadly consistent with the intent of previous discussions within CCAMLR, and should be proposed as follows:

VME – A location on the seafloor where the benthic invertebrate community is of particular ecological importance, and vulnerable to impact by a threat (e.g. bottom fishing). Criteria contributing to ecological importance may include the provision of emergent biogenic habitats and/or anomalously high abundance, ecological significance, diversity, or rarity when assessed at an appropriate scale (see Annex 6, paragraphs 3.42 to 3.49). Criteria contributing to vulnerability include high fragility and/or low resilience, as defined above. A VME is a biological entity; it exists independent of whether or not it has been directly observed, and independent of the distribution of threats or fishery management boundaries.

9.10 Other members considered that the definition of a VME could naturally be constructed from the terms ‘vulnerability’ and ‘threat’ in the glossary (paragraph 9.4). They noted that WG-EMM had characterised a VME in this way, such that a VME could be identified by (i) anomalously high densities of VME taxa, (ii) rare or unique benthic communities, (iii) high diversity of VME taxa, (iv) benthic communities likely to be of particular importance for ecosystem function or species’ life cycles, or (v) benthic communities with other characteristics likely to be vulnerable to bottom fisheries activities (Annex 6, paragraph 3.48). In particular, they noted that the ecological connectivity of patches will be an important determinant as to whether a benthic ecosystem may be vulnerable to bottom fishing activities. Thus, a definition could be:

VME – The spatial mosaic of ecologically connected benthic areas, including benthic and related fauna, in which taxa or habitats are vulnerable to a threat.

9.11 Those Members also noted that the use of the term ‘registered VME’ for small areas where evidence of a VME was found may be confusing because the VMEs where such evidence is found were likely to be larger than the current designations.

#### Historical bottom fishing effort

9.12 Maps summarising historical fishing effort convey different information than the actual footprint of fishing gear interactions with the seafloor. ‘Fishing footprint’ (paragraph 9.4) refers to the actual area over which bottom fishing gear makes contact with the ocean floor (e.g. reflecting lateral movement for longlines or door-to-door swept area for trawls), the determination of which is not scale-dependent. In contrast, maps depicting

fishing effort distributions (as in Appendix E, Figures 7 and 8) are inherently scale-dependent and should not be used in isolation to calculate or infer areal estimates of footprint. The Working Group suggested that such maps be referred to as ‘fishing effort distributions’.

#### VME impact assessment methods

9.13 WG-FSA-10/31 provided an update of the impact assessment framework described in WG-SAM-10/20 and Sharp et al. (2009) to estimate the cumulative footprint and potential impact on VME taxa of bottom longline fisheries in the CCAMLR area. This method was recommended by WG-SAM (Annex 4, paragraph 4.16) and WG-EMM (Annex 6, paragraph 3.20) as a framework for use by Members notifying their intention to participate in new and exploratory fisheries (paragraphs 9.15 to 9.21), as well as the means by which WG-FSA could generate cumulative impact assessments for all bottom fishing methods at the scale of subareas or divisions (paragraphs 9.22 to 9.26). This method is presented in detail in the Report on Bottom Fisheries and Vulnerable Marine Ecosystems (Appendix E).

9.14 The Working Group reviewed the appropriateness of the input parameters used in the autoline longline method assessment described in WG-SAM-10/20 for use in the cumulative assessment combined across all methods to characterise two different types of bottom contact by autoline longlines, i.e. the ‘standard footprint’ and the ‘lateral movement footprint’ (see WG-EMM-10/33). The Working Group discussed the relationship between lateral movement frequency  $f_l$  and depth and chose instead to apply  $f_l = 0.5$  to all sets independent of depth. Other input parameter functions used in WG-FSA-10/31 were retained for use in the combined assessment (paragraphs 9.22 to 9.26).

#### Review of preliminary impact assessments

9.15 Nine Members submitted notifications to participate in new and exploratory fisheries under CM 21-02 (CCAMLR-XXIX/20) and submitted preliminary benthic impact assessments as required under CM 22-06 (CCAMLR-XXIX/21). An additional notification from France was submitted but withdrawn and not considered further. Review of the benthic impact assessments followed the report card format endorsed by the Scientific Committee (SC-CAMLR-XXVIII, paragraph 4.244 and Annex 5, paragraphs 10.4 to 10.8 and Table 17).

9.16 Preliminary impact assessments submitted in 2010 were much more complete compared to those submitted in 2009, and most provided detailed information and diagrams of gear configuration, proposed effort and anticipated impacts, allowing a more meaningful review and estimation of cumulative proposed fishing footprint (Table 24).

9.17 Because of the variety of responses provided as part of each Member’s assessment, direct comparisons were not appropriate for each item in the pro forma. However, each notification did address each topic requested and the data required were sufficient to generate a composite impact assessment. All submitted assessments concluded that the potential impacts in each area due to the individual notifications of bottom fishing activities were low or negligible. However, all the assessments are currently based on a number of assumptions that require significant additional information, and therefore these assessments should be viewed as preliminary.

9.18 The report card review format is structured around the information requested in CM 22-06, Annex A. Review of the information requested in Annex 22-06/A generated recommendations to edit the pro forma to create a more succinct and streamlined assessment method so that Members only need to provide minimal new and updated information in each notification. The revised pro forma (Appendix D) requests summary data and six categories of information necessary to characterise the potential impacts to VMEs within the fishing footprint. In brief, the information requested consists of:

- (i) an estimate of the total proposed effort in each subarea for notified fishing activities, in the standard units described in the ‘gear configuration’ section;
- (ii) a description of the fishing gear configuration (or a reference to an appropriate description document adopted by CCAMLR), including a definition of standard gear unit (e.g. metre of mainline);
- (iii) a characterisation of the known or expected interaction of the gear with seafloor;
- (iv) an estimate of the footprint index of the gear (WG-SAM-10/20) in standard units of km<sup>2</sup> of seabed area per km of line;
- (v) an estimate of the impact index for the gear type as described in WG-SAM-10/20;
- (vi) a description of any fishing impacts not considered in the descriptions in (ii)–(v) and their frequency (e.g. trials of a new, non-assessed gear type or gear component that may have a different or additional impact on benthic communities).

9.19 Note that most of the information requested in the pro forma can be referenced to adopted documents describing the gear configuration, its behaviour in relation to the seafloor and the generation of footprint and impact indices. The Working Group encouraged Members to provide these documents for review and adoption as part of the development of CCAMLR’s gear library. These documents may then be cited by any Member as the method used in assessing the potential impacts of notified fishing activities on VMEs within each subarea/division. Documents describing the configuration (WG-FSA-08/60), performance (CCAMLR-XXVII/19, Annex I), and an impact assessment framework for autoline longline gear (WG-SAM-10/20) endorsed by WG-SAM (Annex 4, paragraphs 4.12 to 4.19) have been made publicly available for use by Members preparing these preliminary assessments.

9.20 Details of fishing gear configurations, and how each configuration may interact with benthic habitats, are required for all operations but are a particularly high priority for trotlines, trotlines with cachaloteras, Spanish longlines, fish pots and crab pots.

9.21 The Working Group recommended that the revised Annex 22-06/A pro forma be adopted and will provide the information necessary to estimate the spatial footprint and potential impact for the notified fishing activities for the coming season for each notification as tabulated in WG-FSA-09, Table 18 (SC-CAMLR-XXVIII, Annex 5).

## Combined impact assessments

9.22 The Working Group sought to generate combined cumulative fine-scale bottom fishing impact assessments for all bottom fishing methods in all subareas and divisions included under CMs 22-06 and 22-07, following the framework described in WG-SAM-10/20 and Sharp et al. (2009). A full description of the combined impact assessment is included in Appendix E.

9.23 Assumptions and corresponding input parameters within the autoline longline impact assessment have been the subject of considerable discussion within SC-CAMLR working groups (Annex 4, paragraphs 4.12 to 4.19, Annex 6, paragraphs 3.10 to 3.22). However, similar method assessments for other bottom fishing methods – i.e. Spanish longlines, trotlines, pots and bottom trawls – have not been completed. In the absence of detailed method assessments for all bottom fishing methods, the Working Group agreed, for purposes of completing the combined impact assessment, to treat Spanish longlines and trotlines as having impacts identical to the autoline longline method. The validity of this assumption is unknown, but it is thought that the parameter estimates are conservative.

9.24 The Working Group did not consider parameter values to characterise footprint and impact estimates for pots or trawls. Consequently, the combined impact assessment was completed with reference to longlines only. The outputs are displayed as frequency distributions of pixels within each subarea or division experiencing different levels of estimated longline impact, at a scale recommended by WG-EMM (Annex 6, paragraph 3.11) and are included in Appendix E. The corresponding fine-scale impact estimates are presented in map form in SC-CAMLR-XXIX/BG/13. Impact estimate maps in Appendix E are included at a coarser scale. Similarly, fine-scale spatial effort density distributions and corresponding coarse-scale maps are displayed separately for pots and trawls, without corresponding estimates of impact.

9.25 The combined assessment outputs demonstrate that within the fished areas of each subarea or division, fishing effort is distributed unevenly, with most fished pixels experiencing impacts less than 0.4%, and with higher impacts concentrated in a few pixels. Applying the mean impact index estimate, 41 of 10 155 fished pixels in all the subareas included within CM 22-06 are estimated to have experienced greater than 3% longline impact for the most fragile VME taxa. The single-highest fine-scale pixel-specific longline impact estimate is 10.07%.

9.26 The Working Group recommended that Members be requested to complete method assessments for Spanish longlines, trotlines, pots and trawls comparable to the format of WG-SAM-10/20 so that comprehensive combined impact assessments can be completed. Method assessments for the Spanish line and trotline methods will likely require estimates of the same five input parameters used in the autoline assessment above (i.e. characterising both the standard set without lateral movement and also the lateral movement scenario) and potentially of parameters characterising other non-standard scenarios particular to these methods. A method assessment for trawls will likely require parameters characterising distinct footprints for those portions of the seafloor affected by different gear components, e.g. trawl doors, sweeps, ground gear and the trawl net.

## Identification of VMEs using by-catch data

9.27 WG-EMM reviewed methods for identifying vulnerable habitats (Annex 6, paragraphs 3.23 to 3.41).

9.28 WG-FSA-10/30 provided further analysis since WG-EMM-10 of spatial patterns of benthic invertebrate habitats from fishery by-catch in the Ross Sea. Some taxa are relatively common as by-catch (e.g. Porifera, anemones, stylasterid hydrocorals) and the detectability of habitats containing these taxa with autoline longline gear is moderate to high (e.g. 70+%). The detectability of each taxon and any discernible relationship with density should be examined to the fullest extent possible in areas with sufficiently high fishing effort and also for non-autoline gear configurations, and ultimately should be confirmed with independent sampling to link actual densities on the seafloor with amounts of by-catch observed using different fishing methods.

## Risk Areas and VME Registry

9.29 WG-EMM summarised recent encounters with potential VMEs notified according to CM 22-06, as well as Risk Areas arising from the implementation of CM 22-07 (Annex 6, paragraphs 3.42 to 3.49).

9.30 WG-FSA-10/7 described a proposed work plan by the Secretariat for the development of a VME registry to manage, store, process and summarise data notified under CMs 22-06 and 22-07 (SC-CAMLR-XXVIII, paragraph 4.251(xvi)). The registry would include a secure database for holding notification details and related data for generating web-based lists of VMEs notified under CM 22-06 and VME Risk Areas and fine-scale rectangles notified under CM 22-07, and for holding documents outlining CCAMLR's management advice and information related to VMEs and Risk Areas and a selection of maps of VMEs, Risk Areas and associated features. These data are intended to be posted on the public section of the CCAMLR website. The development of the web-based lists, document archive and basic maps are expected to be completed by early 2011. Further work would be required in subsequent years to further develop the maps as well as to maintain the registry and implement transition to future software and system requirements.

9.31 The Working Group endorsed this proposal and work plan.

## Evaluation of management strategies

9.32 WG-FSA-10/29 further developed methods for evaluating the management of benthic impacts from longline fishing using spatially explicit production models, and includes model validation. A spatially explicit production model illustrated a range of scenarios for simulating the effect and management of benthic impacts from longline fishing effort. This paper updated previous work consistent with advice arising from WG-SAM (Annex 4, paragraphs 4.7 to 4.11) and WG-EMM (Annex 6, paragraphs 3.50 to 3.56) to present a set of simulations using a range of simple case studies to approximate biologically plausible scenarios and also extreme case studies to validate the underlying model and code. The results of the simulations in the paper suggest that management action in the form of areal



closures in the Ross Sea are likely to result in an improved outcome relative to scenarios where there was no management action, but that the magnitude of simulated impacts under the biologically plausible modelled scenarios was generally very small. While additional simulations to address a wider range of plausible scenarios may be required, the authors recommended that research be focused, at least in the short term, to provide the observational or experimental data necessary to constrain important model parameters, to reduce uncertainty and provide more plausible scenarios.

9.33 The Working Group agreed that spatially explicit production models could provide a useful tool for the investigation of impacts of fishing effort on benthic organisms, noting that plausible parameterisation will need to account for the relevant attributes of benthic species and assemblages, including life-history characteristics and succession (Annex 6, paragraphs 3.53 and 3.55).

9.34 The Working Group agreed that the model used in WG-FSA-10/29 has demonstrated, with simple case studies, that it operates consistent with expectations under extreme scenarios. It noted that a number of production scenarios could be explored using this model and encouraged Members to develop plausible scenarios for testing in the future.

#### Review of conservation measures

9.35 The Working Group agreed that the requirements for preliminary assessments in CM 22-06 could be improved and recommended that the draft annex be adopted for use next year (see paragraphs above and Appendix D).

#### Report on Bottom Fisheries and Vulnerable Marine Ecosystems

9.36 Following discussion at WG-EMM on the Report on Bottom Fisheries and Vulnerable Marine Ecosystems, the Working Group collated information into a report for review by the Scientific Committee (Appendix E).

#### Advice to the Scientific Committee

9.37 The Working Group noted the progress on the different elements of the work plan of the Scientific Committee on bottom fisheries (SC-CAMLR-XXVIII, paragraph 4.251):

(i) Definition of Risk Areas –

No further progress.

(ii) Review of existing Risk Areas, including the development of a review process –

WG-EMM has summarised data to consider in reviewing Risk Areas (Annex 6, paragraph 3.40).

- (iii) Development of a glossary of terms, including quantitative definitions as appropriate, to improve understanding and communication on these issues (SC-CAMLR-XXVIII, Annex 5, paragraphs 10.36 and 10.40) –

A glossary and accompanying diagram is included in Figure 3 and further discussed in paragraphs 9.2 to 9.11.

- (iv) Further consideration of criteria to assist the Scientific Committee in defining areas as VMEs under CM 22-06 (SC-CAMLR-XXVIII, Annex 10, paragraph 6.14) –

WG-EMM has summarised characteristics that might be considered as evidence of VMEs (Annex 6, paragraph 3.48).

- (v) Evaluation of the proportions of fishable areas that would comprise different benthic habitats and whether the frequency of observations of benthos in by-catch is consistent with the proportional coverage of these different habitats –

Some progress has been made on identifying habitat types using by-catch data (paragraph 9.28).

