

**REPORT OF THE WORKING GROUP
ON FISH STOCK ASSESSMENT**
(Hobart, Australia, 10 to 21 October 2011)

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¹ Appendices D to R are published only in electronic format (www.ccamlr.org/pu/e/e_pubs/fr/drt.htm).

- APPENDIX N: Fishery Report: Exploratory fishery for *Dissostichus* spp.
in Division 58.4.1
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in Subareas 88.1 and 88.2

**REPORT OF THE WORKING GROUP
ON FISH STOCK ASSESSMENT**
(Hobart, Australia, 10 to 21 October 2011)

OPENING OF THE MEETING

1.1 The meeting of WG-FSA was held in Hobart, Australia, from 10 to 21 October 2011. 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.

1.2 Participants paused in memory of those lost during the tragic sinking of the longliner *Insung No. 1* in the Ross Sea in December 2010.

ORGANISATION OF THE MEETING AND ADOPTION OF THE AGENDA

2.1 In accordance with the advice of the Scientific Committee (SC-CAMLR-XXIX, Table 7), this year's agenda of WG-FSA focused on fisheries, research plans and assessments, including the biennial review of assessments for *Dissostichus* spp. in Division 58.5.2 and Subareas 48.3, 88.1 and 88.2. Consideration of other long-standing items, including by-catch, depleted and recovering stocks, biology and ecology, and ecosystem interactions was deferred to the meeting in 2012. It was also recognised that WG-FSA's annual agenda would continue to reflect the work and priorities of the Scientific Committee.

2.2 The agenda of the meeting was discussed and WG-FSA agreed to move Subitem 5.4 ('Research plans to inform current and future assessments') to a separate agenda item which would follow Item 4; with this change the agenda was adopted (Appendix B).

2.3 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.

2.4 WG-FSA-11/11, 11/19 and 11/41 dealt specifically with matters of interest to WG-EMM and were referred to the 2012 meeting of WG-EMM, while consideration of WG-FSA-11/P1, 11/P2 and 11/P3 was deferred to the 2012 meeting of WG-FSA.

2.5 Paragraphs dealing with advice to the Scientific Committee and other working groups have been highlighted. A list of these paragraphs is provided in Item 11.

2.6 Components of WG-FSA's work were developed during the meeting by the following subgroups:

- Subgroup on Assessments (coordinator: Dr M. Belchier, UK)
- Subgroup on New and Exploratory Fisheries (coordinator: Drs R. Mitchell, UK and S. Hanchet, New Zealand)

- Subgroup on Research Plans (coordinator: Dr B. Sharp, New Zealand)
- Subgroup on the Scientific Observer Program (coordinator: Dr R. Leslie, South Africa)
- Subgroup on VMEs (coordinator: Dr S. Parker, New Zealand).

2.7 The report was prepared collectively by the Working Group participants. The information used in developing the assessments is provided in the Report on Bottom Fisheries and VMEs (Appendix D) and the Fishery Reports (Appendices E to R). These reports will be published on the CCAMLR website (www.ccamlr.org – go to ‘Publications’, see ‘Fishery Reports’).

REVIEW OF AVAILABLE INFORMATION

Data requirements specified in 2010

3.1 Since WG-FSA-10 the Secretariat has continued to develop procedures, databases and data forms at the request of WG-FSA, as well as the Commission and the Scientific Committee. This work has included:

- updating fishery and scientific observer data forms and associated guidelines prior to the start of the 2010/11 fishing season, and consequential updates to database tables, queries and entry forms (WG-FSA-11/8)
- developing a tag overlap statistic calculator for use in 2010/11 (see COMM CIRC 10/123 and SC CIRC 10/69; see also, e.g., WG-FSA-11/54)
- processing fishery and observer data from 2010/11, 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
- allocating starting positions of research hauls in the exploratory fisheries in Subareas 48.6 and 58.4 (WG-SAM-11/4; see also Item 5)
- updating fishery and observer information reported in the Fishery Reports (see Item 6) and report on VMEs and bottom fishing (Item 7).

3.2 The Secretariat validated the preliminary CASAL assessments using the assessment input files and results reported in papers submitted to WG-FSA. The validations confirmed the parameter files and MPD estimates of the B_0 estimate in each model run for the preliminary assessments for *Dissostichus eleginoides* in Subarea 48.3 (WG-FSA-11/33 Rev. 1, two- and three-fleet models), Subarea 48.4 (WG-FSA-11/38, catch-at-age and catch-at-length models), Division 58.5.2 (WG-FSA-11/24, base-case), *Dissostichus* spp. in the Ross Sea (WG-FSA-11/42, runs R1, R2.3 and R3), SSRU 882E (WG-FSA-11/44, runs R1, R2.3

and R3) and SSRUs 882C–G combined (WG-FSA-11/43, runs R1, R2.3, R3, R4 and R5). The input files for the preliminary assessment for *D. eleginoides* in Division 58.5.1 failed to produce the B_0 estimate reported in WG-FSA-11/28 (paragraph 6.44).

3.3 The input files for the preliminary assessments in the Ross Sea and Subarea 88.2 also included the MCMC data. The Secretariat's projections based on these data and the CCAMLR decision rule confirmed the yield estimates.

3.4 The Working Group noted that the three groups of researchers involved in preliminary assessments in Areas 48, 58 and 88 used slightly different implementations of the decision rule related to depletion and escapement. The Working Group tasked Dr S. Candy (Australia) and the Secretariat to coordinate a small group to address this issue intersessionally with the aim of submitting a combined/standard method (with associated R code) which could be used in future validations.

3.5 At the request of WG-SAM, the Secretariat mapped the spatial distribution of fishery characteristics for the exploratory longline fisheries for *Dissostichus* spp., including catch, proportion of species caught, mean of catch rate (by length of line and per hook), mean of fish size and proportion of fish above 100 cm (*D. mawsoni*) and 80 cm (*D. eleginoides*) (Annex 5, paragraph 2.8). WG-FSA agreed to include data from all longline fisheries in the Convention Area and all research fishing.

3.6 The Working Group also agreed that these maps provided comprehensive information of the spatial characteristics of the fisheries for *Dissostichus* spp. However, these maps had not been included in the Working Group's reports because of concern over the publication of fishery distribution data at such fine-scale spatial resolution (0.5° latitude \times 1.0° longitude) used in the maps. The Working Group sought advice from the Scientific Committee and Commission on whether maps that show data at this scale may be published in future.

3.7 Secretariat staff met with Korean government officials and fishing industry representatives in Seoul in November 2010 to discuss background information on CCAMLR and data requirements, and facilitate improvements in the quality of data collected on board Korean-flagged fishing vessels.

3.8 Mr T. Jung (Republic of Korea) informed the Working Group that the information provided by the Secretariat during its visit to Seoul had been summarised and translated into Korean and sent to vessel captains to explain the importance of complying with the requirements of CCAMLR fisheries, particularly those conservation measures that had proved problematic in the past.

3.9 The Secretariat investigated the use of the length–weight relationship of *D. eleginoides* and *D. mawsoni* to separate the two species using scientific observer data (WG-FSA-11/21). Although a general discriminant function using length and weight measurements did not provide a means to separate the two species, the process provided an opportunity to examine the variation in biometrics of both species by sex and by area, and indicated the possibility of large-scale coherence in variation in length–weight relationship parameters.

3.10 The Secretariat is continuing to develop and improve its processes for data receipt, processing, integrity checking, validation and quality assurance. This work is being guided

by the findings and recommendations arising from the independent review of the Secretariat's data management systems (CCAMLR-XXX/5; see Item 10), and ongoing data uses and analyses (e.g. WG-FSA-11/21).

3.11 The Working Group acknowledged the important role of fishing crews, scientific observers and Members in collecting CCAMLR data.

Fisheries information

Catch and effort in 2010/11

3.12 The 2010/11 fishing season started on 1 December 2010 and will end on 30 November 2011, and fishing was still in progress in some areas at the time of the meeting. Members' fishing vessels operated in the fisheries targeting icefish (*Champscephalus gunnari*), toothfish (*D. eleginoides* and/or *D. mawsoni*) and krill (*Euphausia superba*), and catches reported to 24 September 2011 are summarised in Table 1; no directed fishing occurred on crabs (*Paralomis* spp.) during the season (see also SC-CAMLR-XXX/BG/1).

3.13 The Secretariat monitored a total of 130 non-zero catch limits for target species and by-catch species in SSRUs (see CM 41-01), SSRU groups, management areas (see CMs 41-02 and 41-03), divisions and subareas (CCAMLR-XXX/BG/8). This included forecasting fishery closures once the catch of a managed species exceeded 50% of its catch limit. As of 24 September 2011, 16 fishing areas including five fisheries, had been closed by the Secretariat in 2010/11 (CCAMLR-XXX/BG/8, Table 2), and all of these closures were triggered by catches of *Dissostichus* spp. approaching their respective catch limits.

3.14 Catch limit overruns (i.e. the catch exceeded the catch limit) occurred for *Dissostichus* spp. in Division 58.4.1 (SSRU E: overrun 6 tonnes, total catch 113% of the limit; whole fishery: overrun 6 tonnes, total catch 103% of the limit), Division 58.4.2 (SSRU E: overrun 96 tonnes, total catch 339% of the limit; whole fishery: overrun 66 tonnes, total catch 194% of the limit), Subarea 88.1 (SSRUs J and L: overrun 54 tonnes, total catch 114% of the limit; whole fishery: overrun 32 tonnes, total catch 101% of the limit), and Subarea 88.2 (SSRUs C, D, F and G, overrun 2 tonnes, total catch 101% of the limit).

3.15 The Working Group noted that the Secretariat continued to experience difficulties in monitoring small catch limits (e.g. limits less than 100 tonnes) where vessels may, on occasions, report daily catches of similar size to the total limit.

3.16 Vessels fishing in the exploratory fisheries for *Dissostichus* spp. in 2010/11 were required to conduct fishery-based research in accordance with the data collection plan and tagging protocol described in CM 41-01. In addition, vessels fishing in Subareas 48.6 and 58.4 were required to deploy research hauls in accordance with the research plan in CM 41-01 and at locations determined by the Secretariat (WG-FSA-11/8 and 11/25; see also WG-SAM-11/4). Five vessels (*Hong Jin No. 701*, *Insung No.7*, *Koryo Maru No. 11*, *Shinsei Maru No. 3* and *Tronio*) completed a total of 124 research hauls.

3.17 Members also conducted research fishing on *Dissostichus* spp. in Divisions 58.4.3b and 58.4.4 and Subareas 88.2 (SSRU A) and 88.3 (WG-FSA-11/9).

3.18 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 2010/11 (WG-IMAF-11/5 Rev. 2; see also Item 8).

3.19 WG-FSA briefly considered finfish by-catch taken in krill fisheries, as recommended by WG-EMM (Annex 4, paragraph 2.117). Finfish by-catch is currently sampled by scientific observers on krill fishing vessels using two protocols; as part of the finfish by-catch biological data form (K5) and the fish sub-sampling protocol (K12 form, since 2010). The K5 protocol records biological information on finfish by-catch such as species, length range, weight and sex. The K12 protocol was developed to sample small/larval fish that may go undetected in the K5 protocol.

3.20 The Secretariat undertook a preliminary analysis of the by-catch of finfish in the krill fishery (WG-FSA-11/5). Substantial differences occurred in the composition of finfish by-catch between the three vessels from which K12 data are currently available. The Working Group noted that the identification of larval fish of some of the species recorded was not straightforward and that these may be reflected in the apparently extralimital records for some species.

3.21 WG-FSA noted that if these preliminary results indicated that the estimated total by-catch for the krill fishery in Subarea 48.1 in 2009/10 included 6.8 tonnes of *Pleuragramma antarcticum* and 4.7 tonnes of *C. gunnari*. However, as the length of these fish is not currently recorded in the K12 form, it is difficult to evaluate the realisable biomass and the potential impact of this catch on the population of those species. Therefore the Working Group recommended that the K12 form be modified to include details of the length of fish sampled.

3.22 WG-FSA also noted that the by-catch observed using the K5 protocol on board the *Dalmor II* fishing in 2010/11 in Subareas 48.1 and 48.2 was dominated by notothenids and myctophids respectively (WG-FSA-11/41).

3.23 WG-FSA welcomed the presentation of quantitative information on the finfish by-catch in the krill fishery and agreed that it was important to establish what fish species were being caught in that fishery and what the implications of the level of this by-catch might be for target species (e.g. *C. gunnari* in Subarea 48.3) and other species that may be depleted as a result of historic fishing.

Estimates of effort from IUU fishing

3.24 In 2010, the Scientific Committee noted WG-FSA's advice on IUU fishing, and agreed that, for the purposes of tracking the progress in eliminating IUU fishing, the Secretariat should monitor trends in IUU effort rather than estimate IUU catch, but that estimates of total removals are needed for stock assessments (SC-CAMLR-XXIX, paragraph 6.5). The Working Group recommended that the Scientific Committee task appropriate experts to develop methodologies to generate these estimates for IUU removals.

3.25 Information available to the Secretariat indicated that five vessels (*Kuko*, *Koosha 4*, *Xiong Nu Baru 44*, *Sima Qian Baru 22* and *The Bird*) had engaged in IUU fishing for *Dissostichus* spp. in the Convention Area in 2010/11 (WG-FSA-11/10 Rev. 1). These vessels

were sighted in Divisions 58.4.1 and 58.4.4. Three other IUU fishing vessels (*Lana*, *Yangzi Hua 44* and *Seabull 22*) were sighted outside the Convention Area. With the exception of the *Sima Qian Baru 22* (longliner) and *Koosha 4* (cargo vessel), these vessels were fishing using gillnets.

3.26 Sighting information for the last nine seasons indicated a change in the area of operations of IUU fishing vessels, from a concentration of activity in the Western Indian Ocean sector to Division 58.4.1.

3.27 In addition, the Secretariat had received two sightings of abandoned fishing gear, one each in Divisions 58.4.1 and 58.5.2. WG-FSA noted that the gear sighted in Division 58.5.2 was a longline which may have been in the water for a number of years, as indicated by the growth of benthic invertebrates, and catches associated with this gear may have been taken into account in previous estimates of catch.

3.28 The Working Group discussed the time series of IUU fishing activities in the Convention Area (WG-FSA-11/10 Rev. 1, Table 4), and agreed that there were sufficient data available to begin a statistical analysis of the trends in IUU fishing. The Working Group recalled the work from JAG (CCAMLR-XXV, Annex 6) and requested that the Scientific Committee and WG-SAM advise on how this work can be further developed in order to provide information on trends in IUU fishing and estimates of IUU catches.

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

3.29 Catches of *D. eleginoides* from fisheries outside the Convention Area and reported in the CDS in the calendar years 2010 and 2011 (to 26 September) are summarised in Table 2 (see also CCAMLR-XXX/BG/24). The total catch of *D. eleginoides* taken outside the Convention Area was 12 441 tonnes in 2010 and 9 190 tonnes in 2011, and most of this catch came from Areas 41 (Southwest Atlantic) and 87 (Southeast Pacific).

3.30 The Working Group noted that scientific samples of *Dissostichus* spp., such as otoliths and tissue samples, are currently required to be reported to the CDS. The submission of DCDs for these small samples seemed unnecessary, and WG-FSA requested that the Scientific Committee consider excluding small scientific samples (e.g. up to 10 kg in 'product' weight) from the requirements of the CDS.

3.31 WG-FSA reviewed information on catches reported by the Ukrainian-flagged vessel *Simeiz* which fished for *D. eleginoides* in the high-seas areas of Divisions 41.3.1 and 41.3.2 (southwestern Atlantic Ocean) from January to August 2011 (WG-FSA-11/12). Fishing activities were conducted using trotlines in depths of 800–1 900 m and 122 tonnes of *D. eleginoides* were caught. There was no recapture of tagged fish.

Incidental mortality arising from fishing

3.32 Mr J. Moir Clark (Convener, WG-IMAF) summarised the findings and recommendations from the meeting of WG-IMAF which was held concurrently with

WG-FSA from 10 to 12 October 2011 (Annex 8). WG-FSA noted WG-IMAF's advice on the likely reduction in the requirements for data on the effectiveness of established mitigation measures, and consequential implications for data collection priorities for scientific observers. This matter was further considered under Item 8.

3.33 WG-FSA also considered WG-IMAF's advice that future meetings of WG-IMAF would be held on an ad hoc basis, as directed by the Scientific Committee's priorities and requirements to review risk assessments and levels of incidental mortality. WG-FSA noted that the future terms of references for WG-IMAF may be focused on the individual needs of each meeting, such as the current practice for SG-ASAM.

3.34 WG-FSA congratulated WG-IMAF on its significant accomplishments in reducing the incidental mortality of seabirds and marine mammals in CCAMLR fisheries.

PREPARATION FOR ASSESSMENTS AND ASSESSMENT TIMETABLE

Report from WG-SAM

4.1 The report of WG-SAM-11 (Annex 5) was presented to the Working Group by Dr Jones (Co-convenor, WG-SAM). It noted that WG-SAM was requested to undertake a focus topic on data-poor toothfish fisheries in the Convention Area, the terms of reference of which were set out in SC-CAMLR-XXIX, paragraph 3.133. The Working Group noted the advice to the Scientific Committee and WG-FSA on the following items (Annex 5):

- (i) evaluation of research hauls in exploratory fisheries (paragraph 2.9)
- (ii) CPUE in longline fisheries (paragraphs 2.15 and 2.33)
- (iii) preliminary assessment in Divisions 58.4.4a and 58.4.4b (paragraph 2.17)
- (iv) research fishing (paragraphs 2.19, 2.25 and 2.26; see also paragraphs 5.3 to 5.6)
- (v) performance metrics for surveys and tag-based research (paragraphs 2.38, 2.46 and 2.48)
- (vi) research design for data-poor fisheries (paragraphs 2.40, 2.44, 2.47 to 2.49)
- (vii) tag-loss rates used in CASAL (paragraph 3.6)
- (viii) pre-recruit survey in Subareas 88.1 and 88.2 (paragraph 3.14)
- (ix) research fishing in areas which cannot support a viable fishery (paragraph 5.7)
- (x) review of the Secretariat's Strategic Plan (paragraph 6.5)
- (xi) Convenor of WG-SAM (paragraph 8.3).

4.2 The Working Group endorsed the advice regarding performance metrics by which the quality of research efforts could be evaluated, as well as recommendations for research designs and standardised methods for mark-recapture programs (Annex 5, paragraphs 2.37 to 2.44) and areal survey methods (Annex 5, paragraphs 2.45 to 2.49). This matter was further considered under Item 5.

Review of preliminary stock assessment papers, including inputs for assessments

4.3 The Working Group discussed preliminary assessment papers for *C. gunnari* in Subarea 48.3 and Division 58.5.2, for *D. eleginoides* in Subareas 48.3 and 48.4 and Divisions 58.5.1 and 58.5.2 and for *D. mawsoni* in Subareas 48.4, 88.1 and 88.2 in preparation for the final stock assessments conducted at the meeting and reported under Item 5.1.

4.4 Papers containing new information on specific input data to be used for assessments were discussed by the Working Group alongside the preliminary assessment papers for each species under consideration within a subarea/division rather than as a separate agenda item. This included information on trawl surveys, tagging data inputs and estimates of unaccounted fishing mortality.

4.5 The Working Group discussed three papers containing information on the reproductive biology of *D. mawsoni* in Subarea 88.1 (WG-FSA-11/4, 11/18 and 11/27) and recommended that these be carried forward to next year's meeting for consideration by the Subgroup on Biology, Ecology and Demography.

C. gunnari South Georgia (Subarea 48.3)

4.6 WG-FSA-11/29 reported on the annual groundfish survey conducted in Subarea 48.3 carried out in January–February 2011. Survey design was similar to that employed for previous years, noting that sampling effort was allocated to five areas and two depth strata. The mean biomass estimated for *C. gunnari* was slightly lower than observed in 2010 but the lower one-sided 95% CL for 2011 was higher than for all years from 2007 to 2010. Small fish (14–20 cm) were dominant in the population around South Georgia, whereas larger fish (27–37 cm) dominated at Shag Rocks. There was a high availability of krill to *C. gunnari* in the area in 2011 evidenced by dietary analysis.

4.7 The survey also identified evidence of *D. eleginoides* recruitment at Shag Rocks, with fish 40–45 cm (age 3+ fish) in many hauls. This is assumed to be the cohort that was identified in the 2010 survey as age 2+ fish. There was also evidence of a smaller cohort of age 2+ toothfish in the 2011 survey.

4.8 WG-FSA-11/30 Rev. 1 reported on an updated preliminary assessment of *C. gunnari* in Subarea 48.3 using the length-based projection model. The Working Group recalled that the use of the length-based model to set catch limits for *C. gunnari* in Subarea 48.3 was endorsed at the 2010 meeting (SC-CAMLR-XXIX, Annex 8, paragraph 5.164). The assessment uses survey data on length densities and biomass density without the need to identify age-specific cohorts.

4.9 The Working Group also noted the importance of the length transition matrix on model productivity, and of the dependence of this transition matrix on specific von Bertalanffy parameters arising from a growth model. The Working Group recalled that there has been considerable discussion of the utility of the length transition matrix at the WG-SAM meeting in 2010 (SC-CAMLR-XXIX, Annex 4, paragraphs 3.34 and 3.35). It was noted that the growth parameters used were the same as had previously been used in the age-based

model. The Working Group noted the well-documented difficulties in ageing meant that it was unlikely that validating the growth curves would be achievable in the near future (Fish WG/1986/Doc. 11; WG-FSA-06/7). The Working Group requested that sensitivity tests be considered to evaluate the impact of uncertainty in icefish growth on the length-based assessment.

C. gunnari Heard and McDonald Islands (Division 58.5.2)

4.10 WG-FSA-11/23 reported the results of three random stratified trawl surveys which were completed in September 2010, March 2011 and May 2011 which added to the time series of annual surveys in Division 58.5.2 that commenced in 1997. Catches of *C. gunnari* in the May 2011 survey were less than 0.5 tonnes. A comprehensive summary of fish and invertebrate catch composition was also provided.

4.11 Details of the length composition of *C. gunnari* obtained in the three surveys were provided in WG-FSA-11/22. An unusual multi-modal cohort structure was observed where at least four contiguous age classes were present simultaneously in the survey samples. This is different from the usual situation observed in *C. gunnari* in Division 58.5.2 in which a single cohort is seen to dominate before disappearing from the population with a frequency of around three years. The cause of this change in population structure is uncertain but may relate to a change in mortality associated with spawning.

4.12 The Working Group noted that having three surveys conducted within a short timeframe of 18 months provided useful data relating to the population dynamics of *C. gunnari*. Of particular note was the observed rapid decline in abundance of the oldest cohort of fish over a five-month period in 2010 (WG-FSA-11/22, Table1).

4.13 Following an examination of the spatial distribution of survey catches of *C. gunnari*, the Working Group was satisfied that the spatial stratification used in the survey was appropriate.

4.14 A preliminary stock assessment of *C. gunnari* in Division 58.5.2 was provided in WG-FSA-11/22. Using the May 2011 survey data and growth parameters used in the 2010 assessment, the density of fish in each age class was estimated using the CMIX procedure and the estimate of yield was obtained using the GYM.

4.15 The Working Group noted a proposal by Australia (WG-FSA-11/34) to introduce a limit reference point in the *C. gunnari* fishery in Division 58.5.2. It recalled that the population on the plateau around Heard Island and McDonald Islands had historically undergone large periodic fluctuations in stock size, and hence the catch limit recommended using the decision rules also fluctuated widely. The Working Group noted that a strict application of the decision rules could result in a commercial catch limit even at relatively low levels of stock biomass. It was agreed that a limit reference point for such stocks may be recommended in the interim pending development of a more formal assessment of the likelihood that the decision rules will achieve CCAMLR's objectives.

4.16 The Working Group agreed that, where the stock assessment of *C. gunnari* in Division 58.5.2 indicated a stock biomass of less than 1 000 tonnes, or the decision rules indicated a catch limit of less than 100 tonnes, a commercial catch limit would not be set.

Instead, a 30 tonne combined research and by-catch limit would apply, which would allow the annual trawl survey to continue to monitor the stock, and accommodate by-catch of icefish that may occur in the *D. eleginoides* trawl fishery in this division. The Working Group recommended that the conservation measures applying to the fisheries in Division 58.5.2 be modified accordingly.

4.17 The Working Group noted that the rationale for limit reference points was not based on detailed analyses and would be strengthened by an evaluation of the performance of the CCAMLR decision rules, as recommended by the Workshop on Approaches to Managing Icefish (SC-CAMLR-XX, Annex 5, Appendix D) taking into account stock-specific biology and ecosystem roles. The Working Group encouraged Members to conduct such evaluations, and that limit reference points should be revised accordingly.

D. eleginoides South Georgia (Subarea 48.3)

4.18 WG-FSA-11/33 Rev. 1 presented an updated assessment of *D. eleginoides* in Subarea 48.3. The input data for the model were updated with data from 2009/10 and 2010/11. Model runs with alternative fleet hypotheses were used to explore fits to commercial catch-at-age data in response to the request for further work into this by WG-FSA in 2009 (SC-CAMLR-XXVIII, Annex 5, Appendix L, paragraph 39).

4.19 In the updated assessment, fits to observations were adequate, with improvements of fits to commercial catch-at-age and tag recaptures compared to the 2009 assessment model. The Working Group noted the poor fits to survey abundance observations from 2005 onwards. It was also noted that, whilst there are alternative approaches to the weighting of fishery-independent pre-recruit surveys in integrated assessment models, the current approach to data weighting is believed to weight the survey data appropriately, given the variability in survey-haul-specific catch-at-length proportions and catch densities.

4.20 The Working Group noted that there is still uncertainty surrounding the strength of the 2001 cohort, although the consistent tracking of this cohort through the groundfish survey and commercial catch-at-age both suggest the cohort was relatively strong. The Working Group noted the importance of the assumptions of fleet structure on estimates of YCS, and the effects of this on long-term yield estimates for the models.

Dissostichus spp. South Sandwich Islands (Subarea 48.4)

4.21 WG-FSA-11/31 Rev. 2 presented initial results for Subarea 48.4 South from a three-year tagging experiment that was initiated by the UK in 2008/09. Standardised CPUE trends indicated a slight decline in catch rates over the three-year study, with greater declines in catch rates from 2010 to 2011. Two years of mark-recapture data generated estimates of vulnerable biomass for *D. mawsoni* between 589 to 660 tonnes for 2010 and 2011 recapture years, similar to those estimated in 2010 with one year of data.

4.22 WG-FSA-11/38 presented an updated assessment of *D. eleginoides* in Subarea 48.4 North. The CASAL integrated assessment model was updated with data from 2010/11. Additionally, age data from randomly sampled otoliths from 2008/09 were included in the

model. These data were used to provide catch-proportions-at-age or size-at-age data for a variety of models. Estimates of yield resulting from the different model configurations were discussed by the Working Group.

4.23 Proportions-at-age in commercial catches in 2008/09 confirmed that catches from the fishery are dominated by fish of a restricted age range. The introduction of size-at-age data into the model, estimation of the von Bertalanffy parameter t_0 and the use of double-normal selectivity, resulted in a 50% increase in estimated SSB_0 . The Working Group noted that the increase in SSB_0 is likely due to the decreasing right-hand limb of the selectivity ogive.

D. eleginoides Kerguelen Islands (Division 58.5.1)

4.24 WG-FSA-11/28 presented a preliminary assessment of *D. eleginoides* in Division 58.5.1. The CASAL integrated assessment model uses catch, CPUE and length-frequency data from the commercial fishery (1979–2011), IUU estimates, abundance estimates from scientific surveys and tagging data to derive estimates of yield.

4.25 The Working Group commended the considerable progress made in the development of the assessment model and recognised the cooperative work between France and Australia during the intersessional period. The Working Group encouraged further development of this assessment along with continued collection and analysis of data on catch and effort, tagging data, and other data that could be used to progress understanding of fish stocks and fishery dynamics on the Kerguelen Plateau.

4.26 The Working Group recommended that the presentation of fishery and tag characterisation of the Division 58.5.1 fishery, analogous to that presented for Subareas 88.1 and 88.2 (WG-FSA-11/45 and 11/46), would provide useful information to assist with the continuing development of an assessment for this fishery.

4.27 The Working Group encouraged the participation of a French stock assessment scientist at future meetings.

4.28 The Working Group noted the close scientific cooperation between France and Australia in Divisions 58.5.1 and 58.5.2 and welcomed their proposal seeking to fund two post-doctoral researchers to work on the further development of the assessment for *D. eleginoides* on the Kerguelen Plateau.

D. eleginoides Heard Island (Division 58.5.2)

4.29 A preliminary stock assessment for *D. eleginoides* in Division 58.5.2 was presented in WG-FSA-11/24. The assessment included updated total removals data by sub-fishery and updated catch-at-age and catch-at-length proportions. Random stratified trawl survey abundance-at-age data for 2010 and 2011 (see paragraph 6.9) were included along with those from 2008 and 2009.

4.30 It was noted that the 2011 integrated assessment used a value for M of 0.155 whereas a value of 0.13 was used previously. The consequence of using a higher M in the integrated assessment was a reduction in the estimate of B_0 with a compensatory increase in R_0 . Sensitivity tests requested by the Working Group are detailed in paragraph 6.37.

D. mawsoni Ross Sea (Subareas 88.1 and 88.2)

4.31 WG-FSA-11/45 provided an updated characterisation of the Subareas 88.1 and 88.2 toothfish fisheries from 1997 to 2011. This report summarised the timing, depth and location of fishing together with the catch of *Dissostichus* spp. and by-catch species by year. The paper concluded that, from the data examined from the fishery data to date, there is no evidence for substantial changes in population structure or abundance at the regional (subarea) or local (SSRU) level.

4.32 The Working Group agreed that such characterisations of the fishery are very useful in providing a synopsis of the dynamics of the fishery over time. It was noted that other measures, such as changes to fleet composition with respect to gear type over time, would be a useful addition to these characterisations.

4.33 WG-FSA-11/46 provided an update on the descriptive analysis of the toothfish tagging program in Subareas 88.1 and 88.2, including summaries of data for the 2011 season.

4.34 An analysis of the tagging performance of two Korean vessels fishing in Subarea 88.1 during the 2011 season was reported in WG-FSA-11/54. The Working Group noted that tag overlap statistics for both vessels were high and a large increase on previous seasons. A considerable amount of data on toothfish catch rates, length and sex composition, and a characterisation of the by-catch and VMEs was reported. The Working Group noted that such reports were highly valuable and thanked the authors for their contribution.

4.35 WG-FSA-11/48 reported on the development of a method to estimate unaccounted fishing mortality from lost fishing lines in the Ross Sea region and Subarea 88.2 *D. mawsoni* fisheries. Estimates suggest that on average 175–244 tonnes (5.3–7.4% of the 2011/12 recommended catch limit) of *D. mawsoni* may be killed annually due to lost gear in the two areas. Outputs from this analysis were incorporated as sensitivities into model runs of the preliminary assessments carried out for Subareas 88.1 and 88.2.

4.36 The Working Group acknowledged that estimation of fishing mortality due to lost gear was a useful development and should be estimated for other fishery regions and considered for use in other assessment models. The Working Group recommended that the Scientific Committee remind Members of the requirement to complete C2 fields, including zeros if no hooks attached to sections of the main line were lost.

4.37 WG-FSA-11/42 and 11/43 presented updated assessments of toothfish in the Ross Sea (Subarea 88.1) and Subarea 88.2 (SSRUs 882C–G) respectively. The major development in the assessment of Subarea 88.2 since 2009 was the move from an assessment of SSRU 882E (see WG-FSA-11/44) to an assessment of SSRUs 882C–G combined. Other changes were the revised tag-loss rate (WG-SAM-11/18) and inclusion of updated data since 2009.

4.38 The Working Group noted that the assessments of the Ross Sea and SSRUs 882C–G are currently undertaken independently. The Working Group recognised the need to combine these assessments at some stage in the future, on the basis that the hypothetical life history and ocean circulation in this region indicated links between these areas.

Progress on assessments for data poor fisheries

4.39 Dr D. Welsford (Australia) presented WG-FSA-11/35, describing GAMs of catch rate (kg per hook) and mean weight per line of *D. mawsoni* in the exploratory fishery in Divisions 58.4.1 and 58.4.2, using vessel, year, gear type, whether hauls were commercial or research, soak time, depth and location. During the meeting, these models were updated to include other factors, including hook type, line length and bait type. The Working Group noted that such analyses have the potential to assist with standardising catch rates within fished areas, locate areas where research could be focused, and with refining hypotheses regarding population structures across this region.

4.40 It was noted that the catch rate model estimated that standardised catch rates were higher in fished areas between 50° and 100°E than sampled areas elsewhere in Divisions 58.4.1 and 58.4.2, and that mean weights were lowest in the Prydz Bay region, and that these conclusions are consistent with patterns inferred from maps of unstandardised catch rates and toothfish sizes in this region (see also paragraph 3.6).

4.41 The Working Group recalled the advice of WG-SAM in 2008 in reviewing another spatial modelling application using BRTs (SC-CAMLR-XXVII, Annex 7, paragraphs 4.13 to 4.19), and noted, in particular, that the extent to which spatial models can be used to make predictions in locations outside those locations where data exist should be tested using spatial validation (SC-CAMLR-XXVII, paragraph 4.16). The Working Group further noted that the use of fishery-dependent data in spatial modelling may make spatial prediction difficult if the fished areas are not well spread across the range of environmental variation in multivariate space, as represented by the ‘environmental overlap statistic’ in WG-SAM-08/12.

4.42 The Working Group agreed that comparisons between the estimates and predictions derived from GAMs and other spatial modelling approaches, such as BRTs, may be useful for identifying appropriate methods to develop predictive models of toothfish or by-catch species, e.g. across Divisions 58.4.1 and 58.4.2, and for identification of regions where ground-truthing may be required.

Assessments to be carried out and assessment timetable

4.43 Assessment approaches used to assess fisheries were based on the preliminary assessment submissions, issues identified during the course of WG-FSA and subgroup discussions. The Working Group agreed to undertake updated assessments for the following fisheries:

- (i) *D. eleginoides* in Subarea 48.3
- (ii) *C. gunnari* in Subarea 48.3
- (iii) *D. eleginoides* in Subarea 48.4

- (iv) *D. mawsoni* in Subarea 48.4
- (v) *D. eleginoides* in Division 58.5.2
- (vi) *C. gunnari* in Division 58.5.2
- (vii) *D. mawsoni* in Subarea 88.1 and SSRUs 882A–B (Ross Sea management area)
- (viii) *D. mawsoni* in Subarea 88.2 and SSRUs 882C–G.

4.44 The Working Group considered the preliminary assessments for the fisheries for *C. gunnari* in Subarea 48.3 (WG-FSA-11/30 Rev. 1) and Division 58.5.2 (WG-FSA-11/22). It was agreed that these assessments would be reviewed during the meeting and the information used to develop the management advice for these fisheries.

4.45 The Working Group considered the preliminary assessments for the fisheries for *Dissostichus* spp. in Subareas 48.3 (WG-FSA-11/33 Rev. 1), 48.4 (WG-FSA-11/31 Rev. 2 and 11/38), 88.1 and 88.2 (WG-FSA-11/42 to 11/44) and Division 58.5.2 (WG-FSA-11/24). It was agreed that these assessments would be reviewed during the meeting and the information used to develop the management advice for these fisheries.

4.46 The Working Group did not update assessments for *D. eleginoides* fisheries in Division 58.5.1, Subarea 58.6 (Crozet) and Subareas 58.7/58.6 (Prince Edward Island). The Working Group discussed the developments towards an assessment for Division 58.5.1 (WG-FSA-11/28), in paragraphs 6.44 to 6.46.

4.47 All assessment work was undertaken by primary authors of preliminary assessments and reviewed independently. The tasks of independent reviewers were to:

- (i) validate that the data in the assessment files were the same as the data in the documentation of the assessment in the fishery report
- (ii) confirm that the general assessment structure was sensible and did not deviate substantially from that discussed
- (iii) confirm that the results of the assessment were accurately documented in the Working Group's report.

4.48 The outcomes of the assessments were reported in the Fishery Reports (Appendices E to R).

RESEARCH PLANS TO INFORM CURRENT OR FUTURE ASSESSMENTS

5.1 The Working Group reviewed three proposals for research fishing under CM 24-01 in closed fisheries or fisheries with zero catch limits:

- in the closed *Dissostichus* spp. fishery in Division 58.4.3b (BANZARE Bank) submitted by Japan (WG-FSA-11/13 Rev. 1)
- in the closed *D. eleginoides* fishery in Divisions 58.4.4a and 58.4.4b submitted by Japan (Ob and Lena Banks) (WG-FSA-11/15 Rev. 1)

- in the closed *Dissostichus* spp. fisheries in Subarea 88.3 submitted by Russia (WG-FSA-11/37).

5.2 The Working Group recalled the principles to be followed when developing CCAMLR-sponsored research (SC-CAMLR-XXVII, paragraphs 8.9 to 8.11). The Working Group further noted that the focus topic at WG-SAM-11 had provided further advice based on these principles to use in evaluating research plans for research in data-poor fisheries, including:

- principles and recommended designs for research in data-poor fisheries (Annex 5, paragraphs 2.25 and 2.40)
- the need for a detailed research plan describing how the principles are to be addressed (Annex 5, paragraph 2.26)
- the need to generate an index of abundance, a stock hypothesis and biological parameters to estimate stock status and apply the CCAMLR decision rules to drive the development of research plans (Annex 5, paragraphs 2.27 to 2.29)
- avoiding reliance on interpreting unstandardised CPUE as an index of stock abundance (Annex 5, paragraph 2.33)
- for proposals aimed at tag-based assessments, the importance of high performance with respect to: (i) the length-frequency overlap between the catch and tagged fish; (ii) a consistent spatial area within which research occurs between years; (iii) consistent timing of the research fishing between years; (iv) minimising the trauma (condition and injury) state of released fish; and (v) minimising loss of tagged fish to depredation (Annex 5, paragraph 2.38).

5.3 The Working Group noted that these three proposals had also been presented at WG-SAM-11, and WG-SAM had provided specific recommendations for revisions to each proposal (Annex 5, paragraphs 5.3 to 5.6).

5.4 The Working Group developed a table (Table 3) summarising its evaluation of to what extent each proposal addressed the general principles for CCAMLR-sponsored research and the advice and specific recommendations provided by WG-SAM. Where changes have been made to the research design arising from discussions in WG-FSA, the evaluation results (denoted by *) refer to the amended design, and changes are described in the text.

Subarea 88.3

5.5 The Working Group noted that the research described in WG-FSA-11/37 focused primarily on the collection of biological data to understand spatial and temporal life-cycle patterns, rather than to produce an index of stock abundance (as recommended in Annex 5, paragraph 2.27). The Working Group further noted that the proposed research catch limit of 65 tonnes is inconsistent with catch rates reported in WG-FSA-11/36 and is unlikely to be caught on the 50 trotline sets proposed in the research design.

5.6 The Working Group concluded that the research described was unlikely to lead to a robust estimate of stock status, and provided recommendations to modify the research proposal. The Working Group recommended that the research be spatially constrained within the area in which toothfish are most abundant and tag recaptures are most likely (i.e. SSRUs 883B–C), and that the research proposal utilise the process outlined in Annex 5, paragraph 2.40, to estimate appropriate research catch levels. The Working Group reiterated the specific advice of Annex 5, paragraph 5.6. It further requested that a modified research proposal should provide the following specific information:

- (i) the size-frequency distributions of both the catch and the tagged portion of the catch (i.e. the data underlying the tag overlap statistic) should be shown for the research fishing that has already been completed
- (ii) a spatial analysis of local and regional ice conditions is desirable, which could aid in illustrating the extent to which different potential survey areas are likely to be ice-free and available for survey in different years (<http://nsidc.org/>)
- (iii) a description of the proposed otolith sampling and ageing analysis should be included.

5.7 Dr A. Petrov (Russia) provided the following statement:

‘In our opinion the results of previous surveys and investigations could not show the real situation in the distribution of Antarctic toothfish in Subarea 88.3 because of the difficult ice conditions in this area. This shows the necessity of continuing our investigations and covering the large shelf and continental slope area during the second stage of the Russian survey in Subarea 88.3 in the next season. We hope that the weather and the ice conditions will be favourable for research fishing, and we can investigate the areas which were covered with ice last year. From this research program we could get new data on the age of target species and to carry out planned investigations and other important research activity.

The declared catch of 65 tonnes for scientific research is intended not as a target catch level but to ensure that all 50 trotlines can be set in this area. In this way we will explore a larger area than we explored last year.’

5.8 The Working Group noted that a notification for scientific research under CM 24-01 was received from Russia, proposing to catch up to 10 tonnes of toothfish in SSRU 882A (for which the catch limit is currently zero), but no associated research proposal was received for review by WG-SAM or WG-FSA. The notification states that the purpose of the research is to collect biological and spatial distribution information. The Working Group noted that toothfish in SSRU 882A are part of the currently assessed Ross Sea stock. The research notification does not include an indication of how data collected in the research will be analysed and used to inform the management of the Ross Sea fishery. The Working Group also noted that the results of the previous years’ research fishing in the same SSRU have not been submitted for review by the CCAMLR scientific working groups. The results of a two-year program of Russian investigations will be presented at the next WG-FSA meeting.

Ob and Lena Banks

5.9 WG-FSA-11/14 and 11/15 Rev. 1 described research conducted in the 2011 season in Divisions 58.4.4a and 58.4.4b (Ob and Lena Banks) and a proposal to continue the survey in 2012. The Working Group agreed that the purpose and design of the proposed research were consistent with the advice of WG-SAM for data-poor fisheries and that the research was likely to achieve its aims, subject to the adoption of changes recommended by the Working Group, below. The following recommendations refer directly to the advice of WG-SAM for data-poor fisheries in particular paragraphs, as summarised in Table 3.

5.10 With respect to Annex 5, paragraph 2.27(iii), the Working Group recommended that GSI (i.e. gonad weight in proportion to total weight) be recorded for biologically sampled fish, in addition to gonad stage. The Working Group further recommended that otolith collection and ageing work continue in this area.

5.11 With respect to five performance metrics for tag-based research identified in Annex 5, paragraph 2.38, the Working Group:

- (i) noted the high tag overlap statistic achieved by the research in 2011
- (ii) endorsed the spatial design of the proposed research, noting consistency between years to achieve maximum likelihood of tag recaptures
- (iii) noted that the survey has in past years occurred at different times of year, and recommended seasonal consistency in future, if possible
- (iv) discussed fish condition and injury status (see below) and agreed that supplemental data presented by Japanese researchers indicate that the proposed research is likely to capture sufficient numbers of fish suitable for tagging to achieve the requirements of the proposed tagging program
- (v) expressed concern about the level of killer whale depredation observed by the research vessel, but noted that proposed mitigation measures to be employed by the *Shinsei Maru No. 3* were likely to be effective to ensure sufficient numbers of fish survive to achieve the requirements of the proposed tagging program.

Suitability of fish to be tagged

5.12 The Working Group noted that the use of the term ‘condition’ as an indicator of the suitability for tagging may be confused with the relationship between fish length and weight. The Working Group agreed that the terms ‘condition’, ‘injury’ and ‘trauma’ all refer to factors that affect the suitability of a fish to be tagged. The aim of tagging fish in ‘good condition’ as required under CM 41-01, paragraph 2(ii), is to release tagged fish that have a high probability of survival and are therefore suitable for tagging. The Working Group recommended that the terminology in CM 41-01, paragraph 2(ii), be modified this year to refer to tagging fish with a high probability of survival.

5.13 The Working Group further recommended that the best practices for evaluating the suitability of a fish for tagging be developed intersessionally and terminology be clarified.

5.14 In response to concerns by the Working Group about the rate of multiple-hooking injuries and the general poor condition of toothfish caught on trotlines (see below), Dr K. Taki (Japan) provided supplemental information regarding the condition status of fish captured and tagged in the research on Ob and Lena Banks using a set of prescribed criteria (WG-FSA-11/15 Rev. 1). These data showed that only 11.7% of the trotline-caught fish on Ob and Lena Banks were in good condition and hooked by only one hook, hence suitable for tagging under the recommended updated tagging requirements (below); nonetheless, 77% of the tagged and released fish were in this category. These numbers reflect a deliberate effort by the on-board Japanese researchers to assess the condition and injury status of each fish and to select only the best fish for tagging, paying close attention also to the requirements of the tag overlap statistic. Dr Taki noted that the on-board scientists monitor the tag overlap statistic in real time during the research and notify crew of what size classes are required for tagging to achieve a high overlap statistic; this is necessary because random tagging using the 'pre-select method' (as in WG-FSA-11/50) is clearly not possible when a high proportion of fish are not suitable for tagging. The effort to tag appropriately was also aided by the simultaneous availability of Spanish-line-caught fish from the experimental mixed-gear sets, of which a much greater proportion were suitable for tagging.

5.15 Figure 1 reveals that in order to achieve representative tagging rates in all size classes it was necessary for the *Shinsei Maru No. 3* on Ob and Lena Banks to tag and release some fish with multiple hook wounds, and in some instances to release fish in poor condition, because there were insufficient numbers of large fish available from trotlines that were only single-hooked and in good condition. The Working Group noted the vessels' dedication to achieving a high tag overlap statistic but recommended that in future only single-hooked fish in good condition should be tagged and released. If for particular gear types there are insufficient numbers of fish suitable for tagging in all size classes to achieve a high tag overlap statistic, then tag-based research will require increased use of gear types for which multiple-hooking injury rates are lower (e.g. autoline or Spanish line).

5.16 The Working Group noted that the paired deployment of mixed Spanish line and trotline sets described in WG-FSA-11/13 Rev. 1 and 11/14 provides valuable information and recommended that it should be continued.

Depredation

5.17 In tag-based research for which CPUE is not used as an index of abundance, the reduction in catch from depredation reduces the quantity but not the quality of available data (i.e. by reducing scan rates and numbers of recaptures); of greater concern is that predation by whales of newly tagged and released fish can bias subsequent tag-based assessment methods such as Petersen biomass estimates. Japanese researchers clarified that the *Shinsei Maru No. 3* actively avoided killer whales to the extent practical (i.e. tying off lines and switching between SSRUs when whales first appeared). In addition, they use a holding tank on board the vessel to retain tagged toothfish until no killer whales are present.