- (vi) Development of alternate trigger levels for a range of VME taxa, including distinction between ‘heavy’ and ‘light’ taxa, along with options to enable taxon-specific weights to be collected (SC-CAMLR-XXVIII, Annex 5, paragraph 10.44) –

No further progress.

- (vii) Consideration of whether the presence of high densities of rare taxonomic groups or unique community assemblages specific to the Southern Ocean will warrant additional attention, and perhaps an increased level of precaution (SC-CAMLR-XXVIII, Annex 4, paragraph 5.9) –

Some consideration has been given to this issue but no substantive progress has been made on methods of identifying locations of rare or unique assemblages (Appendix E, paragraphs 32 to 38).

- (viii) Further consideration of fishing footprint and its possible impacts on VMEs, taking account of the differences in the interactions of different gears with the bottom (SC-CAMLR-XXVIII, Annex 5, paragraphs 10.20 to 10.22) –

An impact assessment procedure has been used to assess impacts of longline fishing (paragraphs 9.13 and 9.14). Submissions are needed on Spanish longlines, trotlines, trawl and pot methods (paragraphs 9.19 and 9.20).

- (ix) Refinement of methods for creating cumulative fishery-scale footprint maps (SC-CAMLR-XXVIII, Annex 5, paragraphs 10.14 to 10.16), including resolving technical issues for their production, in order to update the calculations annually (SC-CAMLR-XXVIII, Annex 5, paragraphs 10.16 and 10.17) –

Software is now available in the Secretariat (paragraph 9.12).

- (x) Development of plausible scenarios of the types and dynamics of VMEs and the spatial and temporal interactions of the fishery with VMEs (SC-CAMLR-XXVIII, Annex 5, paragraph 10.45) –

Consideration of plausible scenarios by WG-EMM (Annex 6, paragraphs 3.52 to 3.55). The Working Group recommended that a focus topic be held on this issue at WG-FSA in 2012 when experts in benthic ecology could be invited to attend.

- (xi) Evaluation of management strategies within the conservation measures, along with other possible strategies for avoiding significant adverse impacts on VMEs –

Progress has been made on developing simulation tools to evaluate management strategies (see Report on Bottom Fisheries and Vulnerable Marine Ecosystems) (paragraphs 9.32 and 9.33; Annex 4, paragraphs 4.7 to 4.11).

- (xii) Further development of risk assessment frameworks (SC-CAMLR-XXVIII, Annex 4, paragraph 5.11; Annex 6, paragraphs 4.9 and 4.16; Annex 10, paragraphs 4.1 to 4.5) and simulation approaches, such as ‘Patch’ (SC-CAMLR-XXVIII, Annex 4, paragraphs 5.11 to 5.14; Annex 5, paragraphs 10.46 to 10.48; Annex 6, paragraphs 4.10 to 4.15, 4.17 to 4.19; Annex 10, paragraphs 4.6 to 4.10) –

The Report on Bottom Fisheries and Vulnerable Marine Ecosystems presents the impact assessment framework currently being used to assess cumulative impacts, as well as describing the simulation methods that have been developed.

- (xiii) Further assessment of benthic taxa against the seven criteria for assisting in evaluating their vulnerability (SC-CAMLR-XXVIII, Annex 10, paragraphs 3.1 to 3.10 and Table 1) –

No further progress has been made.

- (xiv) Consideration of different methods for identifying locations of VMEs (SC-CAMLR-XXVIII, Annex 10, paragraphs 5.1 to 5.37 and 6.10 to 6.13) –

Methods to use by-catch data for locating habitat types have been developed (paragraph 9.28).

- (xv) Consideration of how the footprint estimates for different gears might be used to assess whether proposed bottom fishing activities would contribute to having significant adverse impacts on VMEs (SC-CAMLR-XXVIII, Annex 5, paragraph 10.13) –

Work is yet to be undertaken to use the impact assessment methods on assessing the impacts of proposed bottom fishing activities in the future. The simulation methods might be used in this regard.

- (xvi) Further development of the Secretariat’s capability to manage, store, process and summarise data resulting from CMs 22-06 and 22-07 is necessary (SC-CAMLR-

XXVIII, Annex 5, paragraph 10.39), including the development of a work plan and budget, prioritising the capability to provide real-time data, and to provide data for use by the Scientific Committee and its working groups –

The Working Group endorsed the proposal of the Secretariat to further develop this capability (paragraphs 9.29 and 9.30).

(xvii) Further develop the procedural framework for managing bottom fisheries –

No further progress has been made on this. The current framework is contained in the Report on Bottom Fisheries and Vulnerable Marine Ecosystems (Appendix E, Figure 9; SC-CAMLR-XXVIII, Annex 5, paragraph 10.37).

## Depredation

9.38 Depredation of toothfish hooked in longline fisheries has been witnessed for marine mammal species, including killer whales and sperm whales (e.g. WG-FSA-10/P6). The Working Group agreed that the regular collection of data indicative of depredation would be useful, and considered whether marine mammal sightings during gear hauling, and/or directly observed behaviours indicative of depredation events, could be routinely included in the C2 data reporting requirements for longline fisheries. Depredation reporting should record which species is observed, and should be a vessel responsibility rather than an observer responsibility. Options for validation of the resulting data, e.g. using fishery observers, should be considered.

## Other interactions with WG-EMM

9.39 WG-FSA-10/15, 10/20, 10/22, 10/P3, 10/P4 and WG-SAM-10/21 have been considered separately under the Biology and Ecology agenda item. There was no further discussion under Item 9.3.

## SCHEME OF INTERNATIONAL SCIENTIFIC OBSERVATION

10.1 In accordance with CCAMLR's Scheme of International Scientific Observation, scientific observers were deployed on all vessels in all finfish fisheries in the Convention Area. Information collected by scientific observers was summarised in WG-FSA-10/5 Rev. 2 and 10/8.

10.2 The Working Group urged technical coordinators to ensure that observers are aware of the need to accurately record all tag details and the full tag number (including any characters and addresses).

10.3 The Report of the Third Meeting of Ad Hoc TASO, held in Hobart, Australia, from 11 to 15 October 2010 (Annex 7), was presented by the Co-conveners. The Working Group welcomed the advances made by TASO towards developing a system of accreditation of observer programs.

10.4 Recognising that data collected by observers is an important source of information used by the Scientific Committee to assess the status of resources in the CCAMLR region, the Working Group:

- (i) thanked the observers and technical coordinators for the sterling work that they continue to undertake, and for the body of data that they have provided over the years;
- (ii) noted that accreditation of observer programs will contribute to improved data quality from observers;
- (iii) noted that information in the *Scientific Observers Manual* to enable observers and crew to distinguish between *D. eleginoides* and *D. mawsoni* has been substantially improved in accordance with a recommendation made in 2009 (SC-CAMLR-XXVIII, Annex 5), and recommended that a list of the SSRUs where both toothfish species have been recorded be provided in the manual so that observers are sufficiently briefed as to which species are likely to be encountered;
- (iv) considered the template for outlining sampling requirements for the Ross Sea (WG-FSA-10/32, Table 3) and recommended investigation into summarising sampling requirements for other areas;
- (v) recommended that the following have the potential to contribute to continued improvement in the quality of observer data collected as part of the CCAMLR Scheme of International Scientific Observation –
  - (a) enhanced ‘within-trip’ error checking and feedback to observers from technical coordinators;
  - (b) providing the option for database entry of data by observers to allow enhanced data entry checking (e.g. logical and range checking);
  - (c) feedback to observers based on review of data performance metrics, including, inter alia, review of species identification, measurement, sex and maturity-stage determination and tagging.

10.5 It appears that a lack of clarity in the instructions for observers in new and exploratory fisheries exists because of contradictory instructions on sampling requirements in the observer logbook and CM 41-01, Annex B. Furthermore, the recommendation for sampling fish at a rate based on the number of hooks, rather than a fixed number per set, that was agreed by the Working Group in 2008 (SC-CAMLR-XXVII, Annex 5, paragraphs 11.4(ii)(c) and (e)) was incorporated into the observer logbook instructions but not into a revision of CM 41-01, Annex B.

10.6 The Working Group requested advice from the Scientific Committee and Commission on a process to clarify the sampling requirements for target and by-catch species as currently specified in conservation measures, the *Scientific Observers Manual* and the observer logbooks. The Working Group noted that the format described in Table 16 provided a possible means to facilitate this process.

10.7 It was recommended that technical coordinators consider training material, such as for maturity staging and species identification, that the Secretariat could distribute, including on the CCAMLR website, for use by coordinators in other areas. This should be limited to good-quality material with a high degree of transferability.

## FUTURE WORK

### Organisation of intersessional activities of subgroups

11.1 The Working Group thanked all subgroups for their contributions and encouraged each one to continue its work in the forthcoming intersessional period, focusing, where possible, on key issues identified below. Membership to the subgroups was open to all participants, and new participants are encouraged to contact the Secretariat for further information on the subgroups (see paragraph 2.5 for a list of subgroups and coordinators).

11.2 The Working Group agreed to establish a new subgroup to facilitate the development of assessments in data-poor fisheries, coordinated by Dr Taki.

11.3 The Subgroup on Biology and Ecology was tasked with the ongoing development and updating species profiles (paragraph 8.15).

11.4 Dr Jones agreed to contact subgroup coordinators two weeks prior to the next meeting of WG-FSA in order to review subgroup work plans for that meeting (including draft agendas) in light of the Working Group's priorities, meeting agenda and submitted papers. Subgroup coordinators were encouraged to submit a prioritised list of data requests and analyses to the Secretariat at that time, in order to facilitate the subgroups' preparatory work during the meeting.

11.5 The Working Group noted that it had covered a large in-depth range of topics during its meeting. It requested that the Scientific Committee review the Working Group's agenda, and advise on options and priorities for work at future meetings. Some aspects of WG-FSA's work (e.g. assessments) are conducted on a two-year cycle, and it may be feasible for the Working Group to consider other aspects of its work, such as by-catch or VME, on a two-year cycle.

11.6 The Working Group noted that holding its meeting concurrently with TASO in 2010 had provided opportunities for the exchange of expertise between these two groups. However, the concurrent meetings had also limited some of WG-FSA's activities during the first week of the meeting due to some WG-FSA participants attending the TASO meeting. This had impacted on the Working Group's workflow during the meeting.

### Intersessional meetings

11.7 During the course of its meeting, the Working Group identified a number of matters which it referred to WG-IMAF and WG-SAM:

WG-IMAF –

- consideration of the findings reported in WG-FSA-10/P1 (paragraph 3.9).

WG-SAM –

- development of the work plan for implementing research proposals for data-poor fisheries (paragraph 5.97);
- data collection and assessment methods for assessing *Macrourus* spp. (paragraph 6.37).

#### Notification of scientific research activities

11.8 Five notifications have been received in accordance with CM 24-01 for scientific research activities in 2010/11 (WG-FSA-10/9):

(i) Scientific research notifications (CM 24-01, paragraph 2) –

Germany: Subareas 48.1, 88.3 (November 2010–February 2011), krill research  
Subareas 48.1–48.3, 48.6 (February–April 2011), multi-disciplinary research.

(ii) Research fishing notifications (CM 24-01, paragraph 3) –

Japan: Divisions 58.4.4a and 58.4.4b (April–June 2011), toothfish  
Republic of Korea: Subarea 88.3 (March–May 2011), toothfish  
Russia: Subareas 88.2 and 88.3 (January–March 2011), toothfish.

11.9 The notifications involving research fishing were considered under Item 5.

11.10 The Working Group also noted that the UK and Australia will be conducting research surveys in 2011 in Subarea 48.3 and Division 58.5.2 respectively. Notifications for these surveys would be submitted in due course.

#### General matters

11.11 The Working Group identified the following general items of future work:

(i) Assessments –

- assessment of *Dissostichus* spp. in Subarea 48.4 (paragraphs 3.22, 4.5 and 4.6)
- assessment of *C. gunnari* in Subarea 48.3 (paragraphs 4.9 to 4.11)
- assessment of *C. gunnari* in Division 58.5.2 (paragraph 4.13)
- assessment of *D. eleginoides* in Division 58.5.1 (paragraphs 4.16, 4.17 and 5.142)
- assessment of *D. eleginoides* in Division 58.5.2 (paragraph 5.147)
- characterisation of the fishery for *Paralomis* spp. in Subarea 48.3 (paragraph 5.182)

- review of data collected in research hauls from exploratory fisheries in Subareas 48.6 and 58.4 (paragraphs 5.27 and 5.28)
  - assessment of *Dissostichus* spp. in Division 58.4.3b (paragraph 5.71)
  - validation of age readings (paragraph 8.20)
  - submission of detailed inventory of otolith data holdings (paragraph 8.21)
  - collection of validated age data (paragraph 8.22)
  - selection of appropriate samples for age determination (paragraph 8.24)
  - review of tag-specific parameters used in assessments (paragraph 3.32)
  - summary of data collection requirements in exploratory fisheries (paragraph 5.34)
  - research fishing in Division 58.4.4 (paragraph 5.118).
- (ii) IUU fishing –
- development of IUU catch estimates (paragraphs 3.11, 3.14 and 7.4).
- (iii) By-catch –
- future work program for skates (paragraphs 6.26 and 6.28)
  - analysis of data on macrourids in exploratory fisheries (paragraphs 6.35 and 6.36)
  - by-catch data inconsistencies (paragraph 6.12).
- (iv) VMEs –
- development of method assessments for fishing gear (paragraph 9.26)
  - development of the VME registry (paragraphs 9.30 and 9.31)
  - development of plausible scenarios for testing spatially explicit production models (paragraph 9.33).
- (v) Scientific observers –
- recording of tag details and numbers (paragraph 10.2)
  - training material for scientific observers (paragraph 10.7)
  - continued improvements in the quality of observer data (paragraph 10.4(v)).
- (vi) Other –
- development of species profiles (paragraph 8.15)
  - include a reference to CCAMLR statistical areas in geographic references provided in working group papers (paragraph 8.12)
  - translation of information about tagging programs (paragraph 3.31)
  - progressing scientific issues identified by the PRP (paragraphs 5.187 to 5.194)
  - consider a revision of statistical boundaries in the Ross Sea (paragraph 3.17).

11.12 Updates made to the Fishery Reports during the meeting had not been identified in track-change at the time of adoption, and the Working Group requested that the Secretariat highlight the substantive updates in the version of the reports which would be circulated during CCAMLR-XXIX. If inconsistencies were subsequently found between the information in the fishery reports and that reported in the report of the meeting, the Working Group agreed that the information in the report of the meeting would have primacy, and the relevant Fishery Report would be amended accordingly.



11.13 The Working Group agreed that, at future meetings, the version of the Fishery Reports prepared for adoption should retain the track-changes in order to facilitate the review and adoption procedure.

## OTHER BUSINESS

### Independent review of the Secretariat's Data Management Systems

12.1 The Secretariat outlined a proposal for an independent review of its data management systems (CCAMLR-XXIX/13). The goal of the proposed review is to provide assurance that CCAMLR's information assets are appropriately managed and protected, and that identified risks, including those which may arise from the Commission's growing needs, are managed and mitigated using an appropriate international standard as the benchmark. The Working Group also noted that the proposed review is part of the Secretariat's broad consideration of an information security policy.