5.18 The Working Group noted that there appears to be a seasonal pattern of occurrence for killer whales in some parts of the CCAMLR area, and recommended that the Japanese

researchers re-examine available data from previous seasons in Divisions 58.4.4a and 58.4.4b to see if it may be possible to minimise depredation risk by conducting the research at times of the year when killer whales are least likely to be present.

Preliminary estimate of plausible biomass

5.19 The Working Group used 2010/11 tag recaptures to generate Petersen biomass estimates for Divisions 58.4.4a and 58.4.4b. The Working Group noted that to date all four tags recaptured in 2011 were from SSRU C, but that the approximation that all released tags had an equal probability of recapture was valid because the spatial distribution of effort has been consistent between years. The number of recaptured tagged fish in Divisions 58.4.4a and 58.4.4b is much lower than the number of released tagged fish. Consequently, the number of tags available for recapture for a given year of release was approximated as:

$$n1^* = n1 (1 - t) (e^{-\lambda * Y}) (e^{-M * Y})$$

where:

$n1^*$ = tags available for recapture

$n1$ = number of tagged and released fish

t = post-tagging mortality rate = 0.2

λ = annual tag loss rate approximation = 0.0084

M = natural mortality = 0.13

Y = years at liberty between the tag release and tag recapture.

5.20 The Working Group assumed a higher post-tagging mortality rate (0.2 instead of 0.1) to reflect the fact that some fish released in previous years (e.g. 23% of released fish in 2010/11) were multiple-hooked or in poor condition (Table 4).

Target CVs for tag-based biomass estimates

5.21 The cumulative Petersen biomass estimate of 1 928 tonnes (i.e. using all four tag recaptures from the pooled total of available tags) was used to estimate CVs for future Petersen biomass estimates as a function of future catches and tagging rates (as in Annex 5, Figure 3) as shown below in Figure 2. The non-zero intercepts on the y-axis reflect that there are an estimated 314 previously tagged fish already available for recapture in 2011/12. Figure 2 indicates that CVs of 20% may be achieved within two years with an annual research catch of 45 tonnes, or within three years with an annual research catch of 39 tonnes.

Precautionary research catch limit

5.22 The Working Group recalled the GYM scenarios run in 2010 in WG-FSA (SC-CAMLR-XXIX, Annex 8, paragraph 5.117), which estimated the likely trajectory of a *D. eleginoides* stock that had been (i) at a median SSB of 20% SSB_0 in 2006 (when the fishery in Ob and Lena Banks was closed), or (ii) was at a median SSB of 20% in 2009. These

scenarios were rerun (including the catch of 35.4 tonnes taken in the most recent survey by the *Shinsei Maru No. 3*) to estimate current status and corresponding constant catch rates under which the stock is expected to recover to 50% B_0 within two decades from the date of the fishery closure (as in WG-FSA-10/42). Under the first scenario, the median current status was estimated to be 36.5% SSB_0 in 2010; the corresponding precautionary research catch is 1.25% B_0 , or 115 tonnes per year. Under the second scenario the median status was estimated to be 23% SSB_0 in 2010; the corresponding precautionary research catch is 0.074% B_0 , or 58 tonnes per year. The actual current status of the stock is unknown, but these scenarios are thought to be conservative. On this basis, the Working Group advised that research catches up to 115 tonnes per year could be appropriate for this stock.

5.23 The Working Group noted that there was value in maintaining a consistent survey design over time, and recommended that the survey be effort-limited in 2012, using the spatial design and level of research effort proposed in WG-FSA-11/15 Rev. 1 (i.e. 71 sets in an allocated spatial grid including SSRUs B–C). The Working Group endorsed the proposal to deploy at least 14 mixed Spanish line/trotline sets, to provide an increased number of single-hooked fish in good condition suitable for tagging, and to continue to provide data to examine the effects of different gear types on fish condition and gear selectivity. The Working Group noted that in 2011 using an identical survey design the catch was 35.4 tonnes, and it is unlikely that catch rates in 2012 will be more than double the observed catch rates in 2011. The Working Group recommended that the research proceed subject to the advice in paragraphs 5.10 to 5.18 with a catch limit of 70 tonnes for this research, noting that actual catches are expected to be lower.

Division 58.4.3b (BANZARE Bank)

5.24 WG-FSA-11/13 Rev. 1 described research conducted in 2010/11 in Division 58.4.3b and a proposal to continue the survey in 2011/12. The Working Group agreed that the purpose of the proposed research was consistent with the advice of WG-SAM for data-poor fisheries and recommended changes to the research design (detailed below). The following recommendations refer directly to the advice of WG-SAM for data-poor fisheries in particular paragraphs, as summarised in Table 3. Information on this fishery is summarised in Appendix Q.

5.25 With respect to five performance metrics for tag-based research identified in Annex 5, paragraph 2.38, the Working Group:

- (i) noted the high tag overlap statistic achieved by the research in 2010/11
- (ii) proposed an amended spatial sampling design to cover a wider area and increase the probability of tag recaptures (see below)
- (iii) encouraged seasonal consistency between survey years
- (iv) expressed concern about the condition and injury status of tagged and released fish (see below) and recommended changes to the survey design to increase the proportion of fish caught that are suitable for tagging

- (v) noted that depredation on BANZARE Bank has not been a problem in the past but recommended continued monitoring and reporting of predators in the vicinity of the research vessel.

Spatial design

5.26 The Working Group noted that the spatial extent of the survey completed by the *Shinsei Maru No. 3* in 2011 was only one quarter of what was intended to be a larger multi-vessel survey. The Working Group agreed that in the absence of participation by other vessels, and relying on a tag-recapture experimental design as recommended by WG-SAM-11, a modified spatial survey design would be more appropriate to increase the probability of tag recaptures under expected levels of toothfish movement in 2–3 years (i.e. 19–24 n miles; see WG-FSA-11/46). The agreed design is shown in Figure 3.

Suitability of fish to be tagged

5.27 Dr Taki presented supplemental information (Figure 4) revealing that only 2.9% of the trotline-caught *D. mawsoni* on BANZARE Bank were single-hooked and in good condition, hence suitable for tagging under the updated tagging recommendations. Only 31% of *Dissostichus* spp. actually tagged in 2010/11 were single-hooked and in good condition; the Working Group recommended that any analysis of future recaptures of these fish should consider their trauma status at the time of release, and that future Petersen biomass estimates may need to assume a high post-tagging mortality in the estimate of tag numbers available for recapture. On this basis, the Working Group judged that the original proposed survey design in WG-FSA-11/15 Rev. 1 (i.e. 5 mixed-line sets and 19 trotline-only sets) was unlikely to capture enough single-hooked fish in good condition to enable achievement of the proposed tagging rate of five fish per tonne with a high tag overlap statistic.

5.28 The Working Group noted that the higher proportion of multiple-hooked and poor-condition fish on BANZARE Bank relative to Ob and Lena Banks is apparently a consequence of the larger fish size; the data indicate that large fish caught on trotlines suffer multiple hook wounds more often than do small fish. The Working Group agreed that the primary requirement of tag-based research in data-poor fisheries is to achieve high performance with respect to the tagging performance metrics identified in Annex 5, paragraph 2.38. Tagging and releasing injured fish or fish in poor condition will increase the post-tagging mortality of released fish by an unknown amount, undermining the ability to interpret subsequent tag-recapture rates to estimate stock status. The Working Group noted the advice of WG-SAM (Annex 5, paragraph 2.12) that high levels of post-tagging mortality of released fish may account for the failure to develop stock assessments in some exploratory fisheries despite large numbers of tag releases over many years. On this basis it may be that some fishing gears are incompatible with the requirements of tag-based research in some areas.

5.29 The Working Group recommended that Members undertaking tag-based research in data-poor fisheries under CM 24-01 be required to evaluate and report the effects of their fishing gear on fish condition and injury status, as in WG-FSA-11/13 Rev. 1 and 11/14 and Figures 1 and 4, and modify their research design and/or choice of fishing gear configuration

accordingly to ensure that the requirements of an effective tagging program are met. Where particular gear types are incapable of capturing sufficient fish suitable for tagging, alternate sampling tools should be used.

Recommended gear configuration

5.30 In the research on BANZARE Bank, the Working Group recommended that a higher proportion of mixed Spanish line/trotline be deployed to capture higher numbers of single-hooked fish suitable for tagging on the Spanish line segments. The Working Group noted the particular trotline gear configuration utilised by the *Shinsei Maru No. 3*, in which each dropline includes five hook bundles spaced 40 cm apart, each comprised of five hooks with 50 cm snoods (Figure 5). The Working Group recommended that the research on BANZARE Bank use one or more modified trotline gear configurations to achieve lower rates of multiple-hooking injury. The following changes to the gear configuration shown in Figure 5 were suggested: (i) eliminate alternate bundles on each dropline, yielding three bundles, spaced 80 cm apart, with five hooks each; and (ii) retain the existing number and spacing of the bundles but reduce each bundle from five hooks to three hooks. Deployment of mixed lines containing segments of both of the alternate trotline configurations, and/or segments of a single modified trotline configuration mixed with Spanish line segments, can be expected to provide data to evaluate fish trauma and condition as affected by gear type, as well as gear type selectivity.

5.31 The Working Group emphasised that the primary objective of the research is to achieve the requirements of the tagging program, as follows: (i) five tagged fish per tonne; (ii) a high tag overlap statistic; and (iii) only single-hooked fish in good condition are tagged and released. So long as tagging performance is monitored on a continual basis during the survey, the proportional deployment of alternate gear configurations can be adjusted as required. If the vessel is not capturing sufficient numbers of single-hooked fish in good condition to meet the tagging requirements, then the number of sets including Spanish line segments should be increased until the tagging requirements are met. So long as the tagging requirements are being met, then the number of (modified) trotline-only sets may be increased.

5.32 The Working Group recommended that a detailed analysis of the distribution of tags, the effect of different gear types on trauma and condition and tagging rates across the survey area be provided by Japan at next year's meeting.

Preliminary estimate of biomass

5.33 Because Petersen biomass estimates from tag recaptures are not available for this area, the Working Group estimated initial biomass using the CPUE * seabed area comparison as recommended by Annex 5, paragraph 2.40(ii), using the formula $B_x = (I_x A_x B_R) / (I_R A_R)$ where B = current biomass in tonnes, A = fishable seabed area (600–1 800 m) in km², and I = CPUE (tonnes of catch per km of longline, all gear types) for the target stock X and an assessed reference stock R respectively. The target stock area A_x was defined as the fishable depths in Division 58.4.3b SSRUs A, C and E, which contain a topographically continuous

feature with roughly uniform CPUEs (SSRUs B and D contain a topographically separate feature with contrasting CPUE, and may contain a distinct stock unit). SSRU 882E was selected as a reference area; $B_R = 8\,300$ tonnes (see WG-FSA-11/44).

$$I_x = 0.0841 \text{ tonnes/km}; I_R = 0.1638 \text{ tonnes/km}; A_x = 90\,588 \text{ km}^2; A_R = 28\,392 \text{ km}^2.$$

Applying the formula above, the preliminary estimate of target stock biomass is 13 592 tonnes.

Precautionary research catch limit

5.34 The Working Group noted that preliminary biomass estimates based on CPUE and seabed area are highly uncertain, and recalled the advice in Annex 5, paragraph 2.40(iv), to apply a discount factor in estimating precautionary research catch limits. The Working Group adopted the discount factor used by WG-FSA in 1998 for the Ross Sea, i.e. 0.30 for *D. mawsoni* (SC-CAMLR-XXVII, Annex 5, paragraphs 4.58, 4.67 and 4.68) for a precautionary adjusted biomass of 4 078 tonnes. Applying a precautionary exploitation rate of 0.01 (consistent with assuming that the current status of this potentially depleted stock is 30% B_0 under the GYM application described in WG-FSA-10/42 Rev. 1) results in a precautionary research catch limit of 41 tonnes. The actual status of the stock is unknown, but these assumptions are thought to be precautionary.

5.35 The Working Group noted that models that could be used to develop a robust assessment based on the data collected from the proposed survey on BANZARE Bank have not been developed. It recommended that such models be developed as a priority, and that they should account for the existing hypotheses regarding the relationship between the populations of *D. mawsoni* in Divisions 58.4.1, 58.4.2 and 58.4.3b, and the IUU and exploratory fishing that has occurred in those areas.

5.36 The Working Group recommended that the proposed research using the *Shinsei Maru No. 3* on BANZARE Bank proceed in 2012, limited to 48 sets in locations shown in Figure 3, with a catch limit of 40 tonnes, subject to the recommendations in paragraphs 5.27 to 5.32 above.

Advice for tag-based research in other areas

5.37 The Working Group evaluated WG-FSA-11/13 Rev. 1 and 11/14, describing research carried out in 2010/11 by the *Shinsei Maru No. 3* on BANZARE and Ob and Lena Banks respectively, and developed advice to inform the design of effective tag-based research programs more generally. The research described in these papers included deployment of sets containing both Spanish line and trotline sections on the same lines, enabling comparison of the condition/injury status of toothfish caught using these different methods, and their suitability for tagging. The Working Group thanked Japan for providing additional information regarding rates of multiple-hooking injuries on trotline-caught toothfish, as requested by WG-SAM-11. The Working Group noted that determining which fish are of a

suitable physical and physiological state for tagging is an important component of a successful tagging program (Annex 5, paragraph 2.38), and that the data collected by Japan in this research effort will contribute to developing that guidance.

5.38 The Working Group recommended that the tagging requirements in CM 41-01, Annex C, be updated to require that only *single-hooked fish with a high probability of survival* be tagged and released. It also recommended operational guidance for tagging programs be developed to achieve CCAMLR's objectives in the intersessional period (paragraph 6.89).

5.39 The Working Group noted that there are differences between trotline gear configurations utilised by different vessels, and that some of these differences, for example, numbers of hooks per bundle, bundle spacing or snood length, are likely to substantially influence the rate of multiple-hooking injury and the corresponding suitability of fish for tag and release. It is important, therefore, to distinguish between different trotline configurations when evaluating the suitability for tagging of fish caught using different gear types. The Working Group encouraged Members using trotline gear to provide detailed descriptions of their gear configuration and setting and hauling procedures (e.g. Figure 5, or see WG-FSA-11/53 for Spanish longlines) to enable informed discussion of the likely effects of different fishing gears, consistent with the advice of the Scientific Committee in 2010 to have all gear types described in the CCAMLR gear library (SC-CAMLR-XXIX, Annex 8, paragraphs 9.19 and 9.20).

5.40 The Working Group noted that detailed description of fishing gears used are essential in understanding how target and by-catch species interact with the fishing gear and enhance the selection of the most appropriate gear for the experimental design of the research.

5.41 The Working Group requested that all vessels participating in data-poor exploratory fisheries provide detailed information from all research hauls to assess the suitability for tagging of fish caught using different gear types, similar to the information provided to WG-FSA-11 by the *Shinsei Maru No. 3* (e.g. Figures 2 and 4).

5.42 The Working Group recommended that depredation avoidance and mitigation practices be developed as much as possible into clearly defined protocols, and that the use of a holding tank to retain tagged fish until predators are absent be considered on board vessels undertaking tag-based research in areas where depredation is known to occur.

5.43 The Working Group further requested that Members conducting tag-based research under CM 24-01 collect and present data indicative of predator prevalence and abundance and associated depredation levels.

Research in fisheries with assessments

5.44 WG-FSA-11/47 described a proposed survey to monitor the relative abundance of pre-recruit *D. mawsoni* in the Ross Sea. The Working Group noted that this research is not proposed in a data-poor area, so its purpose is not to provide information to achieve an estimate of stock status, but rather to provide information to improve the management of a stock for which a robust stock assessment already exists (SC-CAMLR-XXIX, paragraph 3.129). Some of the advice of the focus topic on data-poor fisheries may not be

applicable to CCAMLR-sponsored research proposals in fisheries with assessments. However, the Working Group agreed that much of the advice of WG-SAM to guide research design in data-poor fisheries (e.g. as in Table 3) is also relevant to the design of this survey, and that the research described in WG-FSA-11/47 was in all relevant categories consistent with the advice of WG-SAM-11. The Working Group also noted that the proposal had incorporated the specific recommendations of WG-SAM-11 (Annex 5, paragraph 3.14).

5.45 The Working Group noted that this research was requested by the Scientific Committee (SC-CAMLR-XXIX, paragraph 3.185), and agreed with the conclusions of WG-SAM-11 that the proposed survey design is likely to achieve its objectives. On this basis WG-FSA endorsed the research design proposed in WG-FSA-11/47, and recommended annual reporting and review of interim research results by WG-FSA, as recommended by WG-SAM-11.

ASSESSMENTS AND MANAGEMENT ADVICE

Fisheries with assessments

C. gunnari South Georgia (Subarea 48.3)

6.1 The fishery report for *C. gunnari* at South Georgia (Subarea 48.3) is contained in Appendix E.

6.2 In 2010/11, the catch limit set for *C. gunnari* in Subarea 48.3 was 2 305 tonnes. Limited commercial fishing was conducted by one vessel in February and one vessel in September/October 2011 but with zero catches. A total catch of 10 tonnes was reported from the research survey.

6.3 In January/February 2011, the UK undertook a random stratified bottom trawl survey of the South Georgia and Shag Rocks shelves (WG-FSA-11/29; see also paragraphs 4.6 and 4.7).

6.4 The Working Group agreed that the length-based assessment for icefish should be used in Subarea 48.3, following the methodology presented in WG-FSA-11/30 Rev. 1.

6.5 The growth parameters were those used by CCAMLR in previous years (SC-CAMLR-XXVI, Annex 5, Appendix O, Table 5). The length–weight parameters were, however, updated according to the 2011 survey results (WG-FSA-11/29).

Management advice

6.6 The Working Group recommended that the catch limit for *C. gunnari* should be set at 3 072 tonnes in 2011/12 and 2 933 tonnes in 2012/13 based on the outcome of the short-term assessment.

C. gunnari Heard Islands (Division 58.5.2)

- 6.7 The fishery report for *C. gunnari* in Division 58.5.2 is contained in Appendix F.
- 6.8 The catch limit of *C. gunnari* in Division 58.5.2 for the 2010/11 season was 78 tonnes and the catch reported for this division as of 9 October was 1 tonne.
- 6.9 The results of three bottom trawl surveys undertaken between April 2010 and May 2011 were summarised in WG-FSA-11/24 (see also paragraphs 4.29 and 4.30). The Working Group noted that the 2008 to 2011 Australian bottom trawl surveys had sampled a large cohort, which dominated the population structure in 2010 as the 4+ year class, but this appears to have declined rapidly over the past year. A new 1+ and 2+ cohort was also detected. Unusually for this stock, four or five consecutive year classes are present in the population simultaneously.
- 6.10 The short-term assessment was implemented in the GYM, using the one-sided bootstrap lower 95% confidence bound of total biomass of 983 tonnes from the 2011 survey and using the revised growth parameters described in WG-FSA-10/12. Other fixed parameters remained unchanged from previous assessments.
- 6.11 The projection of fish of 1+ to 3+ age classes from 2010/11 gives a projected yield of 101 tonnes in 2011/12 and 82 tonnes in 2012/13.
- 6.12 The Working Group noted a proposal by Australia to introduce a limit reference point in the *C. gunnari* fishery in Division 58.5.2 (WG-FSA-11/34). As the assessment for catch in 2011/12 indicated a lower one-sided 95% of biomass less than 1 000 tonnes, it was recommended that the limit reference point be applied pending the results of a planned survey in 2012.

Management advice

- 6.13 The Working Group recommended that the Scientific Committee consider a catch limit for *C. gunnari* in 2011/12 of 0 tonnes, with a 30 tonne research and by-catch limit.

D. eleginoides South Georgia (Subarea 48.3)

- 6.14 The fishery report for *D. eleginoides* in Subarea 48.3 is contained in Appendix G. The catch limit for *D. eleginoides* in 2010/11 was 3 000 tonnes, and the recorded catch was 1 788 tonnes.
- 6.15 Two CASAL assessment models were presented in WG-FSA-11/33 Rev. 1: a two-fleet model, with an initial fleet 1985–1997 and a new fleet 1998–2011; and a three-fleet model, with an initial fleet 1985–1997, an intermediate fleet 1998–2003, and a new fleet 2004–2011.
- 6.16 The Working Group expressed concern that the tagging datasets used in the two- and three-fleet models were inconsistent, with no rationale presented in WG-FSA-11/33 Rev. 1

for the removal of 2003 and 2004 tag-releases and associated recaptures for the three-fleet model. To address these concerns, an MPD run for the three-fleet model was presented to the Working Group using the tagging dataset from the two-fleet model. The results confirmed that the removal of the 2003 and 2004 tag-releases and associated recaptures in the three-fleet model had a negligible effect on model output for the three-fleet model structure.

6.17 The Working Group recommended that in the future any removal of historic data be accompanied with an explicit justification of why the data should be removed, along with presentation of analyses of the impact on the change in data on model estimates.

6.18 Analysis of the depth distribution of effort by year in the fishery was presented to the Working Group. This analysis identified a gradual shift in effort to deeper waters with time which does not support the higher selectivity of younger fish in recent years estimated by the three-fleet model. Consequently, the Working Group agreed that the assessment model should be based on the two-fleet model presented in WG-FSA-11/33 Rev. 1.

6.19 Likelihood profiles for the two-fleet model (Appendix G, Figure 13) demonstrated that catch-at-length data from the early fleet and the survey abundance index were relatively uninformative. The tagging dataset as a whole was most informative on SSB_0 . Adequate fits were achieved, with improvements in model fits to tag-recapture and catch-at-age observations compared to the 2009 assessment model (SC-CAMLR-XXVIII, Annex 5, Appendix L).

6.20 Historical catch-weighted survey densities from the Subarea 48.3 groundfish survey and plots of commercial proportions-at-age were also presented to the Working Group as requested. Both datasets indicate that the 2001 cohort was likely to have been strong, although uncertainty around the relative strength of the 2001 cohort persists. In addition, data from the 2010 and 2011 surveys indicate a potentially strong 2007 cohort.

6.21 The yield satisfying the CCAMLR decision rules is 3 200 tonnes, using future recruitment with lognormally distributed YCS with a mean equal to the long-term average YCS estimate and a CV of 0.6 based on YCS estimates from 1985 to 2003. WG-FSA-11/33 Rev. 1 noted that CASAL model estimates of recent YCS are lower than the long-term average, with the exception of 2001. Consequently, WG-FSA-11/33 Rev. 1 suggested that a catch limit of 3 200 tonnes would not be appropriate at this time. Instead, projections were undertaken using recruitment with empirical lognormally distributed YCS with a mean and CV set using a truncated range of YCS estimates from the CASAL model.

6.22 The Working Group agreed that YCS from 1991 to 2003 would provide an appropriate mean and CV of YCS for this purpose, which includes mostly below-average YCS, although with some strong cohorts. This resulted in a yield of 2 600 tonnes that satisfies the CCAMLR decision rules, using the CASAL model's estimate of SSB_0 in the decision rule.

6.23 With regard to future developmental work for the stock assessment model used for this stock, the Working Group noted the importance of the assumptions of fleet structure on estimates of YCS, and the effects of this on long-term yield estimates. Consequently, the Working Group recommended further examination of historical changes in fleet selectivity to be completed intersessionally.

Management advice

6.24 The Working Group noted the advice of WG-IMAF that the 2011/12 season for longline fishing operations may be extended in two periods: (i) to start on 16 April and (ii) to end on 14 September for any vessel which has demonstrated full compliance with CM 25-02 in the previous season (Annex 8, paragraph 8.11).

6.25 The Working Group recommended a catch limit of 2 600 tonnes for 2011/12 and 2012/13.

Dissostichus spp. South Sandwich Islands (Subarea 48.4)

6.26 The Fishery Report for *Dissostichus* spp. South Sandwich Islands (Subarea 48.4) is contained in Appendix H.

6.27 A tagging experiment has been conducted in Subarea 48.4 North over the last six years. This experiment was extended to Subarea 48.4 South in 2008/09.

6.28 The catch limits for *D. eleginoides* and *D. mawsoni* in Subarea 48.4 North in 2010/11 were 40 tonnes and 0 tonnes (except for scientific purposes) respectively, with recorded catches of 36 tonnes and 1 tonne respectively. The catch limit for *Dissostichus* spp. in Subarea 48.4 South in 2010/11 was 30 tonnes, with a recorded catch of 17 tonnes.

6.29 The Working Group noted that an integrated assessment model for *D. eleginoides* in Subarea 48.4 North incorporating both catch-at-age and catch-at-length data would incorporate more observations from the fishery, compared to the models presented in WG-FSA-11/38. The yield satisfying the CCAMLR decision rule using projections with randomised lognormal YCS with a mean of the long-term average of the stock and a CV of 1 was 48 tonnes.

6.30 A three-year tagging experiment was completed in 2010/11 in Subarea 48.4 South. No full assessment is currently available. Due to reduced catches and low tag returns realised in the last year of the experiment, the UK proposed to extend the tagging experiment for a fourth year in Subarea 48.4 South in 2011/12, carrying forward the original proposal objectives from 2009 as detailed in WG-FSA-09/18. The proposed tagging experiment has the objective of providing the data required for assessments of the population structure, size, movement and growth of both *D. eleginoides* and *D. mawsoni* in Subarea of 48.4 South. It also provides an opportunity to investigate the degree of mixing of *D. eleginoides* populations between the north and south and, therefore, validate the stock assessment of this species in the northern area.

6.31 The Working Group discussed the proposal and noted that detailed discussion and a review of the research had been undertaken when this research was first proposed. The proposal to extend the research for a further year was discussed in reference to the new research criteria as proposed in WG-SAM (Annex 5, paragraphs 2.48 and 2.49), and the Working Group was satisfied that the research met all the relevant criteria. It was recommended that all the conservation measures related to this fishery be carried over into 2011/12.

6.32 Petersen estimates from tag recaptures to date suggest a vulnerable population of approximately 600 tonnes for *D. mawsoni*. Limited tag recaptures of *D. eleginoides* suggest a vulnerable biomass in the region of 150 to 350 tonnes. This is consistent with the estimate made in 2010 (SC-CAMLR-XXIX, Annex 8). Application of γ from the most recent Subarea 48.3 assessment (0.038) to the current estimates of vulnerable biomass results in a yield estimate of 33 tonnes.

Management advice

6.33 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 48 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 7.5 tonnes (16% of the catch limit for *D. eleginoides*) and a limit for rajids of 2.5 tonnes (5% of the catch limit for *D. eleginoides*).

Subarea 48.4 South –

- (i) a catch limit of 33 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.

D. eleginoides Heard Island (Division 58.5.2)

6.34 The Fishery Report for *D. eleginoides* in Division 58.5.2 is contained in Appendix I.

6.35 The catch limit of *D. eleginoides* in Division 58.5.2 west of 79°20'E was 2 550 tonnes (CM 41-08) for 2009/10 and 2010/11. The catch of *D. eleginoides* reported for this division for 2009/10 was 2 459 tonnes. The catch of *D. eleginoides* reported for 2010/11 up to 10 October was 1 676 tonnes. Of this, 1 122 tonnes was taken by longline, 521 tonnes by trawl and 33 tonnes by pot.

6.36 A preliminary stock assessment was presented in WG-FSA-11/24. Catch-at-length proportions for the commercial fisheries, both trawl and longline, were used for 2009 to 2011 since there were few fish aged for these years. The total number of aged otoliths used to construct age-length keys was 10 230. The total number of length-frequency samples applied to the age-length keys over all sub-fisheries, surveys and years was 350 064. A revised value

of M of 0.155 was used in the current assessment, whereas a value of 0.13 was used previously. The value of 0.155 was estimated externally to CASAL from catch-at-age and aged mark-recapture data as described in Candy et al. (2011).

6.37 The Working Group suggested a number of sensitivity CASAL runs be carried out in addition to the model run presented in the preliminary assessment (WG-FSA-11/24). These runs are given in Table 5. The preliminary assessment model is denoted a2-2011-alkpool-PE described in WG-FSA-11/24. Discussions focused on the consequence of (1) applying the higher value of M and (2) removing the ageing error matrix (AEM) (i.e. assuming no ageing error). The results of the five sensitivity runs, shown in Table 5, are as follows:

- (i) The effect of (1) is seen most clearly by comparing results in Table 5 for models a2-2011-alkpool-noPE and a2-2011-alkpool-noPE-M13. Model a2-2011-alkpool-noPE uses an M of 0.155, but differs from a2-2011-alkpool-PE by not down-weighting commercial catch-at-age data for process error.
- (ii) Model a2-2011-alkpool-PE-M13 is the same as a2-2011-alkpool-PE but applies an M of 0.13. The fit to the data of the former model is substantially worse and gives an estimate of B_0 that is unrealistically high (Table 5).
- (iii) The effect of (2) was greatest on the coefficient of variation of recruitment (CV_R) which was reduced from 0.78 to 0.24.

6.38 The Working Group noted the high degree of variation prior to 1996 in estimated YCS in the model presented in WG-FSA-11/24. Removing the AEM reduced this variation. However, it was agreed that the AEM was well estimated and ageing error should continue to be included.

6.39 To investigate the effect of dropping the AEM on long-term yield, projections were run using model a2-2011-alkpool-PE-NoAEM and it was found that the escapement decision rule, which was the trigger for both models, gave a long-term yield that was close to identical for each model. It was suggested that consideration should be given in future versions of CASAL of allowing YCS parameters to be estimated as random effect parameters and to allow estimation of an autocorrelation covariance structure between these parameters.

6.40 The preliminary stock assessment described in WG-FSA-11/24 was considered suitable to provide advice on long-term yield. The estimated current stock status in 2011 was 63% of B_0 . The long-term annual yield that meets the decision rules was calculated to be 2 730 tonnes.

6.41 The Working Group noted the program of future work, including plans to:

- (i) continue regular surveys across Division 58.5.2
- (ii) re-estimate the von Bertalanffy growth function using the additional length–age data obtained from 2008 to 2011
- (iii) investigate simplification of the spatial structuring of fishing selectivity functions
- (iv) investigate whether the model could be developed as a two-sex model

- (v) investigate improvements in the model structure that can be made to allow the inclusion of tagging data to assist the estimation of parameters in the model using CASAL; in order to provide some confidence that significant progress in understanding key uncertainties that occur in this division, common to all toothfish assessments, can be made before it is forecast that stock trajectory of SSB reaches the target level.

Management advice

6.42 The Working Group recommended that the catch limit for *D. eleginoides* in Division 58.5.2 west of 79°20'E should be 2 730 tonnes for 2011/12 and 2012/13.

D. eleginoides Kerguelen Islands (Division 58.5.1)

6.43 The Fishery Report for *D. eleginoides* in Division 58.5.1 is contained in Appendix J. The catch of *D. eleginoides* reported for this division to October 2011 was 2 906 tonnes.

6.44 The Working Group noted that the data files used to produce the assessment results reported in WG-FSA-11/28 required zero catches in 2011 for several fisheries in order to produce the reported B_0 of 200 722 tonnes. When catches in all fisheries up to 2011 were included in the data, the estimate of B_0 hit the upper bound of 205 000 tonnes and produced errors when the boundaries for the estimate of B_0 were widened. As a result, the model as it is currently configured could not be used for management advice. The Working Group agreed that a model that uses all the data through the current year for all fisheries and also avoids parameter estimates at the estimation boundaries is required to assess these fisheries.

6.45 The Working Group further requested that more complete documentation of the data sources used in the assessment be reported, and that a description of the historical development of the fishery be provided (paragraph 4.26).

6.46 The Working Group agreed that this assessment could benefit from an otolith ageing program. The main priority would be to estimate a growth curve for Division 58.5.1 as well as to estimate proportion-at-age for the two POKER surveys. It would also be very useful to determine proportion-at-age for catches from the longline fishery.

Management advice

6.47 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 outside areas of national jurisdiction for *D. eleginoides*, described in CM 32-13, remain in force.

Dissostichus eleginoides Crozet Islands (Subarea 58.6)

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

6.49 The catch of *D. eleginoides* reported for this subarea to October 2011 was 551 tonnes. Only longlining is currently permitted in the fishery. IUU catch for 2010/11 had not been estimated.

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

Management advice

6.51 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.

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

6.53 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)

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

6.55 The catch limit of *D. eleginoides* in the South African EEZ for 2010/11 was 440 tonnes for the period from 1 December 2010 to 30 November 2011. The catch reported for Subareas 58.6 and 58.7 as of 5 October 2011 was 76 tonnes, all of which was taken by trotlines.

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

6.57 South Africa has licensed five operators to fish at the Prince Edward Islands, each with a fixed proportional allocation of the catch limit. Since 2006 only one operator (with 27% of the catch limit) has been active in the fishery. However, a second vessel licensed to catch the remaining 73% of the catch limit entered the fishery in late 2010.

6.58 The catch limit of *D. eleginoides* in the South African EEZ for 2011/12 is likely to be 320 tonnes.

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

6.59 The Working Group noted that a revised operational management procedure to form the basis for management advice is under development by national scientists.

6.60 The Working Group was unable to provide management advice for the fishery in the South African EEZ at the Prince Edward Islands.

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

6.61 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.

New and exploratory fisheries

6.62 Seven exploratory longline fisheries for *Dissostichus* spp. were agreed for 2010/11 (CMs 41-04 to 41-07 and 41-09 to 41-11). Activities in these fisheries are summarised in Table 1.

6.63 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 2011/12 (Table 6).

6.64 The Working Group noted the exceptionally high CPUEs recorded in SSRU 5841E in the last two seasons and in SSRU 5842E in 2010/11, which were over five times greater than those recorded in previous seasons for the same SSRUs. The Working Group did not investigate potential reasons for these outliers.

6.65 Unstandardised CPUE data for *Dissostichus* spp. caught in exploratory longline fisheries between 1996/97 and 2010/11 are summarised in Table 7. The Working Group noted the advice from WG-SAM on the caution required in interpreting unstandardised CPUE as an index of stock abundance.

6.66 Under CM 41-01, each longline vessel fishing in exploratory fisheries for *Dissostichus* spp. in 2010/11 was required to tag and release *Dissostichus* spp. at a specified rate per tonne (Table 8).

6.67 Consideration of the cumulative tag-releases prepared by the Secretariat showed that in exploratory fisheries most vessels released tags continuously, at or above the required rates, throughout their fishing trips. The Working Group recommended that a performance metric to reflect the deviations away from the required tag-to-tonne ratio line be developed during the intersessional period.

6.68 Length-frequency overlap statistics showed that in all subareas/divisions all vessels had achieved the required overlap statistic of at least 50% between tag-release length frequency and catch-weighted length frequency under CM 41-01 (Table 9). The Working Group was encouraged to see that almost all vessels had improved their performance over the last three years, some significantly. The marked improvement from last year is encouraging, and shows that vessels can achieve the required overlap statistic of 60% in 2011/12. The Working Group noted that it had initially recommended a tagging overlap statistic of 70% at its 2010 meeting, and that the impact of a lower overlap statistic on the stock assessment results should be evaluated at its next meeting in 2012.

6.69 In 2010/11, 6 279 *Dissostichus* spp. were reported to have been tagged and released in the exploratory longline fisheries (Table 10), and 285 tags were recovered (Table 11). As in previous years, most tags have been recaptured from Subareas 88.1 and 88.2. Out of a total of almost 14 000 tags reported to have been released in Subareas 48.6 and 58.4, there have been only 69 (0.5%) recaptures. Only seven tags were recaptured from these subareas in 2010/11: two from Subarea 48.6 and five from Division 58.4.1. This is the lowest number of tags recaptured since the start of the tagging program even though catches in 2010/11 in these subareas were higher than in the previous two years.

6.70 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. The results suggested that at the broad scale there was a moderately good overlap of where the tags were released and where the effort was subsequently carried out, suggesting that spatial overlap was not the primary problem. However, this analysis did not take into account overlap at smaller spatial scales or movement of fish since release.

6.71 Each longline vessel fishing in exploratory fisheries for *Dissostichus* spp. in Subareas 48.6 and 58.4 in 2010/11 was required to complete 10 research hauls on entering an SSRU in the exploratory fishery. The Secretariat allocated starting positions for research hauls 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). Although Members generally adhered to the requirements, there were a number of cases in 2010/11 (WG-SAM-11/4), and in previous years (SC-CAMLR-XXIX, Annex 8, paragraphs 5.25 to 5.28), where hauls had not been made in the allocated position, had been made in very deep water, or had not been completed before the vessel left the fishery.

Progress on assessments in data-poor exploratory fisheries (Subareas 48.6 and 58.4)

6.72 The Working Group reviewed the unstandardised CPUE from the research hauls summarised in WG-FSA-11/25. The estimates were highly variable between SSRUs, fishing strata and gear types and there were no significant differences in catch rates of research hauls between fished and lightly fished strata or between different gear types. The Working Group noted that the power of these tests was probably low due to the low sample size and high variance and that an increased number of research hauls would likely be necessary to detect

significant trends over time. The Working Group recalled the advice from WG-SAM that CPUE by itself was unlikely to lead to an assessment of stock abundance (Annex 5, paragraph 2.33).

6.73 The Working Group recalled the advice of WG-SAM that failure to acquire the data necessary to develop assessments in data-poor fisheries may be a consequence of poor tagging implementation rather than poor research design (Annex 5, paragraphs 2.37 and 2.38) and that the success of tagging programs may be undermined in a number of different ways, including a low tag overlap statistic, lack of spatial overlap between fishing effort and previous release of tags, depredation of tagged fish, release of fish in poor condition (i.e. high mortality of tagged fish), and capture of tagged fish by IUU vessels (SC-CAMLR-XXIX, Annex 8, paragraphs 5.19 to 5.24). The requirement to meet a tag overlap statistic of 50% has only been in place for one year and the number of recaptures could be expected to increase in future years. There was also new evidence from research fishing in Divisions 58.4.3b and 58.4.4 that there was a high incidence of multiple hooking associated with trotlines (paragraphs 5.37 to 5.43) which could lead to the release of fish in poor condition throughout the Convention Area where this gear type is used. Depredation by killer whales in these studies was also identified as a potential problem.

6.74 The Scientific Committee considered the assessment of *Dissostichus* spp. in data-poor fisheries to be of a high priority (SC-CAMLR-XXIX, paragraphs 3.125 to 3.145). The Working Group noted that no progress had been made in the assessment of the data-poor exploratory toothfish fisheries over the past few years. It also agreed that the research being conducted under the existing research plan in CM 41-01, Annex B, is unlikely to lead to assessments in these fisheries in the next 3–5 years.

6.75 The Working Group therefore agreed that the number of research hauls and the tagging rates should be increased to increase the amount of data and number of tags coming back from the fishery. Increasing the number of research hauls in previously fished strata would increase the likelihood of tagged fish being recaptured. 2010/11 was the first season that all vessels achieved the 50% tag overlap statistic, so vessels should be required to fish in locations fished in 2010/11 to increase the chance of recapturing these larger fish. Vessels should also increase the number of research sets in unfished strata to increase our knowledge of the distribution of toothfish in the SSRU.

6.76 Because of the generally low number of tag recaptures in these fisheries, it would be difficult to predict the likely increase in tag recaptures for a given increase in the number of research hauls. However, the Working Group agreed that a substantial increase would be necessary to provide enough tag recaptures for a stock assessment. To test the extent to which tag-recapture rates can be improved by increasing spatial overlap in fishing effort between years, it recommended that, sea-ice conditions permitting, at least 40 research hauls should be made in the group of fine-scale rectangles (0.5° latitude \times 1.0° longitude) which had been fished with three or more sets in the last two years, and that an additional 10 research hauls should be made in unfished/lightly fished strata in each SSRU (see Figure 6). An alternative option would be to require all fishing carried out in these SSRUs to be research hauls.

6.77 To test the extent to which low tag recapture rates may be a consequence of releasing fish with a low probability of survival, the Working Group recommended that vessels be required on all research hauls to collect data characterising the suitability of captured fish for tagging, including number of hooking injuries (paragraph 5.41).

6.78 The Working Group also noted that an increase in the tagging rate and the tagging of fish in only good condition should also lead to an increase in tag recaptures in the future. Although these are not exploratory fisheries, tagging rates of five fish per tonne have been achieved in Subarea 48.4 and Division 58.4.3b (WG-FSA-11/8). The Working Group therefore recommended that the tagging rate be increased to five fish per tonne. It also recommended that only single-hooked good-condition fish be tagged and released (paragraph 5.38).

6.79 The Working Group also considered the focus topic on implementing research proposals in data-poor fisheries held by WG-SAM (Annex 5, paragraph 2.21). It noted that there were a number of key elements which had led to assessments of toothfish in SSRU 882E and Subarea 48.4 North (Annex 5, paragraph 2.21), including a robust experimental design with a well-coordinated multi-year tagging program focused on repeatedly visiting a relatively small area and a commitment by vessels to achieving high tagging performance. It further noted that research proposals incorporating these elements could potentially be applied in data-poor exploratory fisheries to provide the data necessary to assess the stocks.

6.80 The Working Group recommended that the Scientific Committee consider a change to the requirements in the fishery notification whereby Members are required to submit a research proposal when notifying to fish in a data-poor exploratory fishery (CM 21-02). The research proposal would have the key elements identified in Table 6 of Annex 5. A well-designed multi-annual research proposal should focus on an appropriate area within Subareas 48.6 and 58.4 and could include research in open and in closed SSRUs. The Working Group noted that worked examples could be provided for particular areas to make it clearer over what would be expected.

6.81 The Working Group recalled its discussions on ageing toothfish otoliths in 2010 (SC-CAMLR-XXIX, Annex 8, paragraphs 8.18 to 8.24) and the importance of reliable and validated age data in assessing toothfish stocks. The Working Group agreed that the inventory of otoliths available from the various fisheries, the number of otoliths read, and the location of the otoliths collated by the Secretariat (WG-FSA-11/7) was a useful resource and should be updated. The Working Group noted that Ukraine had begun ageing *D. mawsoni* otoliths collected by Members from Subarea 48.6 and Divisions 58.4.1 and 58.4.2 (WG-FSA-10/13). Dr L. Pshenichnov noted that Ukraine proposes to continue this work during the intersessional period. The Working Group also noted that preliminary otolith ageing had been carried out on fish caught in research surveys in Subarea 88.3 (by Russia) and in Division 58.4.4 (by Japan). It recommended that a coordinated plan to read otoliths from all the data-poor exploratory fisheries in Subareas 48.6 and 58.4 needs to be developed.

6.82 Dr Welsford offered the use of the laboratory facilities at the AAD for inter-laboratory ageing comparisons of *D. mawsoni* during the 2012 meeting of WG-FSA. The Working Group thanked Dr Welsford for his offer and requested Members bring prepared otolith material (including reference collections) which could be read and exchanged at the meeting. The Working Group agreed that an afternoon during the first week of WG-FSA should be set aside to facilitate this otolith reading work and encouraged Members with an interest in ageing *D. mawsoni* to be involved. Drs Petrov, Pshenichnov and Hanchet agreed to bring aged otolith material for this informal workshop.

Tagging

6.83 The Secretariat presented WG-FSA-11/6 which outlined a methodology developed by the Secretariat to assess the level of confidence in the links made between a recaptured tag and its tagging event. The link status included those where the link could be made immediately based on the tag number details, where links could be made but there were inconsistencies in the associated data, and those where no tagging event exists in the database.

6.84 The Working Group requested that an analysis be done to determine whether the majority of errors were occurring when the tags were being released or recovered and noted that one source of error may come from measuring and weighing live toothfish prior to tagging which was not always easy or practical. To allow for the potential errors arising from measuring live and dead fish, the Working Group recommended that a threshold value be developed to determine whether such differences would affect the tag-linking status.

6.85 WG-FSA-11/50 reviewed the current tagging objectives, procedures and vessel performance metrics and provided suggestions on how observer and vessel crew guidelines might be improved. The paper reviewed these items from a user perspective noting that, while in general CCAMLR tagging protocols were working well, there were a number of areas where changes could improve the tagging program.

6.86 Simulations carried out and presented in the paper indicated that under certain circumstances, specifically related to discrete differences in length-frequency distributions within a subarea or division, or where tagging rates varied within a subarea or division, a degraded tag overlap statistic could result despite the vessels following all measures correctly, but in no instance was this effect strong enough to generate a tag overlap statistic lower than 70%. Simulations also indicated that the 2-tonne trigger level currently set to activate Annex 41-01/C was too low and could result in an unintentional breach of the conservation measure. Some issues in respect to the proportional tagging by species could be solved by a change to this trigger level.

6.87 The Working Group recommended that Annex 41-01/C, paragraph (ii), be modified as follows: 'Each vessel catching more than 10 tonnes of *Dissostichus* spp. in a fishery shall achieve a minimum tag overlap statistic of 60% from 2011/12 onward'.

6.88 WG-FSA-11/50 also noted that instances where tags were not initially seen by crew appeared to be related to the colour currently used by CCAMLR in *Dissostichus* fisheries and suggested the use of a more contrasting colour when the existing pool of CCAMLR tags had been deployed. The Working Group recommended a change to the use of more contrasting-coloured tags for toothfish to improve tag detection rates.

6.89 The Working Group recommended that the CCAMLR tagging protocols be reviewed, updated and translated into other languages intersessionally. This process would include the development and provision of a training module for use on vessels.

Update Fishery Reports for new and exploratory fisheries

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

Dissostichus spp. Subarea 48.6

6.90 Three Members (Japan, South Africa and the Republic of Korea) and four vessels fished in Subarea 48.6 SSRUs A, B, C and G in 2010/11. 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 M.

6.91 The combined SSRUs B, C, D, E and F were closed on 7 February 2011 (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: 196 tonnes) were closed on the 19 April 2011. There was no evidence of IUU fishing in 2010/11.

6.92 The number of tag recaptures was very low in Subarea 48.6 in 2010/11. The Working Group noted that in total there have been very few tag recaptures from this subarea, and that no progress could be made on assessments of *D. eleginoides* in Subarea 48.6. The Working Group noted all vessels fishing in Subarea 48.6 in 2010/11 achieved a tag overlap statistic greater than 50% (range 53 to 95%). It also noted that this improved performance indicated that vessels can achieve the required overlap statistic of 60% in the 2011/12 fishing year.

6.93 Five Members (Japan, Republic of Korea, Norway, Russia and South Africa) and a total of seven vessels notified for toothfish in Subarea 48.6 in 2011/12.