12.2 The Working Group agreed that the current delivery of the Secretariat's data services is efficient and provides information essential to the work of WG-FSA. The proposed review was expected to assist in the further development of these services, including the implementation of data-quality metrics for fishery and observer data (Annex 4, paragraph 6.2). The proposed review was supported.

### *CCAMLR Science*

12.3 The Secretariat provided an update on the online availability of Volume 17 of *CCAMLR Science* and outlined the potential developments of the journal as it moves to an increasing emphasis on electronic publication (SC-CAMLR-XXIX/8). The Working Group agreed that while it was important for the journal to develop, it was also important that any changes did not undermine the specific role of *CCAMLR Science* in showing the breadth and quality of science that CCAMLR considered in providing its management advice.

### Rational use

12.4 The Working Group had insufficient time to consider SC-CAMLR-XXIX/BG/9 'Considering rational use in the context of designing CCAMLR's Representative System of Marine Protected Areas'.

## ADVICE TO THE SCIENTIFIC COMMITTEE

13.1 The Working Group's advice arising from the meeting is summarised below, and consideration of the surrounding issues is provided in Sections 2 to 12:

- (i) Development of assessments –
- short-term financial support for otolith preparation and age reading (paragraph 8.23)
  - selection of appropriate samples for age determination (paragraph 8.24)
  - implementation of a reward scheme for reporting tag recaptures (paragraphs 6.29 and 6.30)
  - tag-release program in exploratory fisheries (paragraphs 5.20, 5.21, 5.38, 5.45, 5.68 and 5.87)
  - data collection requirements in exploratory fisheries (paragraphs 5.34 and 5.95)
  - development of a research framework for data-poor fisheries (paragraphs 5.11 and 5.12)
  - research fishing in Division 58.4.4 (paragraph 5.116)
  - research plans notified under CM 24-01 (paragraph 5.126).
- (ii) IUU fishing –
- extent of IUU fishing (paragraphs 3.11, 3.14, 7.4 and 7.5).
- (iii) Fishery management advice –
- *D. eleginoides* in Subarea 48.3 (paragraphs 5.129 and 5.130)
  - *Dissostichus* spp. in Subarea 48.4 (paragraphs 5.135 to 5.137)
  - *D. eleginoides* in Division 58.5.1 (paragraphs 5.143 to 5.145)
  - *D. eleginoides* in Division 58.5.2 (paragraph 5.148)
  - *D. eleginoides* in Subarea 58.6, Crozet Islands (paragraphs 5.152 to 5.154)
  - *D. eleginoides* in Subareas 58.6 and 58.7, Prince Edward and Marion Islands (paragraphs 5.159 and 5.160)
  - *C. gunnari* in Subarea 48.3 (paragraph 5.166)
  - *C. gunnari* in Division 58.5.2 (paragraphs 5.172 and 5.173)
  - finfish in Subareas 48.1 and 48.2 (paragraph 5.177)
  - *Paralomis* spp. in Subarea 48.3 (paragraph 5.183)
  - *Paralomis* spp. in Subarea 48.2 (paragraph 5.185)
  - *Dissostichus* spp. in Subarea 48.6 (paragraphs 5.40 and 5.41)
  - *Dissostichus* spp. in Division 58.4.1 (paragraphs 5.47 to 5.49)
  - *Dissostichus* spp. in Division 58.4.2 (paragraphs 5.55 to 5.57)
  - *Dissostichus* spp. in Division 58.4.3a (paragraphs 5.62 and 5.63)
  - *Dissostichus* spp. in Division 58.4.3b (paragraphs 5.78 to 5.81)
  - *Dissostichus* spp. in Subareas 88.1 and 88.2 (paragraphs 5.95 and 5.96).
- (iv) By-catch –
- reporting of ‘discards’ south of 60°S (paragraphs 6.10 and 6.11)
  - outcomes from the Year-of-the-Skate (paragraphs 3.30, 3.31, 6.21 and 6.26 to 6.28)
  - focused data collection for macrourids (paragraph 6.35).

(v) VMEs –

- glossary of VME-related terms (paragraphs 9.4 and 9.5 and Figure 3)
- revision of Annex A of Conservation Measure 22-06 (paragraphs 9.21 and 9.35)
- fishing method assessments (paragraph 9.26)
- progress on the work plan of the Scientific Committee on bottom fisheries (paragraph 9.37).

(vi) Scientific observers –

- clarification of sampling requirements specified in conservation measures (paragraph 10.6)
- training material for scientific observers (paragraph 10.7)
- continued improvements in the quality of observer data (paragraph 10.4(v))
- collection of fish gonad staging information (paragraph 8.14).

(vii) Other –

- progressing scientific issues identified by the PRP (paragraphs 5.190 to 5.193)
- availability of species profiles (paragraph 8.17)
- proposed review of the Secretariat's data management systems (paragraph 12.2).

## ADOPTION OF THE REPORT

14.1 The report of the meeting was adopted.

## CLOSE OF MEETING

15.1 Dr Jones thanked the subgroup coordinators, rapporteurs, all participants and the Secretariat staff for their contributions and involvement in the work of WG-FSA, including the intersessional activities. The contributions were numerous and detailed, and had led to another productive meeting.

15.2 Dr Constable, on behalf of the Working Group, thanked Dr Jones for convening the Working Group. The Working Group had embraced a large body of work, and Dr Jones' thorough preparation and expertise had facilitated the meeting's achievements.

15.3 The meeting was closed.

## REFERENCES

Arana, P.M. and R. Vega. 1999. Exploratory fishing for *Dissostichus* spp. in the Antarctic region (Subareas 48.1, 48.2 and 88.3). *CCAMLR Science*, 6: 1–17.

- de la Mare, W.K., R. Williams and A.J. Constable. 1998. An assessment of the mackerel icefish (*Chamsocephalus gunnari*) off Heard Island. *CCAMLR Science*, 5: 79–101.
- Sharp, B.R., S.J. Parker and N. Smith. 2009. An impact assessment framework for bottom fishing methods in the CAMLR Convention Area. *CCAMLR Science*, 16: 195–210.

Table 1: Total reported catches (tonnes) of target species in fisheries in the Convention Area in 2009/10. **Bold:** fishery closed; CM: conservation measure. (Source: catch and effort reports to 24 September 2010 unless otherwise indicated.)

Target species	Region	Fishery	Fishing period		CM	Catch (tonnes) of target species		Reported catch (%limit)
			Start	End		Limit	Reported	
<i>Champscephalus gunnari</i>	48.3	Trawl	01-Dec-09	30-Nov-10	42-01	1 548	12	1
	58.5.2	Trawl	01-Dec-09	30-Nov-10	42-02	1 658	365	22
<i>Dissostichus eleginoides</i>	48.3	Longline, pot	01-Dec-09	30-Nov-10 <sup>a</sup>	41-02	3 000	2 522	84
	48.4 north	<b>Longline</b>	01-Dec-09	14-Apr-10	41-03	41	40	98
	58.5.1 French EEZ <sup>b</sup>	Longline	ns	ns	ns	ns	2 977	-
	58.5.2	Longline, trawl	01-Dec-09	30-Nov-10	41-08	2 550	1 873	73
	58.6 French EEZ <sup>b</sup>	Longline	ns	ns	ns	ns	512	-
	58 South African EEZ	Longline	ns	ns	ns	ns	21	-
<i>Dissostichus spp.</i>	48.4 south	<b>Longline</b>	01-Dec-09	04-May-10	41-03	75	74	99
	48.6	Longline	01-Dec-09	30-Nov-10	41-04	400	295	74
	58.4.1	<b>Longline</b>	01-Dec-09	20-Feb-10	41-11	210	196	93
	58.4.2	<b>Longline</b>	01-Dec-09	24-Feb-10	41-05	70	93	133
	58.4.3a	Longline	01-May-10*	31-Aug-10	41-06	86	No fishing	-
	58.4.3b	Longline <sup>c</sup>	01-Dec-09*	31-Mar-10	41-07	72	14	19
	88.1	<b>Longline</b>	01-Dec-09	09-Feb-10	41-09	2 850	2 870	101
	88.2	Longline	01-Dec-09	31-Aug-10	41-10	575	314	55
<i>Euphausia superba</i>	48.1, 48.2, 48.3, 48.4	Trawl	01-Dec-09	30-Nov-10	51-01	620 000	196 390	32
	48.6	Trawl	01-Dec-09	30-Nov-10	51-05	15 000	No fishing	-
	58.4.1	Trawl	01-Dec-09	30-Nov-10	51-02	440 000	No fishing	-
	58.4.2	Trawl	01-Dec-09	30-Nov-10	51-03	452 000	No fishing	-
<i>Paralomis spp.</i>	48.2	Pot	01-Dec-09	30-Nov-10	52-02	250	<1	<1
	48.3	Pot	01-Dec-09	30-Nov-10	52-01	1 600	22	1
	48.4	Pot	01-Dec-09	30-Nov-10	52-03	10	No fishing	-

<sup>a</sup> Longline fishery is closed

<sup>b</sup> Reported in fine-scale data

<sup>c</sup> Research fishing only

ns Not specified by CCAMLR

\* Fishing may occur outside the prescribed season

Table 2: Total extrapolated incidental mortality of seabirds and observed mortality rates (birds/thousand hooks) in longline fisheries in Subareas 48.3, 48.4, 48.6, 58.6, 58.7, 88.1, 88.2, Divisions 58.4.1, 58.4.2, 58.4.3a, 58.4.3b, 58.5.1 and 58.5.2 from 1997 to 2010. - indicates no fishing occurred.

Subarea	Year													
	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
<b>Subarea 48.3</b>														
Extrapolated mortality	5 755	640	210 <sup>1</sup>	21	30	27	8	27	13	0	0	0	8	7
Observed mortality rate	0.23	0.032	0.013 <sup>1</sup>	0.002	0.002	0.0015	0.0003	0.0015	0.0011	0	0	0	0.0005	0.0005
<b>Subarea 48.4</b>														
Extrapolated mortality	-	-	-	-	-	-	-	-	0	0	0	0	0	0
Observed mortality rate	-	-	-	-	-	-	-	-	0	0	0	0	0	0
<b>Subarea 48.6</b>														
Extrapolated mortality	-	-	-	-	-	-	-	0	0	0	0	-	0	0
Observed mortality rate	-	-	-	-	-	-	-	0	0	0	0	-	0	0
<b>Subareas 58.6, 58.7</b>														
Extrapolated mortality	834	528	156	516	199	0	7	39	76	0	0	0	0	0
Observed mortality rate	0.52	0.194	0.034	0.046	0.018	0	0.003	0.025	0.149	0	0	0	0	0
<b>Subarea 58.6 French EEZ</b>														
Extrapolated mortality <sup>3</sup>	no data	no data	no data	no data	-	1 243 <sup>2</sup>	720 <sup>2</sup>	343 <sup>2</sup>	242	235	314	131	94	
Observed mortality rate <sup>3</sup>					-	0.1672	0.1092	0.0875	0.0490	0.0362	0.065	0.031	0.0119	
Extrapolated mortality													93	102
Observed mortality rate													0.015	0.024
<b>Subareas 88.1, 88.2</b>														
Extrapolated mortality	-	0	0	0	0	0	0	1	0	0	0	0	0	0
Observed mortality rate	-	0	0	0	0	0	0	0.0001	0	0	0	0	0	0
<b>Divisions 58.4.1, 58.4.2, 58.4.3a, 58.4.3b</b>														
Extrapolated mortality	-	-	-	-	-	-	-	0	8	2	0	0	0	0
Observed mortality rate	-	-	-	-	-	-	-	0	<0.001	0.0002	0	0	0	0
<b>Division 58.5.1 French EEZ</b>														
Extrapolated mortality <sup>3</sup>	no data	no data	no data	no data	1 917 <sup>2</sup>	10 814 <sup>2</sup>	13 926 <sup>2</sup>	3 666 <sup>2</sup>	4 387	2 352	1 943	1 224	643	
Observed mortality rate <sup>3</sup>					0.0920	0.9359	0.5180	0.2054	0.1640	0.0920	0.079	0.059	0.0316	
Extrapolated mortality													417	230
Observed mortality rate													0.034	0.015
<b>Division 58.5.2</b>														
Extrapolated mortality	-	-	-	-	-	-	0	0	0	0	0	2	3	5
Observed mortality rate	-	-	-	-	-	-	0	0	0	0	0	0.002	0.001	0.002
Total seabird mortality	6 589	1 168	366	537	2 146	12 084	14 661	4 076	4 726	2 589	2 257	1 357	521 <sup>4</sup>	344

<sup>1</sup> Excluding *Argos Helena* line-weighting experiment cruise.

<sup>2</sup> The number of hooks has not been collected and the values given are from the total number of hooks set.

<sup>3</sup> Data provided by France for fishing season 1 September to 31 August, not CCAMLR season (1 December to 30 November).

<sup>4</sup> This total excludes the extrapolated totals provided by France for 2009.

Table 3: Seabird mortality totals and rates (BPT: birds/trawl) and species composition, recorded by observers in the CAMLR Convention Area trawl fishery during the 2009/10 season. \* – continuous trawl method; PRX – Procellariidae; PRO – *Procellaria aequinoctialis*; DAC – *Daption capense*; KRI – *Euphausia superba*; ANI – *Champtocephalus gunnari*; TOP – *Dissostichus eleginoides*.

Season	Area	Vessel (target species)	Fishing dates	Trawls		BPT	Dead			Total dead	Total alive
				Set	Observed		PRX	PRO	DAC		
2010	48	<i>Saga Sea</i> (KRI)*	23/1–18/5/10	2192	28 <sup>1</sup>	0.04			1	1	0
		<i>An Xing Hai</i> (KRI)	24/1–11/2/10	110	32	0.00				0	0
		<i>Kai Li</i> (KRI)	24/1–11/2/10	76	32	0.00				0	0
		<i>Juvel</i> (KRI)	26/11–31/12/10	45	44	0.00				0	2
		<i>Fukuei Maru</i> (KRI)	14/2–15/4/10	680	414	0.00				0	0
		<i>Juvel</i> (KRI)	11/2–18/3/10	114	95	0.00				0	2
		<i>Juvel</i> (KRI)	13/4–19/5/10	97	67	0.00				0	0
		<i>Juvel</i> (KRI)	13/6–19/7/10	149	109	0.00				0	0
		<i>Dalmor II</i> (KRI)	3/3–14/7/10	1174	743	0.00				0	0
		<i>Thorshøvdi</i> (KRI)*	29/1–24/3/10	74	51	0.04			2	2	2
		<i>Thorshøvdi</i> (KRI)*	25/4–4/5/10	36	4 <sup>1</sup>	0.00				0	0
		<i>Thorshøvdi</i> (KRI)*	17/6–22/7/10	198	14 <sup>1</sup>	0.00				0	0
		<i>Maksim Starostin</i> (KRI)*	6/1–26/3/10	238	114	0.00				0	0
				Total		5183	1747	0.002			3
	48.3	<i>Betanzos</i> (ANI)	26/3–8/4/10	14	14	0.07	1	1		2	16
		Total		14	14	0.07	1	1		2	16
	58.5.2	<i>Southern Champion</i> (ANI/TOP)	28/12–19/1/10	164	164	0.00				0	0
		<i>Southern Champion</i> (ANI/TOP)	21/3–10/5/10	229	229	0.004			1	1	3
		Total		393	393	0.003			1	1	3

<sup>1</sup> These low observed haul numbers are a result of continuous trawls, refer to WG-FSA-10/5 Rev. 2.