6.94 The Working Group agreed that it could provide no new advice on catch limits for this subarea and noted the recommendations for increasing the research requirements in this fishery identified in paragraphs 6.75 to 6.80.

6.95 The Working Group requested the Secretariat examine the possibility of obtaining a Petersen estimate of *Dissostichus* spp. biomass from tag recaptures in Subarea 48.6 in the intersessional period.

Dissostichus spp. Division 58.4.1

6.96 Three vessels from two Members (Spain and the Republic of Korea) fished in the exploratory fishery in Division 58.4.1 in 2010/11. The precautionary catch limit for toothfish was 210 tonnes in three SSRUs (C: 100 tonnes, E: 50 tonnes and G: 60 tonnes), and 216 tonnes were taken between 1 December 2010 and 12 March 2011. Information on this fishery is summarised in Appendix N.

6.97 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. The IUU catch of *Dissostichus* spp. in 2010/11 was not estimated.

6.98 Vessels were required to tag and release *Dissostichus* spp. at a rate of three fish per tonne of green weight caught and all vessels achieved the target rate. A total of 5 759 *D. mawsoni* and 314 *D. eleginoides* have been tagged and released in Division 58.4.1,

and 26 *D. mawsoni* and one *D. eleginoides* have been recaptured in that division. In 2010/11, 747 *D. mawsoni* and no *D. eleginoides* were tagged with five *D. mawsoni* and no *D. eleginoides* recaptured. The Working Group noted all vessels fishing in Division 58.4.1 in 2010/11 achieved a tag overlap statistic greater than 50% (range 52 to 74%). The Working Group noted that this improved performance indicated that vessels can achieve the required overlap statistic of 60% in 2011/12.

6.99 Six Members (Japan, Republic of Korea, New Zealand, Russia, South Africa and Spain) and a total of 11 vessels notified their intention to fish for toothfish in Division 58.4.1 in 2011/12.

6.100 The Working Group agreed that it could provide no new advice on catch limits for this division and noted the recommendations for increasing the research requirements in this fishery identified in paragraphs 6.75 to 6.80.

Dissostichus spp. Division 58.4.2

6.101 In 2010/11, the exploratory fishery for *Dissostichus* spp. in Division 58.4.2 was limited to Japanese, Korean, New Zealand, South African and Spanish vessels using longlines only. Only one Member (the Republic of Korea) fished in the division and reported a catch of 136 tonnes. SSRU E was closed on 24 February 2011 (SSRU E catch limit for *Dissostichus* spp.: 40 tonnes; final reported catch: 136 tonnes) and SSRU A, and consequently the fishery, was closed on 25 February 2011 (SSRU A catch limit for *Dissostichus* spp.: 30 tonnes; final reported catch: 0 tonnes). The other SSRUs (B, C and D) were closed to fishing. Information on this fishery is summarised in Appendix O.

6.102 The fishery targeted *D. mawsoni* and operated in SSRU E in 2010/11. The total removal of *Dissostichus* spp. in 2010/11 was estimated at 136 tonnes and well in excess of the catch limit of 40 tonnes. The IUU catch of *Dissostichus* spp. in 2010/11 was not estimated.

6.103 The vessel in Division 58.4.2 achieved the target tagging rate of 3 tags per tonne of green weight and achieved a tag overlap statistic greater than 60% (Table 9). A total of 408 toothfish were tagged and released in 2010/11 and no tagged toothfish were recaptured (Tables 10 and 11).

6.104 Five Members (Japan, Republic of Korea, New Zealand, South Africa and Spain) and a total of five vessels notified their intention to fish for toothfish in Division 58.4.2 in 2011/12.

6.105 The Working Group noted the greatly exceeded catch in SSRU E (catch limit for *Dissostichus* spp.: 40 tonnes; final reported catch: 136 tonnes) and expressed the concern that this severely compromises the ability to conduct research in this division and develop adaptive management strategies and stock assessments.

6.106 Some participants requested that the Scientific Committee consider reducing the recommended catch limit in SSRU E to zero for a period of time to reflect the overrun of catches.

6.107 The Working Group agreed that it could provide no new advice on catch limits for this division and noted the recommendations for increasing the research requirements in this fishery identified in paragraphs 6.75 to 6.80.

Dissostichus spp. Division 58.4.3a

6.108 In 2010/11, the exploratory fishery for *Dissostichus* spp. in Division 58.4.3a was limited to one Japanese vessel using longlines only. The precautionary catch limit for toothfish was 86 tonnes. The vessel fished and reported a total catch of 4 tonnes of *D. eleginoides*. Information on this fishery is summarised in Appendix P.

6.109 There was no evidence of IUU fishing in 2010/11.

6.110 Fourteen toothfish were tagged and released in 2010/11 and no tagged toothfish were recaptured during that season.

6.111 Three Members (France, Japan and South Africa) notified their intention to fish for toothfish in Division 58.4.3a in 2011/12.

6.112 The Working Group agreed that it could provide no new advice on catch limits for this division and noted the recommendations for increasing the research requirements in this fishery identified in paragraphs 6.75 to 6.80.

Dissostichus spp. Subareas 88.1 and 88.2

6.113 In 2010/11, five Members and 16 vessels fished in the exploratory fishery in Subarea 88.1 between December 2010 and January 2011. The fishery was closed on 14 January 2011 and the total reported catch of *Dissostichus* spp. was 2 882 tonnes (101% of the limit) (CCAMLR-XXX/BG/8, Table 2). The following SSRUs were closed during the course of fishing:

- SSRUs B, C and G closed on 10 December 2010, triggered by the catch of *Dissostichus* spp. (total catch 349 tonnes; 94% of the catch limit)
- SSRUs J and L closed on 9 January 2011, triggered by the catch of *Dissostichus* spp. (total catch 428 tonnes; 114% of the catch limit)
- SSRUs H, I and K closed on 14 January 2011, triggered by the catch of *Dissostichus* spp. (total catch 2 105 tonnes; 100% of the catch limit).

6.114 Five Members and 12 vessels fished in the exploratory fishery in Subarea 88.2 between December 2010 and February 2011. The fishery closed on 8 February 2011 and the total reported catch of *Dissostichus* spp. was 576 tonnes, including 10 tonnes taken during research fishing in SSRU A (100% of the limit) (CCAMLR-XXX/BG/8, Table 2). The following SSRUs were closed during the course of fishing:

- SSRUs C, D, F and G closed on 8 February 2011, triggered by the catch of *Dissostichus* spp. (total catch 216 tonnes; 101% of the catch limit)
- SSRU E closed on 8 February 2011, triggered by the catch of *Dissostichus* spp. (total catch 350 tonnes; 97% of the catch limit).

6.115 Details of notifications of intentions to fish in 2011/12 are summarised in CCAMLR-XXX/11. For Subarea 88.1, notifications were submitted by seven Members with a total of 20 vessels. For Subarea 88.2, notifications were submitted by six Members with a total of 19 vessels.

6.116 The Fishery Report for *Dissostichus* spp. in Subareas 88.1 and 88.2 is in Appendix R.

6.117 Within Subarea 88.2, SSRUs 882C–G were assessed as a single stock unit for the first time, and two fisheries were identified; north of 70°50'S and south of 70°50'S.

6.118 In all seasons, there was a broad mode of adult fish at about 120–170 cm in Subarea 88.2. In years when fishing occurred in the south of Subarea 88.2, there was also a strong mode at about 60–70 cm. These fish were predominantly caught at the edge of the continental shelf.

6.119 Dr Petrov informed the Working Group that Russia had read over 6 000 otoliths from Subarea 88.1 collected between 2002/03 and 2007/08. The Working Group considered that it would be very useful to conduct inter-laboratory comparisons to evaluate the ageing methodologies and recommended these be initiated during its meeting in 2012 (paragraph 6.82).

6.120 Under CM 41-01, each longline vessel fishing in exploratory fisheries for *Dissostichus* spp. is required to tag and release *Dissostichus* spp. at a rate of one fish per tonne of green weight caught throughout the season.

6.121 A high-quality tag dataset for the assessment of *D. mawsoni* was selected on the basis of data-quality metrics for individual trips (WG-FSA-11/42). The method first selected an initial informative dataset comprising trips with (i) high (above median) rates of recovery of previously released tags, or (ii) where tags released on the trip were subsequently recaptured at a high rate. The method then used these trips to define the upper and lower bounds of data-quality metrics that were informative with respect to tagging data. Other trips with data-quality metric values within these ranges were then added to the initial informative dataset.

6.122 Since 2000/01, more than 29 000 *Dissostichus* spp. have been tagged in Subareas 88.1 and 88.2, with more than 26 000 and 2 600 *D. mawsoni* in the Ross Sea and SSRUs 882C–G respectively (WG-FSA-11/46). A total of 19 514 releases and 962 recaptures were used in the assessment of the Ross Sea (WG-FSA-11/42), and 2 187 releases and 267 recaptures were used in the assessment for SSRUs 882C–G (WG-FSA-11/43).

6.123 The CASAL model, using catch-at-age and tag-recapture data and *D. mawsoni* biological parameters, was used to estimate the current and initial population size, and to calculate the long-term annual yield that would satisfy the CCAMLR decision rules (model R1 for the Ross Sea in WG-FSA-11/42, and model R3 for SSRUs 882C–G in WG-FSA-11/43).

6.124 The constant catch for which there was median escapement of 50% of the median pre-exploitation spawning biomass level at the end of the 35-year projection period for the Ross Sea (Subarea 88.1 and SSRUs 882A–B) was 3 282 tonnes. At this yield, there is a less than 10% chance of spawning biomass dropping to less than 20% of the initial biomass. A yield of 3 282 tonnes is therefore recommended.

6.125 The Working Group noted that the estimated catch associated with the 65 prescribed sets in WG-FSA-11/47 is 40 tonnes (range 22–71 tonnes). The Working Group recommended that a research catch of 40 tonnes should be set aside to allow the pre-recruit survey to be conducted immediately following the closure of the fishery in Subarea 88.1. The Working Group noted that the proposal suggested that if the catch on these hauls exceeds 40 tonnes, then the excess catch could be deducted from the catch limit in the following year.

6.126 The constant catch for which there was median escapement of 50% of the median pre-exploitation spawning biomass level at the end of the 35-year projection period for SSRUs 882C–G was 530 tonnes. At this yield, there is a less than 10% chance of spawning biomass dropping to less than 20% of the initial biomass. A yield of 530 tonnes for these SSRUs combined is therefore recommended.

6.127 The Working Group noted that the Subarea 88.2 fishery had been modelled as two fisheries with a split at 70°50'S, and considered that this was also an appropriate way to allocate catch limits. Over the last three seasons 76% of the catch was taken from the north of 70°50'S and 24% of the catch was taken from the south. The Working Group therefore recommended that 76% of the yield (406 tonnes) be assigned to the region north of 70°50'S and the remainder (124 tonnes) be assigned to the region south of 70°50'S. It recommended that the SSRUs in Subarea 88.2 be renumbered in accordance with Figure 7, noting that a catch limit of 406 tonnes should be applied to the new SSRU 882H and the catch limit of 124 tonnes should be amalgamated across the new SSRUs 882C–G. It further recommended that the proportional allocation and SSRUs should be reviewed in two years' time when this subarea is next assessed.

6.128 The Working Group recommended that the allocation method used to set the 2009/10 catch limits for SSRUs in Subarea 88.1 be continued for 2011/12. This would result in 428 tonnes in the north (SSRUs 881B, C, G), 2 423 tonnes on the slope (SSRUs 881H, I, K) and 431 tonnes on the shelf (SSRUs 881J, L).

6.129 The Working Group agreed that the catch limits for *Dissostichus* spp. in Subarea 88.1 should be 3 282 tonnes and for *Dissostichus* spp. in Subarea 88.2 should be 530 tonnes.

6.130 The Working Group agreed that other measures in the research and data collection plans, including the tagging requirement for one fish per tonne, be retained for the exploratory fisheries in Subareas 88.1 and 88.2.

Assessment and management advice for other fisheries

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

6.131 There was no new information available to the Working Group for 2010/11 for these subareas.

Management advice

6.132 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)

6.133 Crabs were not harvested during 2010/11, and no notifications of intention to fish for crabs in 2011/12 have been received by CCAMLR.

6.134 WG-FSA-11/26 reviewed the information currently available on the biology and ecology of the lithodid crabs at South Georgia and provided an overview of the development of a management regime for them. Considerable gaps in knowledge of the biology, ecology and demography of the lithodid species at South Georgia are highlighted with uncertainty surrounding estimates of biomass, growth rates and survivorship of discards of the targeted species.

6.135 The review reported that recent analyses suggest that the current precautionary catch limit may not be sustainable in the long term if it were reached consistently. It was noted that apart from 2009/10, there has been very little commercial interest in the fishery. Low market value and interest, coupled with the very high level of discarding, are likely to render the fishery commercially unviable.

Management advice

6.136 Reflecting on the high level of discarding and uncertainty surrounding discard mortality, the Working Group recommended that the crab fishery in Subarea 48.3 be closed.

BOTTOM FISHING ACTIVITIES AND VULNERABLE MARINE ECOSYSTEMS (VMEs)

7.1 Following the work plan endorsed by the Scientific Committee (SC-CAMLR-XXIX, paragraph 15.4), the Working Group discussions related to bottom fishing and VMEs in 2011 were restricted to three main topics: (i) reviewing notifications of new VMEs under CM 22-06 and notifications of Risk Areas under CM 22-07, (ii) reviewing the preliminary assessments of bottom fishing impacts by Members, and (iii) updating the bottom fishing

activities in the VME report. Most of the information required to conduct the review was provided by the Secretariat in CCAMLR-XXX/12 and BG/8. As part of this work, three papers related to Members' impact assessments were discussed (WG-FSA-11/51 Rev. 1, 11/53 and 11/54).

Risk Areas and VME Registry

7.2 The Working Group reviewed two new notifications of VMEs made under CM 22-06 (WG-EMM-11/10). The Working Group agreed with the recommendation of WG-EMM that the Scientific Committee include the two areas on the VME registry (Annex 4, paragraphs 3.3 and 3.4).

7.3 These two areas are the first notified VMEs occurring in an area currently open to *Dissostichus* spp. bottom fishing within the area applicable to CM 22-06. Therefore, while other registered VMEs are protected through other conservation measures currently in force in those areas, no specific protection mechanism for registered VMEs exists in areas open to bottom fishing for *Dissostichus* spp. The proposal (WG-EMM-11/10) provided information showing that these areas were isolated from similar habitats and proposed two boxes, of approximately 17 km² and 19 km², that could be closed to fishing.

7.4 The Working Group recommended that a single point and a defined radius for each location could protect the same area while making administration and management of these areas simpler, and conforming to the typical approach used to prohibit fishing near Risk Areas. The Working Group recommended prohibiting fishing within the areas of two circles, centred at -66.934°S 170.861°W and -67.169°S 171.171°W, with radii of 1.25 n miles (2.32 km) to provide protection from direct effects of interactions with fishing gear.

7.5 The Working Group noted that a total of 112 notifications of encounters with potential VMEs have been received by the Secretariat, resulting in the designation of 46 Risk Areas (WG-EMM-11/7). Thirty-one of these risk areas were generated in 2011 in SSRU 881K.

Review of preliminary impact assessments

7.6 WG-FSA-11/51 Rev. 1 presented additional software development of PlotImage, presented in WG-SAM-10/22. The development, termed PlotImpact, uses the framework of PlotImage and the impact assessment method described in Appendix D, to translate gear-specific impact assessments into composite % impact maps and summary tables for applicable subareas and divisions. The Working Group recommended that the locations of notified VMEs and Risk Areas be overlaid on the PlotImage map outputs to visualise their locations relative to fishing effort density and estimated cumulative impact levels (Appendix D, Figure 6(i)).

7.7 WG-FSA-11/53 and 11/54 were presented by the Republic of Korea and described the Spanish longline gear configuration used by some Korean vessels in *Dissostichus* spp. fisheries. The description of the gear was welcomed by the Working Group and future descriptions of other fishing gear types, especially trotline and trawl, was encouraged, especially noting that variations within a class of gear configuration may exist which could

influence gear performance or catchability and that terminology may vary among Members for similar components of gear (e.g. the ‘main line’ of the a gear refers to different components between Spanish and Korean industries, and hook spacing may be easily varied within a set depending on how the snoods are attached). The Working Group commended the authors for considering gear modifications (i.e. transition to smaller smooth steel weights that do not require mesh holders) to reduce impacts to benthic habitats.

7.8 The Working Group noted that the description of gear configuration and operation is useful in refining preliminary impact assessments. It is especially important to estimate the potential frequency and extent of lateral longline movement in contact with the sea floor. The Working Group requested all Members to produce detailed descriptions of gear performance and to incorporate them into the impact assessment procedures endorsed by the Scientific Committee.

7.9 The Working Group recommended that the Spanish gear description (WG-FSA-11/53) and trotline configuration (Figure 5) should be added to the CCAMLR gear library for reference and use by other Members. It also recommended that previous papers (WG-FSA-05/26, 06/5 and 06/15) may provide useful information on gear configurations and could be added to the gear library with author permission. As these papers were prepared before aspects of gear performance such as gear footprint were required, they do not provide the level of detail needed for preliminary assessments of bottom impact, but are a useful starting point in describing the various ways longline gears, especially Spanish and trotline gears, have been configured.

7.10 The Secretariat provided updated total fishing effort summaries by gear type and subarea and division, showing the relative amount of fishing effort in each subarea or division and highlighting how the gear types used vary by subarea and division (Appendix D, Table 1).

7.11 The Working Group conducted reviews of the preliminary bottom fishing impact assessments provided by Members under CM 22-06. The pro forma describing the required information was updated at WG-FSA-10 and noted by the Commission (CAMLR-XXIX, paragraph 5.2). The Working Group therefore developed an updated report card format to match the sections of the new pro forma for review (Annex 22-06/A). The Working Group noted that several Members had not used the new pro forma, and therefore had not provided some of the information needed for a meaningful review. However, with reference to the preliminary assessments submitted in 2010, the 2011 preliminary assessments were much improved, more detailed, and provided a better scientific basis for estimating proposed effort density in the upcoming fishing year.

7.12 In summarising the preliminary assessments to a single table format, several categorical assignments were made. First, the use of the correct pro forma is indicated with a check mark, as information needed was not always provided if the old pro forma was used. Sections 2.1(ii) and 2.1(iii) information was summarised as ‘D’ if gear description and performance were described in the notification, or ‘R’ if they referred to an existing document. The estimated footprint and impact indices, if they could be calculated with the information provided, and typically with more information provided by Member representatives attending WG-FSA, were specified for the gear types notified. An estimate of the total proposed effort (in km of longline) was calculated if possible to show proposed effort in 2012 relative to the cumulative effort to date (Appendix D, Table 1).

7.13 The Working Group recommended that, as the information provided by Members in the preliminary assessments becomes more streamlined, the Secretariat may provide some initial review of the information provided and work with Members to correct any minor issues prior to review by WG-FSA.

7.14 Preliminary assessments were provided by 10 Members, some providing separate assessments for different vessels or gear types. The total proposed effort results in 24 vessels, in 33 vessel/subarea combinations and 68 vessel*subarea combinations (Appendix D, Table 2). For most Members, an estimate of the footprint index and the impact index was generated, which, when combined with the proposed effort levels (or past effort levels), provides estimates of the total spatial effort density for each subarea/division. If Members' preliminary assessments provided documents that evaluated new gear modifications that may minimise benthic impacts further, these documents can be identified under Item 3.

7.15 The summary of estimated gear footprints for the different gear types shows that although the footprint estimates can be strongly influenced by assumptions of the frequency and magnitude of lateral movement, the largest estimates were only six times the smallest. However, even within a gear type, estimates were different and because no documents were provided describing how the gear may interact with the benthos, the Working Group could not review and develop composite estimates of the parameters needed to estimate impact for each gear type. The Working Group recommended that Members should provide or reference a document describing the gear to be used, along with the supporting rationale for how that gear configuration may interact with the sea floor. This supporting evidence can be derived from existing literature, new research and expert knowledge.

7.16 To estimate impact of cumulative longline effort by subarea and division, the descriptive statistics agreed in 2010 by WG-FSA were used for all longline gear types to generate the impact plots in Appendix D, Figures 6(a) to 6(k).

7.17 The spatial maps of impact estimates within the Ross Sea, with Risk Areas and proposed VMEs overlaid, show that Risk Areas fall into two main clusters, and that these clusters do not occur where the highest levels of cumulative impacts have been estimated (Appendix D, Figure 6(i)).

SCHEME OF INTERNATIONAL SCIENTIFIC OBSERVATION

8.1 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-IMAF-11/5 Rev. 2 and 11/6.

8.2 WG-FSA-11/21 developed length-weight relationships for toothfish (paragraph 3.9) and noted a number of errors in these data within the observer database. Noting that the length-weight relationships could be built into the observer logbook to provide data validation and error flagging during data input, the Working Group recommended that this be implemented for 2012/13.

8.3 The Working Group noted that there is some confusion in the way that vessels and observers are reporting position information, and the current format (e.g. *Scientific Observers*

Manual, p. 12) is still occasionally being misinterpreted. The Working Group agreed that all positions should be reported as DD (whole degrees) and MM.mm (minutes and fractions of minutes), using two separate fields in data forms to remove any ambiguity.

8.4 WG-FSA-11/39 Rev. 1 presented an excellent visual guide to macroscopic maturity staging of *D. eleginoides* gonads. The Working Group recommended that this guide be included in the *Scientific Observers Manual* and agreed that this guide could also be applied to *D. mawsoni*, and recommended that similar guides be developed for other target species and common by-catch species.

8.5 The Working Group supported the initiative to develop a comprehensive photographic field guide to Antarctic fishes (WG-FSA-11/40). Members are encouraged to collaborate with this initiative by making additional images and distributional data available to the authors, and especially information useful for field identification.

8.6 Three papers contained potential tasks that could be assigned to observers (but see paragraph 8.7):

- (i) WG-FSA-11/5 and 11/41 reported on fish by-catch in krill fisheries (see discussion in paragraphs 3.12 to 3.17). The Working Group recognised the importance of these data and recommended that the collection of length data would be more important than the weight in determining the part of the fish population most impacted by the krill fishery. In reviewing the species composition reported in WG-FSA-11/5, it was recognised that the identification of some species of fish (particularly the younger specimens) is a difficult task, therefore, where possible, observers are requested to continue to photograph and retain samples to validate identification of some fish species.
- (ii) WG-FSA-11/11 reported observations of baleen whales during krill fishing trips. The Working Group recognised that it may be possible to record cetacean activities from krill fishing vessels in a more quantitative manner but that this would require a restructuring of the observer's tasks and that it may be useful to consult with the IWC on appropriate methodologies.