Table 4: Estimated effort, catch rates and total catches from IUU fishing for *Dissostichus* spp. in the Convention Area in 2009/10. The estimates are derived from information on gillnetters, using the deterministic method and information submitted by Members of sightings by surveillance operations and legal fishing vessels to 30 September 2010, and catch rates of licensed vessels. (Source: WG-FSA-10/6 Rev. 1)

Division	Vessels sighted	No. of vessels sighted	Estimated no. of days fished	Mean catch rate (tonnes per day)	Estimated IUU catch (tonnes)	IUU catch (tonnes) allocation	
						<i>D. eleginoides</i>	<i>D. mawsoni</i>
58.4.1	<i>Corvus, Trosky, Carmela, Chu Lim, Bigaro</i> (30 days)	5	350	2.6	910	10	900
58.4.2	<i>Typhoon-1, Draco-1</i>	2	160	2.7	432	0	432
58.4.3b	<i>Typhoon-1, Draco-1, Bigaro</i> (30 days)	3	190	0.9	171	21	150
58.4.4	<i>Trosky</i>	1	80	1.0	80	80	
58.5.1	<i>Bigaro</i>	1	6	3.7	22	22	0
Total					1615	133	1482



Table 5: Catch history of *Dissostichus* spp. taken by IUU fishing in the Convention Area. IUU fishing was first detected in 1988/89, and estimates are derived from longlining and gillnetting activities. Blank: no estimate; zero: no evidence of IUU fishing. (Source: WG-FSA-10/6 Rev. 1 and SC-CAMLR reports)

Season	Area/subarea/division																All areas	
	48.3	58	58.4.1	58.4.2	58.4.3	58.4.3a	58.4.3b	58.4.4	58.4.4a	58.4.4b	58.5.1	58.5.2	58.6	58.7	88.1	88.2		Unknown
1988/89	144										0		0					144
1989/90	437										0	0	0					437
1990/91	1 775										0	0	0					1 775
1991/92	3 066										0	0	0					3 066
1992/93	4 019										0	0	0					4 019
1993/94	4 780										0	0	0					4 780
1994/95	1 674										0	0	0					1 674
1995/96	0										833	3 000	7 875	4 958	0			16 666
1996/97	0							375			6 094	7 117	11 760	7 327	0			32 673
1997/98	146	625						1 298			7 156	4 150	1 758	598	0			15 731
1998/99	667	875						1 519			1 237	427	1 845	173	0			6 743
1999/00	1 015							1 254			2 600	1 154	1 430	191	0			7 644
2000/01	196							1 247			4 550	2 004	685	120	0			8 802
2001/02	3			295				880			6 300	3 489	720	78	92	0		11 857
2002/03	0			98				110			5 518	1 274	302	120	0	0		7 422
2003/04	0			197	246			0			536	531	380	48	240	0		2 178
2004/05	23			86		98	1 015		220	0	268	265	12	60	28	0	508	2 583
2005/06	0		597	192		0	1 903		0	104	144	74	55	0	0	15	336	3 420
2006/07	0		626	288		0	3 226		0	109	451	0	0	0	0	0		4 700
2007/08	0		136	0		0	360		0	0	720	0	224	0	272	0		1 712
2008/09	0		152	176		0	610		0	0	0	0	0	0	0	0		938
2009/10	0		910	432		0	171		80	0	22	0	0	0	0	0		1 615
All seasons	17 945	1 500	2 421	1 764	246	98	7 285	6 683	300	213	36 429	23 485	27 046	13 673	632	15	844	140 579

Table 6: Estimated IUU catches (tonnes) of *Dissostichus eleginoides* and *D. mawsoni* taken from the Convention Area since IUU fishing was first detected in 1988/89. The allocation of the IUU catches between the two species is based on the catch ratio reported by licensed vessels. (Source: WG-FSA-10/6 Rev. 1 and SC-CAMLR reports)

Season	Estimated IUU catch (tonne)		
	<i>D. eleginoides</i>	<i>D. mawsoni</i>	Both species
1988/89	144	0	144
1989/90	437	0	437
1990/91	1 775	0	1 775
1991/92	3 066	0	3 066
1992/93	4 019	0	4 019
1993/94	4 780	0	4 780
1994/95	1 674	0	1 674
1995/96	16 666	0	16 666
1996/97	32 673	0	32 673
1997/98	15 731	0	15 731
1998/99	6 743	0	6 743
1999/00	7 644	0	7 644
2000/01	8 802	0	8 802
2001/02	11 766	91	11 857
2002/03	7 324	98	7 422
2003/04	1 744	434	2 178
2004/05	1 448	1 135	2 583
2005/06	714	2 706	3 420
2006/07	1 609	3 091	4 700
2007/08	1 303*	409	1 712
2008/09	88	850	938
2009/10	133	1 482	1 615
Total	130 283	10 296	140 579

\* Adjusted to the catch ratio reported in SSRU 881A (see paragraph 3.11).

Table 7: Catch (tonnes) of *Dissostichus* spp. reported from licensed fishing and estimated from IUU fishing in the Convention Area, and reported in the CDS in areas outside the Convention Area in 2008/09 and 2009/10. (Source: data reported to 24 September 2010 and WG-FSA-10/6 Rev. 1)

2008/09 season

Inside	Subarea/division	Reported catch	IUU catch	Total CCAMLR	Catch limit
	48.3	3 382	0	3 382	3 920
	48.4	133	-	133	150
	48.6	282	-	282	400
	58.4.1	222	152	374	210
	58.4.2	66	176	242	70
	58.4.3*	135	610	745	206
	58.4.4*	0	0	0	0
	58.5.1	5 238	0	5 238	0 outside EEZ
	58.5.2	2 464	0	2 464	2 500
	58.6	908	0	908	0 outside EEZs
	58.7	20	0	20	0 outside EEZ
	88.1	2 448	0	2 448	2700
	88.2	484	0	484	567
	88.3	0	-	0	0
	Total inside	15 782	938	16 720	

Outside	Area	CDS catch EEZ	CDS catch high seas	Total outside CCAMLR
	41	4 487	2 521	7 008
	47	88	74	162
	51	18	106	124
	57	0	0	0
	81	503	0	503
	87	4 947	62	5 009
	Total outside	10 043	2 763	12 806

Global total 29 526

\* Divisions 58.4.3a and 58.4.3b, and Divisions 58.4.4a and 58.4.4b were combined.

2009/10 season

Inside	Subarea/division	Reported catch	IUU catch	Total CCAMLR	Catch limit
	48.3	2 522	0	2 522	3 000
	48.4	114	-	114	116
	48.6	295	-	295	400
	58.4.1	196	910	1 106	210
	58.4.2	93	432	525	70
	58.4.3*	14	171	185	158
	58.4.4*	59	80	139	research fishing
	58.5.1	2 977	22	2 999	0 outside EEZ
	58.5.2	1 873	0	1 873	2 550
	58.6	518	0	518	0 outside EEZs
	58.7	15	0	15	0 outside EEZ
	88.1	2 870	0	2 870	2 850
	88.2	314	0	314	575
	88.3	0	-	0	0
	Total inside	11 860	1 615	13 475	

(continued)

Table 7 (continued)

Outside	Area	CDS catch EEZ	CDS catch high seas	Total outside CCAMLR
	41	2 822	2 029	4 851
	47	13	27	40
	51	104	51	155
	57	0	0	0
	81	276	0	276
	87	4 603	27	4 630
	Total outside	7 818	2 134	9 952
Global total				23 427

\* Divisions 58.4.3a and 58.4.3b, and Divisions 58.4.4a and 58.4.4b were combined.

Table 8: Number of vessels notified in exploratory longline fisheries for *Dissostichus* spp. in 2010/11 (a), and corresponding number of participating Members and vessels, and catch limits agreed in conservation measures in force in 2009/10 (b). (Source: CCAMLR-XXIX/20)

Member notifications	Number of vessels notified by subarea/division						
	48.6	58.4.1	58.4.2	58.4.3a	58.4.3b	88.1	88.2
(a) Exploratory longline fisheries for <i>Dissostichus</i> spp. in 2010/11							
Argentina						1	1
Japan	1	1	1	1	1	1	
Republic of Korea	4	5	4			6	6
New Zealand		3	1			4	4
Russia						4	3
South Africa	1	1	1				
Spain		1	1			1	1
UK						2	2
Uruguay						1	1
Number of Members	3	5	5	1	1	8	7
Number of vessels	6	11	8	1	1	20	18
(b) Conservation measures in force in 2009/10							
Number of Members	3	5	5	2	4	7	7
Number of vessels	1*	10	8	3	1*	15	15
Target species catch limit (tonnes)	400	210	70	86	0**	2850	575

\* Maximum number per Member at any one time

\*\* Excluding research fishing

Table 9: Unstandardised CPUE (kg/hook) of *Dissostichus* spp. in exploratory longline fisheries reported between 1996/97 and 2009/10. (Source: fine-scale data from commercial and fishery-based research hauls)

Subarea/ division	SSRU	Season														
		1996/97	1997/98	1998/99	1999/00	2000/01	2001/02	2002/03	2003/04	2004/05	2005/06	2006/07	2007/08	2008/09	2009/10	
48.6	A								0.04	0.07	0.11	0.15			0.05	
	D											0.05			0.61	
	E									0.08		0.13		0.46	0.51	
	G								0.02	0.07	0.16	0.07	0.12	0.23	0.06	
58.4.1	C									0.13	0.18	0.15	0.19	0.22	0.36	
	D												0.09			
	E									0.22	0.10	0.14	0.12	0.13	0.74	
	F											0.07	0.05			
	G									0.20	0.22	0.24	0.12	0.10	0.12	
58.4.2	H												0.15			
	A									0.08	0.08	0.13	0.20	0.20	1.22	
58.4.3a	C							0.10		0.07	0.17		0.42			
	D							0.19	0.06							
	E							0.21	0.11	0.14	0.22	0.15	0.21	0.23	0.14	
58.4.3b	A									0.05	0.05	0.02	0.08	0.08		
58.4.3b	A									0.04	0.08		0.15	0.17	0.22	0.14
	B									0.14	0.23	0.17	0.12			
	C										0.07		0.04	0.12		0.10
	D										0.08	0.18	0.03	0.12	0.18	0.10
	E										0.10	0.08	0.05		0.21	0.17
88.1	A	0.01				0.02		0.16				0.08	0.05			
	B	0.05	0.03			0.17	0.25	0.26	0.11	0.55	0.07	0.33	0.15	0.39	0.02	
	C					0.44	0.87	0.59	0.31	0.53	1.06	0.71	0.36	0.46	0.91	
	E		0.07	0.06		0.03		0.05	0.08	0.28		0.02				
	F		0.00					0.03				0.16				
	G		0.06	0.02		0.13	0.12	0.12	0.12	0.15						
	H		0.17	0.26	0.38	0.41	0.74	0.46	0.22	0.77	0.59	0.37	0.40	0.33	0.31	
	I		0.37	0.23	0.29	0.29	0.43	0.19	0.15	0.43	0.40	0.34	0.43	0.52	0.36	
	J			0.12	0.18	0.04			0.11	0.19	0.21	0.32	0.18	0.25	0.20	
	K		0.32	0.15	0.40		0.45		0.01	0.34	0.51		0.28	0.49	0.79	
	L					0.12			0.10	0.14	0.19		0.17	0.10	0.19	
	M			0.08		0.08					0.00	0.58	0.39	0.31		
	88.2	A									0.14	0.06				
B							0.82		0.11	0.47	0.54					
D									0.06							
E											0.43	0.31	0.19	0.14	0.26	
F								0.35	0.42	0.70	0.33	0.22	0.49	0.20	0.29	
G											0.26	0.02	0.39	0.16	0.23	

Table 10: Number of individuals of *Dissostichus* spp. tagged and released and the tagging rate (fish per tonne of green weight caught) reported by vessels operating in 2009/10 in fisheries for *Dissostichus* spp. which have tagging requirements outlined in the conservation measures. The required tagging rate (required rate) for *Dissostichus* spp. is listed for each subarea and division, and does not include any additional requirements when conducting research fishing in closed SSRUs. The number of *D. eleginoides* tagged is indicated in parentheses. (Source: observer data and catch and effort reports)

Subarea/division (required rate)	Flag State	Vessel name	<i>Dissostichus</i> spp. tagged and released		
			Number of fish	Tagging rate	
48.4 (5)	New Zealand	<i>San Aspiring</i>	310	(162)	5.38
	UK	<i>Argos Froyanes</i>	310	(256)	5.52
	Total		620	(418)	
48.6 (3)	Japan	<i>Shinsei Maru No. 3</i>	295	(0)	3.03
	Republic of Korea	<i>Insung No. 1</i>	310	(310)	3.16
		<i>Insung No. 2</i>	305	(0)	3.06
	Total		910	(310)	
58.4.1 (3)	Japan	<i>Shinsei Maru No. 3</i>	275	(12)	3.11
	Republic of Korea	<i>Insung No. 2</i>	352	(0)	3.26
	Total		627	(12)	
58.4.2 (3)	Republic of Korea	<i>Insung No. 2</i>	291	(0)	3.14
	Total		291	(0)	
58.4.3b (4)	Japan	<i>Shinsei Maru No. 3</i>	60	(8)	4.34
	Total		60	(8)	
88.1 (1)	Argentina	<i>Argenova XXI</i>	33	(0)	1.08
	Republic of Korea	<i>Hong Jin No. 707</i>	368	(0)	1.11
		<i>Insung No. 1</i>	313	(0)	1.10
		<i>Jung Woo No. 2</i>	268	(0)	1.17
		<i>Jung Woo No. 3</i>	185	(0)	1.05
		<i>Antarctic Chieftain</i>	164	(0)	1.01
	New Zealand	<i>Janas</i>	415	(0)	1.02
		<i>San Aotea II</i>	288	(0)	1.12
		<i>San Aspiring</i>	515	(2)	1.06
	Spain	<i>Tronio</i>	308	(0)	1.00
	UK	<i>Argos Froyanes</i>	158	(0)	1.04
		<i>Argos Georgia</i>	61	(0)	1.27
	Total		3076	(0)	
	88.2 (1)	Argentina	<i>Argenova XXI</i>	8	(0)
Republic of Korea		<i>Jung Woo No. 3</i>	6	(0)	1.14
Spain		<i>Tronio</i>	52	(0)	1.23
UK		<i>Argos Froyanes</i>	250	(0)	1.00
		<i>Argos Georgia</i>	9	(0)	1.06
Total			325	(0)	

Table 11: Overlap between the catch-weighted length frequencies of *Dissostichus* spp. reported by vessels in the exploratory fisheries in 2009/10, and the length frequencies of individuals tagged and released (length data aggregated by 10 cm length intervals). High  $\geq 60\%$  overlap, Medium  $\geq 30$  to  $< 60\%$ , Low  $< 30\%$ .

Species	Flag State	Vessel name	Subarea/division					
			48.6	58.4.1	58.4.2	58.4.3b	88.1	88.2
<i>D. mawsoni</i>	Argentina	<i>Argenova XXI</i>					Medium	Medium
	Japan	<i>Shinsei Maru No. 3</i>	High	Medium		Medium		
	Republic of Korea	<i>Hong Jin No. 707</i>					Medium	
		<i>Insung No. 1</i>	<sup>a</sup>				Low	
		<i>Insung No. 2</i>	Medium	Medium	High			
	New Zealand	<i>Jung Woo No. 2</i>					Low	
		<i>Jung Woo No. 3</i>					Medium	Low
		<i>Antarctic Chieftain</i>					Medium	
		<i>Janas</i>					High	
		<i>San Aotea II</i>					High	
		<i>San Aspiring</i>					High	
	Spain	<i>Tronio</i>					High	Medium
	UK	<i>Argos Froyanes</i>					Medium	Medium
			<i>Argos Georgia</i>				Medium <sup>b</sup>	High
<i>D. eleginoides</i>	Argentina	<i>Argenova XXI</i>						
	Japan	<i>Shinsei Maru No. 3</i>		Medium		Medium		
	Republic of Korea	<i>Hong Jin No. 707</i>					b	
		<i>Insung No. 1</i>	Medium					
	New Zealand	<i>San Aotea II</i>					b	
		<i>San Aspiring</i>					Medium <sup>b</sup>	
	Spain	<i>Tronio</i>						b
UK	<i>Argos Froyanes</i>						b	

<sup>a</sup> 2 404 fish caught, 0 fish tagged and released.

<sup>b</sup> Less than 30 fish were caught.

Table 12: Time series (since 2006/07) of overlap between the catch-weighted length frequencies of *Dissostichus* spp. reported by vessels actively fishing in the exploratory fisheries in 2009/10, and the length frequencies of individuals tagged and released (length data aggregated by 10 cm length intervals). The overlap values where less than 30 fish were caught, and for *D. eleginoides* caught in Subareas 88.1 and 88.2, are not included. Shaded cells are those classified as low (<30%).

Species	Flag State	Vessel name	Subarea/ division	Season			
				2007	2008	2009	2010
<i>D. mawsoni</i>	Argentina	<i>Argenova XXI</i>	88.1				52
			88.2				49
	Japan	<i>Shinsei Maru No. 3</i>	48.6	34	31	65	64
			58.4.1				56
			58.4.2			36	
	Republic of Korea	<i>Hong Jin No. 707</i>	58.4.3a				
			58.4.3b	31	49	36	55
			88.1		20	26	47
			88.2			33	
			48.6				
		<i>Insung No. 1</i>	58.4.1	13	15	15	
			58.4.2	24	12		
			88.1			14	20
		<i>Insung No. 2</i>	48.6				41
			58.4.1		29		42
			58.4.2				69
			88.1		3		
		<i>Jung Woo No. 2</i>	48.6	13			
			58.4.2	26			
			88.1	32	24	20	23
	88.2				21	38	
	New Zealand	<i>Antarctic Chieftain</i>	88.1			57	59
			88.2			63	
		<i>Janas</i>	88.1	69	76	40	75
			88.2			73	
			88.1	56	67	77	79
	Spain	<i>San Aotea II</i>	88.1	80	74	82	87
			58.4.1	28	21		
		<i>Tronio</i>	58.4.3b	69			
			88.1		24	20	62
			88.2			17	51
			88.1		43	43	55
	UK	<i>Argos Froyanes</i>	88.2		31	53	51
88.1			57	61		47	
88.2					56	67	
<i>D. eleginoides</i>	Japan	<i>Shinsei Maru No. 3</i>	48.6	33	44	27	
			58.4.1				43
			58.4.2			100	
			58.4.3a	37		45	
	Republic of Korea	<i>Insung No. 1</i>	58.4.3b	36	36	21	30
			48.6				33
			58.4.1	82			
			58.4.1		70		
	Spain	<i>Jung Woo No. 2</i>	48.6	43			
			58.4.2				
			58.4.1	39	64		
	UK	<i>Tronio</i>	58.4.3a	57			
88.1			100				



Table 13: Number of *Dissostichus* spp. tagged and released in exploratory longline fisheries. (Source: scientific observer data submitted to CCAMLR)

Subarea/ division	Season										Total
	2000/01	2001/02	2002/03	2003/04	2004/05	2005/06	2006/07	2007/08	2008/09	2009/10	
48.6				4	62	171	129		941	910	2 217
58.4.1					462	469	1 507	1 134	1 127	627	5 326
58.4.2					342	136	248	673	277	291	1 967
58.4.3a					199	104	9	41	113		466
58.4.3b					231	175	289	417	356	60	1 528
88.1	326	960	1 068	2 250	3 223	2 972	3 608	2 574	2 954	3 076	23 011
88.2		12	94	433	341	444	278	389	606	325	2 922
Total	326	972	1 162	2 687	4 860	4 471	6 068	5 228	6 374	5 289	37 437

Table 14: Number of tagged *Dissostichus* spp. recaptured in exploratory longline fisheries. (Source: scientific observer data submitted to CCAMLR)

Subarea/ division	Season										Total
	2000/01	2001/02	2002/03	2003/04	2004/05	2005/06	2006/07	2007/08	2008/09	2009/10	
48.6						3	2		2	5	12
58.4.1							4	6	8	4	22
58.4.2									1	1	2
58.4.3a						6		2	2		10
58.4.3b					1	6	1	1	1	1	11
88.1	1	4	13	32	59	71	206	216	103	250	955
88.2				18	17	28	33	36	56	44	232
Total	1	4	13	50	77	114	246	261	173	305	1244

Table 15: Total number of longline hauls and research hauls (in brackets) and number of fishing vessels in the exploratory fisheries in Subareas 48.6 and 58.4. The strata were defined in 2008 and refer to levels of fishing efforts reported prior to 2008/09.

Subarea/ division	SSRU	Stratum	Total no. of hauls	2002/03		2003/04		2004/05		2005/06		2006/07		2007/08		2008/09		2009/10	
				Hauls	Vessels	Hauls	Vessels	Hauls	Vessels	Hauls	Vessels	Hauls	Vessels	Hauls	Vessels	Hauls	Vessels	Hauls	Vessels
48.6	A	Fished	89 (23)					51 (11)	1	12 (4)	1	2 (2)	1					24 (6)	1
		Lightly fished	70 (11)					10 (4)	1	11 (2)	1	21 (2)	1					28 (3)	1
		Unfished	19 (1)															19 (1)	1
	D	Fished	44 (20)									10 (10)	1					34(10)	1
	E	Fished	62 (36)					6 (6)	1			15 (14)	2			26 (11)	2	15 (5)	1
		Unfished	23 (15)													16 (10)	2	7 (5)	1
	G	Fished	469 (78)					53 (15)	1	185 (13)	1	86 (21)	2	38 (19)	1	48 (5)	1	59 (5)	1
		Lightly fished	123 (16)					4 (2)	1	55 (1)	1	24 (2)	1	1 (1)	1	5 (5)	1	34 (5)	1
58.4.1	C	Fished	689 (309)					143 (52)	6	117 (60)	3	161 (65)	4	141 (97)	5	67 (20)	2	60(15)	2
		Unfished	296 (161)					61 (42)	3	32 (26)	3	134 (61)	3	22 (22)	4	39 (5)	1	8 (5)	1
	G	Fished	458 (173)					35 (15)	3	66 (38)	3	67 (33)	2	154 (68)	4	64 (5)	1	72(14)	2
		Lightly fished	147 (60)					48 (23)	3	7 (7)	1	10 (7)	1	41 (12)	3	31 (5)	1	10 (6)	2
58.4.2	A	Fished	216 (134)					92 (50)	3	8 (8)	1	57 (26)	2	49 (40)	2	5 (5)	1	5 (5)	1
		Unfished	5 (5)															5 (5)	1
	E	Fished	358 (162)	72 (17)	1	28 (19)	1	27 (20)	2	87 (49)	3	57 (21)	2	45 (20)	1	20 (10)	2	22 (6)	1
		Lightly fished	90 (47)	11 (3)	1			27 (21)	2	11 (9)	2					16 (10)	2	25 (4)	1
58.4.3a	A	Fished	293 (112)					120 (46)	4	103 (30)	1	27 (23)	2	11 (8)	1	32 (5)	1		
		Lightly fished	114 (45)					49 (28)	4	25 (3)	1	13 (9)	2			27 (5)	1		
58.4.3b	A	Fished	164 (33)			1 (1)	1	2 (2)	1			129 (16)	1	6 (6)	1	23 (5)	1	3 (3)	1
		Lightly fished	58 (37)			9 (9)	1	9 (9)	1			16 (2)	1	19 (12)	2	5 (5)	1		
	C	Fished	26 (12)											26 (12)	1				
		Lightly fished	48 (47)					37 (36)	3			2 (2)	1					9 (9)	1
	D	Fished	5 (1)					5 (1)	1										
		Lightly fished	77 (49)					15 (9)	3			1 (1)	1	26 (20)	1	26 (10)	1	9 (9)	1
	E	Fished	54 (34)					2 (1)	1	23 (18)	1	21 (7)	1			5 (5)	1	3 (3)	1
		Lightly fished	34 (16)							4 (3)	1	6 (5)	1			24 (8)	2		
		Unfished	12 (7)													12 (7)	1		
Total			4054 (1654)																

Table 16: Data collection requirements. Shaded requirements are part of the New Zealand National Data Collection Program. ‘Others’, includes the families Moridae, Muraenolepidae.

<b>Data collected</b>	<b>Frequency</b>	<b>Rationale for frequency</b>	<b>Change from current?</b>
<b>Catch and effort data</b>			
C2 catch and effort data	Every set as previously.	Data required at that level of detail for numerous analyses.	No
<b>Ongoing yearly toothfish biological data</b>			
Length, sex, gonad state	<b>TOA and TOP:</b> 4 per 1 000 hooks on the shelf and slope of the Ross Sea, 7 per 1 000 hooks everywhere else each species.	Retain current CV whilst reducing observer burden to allow by-catch sampling.	Yes: rate halved on the shelf and slope, identical elsewhere.
Otoliths	<b>TOA and TOP:</b> 5–10 per set each species	Ensure appropriate sampling for representative ageing.	Yes: reduced to reflect industry practice and science needs.
<b>Ongoing yearly tagging rate / other for stock assessment purposes</b>			
Toothfish tagging	One per tonne, double-tagged	Unchanged to avoid starting a new time series which might not be comparable with data collected to date.	No
Skate tagging	Optional this year but second wave in a future skate year.	Might be required to increase numbers of tags recovered.	Yes: skate tagging stopped for now, restart another year.
Skate and toothfish tag recaptures	Scan every fish for tags.	To maximise returns.	No
Acoustic data (e.g. for macrourids)	Record data within the CCAMLR region (e.g. on ES60 echosounder) if echosounder on board.	Potential future use as biomass index of various species.	Yes: addition
<b>Ongoing yearly bottom fishing activities</b>			
Mid-point latitude and longitude of segment and weight of VME-indicator organism caught	Any segment where 5 kg or more is caught, whenever possible otherwise. A segment is 1 000 hooks or 1 200 m line.	As required under CMs 22-06 and 22-07, unchanged until further data analysis.	No
VME vs TOA	Segment-level toothfish and VME catch	To investigate potential interactions between fish and VME.	No

(continued)

Table 16 (continued)

<b>Data collected</b>	<b>Frequency</b>	<b>Rationale for frequency</b>	<b>Change from current?</b>
<b>Year-specific fish biological data – 2010/11 and 2013/14 skate and ‘other’ species</b>			
Length, sex	<b>Others:</b> 10 fish of combined cod species every set <b>Skates:</b> 10 of combined skate species every set	Do focused data collection aiming at detecting any potential change through time.	Yes: more prescriptive to better study less by-catch species each year.
Gonad state, gonad weight	<b>Others:</b> 10 of combined cod species every set <b>Skates:</b> Only on those skates which will have thorns removed or which are not going to be released.	Comprehensive dataset to allow future age frequency if needed, release as many healthy skates as possible.	Yes: more prescriptive to better study less by-catch species each year.
Otoliths / thorns	<b>Others:</b> 5 otolith pairs of combined cod species every set <b>Skates:</b> 5 thorns of combined skate species every set, choose skates that are least likely to survive. <b>Note:</b> maximum 200 fish per species per vessel.	Comprehensive dataset to allow future age frequency if needed, release as many healthy skates as possible.	Yes: more prescriptive to better study less by-catch species each year.
Isotope and stomach sampling	<b>Others:</b> sample a 50 g fillet sample and freeze of a single fish every set in Subarea 88.1, 3 fish per set in Subarea 88.2, rotate species. <b>Skates:</b> sample a 50 g fillet sample and freeze of a single fish every set in Subarea 88.1, 3 fish per set in Subarea 88.2, rotate species. <b>Note:</b> Maximum 100 fish per species per vessel.	Do focussed data collection aiming at detecting any potential change in diet and trophic level, more data is needed in Subarea 88.2 as no data currently available from there.	Yes: more prescriptive to better study less by-catch species each year.
<b>Year-specific fish biological data – 2011/12 and 2014/15 macrourid species</b>			
Length, sex, gonad state, gonad weight	<b>Macrourid:</b> 10 fish every other set on the shelf and slope of the Ross Sea, 10 fish every set elsewhere.	Do focused data collection aiming at detecting any potential length frequency and reproductive change through time, acknowledging the numbers caught on the shelf and slope.	Yes: more prescriptive to better study less by-catch species each year.
Otoliths	<b>Macrourid:</b> 5 fish every other set on the shelf and slope of the Ross Sea, 5 fish every set elsewhere. <b>Note:</b> maximum 200 fish per species per vessel.	Comprehensive dataset to allow future age frequency if needed, acknowledging the numbers caught on the shelf and slope.	Yes: more prescriptive to better study less by-catch species each year.
Isotope and stomach sampling	<b>Macrourid:</b> sample a 50 g fillet sample and freeze of a single fish every other set on the shelf and slope, every set in the north, and 3 fish per set in Subarea 88.2. <b>Note:</b> Maximum 100 fish per species per vessel.	Do focused data collection aiming at detecting any potential change in diet and trophic level, more data is needed in Subarea 88.2 as no data currently available from there.	Yes: more prescriptive to better study less by-catch species each year.