8.7 In 2010 the Working Group recommended that the sampling requirements for observers be clarified and that the requirements listed in various conservation measures and in the observer logbook be aligned (SC-CAMLR-XXIX, Annex 8, paragraphs 10.4 to 10.6). Noting the summary presented in WG-FSA-11/25 and the discussion of observer tasking in WG-EMM (Annex 4, paragraphs 2.42 to 2.44) and WG-IMAF (Annex 8, paragraphs 7.8 and 7.9), the Working Group requested the Scientific Committee to constitute a task group with representation from all interested parties (including WG-FSA, WG-EMM, WG-IMAF and SCIC) to review observer sampling requirements across all fishing sectors and conservation measures. In this regard the Working Group noted that:

- (i) CM 41-01 was revised in 2010 in response to a recommendation from WG-FSA-10 (SC-CAMLR-XXVII, Annex 5, paragraphs 11.4(ii)(c) and (d) and SC-CAMLR-XXIX, Annex 8, paragraph 10.5) to determine the maximum number of fish sampled per line based on the number of hooks set. However, CM 41-01 omits guidance on the minimum sampling requirement. The Working Group recommended that CM 41-01, Annex B, be revised as follows: 'In the

exploratory fisheries in Statistical Subareas 88.1 and 88.2, all data specified in the Data Collection Plan (Annex 41-01/A) of this conservation measure shall be collected for every haul: all fish of each *Dissostichus* species in a haul (at a rate of 7 fish per 1 000 hooks up to a maximum of 35 fish for each species) are to be measured and randomly sampled for biological studies (paragraphs 2(iv) to (vi) of Annex 41-01/A)’

- (ii) the operating model development outlined in WG-FSA-11/20 could aid in the evaluation of data collection and sampling requirements
- (iii) some vessels provide a more suitable working area, facilities and assistance for observer tasks enabling observers to complete tasks more efficiently and effectively. Cognisance should be taken of this when assessing the workload of observers.

FUTURE WORK

9.1 The Working Group noted the three-year tasking for the working groups undertaken at the Scientific Committee meeting last year (SC-CAMLR-XXIX, Table 7) and recognised that despite this process there were still a large number of issues for consideration next year. In order to produce a tractable agenda for its meeting in 2012 that would facilitate broad participation, the Working Group recommended that focus on a smaller number of high-priority issues may be required. This could take the form of a focus topic in the Working Group meeting or, following the example of SG-ASAM, if there is a requirement to address a particular high-priority issue, the Scientific Committee could consider the possibility of holding a meeting with clearly defined terms of reference rather than remit additional tasks to the working groups.

9.2 The Secretariat informed the meeting that it hoped that the changes proposed in the revised Strategic Plan (CCAMLR-XXX/8) would strengthen the Secretariat’s role in facilitation of successful completion of priority intersessional tasks.

9.3 The Working Group agreed that the review of VMEs, research fishing in data-poor fisheries and by-catch (including results from the Year-of-the-Skate and fish by-catch in krill fisheries), ageing *D. mawsoni* otoliths (paragraphs 6.81 and 6.82) were priority issues for consideration, but noted that this did not include all of the items indicated in SC-CAMLR-XXIX, Table 7, for consideration by WG-FSA in 2012.

9.4 Four notifications in accordance with CM 24-01 for scientific research activities in 2011/12 were received by the Secretariat and presented in WG-FSA-11/9:

- (i) Scientific research notifications (CM 24-01, paragraph 2) –
Germany: Subareas 48.1 (March–April 2012), fish research
- (ii) Research fishing notifications (CM 24-01, paragraph 3) –
Russia: Subareas 88.2 and 88.3 (January–March 2012), toothfish
Chile: Subarea 48.3 (August 2012), toothfish.

9.5 A notification from New Zealand to conduct a survey in Subarea 88.1 is considered in paragraphs 5.44 and 5.45.

9.6 In respect of the proposal from Chile, Dr M. Collins noted that the UK was undertaking similar research in the same region and offered to work intersessionally with Chile to develop a collaborative proposal.

9.7 The Working Group also noted that the UK and Australia will be conducting research surveys in 2012 in Subarea 48.3 and Division 58.5.2 respectively, and that the USA will be conducting a survey for pelagic fish in Subarea 48.1 in early 2012.

General matters

9.8 The Working Group identified the following items of future work (not including recommendations for modifications to research fishing provided in section 5):

- (i) implementations of the decision rule related to depletion and escapement (paragraph 3.4)
- (ii) fish by-catch in krill fisheries (paragraph 3.21)
- (iii) methods for the estimation of IUU catch for use in assessments (paragraph 3.28)
- (iv) evaluation of the performance of decision rules and the use of limit reference points (paragraph 4.17)
- (v) development of metrics for use in evaluating research proposals (paragraph 4.2)
- (vi) approaches to modelling data from data-poor fisheries (paragraphs 4.41 and 4.42)
- (vii) progress on assessment for French EEZ in Division 58.5.1 (paragraphs 4.25 to 4.27 and 6.45)
- (viii) further examination of historical changes in fleet selectivity (paragraph 6.23)
- (ix) coordination of ageing of otoliths of *D. mawsoni* (paragraphs 6.81, 6.82 and 6.119)
- (x) development of threshold levels for tag-linking status (paragraph 6.84)
- (xi) review and update of CCAMLR tagging protocols (paragraph 6.89)
- (xii) update information in the CCAMLR gear library (paragraph 7.9)
- (xiii) pre-review of preliminary impact assessments by the Secretariat (paragraph 7.13)
- (xiv) data validation based on length and weight of toothfish (paragraph 8.2)

- (xv) include visual guide to macroscopic maturity staging of *D. eleginoides* gonads in the *Scientific Observers Manual* and develop similar guides for other target species and common by-catch species (paragraph 8.4)
- (xvi) review of observer tasks (paragraph 8.7).

OTHER BUSINESS

Review of the Secretariat's Strategic Plan and data management systems

10.1 The Working Group noted the outcomes of the independent review of the Secretariat's data management systems (CCAMLR-XXX/5) and the review of the Secretariat's Strategic Plan (CCAMLR-XXX/8). The independent review of the Secretariat's data management systems recommended restructuring of existing functions and associated staffing arrangements in the Secretariat in relation to data management and IT support, including the use and management of the Secretariat's website, increased attention to risk management and data quality assurance, harmonisation of internal data administration policies and procedures, consideration of end-of-life matters relating to software applications and rationalisation of IT hardware. The review provided expert input to the review of the Strategic Plan, and a summary of the key recommendations was also presented to WG-SAM and WG-EMM (Annex 5, paragraphs 6.1 to 6.5; Annex 4, paragraphs 6.1 to 6.3).

10.2 The review of the Strategic Plan included contributions from external stakeholders, in-house workshops comprising all Secretariat staff and advice from external experts in relation to staffing matters. The outcomes included a revised Strategic Plan for 2012 to 2014 and associated Staffing and Salary Strategy. The key areas of relevance to the Scientific Committee and its working groups are:

- six functional services each headed by a Manager reporting to the Executive Secretary. Previously there were nine direct reports to the Executive Secretary and a mix of titles of 'Manager' and 'Officer' had been used to designate section heads. The staff complement at the Secretariat will be reduced from 28 to 26 staff
- establishment of an Analytical Support Officer position within Science Services and a Data Assistant post within the Data Centre
- re-titling of the Scientific Observer Data Analyst post to Scientific Observer Scheme Coordinator
- support to development of IT and data strategies (structured and unstructured) focusing on risk management and addressing concerns relating to potential single-point failures.

10.3 The Working Group noted that much of the restructuring work associated with the implementation of the review had been implemented in 2011. Work in 2012 is required in relation to processes, procedures and internal coordination and collaboration. It was also noted that the implementation of the revised Strategic Plan can be supported through to 2014 within the Commission's policy of a zero growth budget in real terms.

10.4 The Working Group endorsed the recommendations related to the Secretariat's support to the Scientific Committee and its working groups, noting that the establishment of the new posts of Analytical Support Officer and Data Assistant would enhance the Secretariat's ability to support the work of WG-FSA, including data processing, validation and grooming and assessment analysis.

Conditional transition of the fishery for *Dissostichus* spp. in the Ross Sea

10.5 The Working Group noted the proposal for a conditional transition of the fishery for *Dissostichus* spp. in the Ross Sea from an exploratory fishery to an established fishery (WG-FSA-11/32). The proposal outlined the criteria of the exploratory classification set out in CM 21-02 (paragraph 1), and the key advancements in the Ross Sea fishery which address each of these, including:

- the advancements with respect to the current state of knowledge on the biology, life history characteristics, distribution, abundance and demography of *D. mawsoni*
- progress in understanding the fishery's potential impacts on dependent and related species, including the review undertaken at FEMA2, studies of the trophic status of *D. mawsoni* and estimates of yield for key by-catch taxa (macrourids and rajids)
- the establishment of the integrated assessment of long-term precautionary yield for *D. mawsoni* in the Ross Sea.

10.6 The Working Group agreed that the current state of knowledge in this exploratory fishery adequately addresses the criteria set out in CM 21-02 (paragraph 1).

Electronic satellite tags

10.7 The Working Group noted that four pop-off satellite transmitters will be deployed on *D. mawsoni* along the continental slope of the Ross Sea in January 2012 (WG-FSA-11/49). The tags have a bulbous float, a whip antenna, a cylindrical body with solar cells wrapped around the top half, and are approximately 24 cm in length and 2 cm in diameter. The tags will be attached externally with a single tether to a dart embedded in the dorsal musculature of the fish, and will be obvious if the fish is recaptured. The tags will be programmed to pop-off the fish and float to the surface for transmission of data in December 2012.

10.8 The Working Group noted that the following procedure should be followed by vessels, crews and observers operating in the Ross Sea in 2011/12 if a tag is recovered:

If a tag is found attached to a fish, the fish is alive, healthy and in good condition, and the tag is still firmly attached to the fish (i.e. capture and landing have not damaged the tag, the tether attachment, or the fish), please note the tag number from the label and fish length, and immediately release the fish. Also, note the date, location and haul number, and let the observer know to report the tag sighting to s.parker@niwa.co.nz.

If the tag or tag attachment site has been damaged, or the fish is injured or in poor condition, please retain the fish for full biological sampling. Note the date, haul number and location, and notify the observer. The observer can remove and retain the tag for return to NIWA² for a future deployment.

Please record the date, observer name, vessel name, latitude and longitude, haul number and fish length.

If the tag is retained, please also record the fish weight, otolith tracking number, stomach contents and the reason why the fish was not released.

10.9 The Working Group, through the Scientific Committee and Commission, encouraged Members to communicate this information to their vessels and observers operating in the Ross Sea in the forthcoming season, and requested that the information contained in WG-FSA-11/49 be posted on the CCAMLR website.

Participation of observers in working group meetings

10.10 The Working Group noted that following the request of the Scientific Committee (SC-CAMLR-XXIX, paragraph 15.19), WG-EMM had considered a potential mechanism to facilitate the engagement of observers (e.g. ASOC, COLTO etc.) in working group meetings. This mechanism would provide for a single representative of those international organisations that are invited to attend the Scientific Committee to attend working group meetings. That representative would contribute to discussion only at the direct request of a Member and would not provide written statements for the report of the meeting. The submission of papers to working group meetings would be subject to the agreement of the Convener and the Chair of the Scientific Committee that the paper is scientifically relevant. All observers would be bound by a confidentiality agreement and any breach of that agreement would result in permanent disbarment of that observer organisation from all working group meetings (Annex 4, paragraphs 6.4 to 6.7).

10.11 WG-FSA agreed with WG-EMM in recognising that, inter alia:

- (i) the inclusion of fishing industry representatives in some delegations had brought important insights into the operation of fisheries that provided important context for scientific discussions
- (ii) the potential positive contribution that the presence of observers might bring to the work of the working groups included increasing transparency and awareness of processes in those groups
- (iii) the long history of positive engagement by observers at the Scientific Committee has demonstrated interest in, and knowledge of, CCAMLR
- (iv) understanding the discussion of science issues at the Scientific Committee in the absence of participation in the working groups is challenging

² National Institute of Water and Atmospheric Research Ltd (NIWA), PO Box 893, Nelson, New Zealand

- (v) increasing the understanding of meetings by observers that have a genuine interest in CCAMLR would be beneficial.

10.12 The Working Group also considered two alternative ways of enhancing transparency and communicating with observer groups:

- participation in public fora where working group scientists and observers and other interested parties (e.g. students, media) may discuss current issues and research
- development of the Secretariat's role in outreach and communication (see CCAMLR-XXX/8).

ICES Training Programme

10.13 The Working Group noted that ICES recently conducted a course on trawl survey design and evaluation, and requested that the Secretariat contact ICES about the feasibility of providing course material to CCAMLR Members involved in conducting surveys.

World Fisheries Congress

10.14 The Working Group noted that the Sixth World Fisheries Congress will be held from 7 to 11 May 2012 in Edinburgh (<http://www.6thwfc2012.com>). Dr I. Everson (Chair of the local organising committee and former Convener of WG-FSA) encouraged CCAMLR fishery scientists and managers to participate in the congress. Thematic sessions include sustainable fisheries under a changing climate regime, and adaptive management and tools to cope with changing environments.

ADVICE TO THE SCIENTIFIC COMMITTEE

11.1 The Working Group's advice to the Scientific Committee and other working groups is summarised below; the body of the report leading to these paragraphs should also be considered.

- (i) Development of assessments –
 - development and use of performance metrics (paragraph 4.2).
- (ii) Research plans –
 - research fishing in Subarea 88.3 (paragraph 5.6)
 - research fishing in Divisions 58.4.4a and 58.4.4b, Ob and Lena Banks (paragraphs 5.16 and 5.23)
 - research fishing in Division 58.4.3b, BANZARE Bank (paragraphs 5.29 and 5.36)
 - tag-based research in other areas (paragraphs 5.38, 5.39, 5.41 and 5.42)
 - pre-recruit survey in the Ross Sea (paragraphs 5.45 and 6.125).

- (iii) Requirements for exploratory fisheries –
 - tagging in exploratory fisheries (paragraphs 5.12, 6.67, 6.68, 6.74 and 6.87 to 6.89)
 - development of assessments in data-poor fisheries (paragraphs 6.76, 6.78, 6.80 and 6.81)

- (iv) Fishery management advice –
 - *C. gunnari* in Subarea 48.3 (paragraph 6.6)
 - *C. gunnari* in Division 58.5.2 (paragraph 6.13)
 - *D. eleginoides* in Subarea 48.3 (paragraphs 6.24 and 6.25)
 - *Dissostichus* spp. in Subarea 48.4 (paragraph 6.33)
 - *D. eleginoides* in Division 58.5.1 (paragraph 6.47)
 - *D. eleginoides* in Division 58.5.2 (paragraph 6.42)
 - *D. eleginoides* in Subarea 58.6, Crozet Islands (paragraphs 6.51 to 6.53)
 - *D. eleginoides* in Subareas 58.6 and 58.7, Prince Edward and Marion Islands (paragraphs 6.60 and 6.61)
 - *Dissostichus* spp. in Subarea 48.6 (paragraphs 6.94 and 6.95)
 - *Dissostichus* spp. in Division 58.4.1 (paragraph 6.100)
 - *Dissostichus* spp. in Division 58.4.2 (paragraph 6.107)
 - *Dissostichus* spp. in Division 58.4.3a (paragraph 6.112)
 - *Dissostichus* spp. in Division 58.4.3b (paragraphs 5.29 and 5.36)
 - *Dissostichus* spp. in Subareas 88.1 and 88.2 (paragraphs 6.124 to 6.130)
 - finfish in Subareas 48.1 and 48.2 (paragraph 6.132)
 - *Paralomis* spp. in Subarea 48.3 (paragraph 6.136).

- (v) Bottom fishing and VMEs –
 - preliminary impact assessments (paragraphs 7.8, 7.9, 7.13 and 7.15)
 - development of the fishing gear library (paragraphs 5.39 and 7.9)
 - VMEs (paragraph 7.4).

- (vi) Scientific observers –
 - modification of data form K12 (krill by-catch sampling) to include details of the length of fish sampled (paragraph 3.21)
 - reporting of position information (paragraph 8.3)
 - review of sampling requirements and priorities (paragraph 8.7).

- (vii) Other –
 - requirement for maps of spatial characteristics of fisheries for *Dissostichus* spp. (paragraph 3.6)
 - information on IUU fishing activities, trends in effort and estimates of catch (paragraphs 3.24 and 3.28)
 - exclusion of small scientific samples of *Dissostichus* spp. from the requirements of the CDS (paragraph 3.30)
 - completion of the C2 data form and inclusion of zeros if no hooks attached to sections of the main line were lost (paragraph 4.36)

- terminology related to fish condition, injury and trauma, and suitability for tagging (paragraph 5.12)
- pop-up tags (paragraph 10.9)
- review of the Secretariat's strategic plan (paragraph 10.4).

(viii) Meeting arrangements –

- future work plan and focus topics (paragraphs 9.1 and 9.3)
- Convener of WG-FSA (paragraph 13.2).

ADOPTION OF THE REPORT

12.1 The report of the meeting was adopted.

CLOSE OF MEETING

13.1 In closing the meeting, Dr Jones thanked the subgroup coordinators, rapporteurs, all participants and all Secretariat staff for their contributions and involvement in the work of WG-FSA, which had collectively supported detailed discussions and another productive meeting.

13.2 This was Dr Jones' last year as Convener of WG-FSA, and the group warmly welcomed the incoming Convener, Dr Belchier, to the position.

13.3 Drs Welsford and K.-H. Kock (Germany), on behalf of the Working Group, thanked Dr Jones for convening the Working Group during a formative period of development in assessments for the exploratory fisheries and consideration of the impacts of bottom fishing on VMEs. This period had embraced a large and diverse body of work, and Dr Jones' leadership had expertly guided WG-FSA in its deliberations and formulation of scientific advice.

REFERENCES

Candy, S.G., D.C. Welsford, T. Lamb, J.J. Verdouw and J.J. Hutchins. 2011. 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. *CCAMLR Science*, 18: 29–45.

Table 1: Total reported catches (tonnes) of target species in fisheries in the Convention Area in 2010/11. **Bold:** fishery closed; CM: conservation measure. (Source: catch and effort reports to 24 September 2011 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-10	30-Nov-11	42-01	2 305	10	<1	
	58.5.2	Trawl	01-Dec-10	30-Nov-11	42-02	78	1	1	
<i>Dissostichus eleginoides</i>	48.3	Longline, pot	01-Dec-10	30-Nov-11 ^a	41-02	3 000	1 788	60	
	48.4 north	Longline	01-Dec-10	30-Nov-11	41-03	40	36	90	
	58.5.1 French EEZ ^b	Longline	ns	ns	ns	ns	2 906	-	
	58.5.2	Longline, trawl, pot	01-Dec-10	30-Nov-11 ^a	41-08	2 550	1 614	63	
	58.6 French EEZ ^b	Longline	ns	ns	ns	ns	551	-	
<i>Dissostichus spp.</i>	58 South African EEZ ^c	Longline	ns	ns	ns	ns	85	-	
	48.4 south	Longline	01-Dec-10	30-Nov-11	41-03	30	17	57	
	48.6	Longline	01-Dec-10	30-Nov-11	41-04	400	393	98	
	58.4.1	Longline	01-Dec-10	30-Nov-11	41-11	210	216	103	
	58.4.2	Longline	01-Dec-10	30-Nov-11	41-05	70	136	194	
	58.4.3a	Longline	01-May-11	31-Aug-11	41-06	86	4	4	
	58.4.3b	Research fishing	01-May-11	31-Aug-11	41-07	-	11	-	
	58.4.4a, 58.4.4b	Research fishing	01-Dec-10	30-Nov-11	24-01	-	35	-	
	88.1	Longline	01-Dec-10	31-Aug-11	41-09	2 850	2 882	101	
	88.2	Longline	01-Dec-10	31-Aug-11	41-10	575	576	100	
	88.3	Research fishing	01-Dec-10	30-Nov-11	24-01	-	5	-	
	<i>Euphausia superba</i>	48.1, 48.2, 48.3, 48.4	Trawl	01-Dec-10	30-Nov-11	51-01	620 000	179 131	29
		58.4.1	Trawl	01-Dec-10	30-Nov-11	51-02	440 000	No fishing	-
58.4.2		Trawl	01-Dec-10	30-Nov-11	51-03	452 000	No fishing	-	
<i>Paralomis spp.</i>	48.3	Pot	01-Dec-10	30-Nov-11	52-01	1 600	No fishing	<1 ^d	

^a Longline fishery is closed

^b Reported in fine-scale data to 12 August

^c Inside the Convention Area

^d Taken as by-catch

* Fishing may occur outside the prescribed season

ns Not specified by CCAMLR

Table 2: Catches of *Dissostichus eleginoides* reported in the CDS for fisheries operating outside the Convention Area in the calendar years 2010 and 2011 (to 26 September 2011).

Ocean sector	Area	Calendar year	
		2010	2011
Southwest Atlantic	41.2.3	448	146
	41.3	299	41
	41.3.1	1 819	1 126
	41.3.2	3 967	3 609
	41.3.3	-	79
Southeast Atlantic	47	27	-
	47.4	51	196
Western Indian	51	238	466
Southwest Pacific	81	276	379
Southeast Pacific	87	5 316	3 148
Total		12 441	9 190

Table 3: Evaluation of research proposals as set out in WG-FSA-11/13 Rev. 1, 11/15 Rev. 1 and 11/37. Evaluation criteria are as agreed by the focus topic on data-poor fisheries (Annex 5, paragraph 1.4).

WG-SAM-11 paragraph (Annex 5)	WG-FSA-11/37 – 88.3	WG-FSA-11/15 Rev. 1 – 58.4.4a+b	WG-FSA-11/13 Rev. 1 – 58.4.3b
Generic advice			
2.25 – primary purpose of research: achieve estimate of stock status	N*	Y	Y
2.25 – detailed survey/data collection plan	Y	Y	Y
2.27 – requirements for estimate of stock status	(Does the research adequately address these three requirements for an estimate of stock status?)		
(i) index of abundance	N	Y	Y
(ii) stock hypothesis	N	Y	Y*
(iii) biological parameters	Y*	Y*	Y*
2.38 – tagging performance metrics	(Will the research achieve high levels of performance with respect to five tag-based research performance metrics?)		
(i) tag overlap	Y	Y	Y
(ii) spatial overlap	N	Y	Y*
(iii) temporal overlap	Y	Y	Y
(iv) fish trauma	N	Y*	Y*
(v) depredation	Y	Y*	Y
2.40 – initial design for data-poor area	(Does the proposed research follow the recommended design process?)		
(i) appropriate spatially restricted area	N	Y	Y*
(ii) preliminary plausible estimate of B	N	Y*	Y*
(iii) catch and tag rates to achieve a target CV	N	Y*	N
(iv) evaluate effects on stock/set safe catch limits	N	Y*	Y*
Detailed description of data analyses/future planned research leading to an assessment	N	N	N

(continued)

Table 3 (continued)

	WG-FSA- 11/37 – 88.3	WG-FSA- 11/15 Rev. 1 – 58.4.4a+b	WG-FSA- 11/13 Rev. 1 – 58.4.3b
Specific advice			
Does the (revised) proposal to WG-FSA incorporate the specific advice of WG-SAM-11? (paragraphs in Annex 5)			
	5.6(i) N	5.3(i) N	5.5(i) Y*
	5.6(ii) N	5.3(ii) Y*	5.5(ii) Y*
	5.6(iii) Y	5.3(iii) Y*	5.5(iii) N
	5.6(iv) N		5.5(iv) Y*
	5.6(v) Y		

* Indicates criteria based on revisions to the proposal that were developed during WG-FSA 2011. Relevant changes with respect to each evaluated criterion are noted in the text.

Table 4: 2011 tag recaptures, Petersen biomass estimates, Ob and Lena Banks.

Release year	Released tags (n_1)	Available tags	Recaptured tags in 2011 (n_2)	Petersen B (tonnes)	95% CI
2008	145	76.6	2	1 409	216–7 950
2009	0	0	-	-	
2010	191	133.1	2	2 448	376–13 812
Cumulative in 2011	336	209.6	4	1 928	531–5 628

Table 5: Results of assessments of stock status of *Dissostichus eleginoides* in Division 58.5.2 using CASAL. B_0 is the MPD estimate of the pre-exploitation median spawning stock biomass (SSB), SSB status 2011 is the ratio of the CASAL prediction of SSB in 2011 to B_0 , and R_0 is the MPD estimate of mean age-1 recruitment prior to exploitation (1981), and CV_R is the coefficient of variation of the annual recruitment series (1996–2008 except for a2-2011-alkpool-PE-NoAEM of 1984–2008).

Model	Description	B_0 (tonnes) (SE)	M	SSB status 2011	R_0 (million)	CV_R	Objective function value
a2-2011-alkpool-PE	WG-FSA-11/24	86 400 (1 915)	0.155 (-)	0.629	5.765	0.78	7 646 ^a
a2-2011-alkpool-noPE-M13	ignore process error	109 659 (2 281)	0.130 (-)	0.544	3.968	0.59	15 340 ^b
a2-2011-alkpool-noPE	ignore process error	79 952 (1 782)	0.155 (-)	0.585	5.335	0.57	15 620 ^b
a2-2011-alkpool-PE-M13	a2-2011-alkpool-PE	181 151 (2 975)	0.130 (-)	0.718	6.555	1.22	7 922 ^a
a2-2011-alkpool-PE-NoAEM	assume zero ageing error	79 191 (1 363)	0.155 (-)	0.568	5.284	0.24	7 773 ^a

^{a, b} Minimum of -2 log-likelihood, comparable values share same letter while lower values represent improved fit.

Table 6: Number of vessels notified in exploratory longline fisheries for *Dissostichus* spp. in 2011/12 (a), and corresponding number of participating Members and vessels, and catch limits agreed in *Conservation Measures in Force in 2010/11* (b).

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 2011/12							
France				1			
Japan	1	1	1	1	1	1	
Korea, Republic of	2	3	1			6	6
New Zealand		3	1			4	4
Norway	1					1	1
Russia	2	2				5	5
South Africa	1	1	1	1			
Spain		1	1			1	1
UK						2	2
Nos Members	5	6	5	3	1	7	6
Nos Vessels	7	11	5	3	1	20	19
(b) Limits in force in 2010/11							
Nos Members	3	5	5	1	1	7	6
Nos vessels	1*	10	5	1	1	19	17
Target species catch limit (tonnes)	400	210	70	86	0**	2850	575

* Only one vessel per Member permitted to fish at any one time

** Excluding research fishing

Table 7: Unstandardised CPUE (kg/hook) of *Dissostichus* spp. in exploratory longline fisheries since 1996/97. (Source: fine-scale data from commercial and fishery-based research hauls.)

Subarea/ division	SSRU	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
48.6	486A								0.04	0.07	0.11	0.15			0.07	0.17
	486B															0.81
	486C															0.44
	486D											0.05			0.61	
	486E									0.08		0.13		0.46	0.51	
	486G								0.02	0.07	0.16	0.07	0.12	0.23	0.17	0.28
58.4.1	5841C									0.13	0.18	0.15	0.19	0.22	0.36	0.1
	5841D												0.09			
	5841E									0.22	0.1	0.14	0.12	0.13	0.74	1.27
	5841F											0.07	0.05			
	5841G									0.2	0.22	0.24	0.12	0.1	0.12	0.09
	5841H												0.15			
58.4.2	5842A									0.08	0.08	0.13	0.2	0.2	1.22	
	5842C							0.1		0.07	0.17		0.42			
	5842D							0.19	0.06							
	5842E							0.21	0.11	0.14	0.22	0.15	0.21	0.23	0.14	1.07
58.4.3a	5843aA									0.05	0.05	0.02	0.08	0.08		0.1
58.4.3b	5843bA								0.04	0.08		0.15	0.17	0.22	0.14	
	5843bB								0.14	0.23	0.17	0.12				
	5843bC									0.07		0.04	0.12		0.1	
	5843bD									0.08	0.18	0.03	0.12	0.18	0.1	
	5843bE									0.1	0.08	0.05		0.21	0.17	
88.1	881A	0.01				0.02		0.16			0.08	0.05				
	881B	0.05	0.03			0.17	0.25	0.26	0.11	0.55	0.07	0.33	0.15	0.39	0.02	0.22
	881C					0.44	0.87	0.59	0.31	0.53	1.06	0.71	0.36	0.46	0.88	0.51
	881E		0	0.06		0.03		0.05	0.08	0.28		0.02				
	881F		0					0.03				0.16				
	881G		0.06	0.02		0.13	0.12	0.12	0.12	0.15						
	881H		0.17	0.26	0.38	0.41	0.74	0.46	0.22	0.77	0.59	0.37	0.4	0.33	0.31	0.52
	881I		0.37	0.23	0.29	0.29	0.43	0.19	0.15	0.43	0.4	0.34	0.43	0.52	0.36	0.47
	881J			0.12	0.18	0.04			0.11	0.19	0.21	0.32	0.18	0.25	0.2	0.26
	881K		0.32	0.15	0.4		0.45		0.01	0.34	0.51		0.28	0.49	0.79	0.39
	881L					0.12			0.1	0.14	0.19		0.17	0.1	0.19	0.25
	881M			0.08		0.08				0	0.58	0.39	0.31			
	882									0.14	0.06					
88.2	882A						0.82		0.11	0.47	0.54					0.28
	882B								0.06							
	882C															0.15
	882D										0.43	0.31	0.19	0.14	0.26	0.32
	882E							0.35	0.42	0.7	0.33	0.22	0.49	0.2	0.29	0.2
	882F										0.26	0.02	0.39	0.16	0.23	0.22
	882G										0.03				0.06	

Table 8: 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 2010/11 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	TOT tagged and released		
			Number of fish	Tagging rate	
48.4 (5)	New Zealand	<i>San Aspiring</i>	135	(110)	5.8
	UK	<i>Argos Georgia</i>	173	(115)	5.7
48.6 (3)	Japan	<i>Shinsei Maru No. 3</i>	594	(0)	3.0
	Korea, Republic of	<i>Hong Jin No. 701</i>	493	(52)	4.0
		<i>Insung No. 7</i>	132	(5)	3.0
South Africa	<i>Koryo Maru No. 11</i>	89	(79)	3.1	
58.4.1 (3)	Korea, Republic of	<i>Hong Jin No. 701</i>	180	(0)	4.5
		<i>Insung No. 7</i>	335	(0)	3.3
	Spain	<i>Tronio</i>	232	(0)	3.1
58.4.2 (3)	Korea, Republic of	<i>Insung No. 7</i>	408	(0)	3.0
58.4.3a (3)	Japan	<i>Shinsei Maru No. 3</i>	14	(14)	3.9
58.4.3b (5)	Japan	<i>Shinsei Maru No. 3</i>	62	(16)	5.8
88.1 (1)	Korea, Republic of	<i>Hong Jin No. 707</i>	252	(34)	1.1
		<i>Insung No. 1</i>	Vessel sunk		1.1*
		<i>Insung No. 7</i>	46	(0)	1.0
		<i>Jung Woo No. 2</i>	285	(0)	1.1
		<i>Jung Woo No. 3</i>	157	(0)	1.0
	New Zealand	<i>Antarctic Chieftain</i>	238	(0)	1.0
		<i>Janas</i>	172	(0)	1.0
		<i>San Aotea II</i>	323	(2)	1.1
		<i>San Aspiring</i>	202	(3)	1.1
	Russia	<i>Chio Maru No. 3</i>	196	(0)	1.4
		<i>Gold Gate</i>	99	(1)	1.3
		<i>Ostrovka</i>	18	(0)	1.0
		<i>Sparta</i>	110	(0)	1.2
	Spain	<i>Tronio</i>	430	(1)	1.0
	UK	<i>Argos Froyanes</i>	332	(0)	1.1
		<i>Argos Georgia</i>	213	(0)	1.0
	88.2 (1)	Korea, Republic of	<i>Hong Jin No. 707</i>	40	(0)
<i>Jung Woo No. 3</i>			35	(0)	1.1
New Zealand		<i>Antarctic Chieftain</i>	46	(0)	1.0
		<i>Janas</i>	30	(0)	1.1
		<i>San Aspiring</i>	190	(0)	1.1
Russia		<i>Chio Maru No. 3</i>	90	(0)	2.2
		<i>Gold Gate</i>	44	(0)	1.1
		<i>Sparta</i>	50	(0)	1.2
UK		<i>Argos Froyanes</i>	68	(0)	1.0
		<i>Argos Georgia</i>	58	(0)	1.1
Uruguay		<i>Ross Star</i>	16	(0)	1.2

* Based only on data reported in the five-day catch and effort reports

Table 9: Time series of the tag overlap statistic (CM 41-01) for *Dissostichus mawsoni* (a) and *D. eleginoides* (b) tagged by vessels actively fishing in the exploratory fisheries in 2010/11. The statistic was implemented in 2010/11, and comparative values were calculated for previous seasons. Values were not calculated for total catches of less than 2 tonnes (*) and length data were aggregated by 10 cm length intervals.

(a) *Dissostichus mawsoni*

Flag State	Vessel name	Subarea/ division	2007	2008	2009	2010	2011
Japan	<i>Shinsei Maru No. 3</i>	48.6	33	31	65	68	95
		58.4.1			*	56	
		58.4.2			36		
		58.4.3a	*		*		
		58.4.3b	29	48	36	55	*
		58.4.4b			*		
Korea, Republic of	<i>Hong Jin No. 701</i>	48.6					84
		58.4.1					74
	<i>Hong Jin No. 707</i>	88.1		18	25	50	63
		88.2			36		73
	<i>Insung No. 7</i>	48.6					54
		58.4.1					70
		58.4.2					64
	<i>Jung Woo No. 2</i>	88.1					66
		48.6	11				
		58.4.2	29				
	<i>Jung Woo No. 3</i>	88.1	29	25	19	26	93
		88.1			21	42	88
88.2					15	84	
New Zealand	<i>Antarctic Chieftain</i>	88.1			57	61	96
		88.2			61		92
	<i>Janas</i>	88.1	69	80	43	79	85
		88.2			73		82
	<i>San Aotea II</i>	88.1	52	69	77	79	88
		<i>San Aspiring</i>	88.1	76	74	81	88
	88.2						77
Russia	<i>Chio Maru No. 3</i>	88.1					78
		88.2					54
	<i>Gold Gate</i>	88.1					88
		88.2					76
	<i>Ostrovka</i>	88.1					65
		<i>Sparta</i>	88.1				63
	88.2					78	
South Africa	<i>Koryo Maru No. 11</i>	48.6					53
Spain	<i>Tronio</i>	58.4.1	31	21			52
		58.4.3b	65				
		88.1		22	19	69	69
		88.2			17	49	
UK	<i>Argos Froyanes</i>	88.1		46	43	53	75
		88.2		31	54	54	75
	<i>Argos Georgia</i>	88.1	55	65		47	69
		88.2			56	*	50
Uruguay	<i>Ross Star</i>	88.1	19	21	48		
		88.2		10	64		68

Table 9 (continued)

(b) *Dissostichus eleginoides*

Flag State	Vessel name	Subarea/ division	2007	2008	2009	2010	2011
Japan	<i>Shinsei Maru No. 3</i>	48.6	36	45	26	40	*
		58.4.1			*	43	
		58.4.2			*		
		58.4.3a	*		45		84
		58.4.3b	36	36	21	*	*
		58.4.4a			*	*	
		58.4.4b			*	*	*
Korea, Republic of	<i>Hong Jin No. 701</i>	48.6					75
		58.4.1					*
	<i>Hong Jin No. 707</i>	88.1			21	*	*
		<i>Insung No. 7</i>	48.6				*
	<i>Jung Woo No. 2</i>	88.1					*
		48.6	42				
		58.4.2	*				
	88.1	56	42				
New Zealand	<i>Antarctic Chieftain</i>	88.1					*
	<i>Janas</i>	88.1	*	*	*		*
	<i>San Aotea II</i>	88.1	*	*	*	*	*
	<i>San Aspiring</i>	88.1	*	*	*	*	*
Russia	<i>Chio Maru No. 3</i>	88.1					*
	<i>Gold Gate</i>	88.1					*
	<i>Ostrovka</i>	88.1					*
	<i>Sparta</i>	88.1					*
		88.2					*
South Africa	<i>Koryo Maru No. 11</i>	48.6					81
Spain	<i>Tronio</i>	58.4.1	*	*			*
		58.4.3a	*				
		88.1		76	*	*	*
		88.2				*	
UK	<i>Argos Froyanes</i>	88.1			*		
		88.2				*	
	<i>Argos Georgia</i>	88.1	*	*			*
Uruguay	<i>Ross Star</i>	88.1	*	*			

Table 10: Number of *Dissostichus* spp. tagged and released in exploratory longline fisheries. (Source: scientific observer data)

Subarea/ division	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	Total
48.6				4	62	171	129		941	1 213	1 308	3 828
58.4.1					462	469	1 507	1 134	1 127	627	747	6 073
58.4.2					342	136	248	673	277	291	408	2 375
58.4.3a					199	104	9	41	113		14	480
58.4.3b					231	175	289	417	356	60	62	1 590
88.1	326	960	1 068	2 250	3 209	2 972	3 608	2 574	2 943	3 066	3 073	26 049
88.2		12	94	433	355	444	278	389	603	325	667	3 600
Total	326	972	1 162	2 687	4 860	4 471	6 068	5 228	6 360	5 582	6 279	43 995

Table 11: Number of tagged *Dissostichus* spp. recaptured in exploratory longline fisheries. (Source: scientific observer data)

Subarea/ division	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	Total
48.6						3	2		2	10	2	19
58.4.1							4	6	8	4	5	27
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	218	1173
88.2				18	17	28	33	36	56	44	60	292
Total	1	4	13	50	77	114	246	261	173	310	285	1534

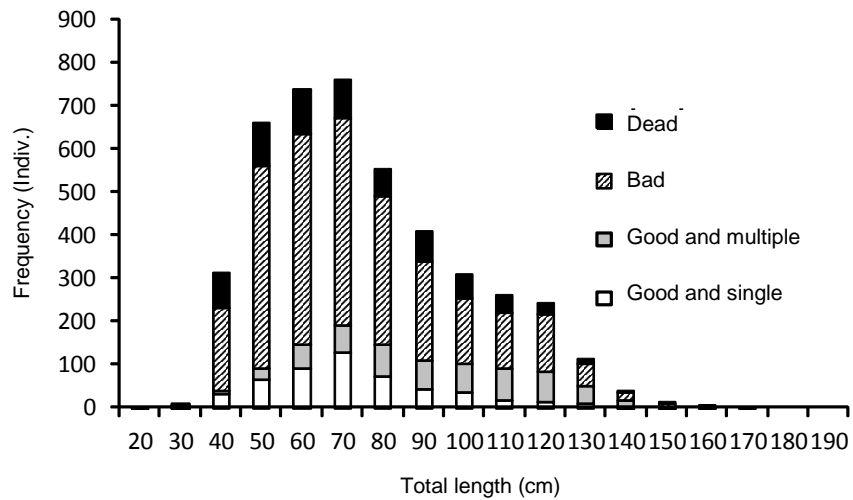


Figure 1: Fish condition and number of hook injuries as a function of size, for fish caught by trotlines in Divisions 58.4.4a and 58.4.4b (Ob and Lena Banks) by the *Shinsei Maru No. 3* in 2011. 11.7% of fish are single-hooked and in good condition.

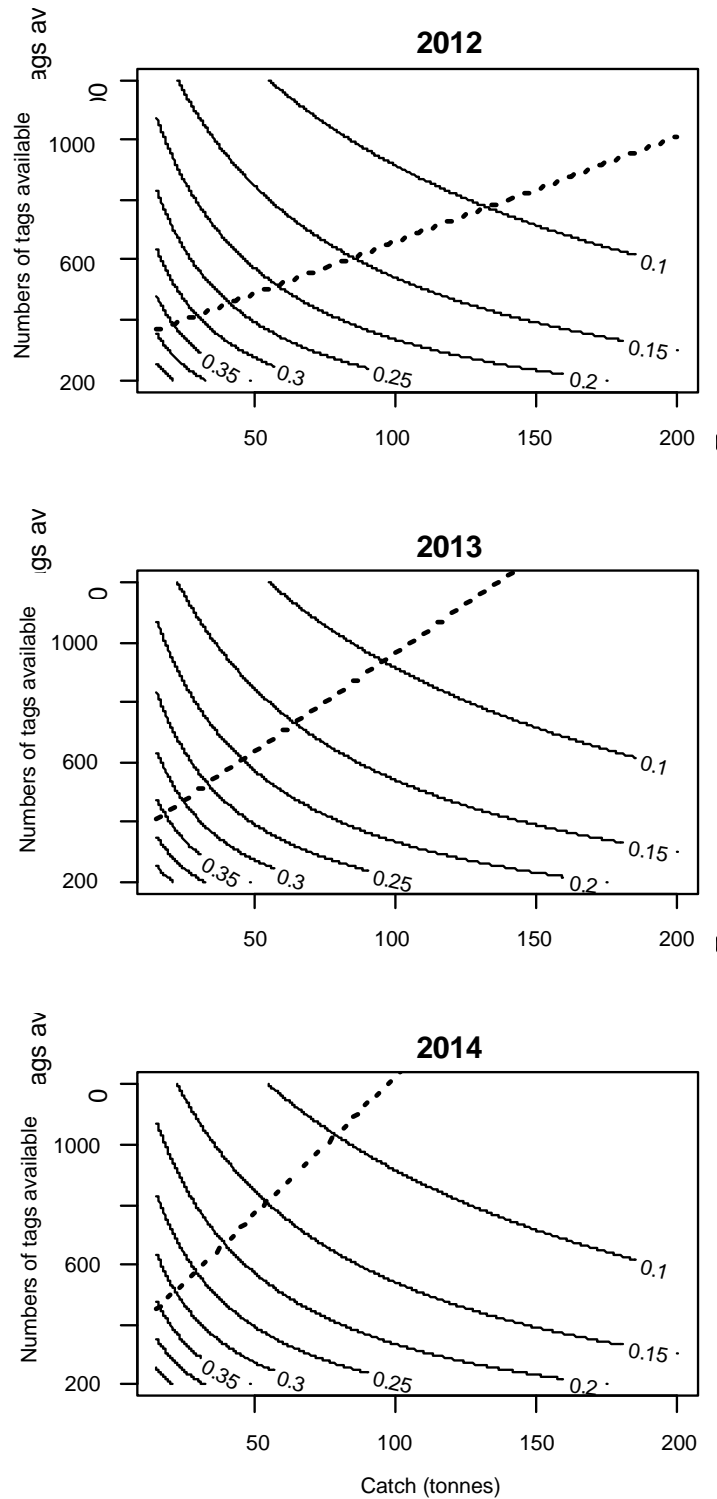


Figure 2: Estimated CVs achievable from Petersen biomass estimates as a function of research catch and number of tags available for 2012, 2013 and 2014 in Divisions 58.4.4a and 58.4.4b (Ob and Lena Banks), assuming an initial biomass of 1 928 tonnes. Note that accounting for natural mortality and post-tagging mortality, there are an estimated 314 previously tagged fish available for recapture in 2012. Dashed lines represent a tagging rate of five fish per tonne.

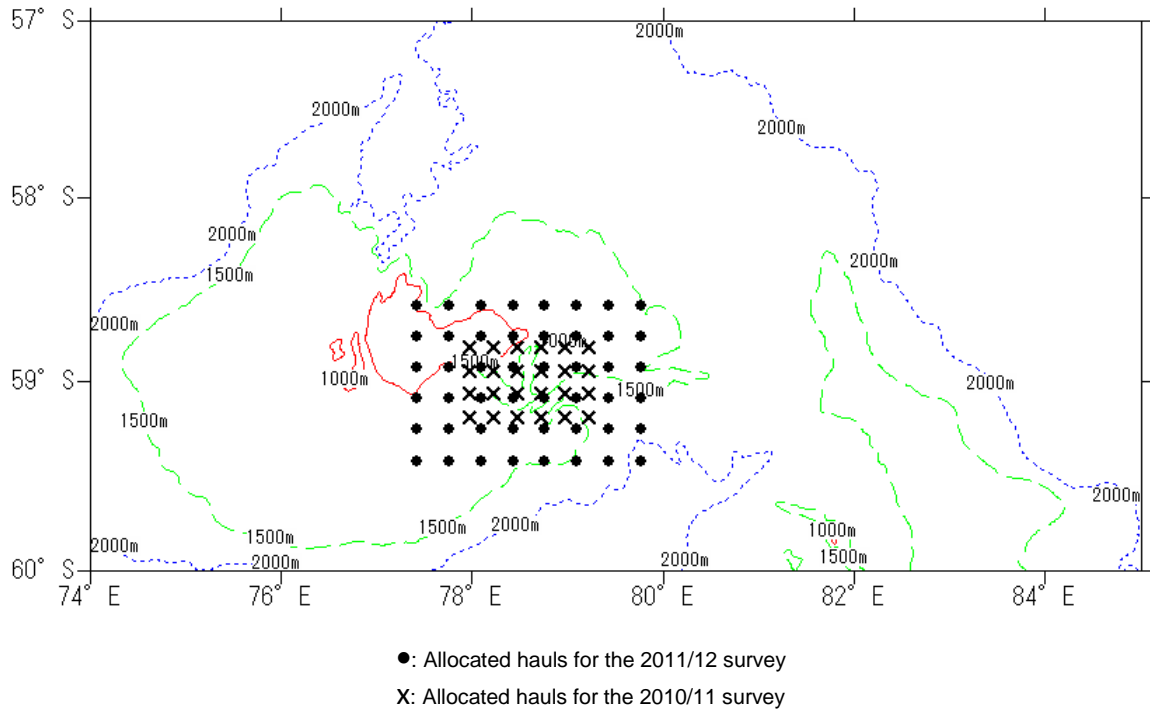


Figure 3: Proposed spatial configuration for research by the *Shinsei Maru No. 3* on BANZARE Bank in 2012. Forty-eight sets are proposed in a regular grid pattern with spacing of 10 n miles between adjacent sets.

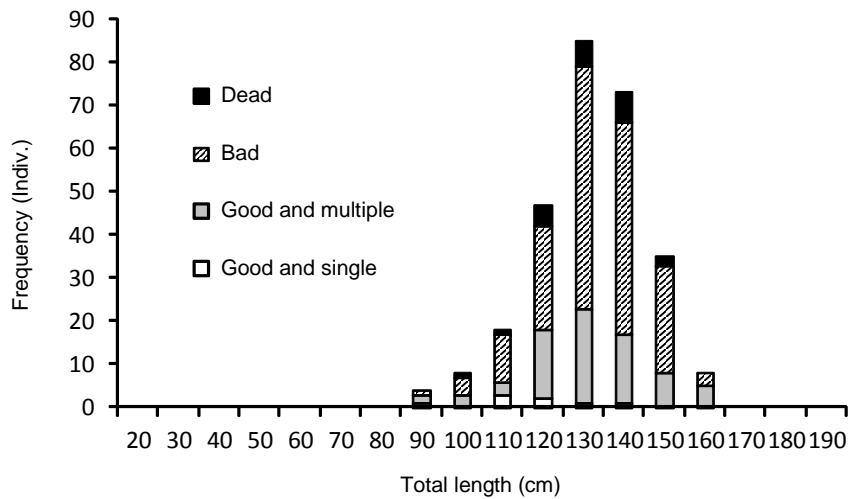


Figure 4: Fish condition and number of hook injuries as a function of size for *D. mawsoni* caught by trotlines in Division 58.4.3b (BANZARE Bank) by the *Shinsei Maru No. 3* in 2011. 2.9% of fish are single-hooked and in good condition.