(continued)

Table 16 (continued)

Data collected	Frequency	Rationale for frequency	Change from current?
<b>Year specific fish biological data – 2012/13 and 2015/16 toothfish and icefish species</b>			
Length, sex, gonad state	<b>TOT:</b> not required <b>Icefish:</b> 10 of combined icefish species every set	Do focused data collection aiming at detecting any potential length-frequency change through time, toothfish already carried out yearly.	Yes: more prescriptive to better study less by-catch species each year.
Gonad weight	<b>TOT:</b> 10 of combined toothfish species every other set in the slope and shelf of the Ross Sea, 10 every set elsewhere <b>Icefish:</b> 10 of combined icefish species every set	Do focused data collection aiming at detecting any potential reproductive change through time, including toothfish species.	Yes: more prescriptive to better study less by-catch species each year.
Otoliths	<b>TOT:</b> not required <b>Icefish:</b> 5 otolith pairs of combined icefish species every set <b>Note:</b> maximum 200 fish per species per vessel.	Comprehensive dataset to allow future age frequency if needed, toothfish already carried out yearly.	Yes: more prescriptive to better study less by-catch species each year.
Isotope and stomach sampling	<b>TOT:</b> sample a 50 g fillet sample, a 50 g liver sample and stomach of a single animal, preferably with full stomach and freeze; one fish every other set on the shelf and slope, one fish per set in the north and 3 fish per set in Subarea 88.2. <b>Icefish:</b> sample a 50 g fillet sample and freeze of a single fish every set in Subarea 88.1, 3 fish per set in Subarea 88.2, rotate species. <b>Note:</b> Maximum 100 fish per species per vessel.	Do focused data collection aiming at detecting any potential change in diet and trophic level, more data is needed in Subarea 88.2 as no data currently available from there.	Yes: more prescriptive to better study less by-catch species each year.

Table 17: Catches of *Champscephalus gunnari* (ANI), *Macrourus* spp. (GRV), *Channichthys rhinoceratus* (LIC), *Lepidonotothen squamifrons* (NOS), Rajidae (SRX), *Dissostichus* spp. (TOT), and all other species from trawl fisheries in 2009/10, and reported in fine-scale (C1) data. Catches are given in tonnes.

Subarea/ division	Target	ANI	GRV	LIC	NOS	SRX	TOT	Other species
48.3	ANI	1	0	0	0	0	0	0
58.5.2	ANI	365	1	51	0	12	22	3
58.5.2	TOT	0	2	5	11	5	621	3

Table 18: Catches for macrourids, rajids and other species taken as by-catch from longline fisheries in 2009/10, and reported in fine-scale (C2) data. Catches are given in tonnes and as a percentage of the catch of *Dissostichus* spp. (TOT) reported in fine-scale data. (Rajids released from longlines are not included in these estimates.) na – not applicable.

Subarea/division	Toothfish catch	Macrourids				Rajids				Other species		
		Catch	% TOT	Catch limit	% Catch limit	Catch	% TOT	Catch limit	% Catch limit	Catch	% TOT	Catch limit
48.3	2518	70	2.8	196	35.5	7	0.3	150	4.5	16	0.6	0
48.4 North <sup>1</sup>	40	4	10.6	12	35.1	1	3.3	na	-	0	0.6	-
48.4 South	74	12	15.7	na	-	1	1.3	na	-	1	1.1	-
48.6	295	7	2.3	64	10.8	0	0.0	100	0.0	0	0.2	140
58.4.1	196	6	3.2	33	18.8	0	0.0	50	0.0	0	0.2	60
58.4.2	93	4	3.8	20	17.7	0	0.0	50	0.0	0	0.2	40
58.4.3a	0	0	0.0	26	0.0	0	na	0	-	0	-	0
58.4.3b	14	2	13.6	80	2.3	0	1.0	50	0.3	0	0.5	20
58.5.1 French EEZ	2977	391	13.1	na	-	322	10.8	na	-	0	0.0	-
58.5.2	1237	100	8.1	360	27.7	11	0.9	120	9.3	6	0.5	50
58.6 French EEZ	512	86	16.9	na	-	52	10.2	na	-	0	0.0	-
58 South African EEZ	21	2	9.7	na	-	0	0.0	na	-	0	0.6	-
88.1	2869	119	4.2	430	27.8	8	0.3	142	5.7	15	0.5	160
88.2	314	49	15.7	90	54.8	0	0.0	50	0.0	15	4.8	100

<sup>1</sup> By-catch limits for Subarea 48.4 North not included.

Table 19: Numbers of rajids retained, discarded and released as reported in fine-scale (C2) data in the 2009/10 season, calculated total numbers of rajids hauled on lines, numbers of rajids tagged and recaptured as reported in scientific observer data submitted to CCAMLR in the 2009/10 season, and calculated tag rates across subareas.

Subarea/division	Retained ( <i>n</i> )	Discarded ( <i>n</i> )	Released ( <i>n</i> )	Total hauled ( <i>n</i> )	Tagged ( <i>n</i> )	Tags recaptured ( <i>n</i> )	Tag rate
48.3	15	902	15 810	16 727	1 480	43	0.09
48.4 North	0	254	3 742	3 996	97	0	0.02
48.4 South	0	183	2 441	2 624	146	3	0.06
48.6	0	0	0	0	0	0	
58 South African EEZ	0	0	5	5	5	1	1.00
58.4.1	0	0	0	0	0	0	
58.4.2	0	0	7	7	7	0	1.00
58.4.3a	-	-	-	0	-	-	-
58.4.3b	0	26**	22	48	11	0	0.23
58.5.1 French EEZ	59 051	10 936	2	69 989	0	0	0.00
58.5.2*	1 345	0	7 456	8 801	819	0	0.09
58.6 French EEZ	5 302	11 556	5 543	22 401	0	0	0.00
88.1	926	66**	6 796	7 788	2 256	30	0.29
88.2	0	0	0	0	0	0	0.09

\* Tags released as part of a national tagging program, not reported in scientific observer data submitted to CCAMLR.

\*\* See paragraphs 6.8 to 6.11.

Table 20: Fate of rajid by-catch caught during scientific observation periods as reported in scientific observer data (L5) reported to CCAMLR for the 2009/10 season, given in (a) numbers and (b) as a percentage of all rajids observed.

(a)

Subarea/division	Lost/dropped at surface	Released with tags	Released in good health	Released in average health	Released in poor health	Discarded dead	Number predated	Retained without tags	Retained with tags <sup>+</sup>	Total caught
48.3	127	1594	4111	1035	529	231	3	52	19	7701
48.4	20	238	944	451	465	68	-	-	-	2186
48.6	-	0	-	-	-	-	-	-	-	0
58.4.1	-	-	-	-	-	1	-	-	-	1
58.4.2	-	7	3	4	-	-	-	-	-	14
58.4.3.a	-	-	-	-	-	-	-	-	-	0
58.4.3.b	3	8	17	7	-	26**	-	-	-	61
58.5.1 French EEZ	-	-	-	-	-	-	-	-	-	0
58.5.2*	-	819	179	230	251	6	-	677	-	2162
58.6 French EEZ	-	-	-	-	-	-	-	-	-	0
58 South African EEZ	13	15	29	4	8	3	-	30	-	102
88.1	104	2208	2946	499	76	143**	-	424	18	6418
88.2	-	-	-	-	-	-	-	-	-	0

(b)

Subarea/division	Lost/dropped at surface	Released with tags	Released in good health	Released in average health	Released in poor health	Discarded dead	Number predated	Retained without tags	Retained with tags <sup>+</sup>
48.3	1.6	20.7	53.4	13.4	6.9	3.0	0.0	0.7	0.2
48.4	0.9	10.9	43.2	20.6	21.3	3.1	-	-	-
48.6	-	0.0	-	-	-	-	-	-	-
58.4.1	-	-	-	-	-	100.0	-	-	-
58.4.2	-	50.0	21.4	28.6	-	-	-	-	-
58.4.3.a	-	-	-	-	-	-	-	-	-
58.4.3.b	4.9	13.1	27.9	11.5	-	42.6	-	-	-
58.5.1 French EEZ	-	-	-	-	-	-	-	-	-
58.5.2*	-	37.9	8.3	10.6	11.6	0.3	-	31.3	-
58.6 French EEZ	-	-	-	-	-	-	-	-	-
58 South African EEZ	12.7	14.7	28.4	3.9	7.8	2.9	-	29.4	-
88.1	1.6	34.4	45.9	7.8	1.2	2.2	-	6.6	0.3
88.2	-	-	-	-	-	-	-	-	-

\* Tagging not reported to CCAMLR in L5 forms.

\*\* See paragraphs 6.8 to 6.11.

<sup>+</sup> Tag recaptures from observation periods only.



Table 21: Individual vessel rajid tagging rates calculated from total numbers of rajids tagged (source: scientific observer data submitted to CCAMLR) and total numbers of rajids caught (source: fine-scale (C2) data) for vessels in new and exploratory fisheries during the 2009/10 season. na – not applicable.

Subarea/division	Nationality	Vessel	Total caught*	Total tagged	Tagging rate	
48.6	JPN	<i>Shinsei Maru No. 3</i>	0	0	na	
	KOR	<i>Insung No. 1</i>	0	0	na	
	KOR	<i>Insung No. 2</i>	0	0	na	
58.4.1	JPN	<i>Shinsei Maru No. 3</i>	0	0	na	
	KOR	<i>Insung No. 2</i>	0	0	na	
58.4.2	KOR	<i>Insung No. 2</i>	7	7	1.00	
58.4.3b	JPN	<i>Shinsei Maru No. 3</i>	48	8	0.17	
88.1	ARG	<i>Argenova XXI</i>	16	5	0.31	
	KOR	<i>Hong Jin No. 707</i>	246	55	0.22	
	KOR	<i>Insung No. 1</i>	477	98	0.21	
	KOR	<i>Jung Woo No. 2</i>	43	13	0.30	
	KOR	<i>Jung Woo No. 3</i>	59	16	0.27	
	NZL	<i>Antarctic Chieftain</i>	1038	292	0.28	
	NZL	<i>Janas</i>	568	269	0.47	
	NZL	<i>San Aotea II</i>	1830	521	0.28	
	NZL	<i>San Aspiring</i>	2290	607	0.27	
	ESP	<i>Tronio</i>	140	44	0.31	
	GBR	<i>Argos Froyanes</i>	6	4	0.67	
	GBR	<i>Argos Georgia</i>	1332	339	0.25	
	88.2	ARG	<i>Argenova XXI</i>	0	0	na
		KOR	<i>Jung Woo No. 3</i>	0	0	na
ESP		<i>Tronio</i>	0	0	na	
GBR		<i>Argos Froyanes</i>	0	0	na	
GBR		<i>Argos Georgia</i>	0	0	na	

\* Total caught includes those fish tagged and released.

Table 22: Instances where the five-day/5 n miles move-on rule in CM 33-03, paragraph 5, was implemented by subarea, vessel and trigger level during 2009/10. GRV – *Macrourus* spp.

Subarea/division	SSRU	Vessel	By-catch weight (GRV) (kg)
88.1	881I	<i>San Aotea II</i>	1095.9
88.1	881I	<i>San Aotea II</i>	1695.4
88.1	881I	<i>San Aotea II</i>	1272.8
88.1	881I	<i>San Aspiring</i>	2460.0
88.1	881I	<i>San Aspiring</i>	1649.2
88.1	881I	<i>San Aspiring</i>	1078.4
88.1	881I	<i>San Aspiring</i>	1589.2
88.2	882E	<i>Argos Froyanes</i>	1174.2
88.2	882E	<i>Argos Froyanes</i>	1193.5
88.2	882E	<i>Argos Froyanes</i>	1499.3
88.2	882E	<i>Argos Froyanes</i>	1365.1
88.2	882G	<i>Tronio</i>	1666.0

Table 23: Conservation Measure 33-03, paragraph 6, triggers by subarea, vessel and action during 2009/10.

Subarea	Vessel	SSRU	Occurrences	First occurrence	Last occurrence	Advice
88.1	<i>Antarctic Chieftain</i>	881I	1	11-Jan-10	11-Jan-10	
88.1	<i>Argos Georgia</i>	881H	1	01-Jan-10	01-Jan-10	
88.1	<i>Argos Georgia</i>	881I	2	11-Jan-10	21-Jan-10	Move-on
88.1	<i>Janas</i>	881I	1	11-Jan-10	11-Jan-10	
88.1	<i>San Aotea II</i>	881I	1	21-Jan-10	21-Jan-10	
88.1	<i>San Aspiring</i>	881I	2	11-Jan-10	21-Jan-10	Move-on
88.2	<i>Argos Froyanes</i>	882E	2	01-Feb-10	11-Feb-10	Move-on
88.2	<i>Tronio</i>	882G	1	01-Mar-10	01-Mar-10	

Table 24: Report card review of Members' preliminary assessments of the effects of bottom fishing on VMEs under CM 22-06. Individual assessments were not ranked relative to each other, but reviewed relative to compliance, completeness and level of detail provided.

<b>Member/gear</b>	<b>Argentina</b>	<b>Japan</b>	<b>Korea, Republic of</b>	<b>New Zealand</b>	<b>Russia</b>	<b>South Africa</b>	<b>Spain</b>	<b>UK</b>	<b>Uruguay</b>	<b>Total</b>
<b>1.1 Scope</b>										
<b>Number of vessels</b>	1	1	7	4	4	1	1	2	1	22
<b>Number of subareas/divisions</b>	2	6	5	4	2	3	4	2	2	30
<b>Notifications (vessel*fishery)</b>	2	6	25	12	7	3	4	4	2	65
<b>Assessment submitted</b>	+	+	+	+	+	+	+	+	+	
<b>1.2 Proposed fishing activity</b>										
1.2.1 Detailed description of gear	L	M	H	H	H	H	H	H	M	
1.2.2 Scale of proposed activity (number of sets)	90	400	840	550	875	NA	125	250	64	
1.2.3 Spatial distribution of activity	+	+	+	+	+	+	+	+	+	
<b>1.3 Mitigation measures to be used</b>	+	+	+	+	+	+	+	+	+	
<b>Effectiveness</b>	+	+	+	+	+	+	+	+	+	
<b>2.1 Assessment of known/ anticipated impacts on VMEs</b>										
2.1.1 Estimated spatial effort footprint <i>Please provide details of % area covered by fishing effort.</i>	+	+	+	+	+	+	+	+	+	
2.1.2 Summary of potential VMEs present within areas of activity	+	+	+	+	+	+	+	+	+	
2.1.3 Probability of impacts	+	+	+	+	+	+	+	+	+	
2.1.4 Magnitude/severity of the interaction of the proposed fishing gear with VMEs	+	+	+	+	+	+	+	+	+	
2.1.5 Physical and biological/ecological consequences of impact	+	+	+	+	+	+	+	+	+	
<b>2.2 Estimated cumulative footprint</b>	+	+	+	+	+	+	+	+	+	
<b>2.3 Research activities related to provision of new information on VMEs</b>										
2.3.1 Previous research	+	+	+	+	+	+	+	+	+	
2.3.2 In-season research	+	+	+	+	+	+	+	+	+	
2.3.3 Follow-on research	+	+	+	+	+	+	+	+	+	
<b>Cumulative assessment quality</b>	<b>H</b>	<b>H</b>	<b>H</b>	<b>H</b>	<b>H</b>	<b>H</b>	<b>H</b>	<b>H</b>	<b>H</b>	

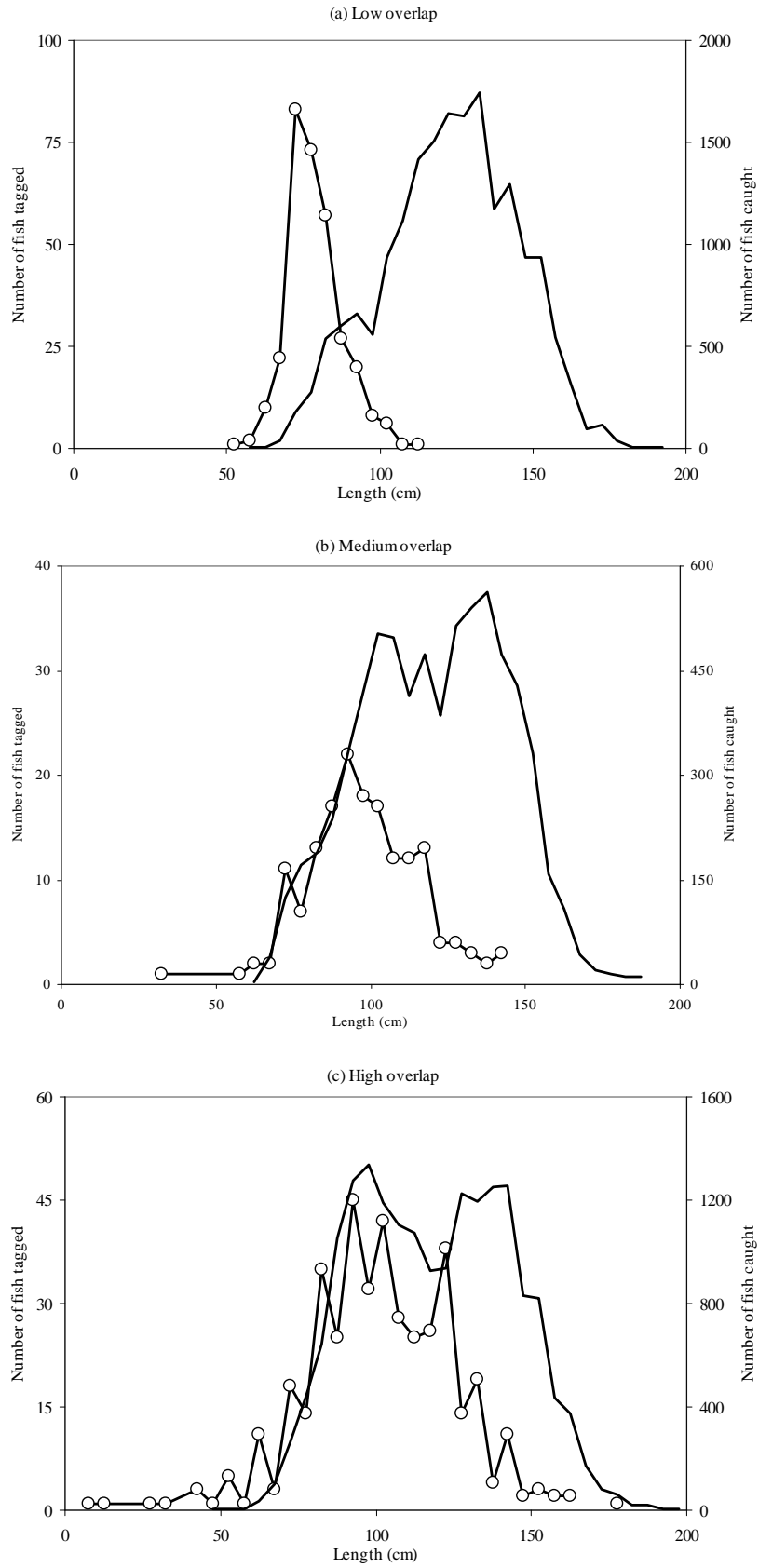


Figure 1: Example plots of the length frequencies of fish caught (solid lines) and tagged (circles) for vessels where the overlap data metric was (a) low (overlap of 20%), (b) medium (59%) and (c) high (75%).

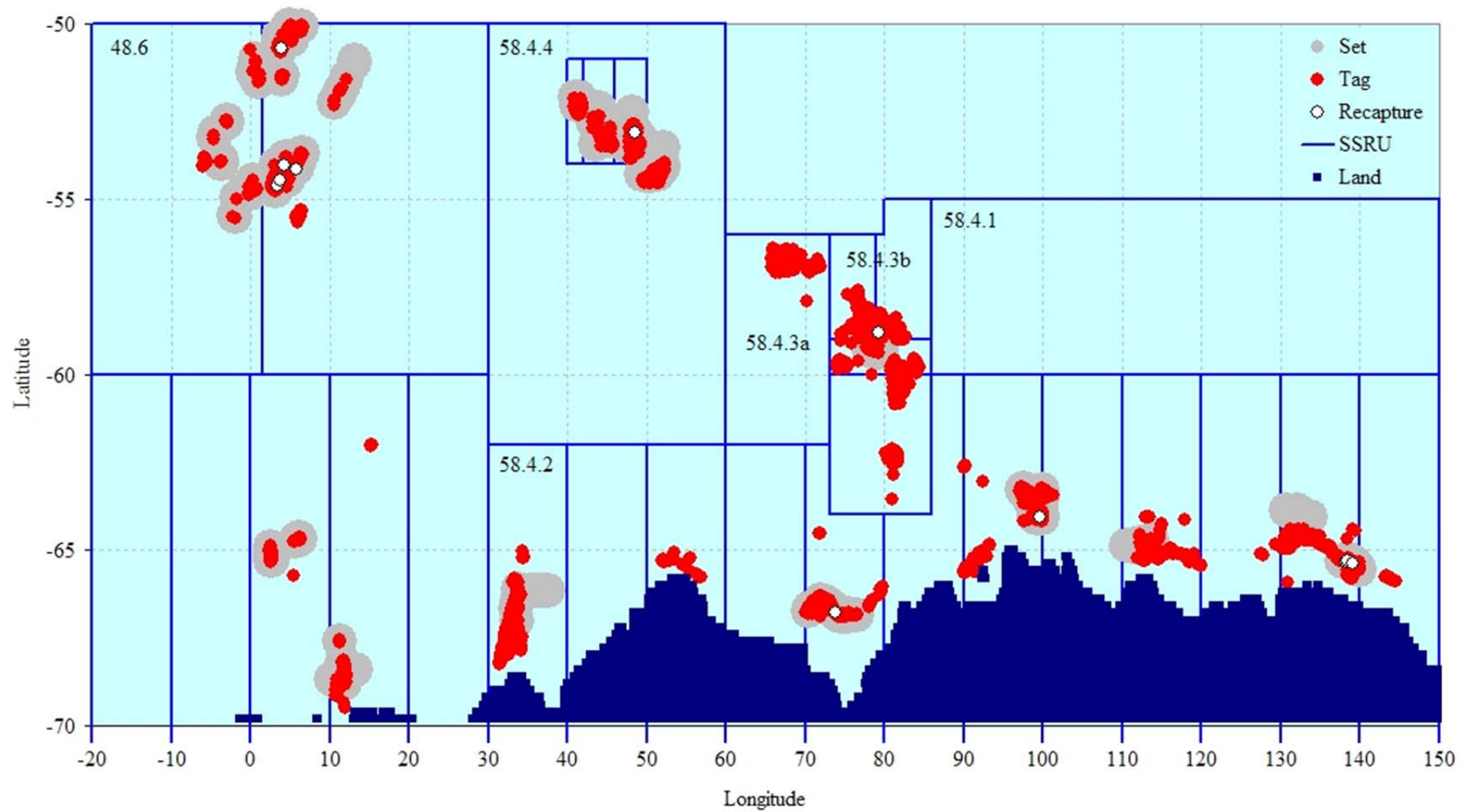


Figure 2: Distribution of fishing effort (including research fishing) and tag-recaptures in 2009/10, and tag-releases (all season) for *Dissostichus* spp. in Subareas 48.6 and 58.4.

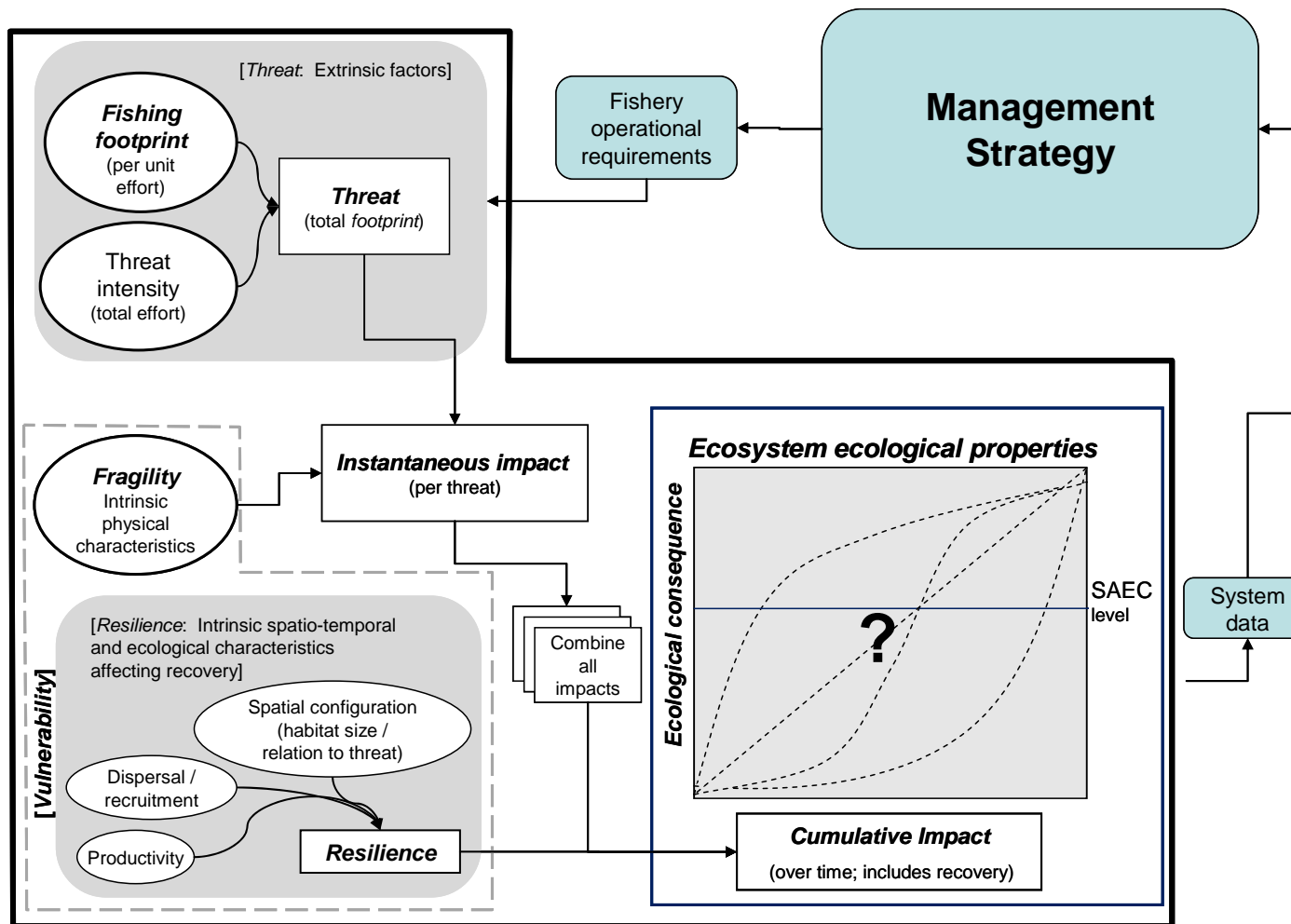


Figure 3: Conceptual diagram of the relationships among the terms used in the VME glossary. The thick black box indicates aspects of ecosystem dynamics and the relationship of the fishery to the ecosystem. Data are derived either from the fishery or as fishery-independent activities. These data are used in the management strategy, which determines the operational requirements of the fishery. A management strategy includes assessment method/s and decision rules or approaches by which the results of the assessment, which can include estimates of risk, can be used to adjust the operations of the fishery as needed.

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**AGENDA**

Working Group on Fish Stock Assessment  
(Hobart, Australia, 11 to 22 October 2010)

1. Opening of the meeting
2. Organisation of the meeting and adoption of the agenda
  - 2.1 Organisation of meeting
  - 2.2 Subgroup organisation and coordination
3. Review of available information
  - 3.1 Data requirements specified in 2009
  - 3.2 Fisheries information
  - 3.3 Inputs for stock assessment
4. Preparation for assessments and assessment timetable
  - 4.1 Report from the Working Group on Statistics, Assessments and Modelling (WG-SAM)
  - 4.2 Review of preliminary stock assessment papers
  - 4.3 Assessments to be carried out and assessment timetable
5. Assessments and management advice
  - 5.1 New and exploratory fisheries
    - 5.1.1 New and exploratory fisheries in 2009/10
    - 5.1.2 New and exploratory fisheries notified for 2010/11
    - 5.1.3 Update Fishery Reports for new and exploratory fisheries
    - 5.1.4 Research plans notified under Conservation Measure 24-01
  - 5.2 Development of methods to assess exploratory fisheries in the future
  - 5.3 Update Fishery Reports for assessed fisheries
  - 5.4 Assessment and management advice for other fisheries
  - 5.5 Progressing scientific issues identified in the Performance Review Panel (PRP) Report
6. Fish and invertebrate by-catch
7. Evaluation of the threats arising from IUU activities
8. Biology, ecology and demography of target and by-catch species

9. Considerations of ecosystem management
  - 9.1 Bottom fishing activities and vulnerable marine ecosystems (VMEs)
  - 9.2 Depredation
  - 9.3 Other interactions with WG-EMM
10. Scheme of International Scientific Observation
  - 10.1 Report from the ad hoc Technical Group for At-Sea Operations (TASO)
  - 10.2 Summary of information extracted from observer reports and/or provided by technical coordinators
  - 10.3 Implementation of the observer program
11. Future work
  - 11.1 Organisation of intersessional activities in subgroups
  - 11.2 Intersessional meetings
  - 11.3 Notification of scientific research
12. Other business
13. Advice to Scientific Committee
14. Adoption of the report
15. Close of the meeting.