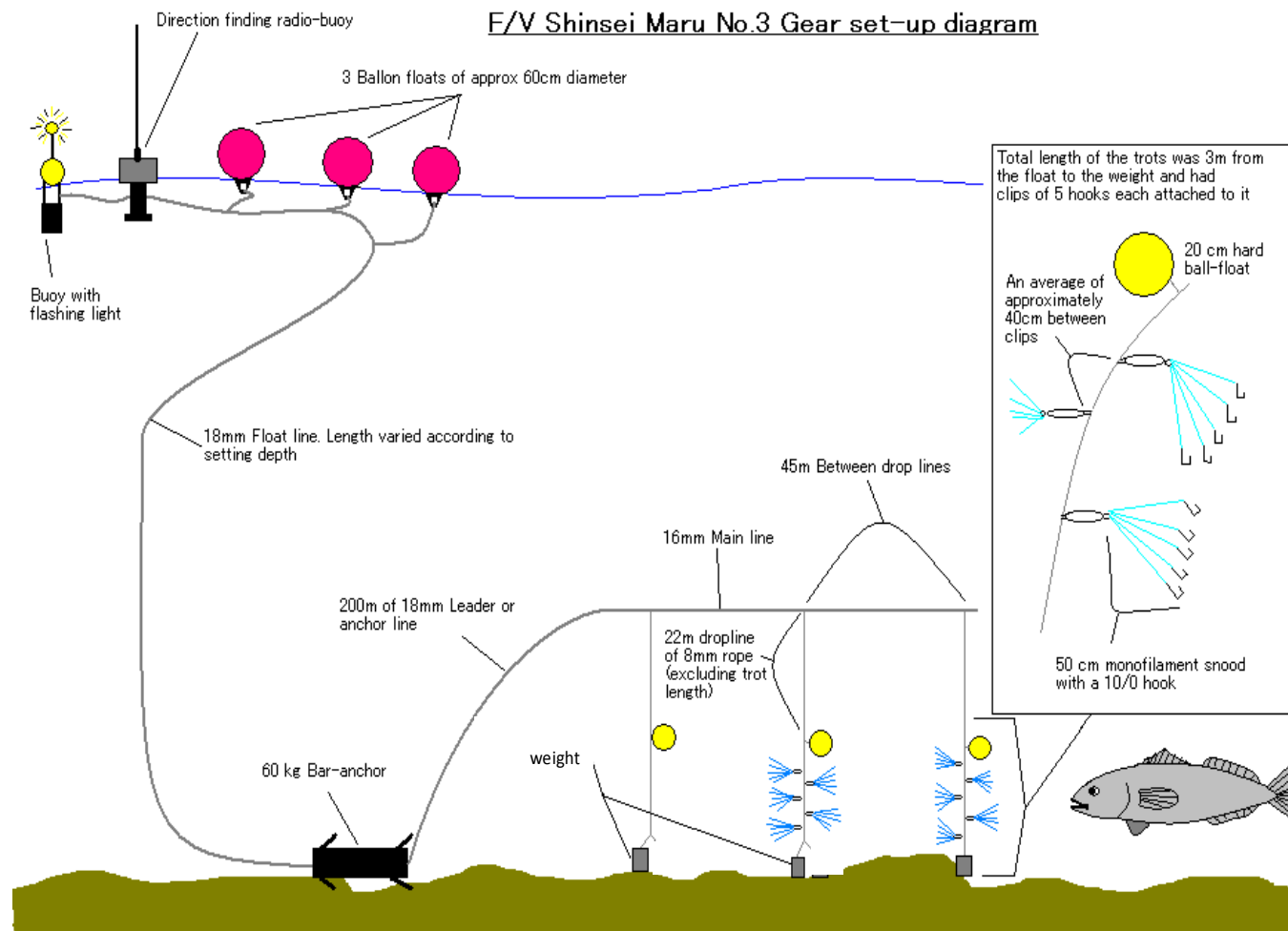


Figure 5: Gear configuration diagram for trotline gear deployed in research fishing by the *Shinsei Maru No. 3* in 2011 in Divisions 58.4.3b, 58.4.4a and 58.4.4b. Amendments to this gear configuration have been recommended by WG-FSA-11 for research in the same areas in 2012.

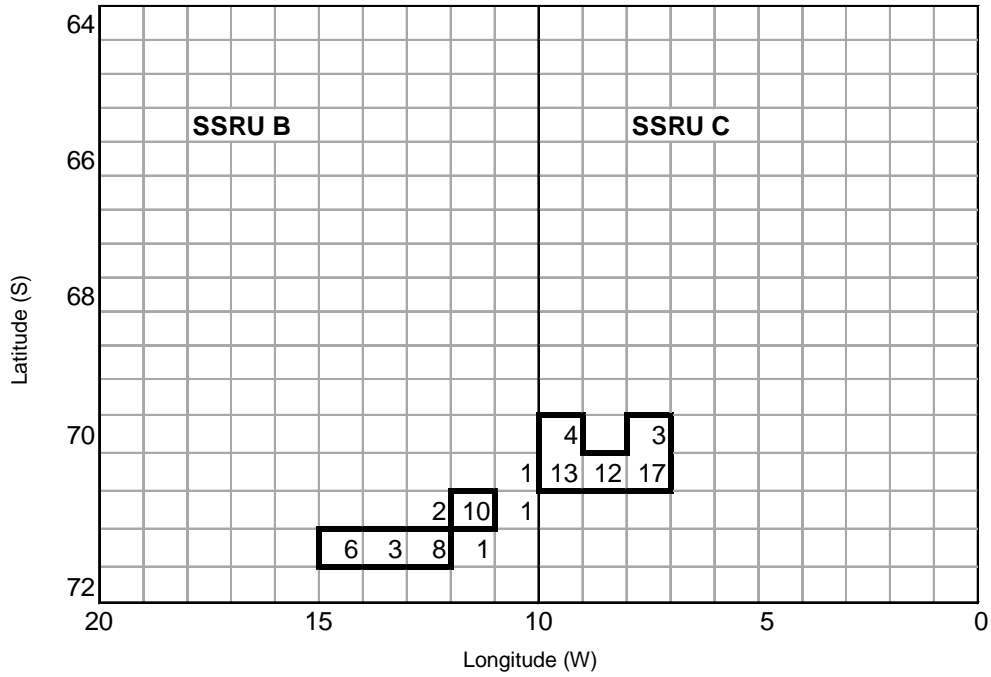


Figure 6: Fishing effort (number of sets per fine-scale rectangle) in the exploratory fishery for *Dissostichus* spp. in Subarea 48.6 SSRUs B and C in 2009/10 and 2010/11, and example of research areas for 2011/12 (black boxes with ≥ 3 sets per fine-scale rectangle).

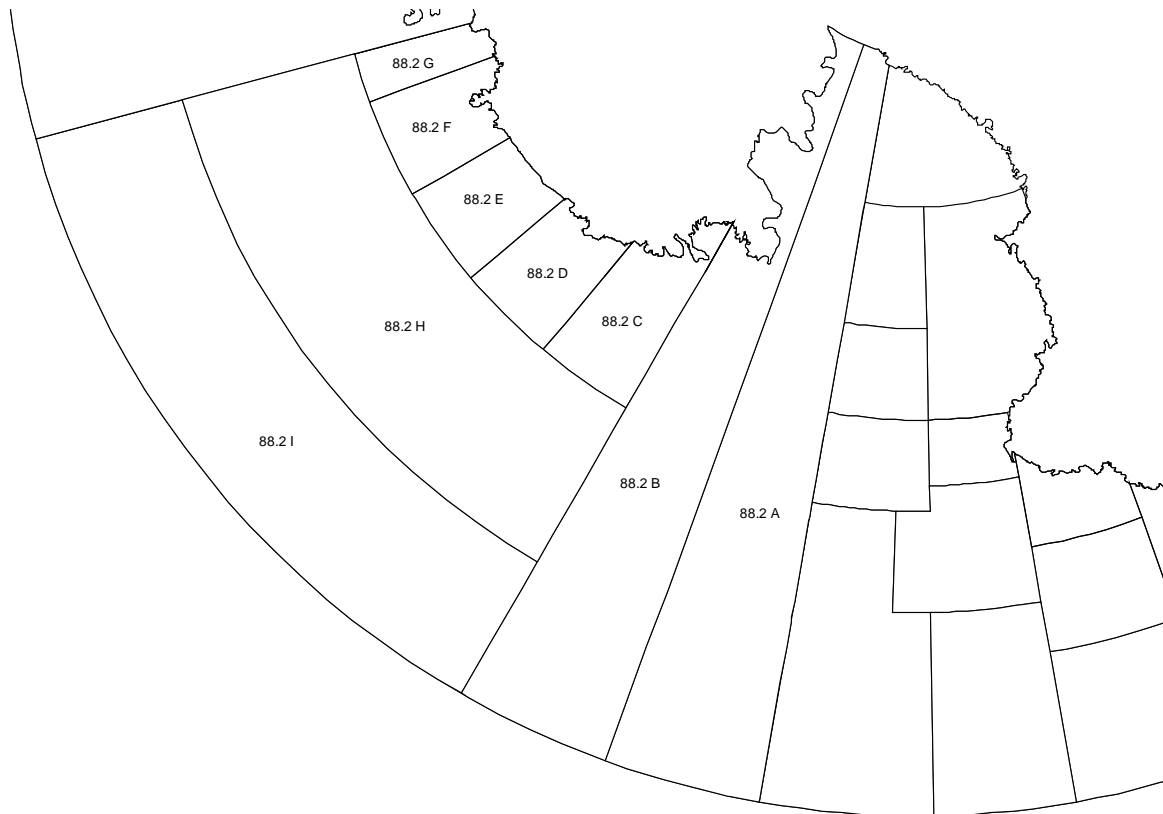


Figure 7: Revised boundaries of SSRUs in Subarea 88.2.

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AGENDA

Working Group on Fish Stock Assessment
(Hobart, Australia, 10 to 21 October 2011)

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 2010
 - 3.2 Fisheries information
4. Preparation for assessments and assessment timetable
 - 4.1 Report from WG-SAM
 - 4.2 Review of preliminary stock assessment papers
 - 4.3 Progress on assessments for data poor fisheries
 - 4.4 Assessments to be carried out and assessment timetable
5. Research plans to inform current or future assessments
 - 5.1 New and exploratory fisheries
 - 5.2 Closed fisheries or fisheries with zero catch limits
 - 5.3 Research in fisheries with assessments
6. Assessments and management advice
 - 6.1 Update Fishery Reports for assessed fisheries
 - 6.2 New and exploratory fisheries
 - 6.2.1 New and exploratory fisheries in 2010/11
 - 6.2.2 New and exploratory fisheries notified for 2011/12
 - 6.2.3 Update Fishery Reports for new and exploratory fisheries
 - 6.3 Assessment and management advice for other fisheries
7. Bottom fishing activities and VMEs

8. Scheme of International Scientific Observation
 - 8.1 Summary of information extracted from observer reports and/or provided by technical coordinators
 - 8.2 Implementation of the observer program
9. Future work
 - 9.1 Organisation of intersessional activities in subgroups
 - 9.2 Intersessional meetings
 - 9.3 Notification of scientific research
10. Other business
11. Advice to Scientific Committee
12. Adoption of the report
13. Close of the meeting.

LIST OF DOCUMENTS

Working Group on Fish Stock Assessment
(Hobart, Australia, 10 to 21 October 2011)

WG-FSA-11/1	Provisional Agenda and Provisional Annotated Agenda for the 2011 Meeting of the Working Group on Fish Stock Assessment (WG-FSA)
WG-FSA-11/2	List of participants
WG-FSA-11/3	List of documents
WG-FSA-11/4	Data on reproduction biology of <i>Dissostichus mawsoni</i> from the Ross Sea (Statistical Subarea 88.1) A.K. Zaytsev (Russia)
WG-FSA-11/5	Finfish by-catch in the krill fishery for the 2010 and 2011 seasons Secretariat
WG-FSA-11/6	Developments in the CCAMLR tagging program Secretariat
WG-FSA-11/7	Developments in the CCAMLR otolith program Secretariat
WG-FSA-11/8	CCAMLR fishery information 2011 Secretariat
WG-FSA-11/9	Scientific research notifications (Conservation Measure 24-01) Secretariat
WG-FSA-11/10	IUU fishing activity during the 2010/11 fishing season Secretariat
WG-FSA-11/11	Cetacean observation during krill fishing cruise (48.1, 48.2 Statistical Subareas, 2011) K. Vyshniakova (Ukraine)
WG-FSA-11/12	Information on Patagonian toothfish (<i>Dissostichus eleginoides</i>) fishery (Statistical Area 41 outside the zone of CCAMLR responsibility) Delegation of Ukraine

- WG-FSA-11/13 Rev. 1 Revised reports on abundance and biological information of toothfish in Division 58.4.3b by *Shinsei Maru No.3* in 2010/11 and proposal of the consecutive survey in 2011/12
K. Taki, T. Iwami and M. Kiyota (Japan)
- WG-FSA-11/14 Revised reports on abundance and biological information on toothfish in Division 58.4.4 a and b by *Shinsei Maru No. 3* in 2010/11 season
K. Taki, T. Iwami and M. Kiyota (Japan)
- WG-FSA-11/15 Rev. 1 Revised research plan for toothfish in Division 58.4.4 a and b by *Shinsei Maru No. 3* in 2011/12
K. Taki, T. Iwami and M. Kiyota (Japan)
- WG-FSA-11/16 Preliminary studies on age, growth and size at sexual maturity of *Dissostichus eleginoides* in the Ob-Lena Bank in the 2007/08 season
K. Taki, T. Iwami and M. Kiyota (Japan)
- WG-FSA-11/17 Distribution and biological characteristics of two toothfish species of genus *Dissostichus* (family Nototheniidae) off Bouvet Island
A.F. Petrov (Russia)
- WG-FSA-11/18 To the problem of spawning character for certain fish species
V. Prutko and A. Petrov (Russia)
- WG-FSA-11/19 Connectivity and population structure in *Pleuragramma antarcticum*
J. Ferguson, J. Ashford, A. Piñones, J. Torres, W. Fraser, C. Jones (USA) and M. Pinkerton (New Zealand)
- WG-FSA-11/20 Development of a generic operating model framework for data collection, assessment method and management strategy evaluations
P. Ziegler (Australia)
- WG-FSA-11/21 A preliminary examination of the length–weight relationship in *Dissostichus eleginoides* and *D. mawsoni* using data from the CCAMLR Scheme of Scientific Observation Secretariat
- WG-FSA-11/22 Data from recent trawl surveys in the vicinity of Heard Island and McDonald Islands (Division 58.5.2), reveal an unusual cohort structure in the mackerel icefish (*Champscephalus gunnari*) population
D.C. Welsford (Australia)

- WG-FSA-11/23 Results from the random stratified trawl surveys to estimate distribution and abundance of *Dissostichus eleginoides* and *Champscephalus gunnari* in the Heard Island region (Division 58.5.2) for 2010 and 2011
G.B. Nowara, S.G. Candy and T. Lamb (Australia)
- WG-FSA-11/24 Update of the integrated stock assessment for the Patagonian toothfish (*Dissostichus eleginoides*) for the Heard and McDonald Islands (Division 58.5.2)
S.G. Candy and D.C. Welsford (Australia)
- WG-FSA-11/25 Fishery-based research in exploratory fisheries
Secretariat
- WG-FSA-11/26 The biology, ecology and development of fishery management advice for the anomuran crabs of South Georgia (CCAMLR Subarea 48.3)
M. Belchier, T. Peatman and J. Brown (United Kingdom)
- WG-FSA-11/27 Preliminary review of Antarctic toothfish maturity in the Ross Sea
S.V. Piyanova and A.F. Petrov (Russia)
- WG-FSA-11/28 Stock assessment of the Patagonian toothfish, *Dissostichus eleginoides*, harvested by the French fishery at Kerguelen Islands (division 58.5.1 of the CCAMLR)
A. Relot-Stirnemann (France)
(Available in English and French)
- WG-FSA-11/29 Results from the groundfish survey conducted in CCAMLR Subarea 48.3 in January/February 2011
J. Brown, S. Gregory, K. Brigden, R. Benedet, O. Hogg, P. Brewin and L. Featherstone (United Kingdom)
- WG-FSA-11/30 Rev. 1 Preliminary assessment of mackerel icefish, *Champscephalus gunnari*, in Subarea 48.3 using a length based population dynamics model
R.E. Mitchell and S.M. Martin (United Kingdom)
- WG-FSA-11/31 Rev. 2 Summary of a three year mark-recapture experiment to estimate population size of Antarctic toothfish (*Dissostichus mawsoni*) in Southern Area of Statistical Subarea 48.4
R.C. Wakeford, T. Peatman, J. Roberts and R.E. Mitchell (United Kingdom)
- WG-FSA-11/32 The Ross Sea toothfish fishery: proposal for conditional transition of classification from exploratory to established
C. Jones (USA) and S. Hanchet (New Zealand)

WG-FSA-11/33 Rev. 1	Preliminary assessment of toothfish in Subarea 48.3 T. Peatman, R.E. Mitchell, G. Parkes and D.J. Agnew (United Kingdom)
WG-FSA-11/34	Recommendation for an explicit limit reference point for the mackerel icefish (<i>Champscephalus gunnari</i>) fishery in CCAMLR Statistical Division 58.5.2 Delegation of Australia
WG-FSA-11/35	Estimation of catch rate and mean weight in the exploratory <i>Dissostichus</i> fisheries across Divisions 58.4.1 and 58.4.2 using generalised additive models D.C. Welsford (Australia)
WG-FSA-11/36	Results of phase I of the Russian research program for toothfish fishery in Subarea 88.3 during the 2010/11 season Delegation of Russia
WG-FSA-11/37	Plan of research fishing in Subarea 88.3 in the 2011/12 season Delegation of Russia
WG-FSA-11/38	Population assessment of Patagonian toothfish in Subarea 48.4 – 2011 update J. Roberts, R. Mitchell and R. Wakeford (United Kingdom)
WG-FSA-11/39 Rev. 1	New gonad identification guides for <i>Dissostichus eleginoides</i> N. Gasco (France), J. Brown (United Kingdom) and G. Duhamel (France)
WG-FSA-11/40	Comprehensive field guide of Antarctic fishes N. Gasco (France)
WG-FSA-11/41	By-catch observation during krill fishing cruise (48.1, 48.2 Statistical Subareas, 2011) K. Vyshniakova (Ukraine)
WG-FSA-11/42	Assessment models for Antarctic toothfish (<i>Dissostichus mawsoni</i>) in the Ross Sea for the years 1997–98 to 2010–11 S. Mormede, A. Dunn and S.M. Hanchet (New Zealand)
WG-FSA-11/43	Assessment models for Antarctic toothfish (<i>Dissostichus mawsoni</i>) in Subarea 88.2 SSRUs 88.2C–G for the years 2002–03 to 2010–11 S. Mormede, A. Dunn and S.M. Hanchet (New Zealand)

- WG-FSA-11/44 Assessment models for Antarctic toothfish (*Dissostichus mawsoni*) in Subarea 88.2 SSRU 88.2E for the years 2002–03 to 2010–11
S. Mormede, A. Dunn and S.M. Hanchet (New Zealand)
- WG-FSA-11/45 A characterisation of the toothfish fishery in Subareas 88.1 and 88.2 from 1997–98 to 2010–11
M.L. Stevenson, S.M. Hanchet, S. Mormede and A. Dunn (New Zealand)
- WG-FSA-11/46 Descriptive analysis of the toothfish (*Dissostichus* spp.) tagging programme in Subareas 88.1 & 88.2 for the years 2000–01 to 2010–11
S. Mormede, A. Dunn and S.M. Hanchet (New Zealand)
- WG-FSA-11/47 Revised proposal for a CCAMLR sponsored research survey to monitor abundance of pre-recruit Antarctic toothfish in the southern Ross Sea
S.M. Hanchet, S. Mormede, S.J. Parker and A. Dunn (New Zealand)
- WG-FSA-11/48 Estimating unaccounted fishing mortality in the Ross Sea and 88.2C–G bottom longline fisheries targeting Antarctic toothfish
D.N. Webber and S.J. Parker (New Zealand)
- WG-FSA-11/49 Pilot study using electronic satellite tags to determine movements of Antarctic toothfish in the Ross Sea region
S. Parker (New Zealand)
- WG-FSA-11/50 CCAMLR measures regulating the tagging of *Dissostichus* species, metrics used to assess vessel tagging performance, the potential for some anomalous results, and general recommendations on tagging; a view from the hauling room
J.M. Fenaughty (New Zealand) and J. Brown (United Kingdom)
- WG-FSA-11/51 Rev. 1 plotImpact – software for producing image plots of spatially referenced impact assessments
D.N. Webber (New Zealand) and J.P. McKinlay (Australia)
- WG-FSA-11/52 Summary of otoliths held in Cape Town that were collected within the CCAMLR area
R. Leslie, C. Heinecken and P. Mullins (South Africa)
- WG-FSA-11/53 Description of fishing gear and procedures of setting / hauling of Spanish longline system for toothfish in CCAMLR area
T. Jung and H.J. Choi (Republic of Korea)

- WG-FSA-11/54 The results of performance of tagging programs of the Korean exploratory fishery for *Dissostichus* spp. in 88.1 in the 2010/11 season
T. Jung and H.J. Choi (Republic of Korea)
- Other documents
- WG-FSA-11/P1 Lead-radium dating provides a framework for coordinating age estimation of Patagonian toothfish (*Dissostichus eleginoides*) between fishing areas
A.H. Andrews, J.R. Ashford, C.M. Brooks, K. Krusic-Golub, G. Duhamel, M. Belchier, C.C. Lundstrom and G.M. Cailliet (*Mar.Freshw. Res.*, 62 (2011): 781–789)
- WG-FSA-11/P2 New data on depths inhabited by striped-eyed rock cod *Lepidonotothen kempfi* (Norman) (Nototheniidae) off Bouvet Island
A.F. Petrov
(*J. Ichthyol.*, 51 (8) (2011): 683–685)
- WG-FSA-11/P3 The diet of toothfish species *Dissostichus eleginoides* Smitt and *D. mawsoni* Norman with overlapping distributions around the South Sandwich Islands, Southern Ocean
J. Roberts, J. Xavier and D. J. Agnew
(*J. Fish Biol.*, 79 (2011): 138–154)

APPENDICES D TO R

**Appendices D to R are only available electronically
at: www.ccamlr.org/pu/e/e_pubs/fr/drt.htm**