**LIST OF DOCUMENTS**

Working Group on Fish Stock Assessment  
(Hobart, Australia, 11 to 22 October 2010)

WG-FSA-10/1	Provisional Agenda and Provisional Annotated Agenda for the 2010 Meeting of the Working Group on Fish Stock Assessment (WG-FSA)
WG-FSA-10/2	List of participants
WG-FSA-10/3	List of documents
WG-FSA-10/4 Rev. 1	CCAMLR fishery information 2010 Secretariat
WG-FSA-10/5 Rev. 2	Summary of Scientific Observations in the CAMLR Convention Area for the 2009/10 season Secretariat
WG-FSA-10/6 Rev. 1	Estimation of IUU catches of toothfish inside the Convention Area during the 2009/10 fishing season Secretariat
WG-FSA-10/7	Development of the VME registry Secretariat
WG-FSA-10/8	A summary of scientific observations related to Conservation Measures 25-02 (2009), 25-03 (2009) and 26-01 (2009) Secretariat
WG-FSA-10/9	Scientific research notifications (Conservation Measure 24-01) Collated by the Secretariat
WG-FSA-10/10	Results of trials undertaken around Crozet Island using pots to target Patagonian toothfish N. Gasco, P. Tixier and C. Guinet (France)
WG-FSA-10/11	Short communication: Diet composition of deepwater icefish <i>Chionobathyscus dewitti</i> Andriashev et Neelov, 1978 ( <i>Chionobathyscus</i> , Channichthyidae) from the Ross Sea area A.F. Petrov (Russia)



- WG-FSA-10/12 Preliminary assessment of mackerel icefish (*Chamsocephalus gunnari*) in the vicinity of Heard Island and McDonald Islands (Division 58.5.2), based on a survey in March–April 2010, including a revised growth model  
D.C. Welsford (Australia)  
(CCAMLR Science, submitted)
- WG-FSA-10/13 Definition of age characteristics of Antarctic toothfish (*Dissostichus mawsoni*) from the Indian Ocean sector of the Antarctic region  
L. Pshenichnov, I. Slypko and K. Vyshniakova (Ukraine)
- WG-FSA-10/14 Brief information on Patagonian toothfish (*Dissostichus eleginoides*) fishery outside the zone of CCAMLR responsibility (Statistical Area 41)  
Delegation of Ukraine
- WG-FSA-10/15 Manual: estimating the age of Patagonian toothfish (*Dissostichus eleginoides*) using transverse cross-sections of otoliths  
K. Underkoffler, N. Ramanna and J. Ashford (USA)
- WG-FSA-10/16 Connectivity and population structure in *Pleuragramma antarcticum* along the west Antarctic Peninsula  
J. Ashford, J. Ferguson, A. Piñones, J. Torres and W. Fraser (USA)
- WG-FSA-10/17 Feasibility of lead-radium dating the otoliths of blackfin icefish (*Chaenocephalus aceratus*) and ocellated icefish (*Chionodraco rastrispinosus*)  
A.H. Andrews, M. La Mesa and J. Ashford (USA)
- WG-FSA-10/18 How much do icefish (Notothenioidei, Channichthyidae) eat in the southern Scotia Arc and the Antarctic Peninsula region?  
K.-H. Kock (Germany), C.D. Jones (USA), J. Gröger and S. Schöling (Germany)
- WG-FSA-10/19 A preliminary assessment of age and growth of eel cod (*Muraenolepis* sp.) and violet cod (*Antimora rostrata*) in the Ross Sea, Antarctica  
P.L. Horn and C.P. Sutton (New Zealand)
- WG-FSA-10/20 A preliminary assessment of age and growth of Antarctic silverfish (*Pleuragramma antarcticum*) in the Ross Sea, Antarctica  
C.P. Sutton and P.L. Horn (New Zealand)  
(CCAMLR Science, submitted)

- WG-FSA-10/21                      Manual for age determination of Antarctic toothfish  
(*Dissostichus mawsoni*)  
C.P. Sutton and P.L. Horn (New Zealand)
- WG-FSA-10/22                      Stomach contents of Antarctic toothfish (*Dissostichus  
mawsoni*) from the Ross Sea region in 2010 and a comparison  
with 2003  
D.W. Stevens, J. Forman and S. Hanchet (New Zealand)
- WG-FSA-10/23                      A characterisation of the toothfish fishery in Subareas 88.1  
and 88.2 from 1997/98 to 2009/10  
S.M. Hanchet, M.L. Stevenson and A. Dunn (New Zealand)
- WG-FSA-10/24                      Updated species profile for Antarctic toothfish (*Dissostichus  
mawsoni*)  
S.M. Hanchet (New Zealand)
- WG-FSA-10/25                      Characterisation of skate catches in the Ross Sea region  
S. Mormede and A. Dunn (New Zealand)
- WG-FSA-10/26                      Stability of trip selections for the assessment of Antarctic  
toothfish in the Ross Sea  
D.A.J. Middleton (New Zealand)
- WG-FSA-10/27                      Revised biological parameters for the Antarctic skates  
*Amblyraja georgiana* and *Bathyraja cf. eatonii* from the  
Ross Sea  
M.P. Francis (New Zealand)
- WG-FSA-10/28                      An updated glossary of terms relevant to the management of  
Vulnerable Marine Ecosystems (VMEs) in the CCAMLR Area  
B.R. Sharp and S.J. Parker (New Zealand)
- WG-FSA-10/29                      Development of methods for evaluating the management of  
benthic impacts from longline fishing using spatially explicit  
production models, including model validation  
A. Dunn, S.J. Parker and S. Mormede (New Zealand)
- WG-FSA-10/30                      Further analysis of spatial patterns of benthic invertebrate  
habitats from fishery bycatch in the Ross Sea region  
S.J. Parker, R.G. Cole and S.M. Hanchet (New Zealand)
- WG-FSA-10/31                      Updated impact assessment framework to estimate the  
cumulative footprint and impact on VME taxa of bottom  
longline fisheries in the CCAMLR Area  
B.R. Sharp (New Zealand)

- WG-FSA-10/32                      Developing a Ross Sea region medium-term data collection plan  
S. Mormede and S. Hanchet (New Zealand)
- WG-FSA-10/33                      DNA barcoding highlights a cryptic species of grenadier (genus *Macrourus*) in the Southern Ocean  
P.J. Smith (New Zealand), D. Steinke (Canada), P.J. McMillan, A.L. Stewart, S.M. McVeagh (New Zealand), J.M. Diaz De Astarloa (Argentina), D. Welsford and R.D Ward (Australia)  
(*J. Fish Biol.*, submitted)
- WG-FSA-10/34                      Non-target species in the Patagonian toothfish fishery inside the French EEZ  
N. Gasco (France)
- WG-FSA-10/35                      Results of the research fishing activities conducted by Chile in Management A of Subarea 48.3 from 2005–2008: the importance of conserving the big older fishes  
C.A. Moreno and P. Rubilar (Chile)
- WG-FSA-10/36                      On necessity of longline fishery and research of Antarctic toothfish in all SSRUs of Subareas and Divisions 88.1, 88.2, 58.4.1, 58.4.2  
K.V. Shust, A.F. Petrov, V.A. Tatarnikov and I.G. Istomin (Russia)
- WG-FSA-10/37                      Estimation of the 2011 catch limit for mackerel icefish (*Champsocephalus gunnari*) in Subarea 48.3 using a length-based population dynamics model  
C.T.T. Edwards, R.E. Mitchell, J. Pearce and D.J. Agnew (UK)
- WG-FSA-10/38                      Results of the groundfish survey carried out in CCAMLR Subarea 48.3 in January 2010  
R.E. Mitchell, M. Belchier, S. Gregory, L. Kenny, J. Nelson, J. Brown and L. Feathersone (UK)
- WG-FSA-10/39                      Population assessment of Patagonian toothfish in the north of Subarea 48.4 – 2010 update  
J. Roberts and D. Agnew (UK)
- WG-FSA-10/40                      Proposal for an extension to the mark-recapture experiment to estimate toothfish population size in the South of Subarea 48.4  
J. Roberts and D. Agnew (UK)

- WG-FSA-10/41 Estimation of natural mortality for the Patagonian toothfish at Heard and McDonald Islands using catch-at-age and aged mark-recapture data from the main trawl ground  
S. Candy, D. Welsford, T. Lamb, J. Verdouw and J. Hutchins (Australia)  
(*CCAMLR Science*, submitted)
- WG-FSA-10/42 Rev. 1 Evaluating the impact of multi-year research catch limits on overfished toothfish populations  
D.C. Welsford (Australia)  
(*CCAMLR Science*, submitted)
- WG-FSA-10/43 Evaluating length-frequency data and length-based performance indicators in new and exploratory fisheries  
P.E. Ziegler, D.C. Welsford and A.J. Constable (Australia)  
(*CCAMLR Science*, submitted)
- WG-FSA-10/44 Brief report on results of experimental harvest regime for the exploratory fishery for crab in the area of the South Orkney Islands (CCAMLR Subarea 48.2) during the 2009/10 season  
Yu.V. Korzun and S.E. Anosov (Ukraine)
- WG-FSA-10/45 Reports on stock status and biological information on toothfish obtained from the scientific research survey by *Shinsei Maru No. 3* in 2009/10 in the SE sector of Division 58.4.3b  
K. Taki, M. Kiyota and T. Ichii (Japan)
- WG-FSA-10/46 Reports on abundance and biological information on toothfish in Divisions 58.4.4 a and 58.4.4b by the *Shinsei Maru No. 3* in the 2009/10 season  
K. Taki, M. Kiyota and T. Ichii (Japan)
- WG-FSA-10/47 Distribution and population structure of *Dissostichus eleginoides* and *D. mawsoni* on BANZARE Bank (CCAMLR Division 58.4.3b), Indian Ocean, Antarctic  
K. Taki, M. Kiyota, T. Ichii and T. Iwami (Japan)  
(*CCAMLR Science*, submitted)
- WG-FSA-10/48 Preliminary studies on age and growth of *Dissostichus eleginoides* in the Ob-Lena Bank  
K. Taki, M. Kiyota and T. Ichii (Japan)
- WG-FSA-10/49 Revised research plan for toothfish in Divisions 58.4.4a and 58.4.4b by the *Shinsei Maru No. 3* in 2010/11  
Delegation of Japan

- WG-FSA-10/50                      Analysis of maturity of Antarctic toothfish in the Amundsen Sea  
S.V. Piyanova and A.F. Petrov (Russia)  
(*CCAMLR Science*, submitted)
- WG-FSA-10/51                      Some aspects of the by-catch fish spawning and oogenesis  
V. Prutko (Ukraine) and D. Chmilevsky (Russia)
- Other Documents
- WG-FSA-10/P1                      At-sea distribution and diet of an endangered top predator: links of white-chinned petrels with commercial longline fisheries  
K. Delord, C. Cotté, C. Péron, C. Marteau, P. Pruvost, N. Gasco, G. Duhamel, Y. Cherel and H. Weimerskirch  
(*Endangered Species Research*, in press)
- WG-FSA-10/P2                      Testing early life connectivity using otolith chemistry and particle-tracking simulations  
J. Ashford, M. La Mesa, B.A. Fach, C. Jones and I. Everson  
(*Can. J. Fish. Aquat. Sci.*, 67 (2010): 1303–1315)
- WG-FSA-10/P3                      Latitudinal variation of demersal fish assemblages in the western Ross Sea  
M.R. Clark, M.R. Dunn, P.J. McMillan, M.H. Pinkerton, A. Stewart and S.M. Hanchet  
(*Ant. Sci.* (2010), doi:10.1017/S0954102010000441)
- WG-FSA-10/P4                      Distribution, abundance and acoustic properties of Antarctic silverfish (*Pleuragramma antarcticum*) in the Ross Sea  
R.L. O’Driscoll, G.J. Macaulay, S. Gauthier, M. Pinkerton and S. Hanchet  
(*Deep-Sea Res. II* (2010), doi:10.1016/j.dsr2.2010.05.018)
- WG-FSA-10/P5                      The Patagonian toothfish: biology, ecology and fishery  
M.A. Collins, P. Brickle, J. Brown and M. Belchier  
(*Advances in Marine Biology*, in press)
- WG-FSA-10/P6                      Estimating the impact of depredation by killer whales and sperm whales on longline fishing for toothfish (*Dissostichus eleginoides*) around South Georgia  
J. Moir Clark and D.J. Agnew  
(*CCAMLR Science*, 17 (2010): 163–178.)

## DRAFT REVISED CONSERVATION MEASURE 22-06, ANNEX A

**PRO FORMA FOR SUBMITTING PRELIMINARY ASSESSMENTS OF  
THE POTENTIAL FOR PROPOSED BOTTOM FISHING ACTIVITIES  
TO HAVE SIGNIFICANT ADVERSE IMPACTS ON  
VULNERABLE MARINE ECOSYSTEMS (VMEs)**

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**Preliminary assessment of bottom fishing activities – Required Information**

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**1. Scope**

- 1.1 Fishing method(s) notified  
*Longline type (e.g. Spanish, auto, trotline, pots etc.)*
- 1.2 Subarea/division where fishing has been notified  
*e.g. Subareas 88.1 and 88.2*
- 1.3 Period of notification  
*Fishing season*
- 1.4 Names of fishing vessels  
*Please provide the name of all vessels notifying to fish*
- 

**2. Proposed fishing activity – please complete separately for each fishing gear method**

- 2.1 Fishing gear details  
*– refer to [CCAMLR fishing gear library](#) for examples noted below.*
- (i) Fishing gear configuration  
*Provide a detailed description of each fishing gear type and its deployment process including diagrams of the different components of the gear and their dimensions – include line type, weight, anchors, size, spacing, material properties (e.g. breaking strain), sink rates in water etc. – so that the fishing footprint can be estimated separately for each gear component. This description can simply cross-reference gear descriptions included in the CCAMLR fishing gear library (see examples or the diagrams available in the CCAMLR observer logbooks).*
- (ii) Expected behaviour of fishing gear  
*Provide a detailed description of the fishing process and the known or expected interaction of the gear with the seafloor, including gear movement (e.g. movement in contact with the seafloor etc.) during the setting, soaking and hauling processes. This description can reference other gear performance descriptions in documents previously adopted and available in the CCAMLR fishing gear library.*
- (iii) Estimated footprint associated with possible unusual fishing events  
*Provide a description of other fishing gear deployment events (e.g. line breakage, gear loss etc.) that can be expected to have a footprint size or impact level associated with fishing activity, with estimates of how frequently such events occur and their associated footprint as in (ii) above. This estimate may reference other gear performance description documents previously adopted and available in the CCAMLR fishing gear library.*
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- (iv) Estimated footprint index (km<sup>2</sup> per unit of fishing effort)  
*Using the description of fishing gear configuration (i) and the expected behaviour of the fishing gear (ii), provide an estimate of the footprint index – i.e. the estimated maximum area within which contact with the seafloor may occur per unit of fishing effort (e.g. km<sup>2</sup> impacted per km mainline deployed or other unit defined in the fishing gear configuration description, or see examples). Describe uncertainties used in estimating the fishing gear footprint (e.g. extent of gear movement in contact with the seafloor etc). This estimate may reference other footprint estimation documents previously adopted and available in the CCAMLR fishing gear library.*
- (v) Estimated ‘impact index’  
*Estimate the impact index per standard unit of fishing gear (i.e. the footprint index multiplied by the composite mortality rate expected within the footprint (see examples).*

2.2 Scale of proposed fishing activity

*Please provide proposed estimated effort within each subarea/division in which activities have been notified, including the expected depth range of fishing activities (e.g. expected effort in units used in (iv) – total km of mainline).*

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**3. Methods used to avoid significant impacts on VMEs**

*Please provide details of modifications (if any) to gear configuration or methods of deployment aimed at preventing or reducing significant impacts on VMEs during the course of fishing.*

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APPENDICES E TO T

**Appendices E to T are only available electronically at:**  
[www.ccamlr.org/pu/e/e\\_pubs/fr/drt.htm](http://www.ccamlr.org/pu/e/e_pubs/fr/drt.htm)