**Report of the Working Group
on Fish Stock Assessment**
(Hobart, Australia, 7 to 18 October 2013)

CONTENTS

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OPENING OF THE MEETING

1.1   The meeting of WG-FSA was held in Hobart, Australia, from 7 to 18 October 2013. The Convener, Dr M. Belchier (UK), opened the meeting and welcomed participants (Appendix A).

ORGANISATION OF THE MEETING AND ADOPTION OF THE AGENDA

2.1   This year's agenda of WG-FSA focused on the assessment of finfish fisheries in the Convention Area, including the biennial assessments for the fisheries for Patagonian toothfish (*Dissostichus eleginoides*) in Subarea 48.3 and Division 58.5.2 and the fisheries for *Dissostichus* spp. in Subareas 88.1 and 88.2, the annual assessments for mackerel icefish (*Champsocephalus gunnari*) in Subarea 48.3 and Division 58.5.2, and the development of advice on precautionary catch limits and other issues relevant to management of CCAMLR fisheries. The agenda of the meeting was discussed and adopted without change (Appendix B).

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

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

- Subgroup on Assessments (coordinator: Dr C. Darby, UK)
- Subgroup on Research to Inform Current or Future Assessments (coordinator: Dr S. Hanchet, New Zealand).

2.4   In this report, paragraphs dealing with advice to the Scientific Committee and other working groups have been highlighted. These paragraphs are listed under Item 13. In addition, the information used in developing assessments and other aspects of the Working Group's work is included in the Report on Bottom Fisheries and VMEs and the Fishery Reports.

2.5   The Working Group discussed the procedure for updating and publishing the Report on Bottom Fisheries and VMEs and the Fishery Reports. In the past, these reports had been appended to the Working Group's report. The Working Group agreed to revise this procedure, such that the reports would be updated during the meeting, and then finalised and published by the Secretariat as separate reports which would include the management advice and conservation measures agreed by the Commission. The Working Group agreed that edits to the Fishery Reports should be supplied to the Secretariat by 10 December 2013, the interim versions should be made available on the CCAMLR website by 20 January 2014 (but only viewable by accredited users), and the final versions made publically available by 20 February 2014.

2.6   The report was prepared by Dr Darby, Dr J. Ellis (UK), Mr J. Fenaughty (New Zealand), Mr N. Gasco (France), Drs Hanchet, T. Ichii (Japan), K.-H. Kock (Germany), R. Leslie (South Africa), E. Marschoff (Argentina), S. Parker (New Zealand), D. Ramm and K. Reid (Secretariat), Mr R. Sarralde (Spain), Dr B. Sharp (New Zealand), Mr R. Scott (UK), Drs D. Welsford (Australia), R. Wiff (Chile), S. Thanassekos (Secretariat) and P. Ziegler (Australia).

REVIEW OF AVAILABLE INFORMATION

Data requirements

3.1   The Working Group reviewed data submitted to the Secretariat from commercial fisheries and fishery-based research in 2012/13, including information relevant to stock assessments. This information is briefly described in this section, noting that the data have been used in assessments described in Item 6.

3.2   The Working Group noted the total catches in the CCAMLR *Dissostichus* spp., *D. eleginoides*, *C. gunnari* and Antarctic krill (*Euphausia superba*) fisheries (Table 1) and *Dissostichus* spp. captured outside the Convention Area in FAO areas adjacent to the Convention Area (Table 2).

3.3   It noted that WG-SAM-13 discussed a framework by which proposed research plans to develop *Dissostichus* spp. assessments in data-poor areas could be evaluated and guided (Annex 4, paragraphs 2.5 to 2.7). A draft flowchart describing the stages of the research leading towards a stock assessment was developed during the intersessional period. The Working Group agreed that the flowchart was useful to develop research plans and to prioritise research as data and assessments are reviewed. The Working Group recommended that it be further discussed under Item 6.1 for inclusion in the Working Group report (paragraphs 6.4 to 6.6).

IUU fishing

3.4   The Secretariat provided an overview of the spatial and temporal distribution of IUU activity within the Convention Area in recent years (CCAMLR-XXXII/BG/09 Rev. 1). The objective of the analysis was not to estimate area-specific IUU catch amounts, but to spatially characterise observed IUU activity, including IUU fishing gear recoveries in the CAMLR Convention Area. This evidence, along with surveillance data from France, suggests that IUU detection is concentrated in the Indian Ocean sector at both high and low latitudes (i.e. Divisions 58.4.1, 58.4.2, 58.4.3a, 58.4.3b, 58.4.4, and outside EEZs in Divisions 58.5.1, 58.5.2 and Subareas 58.6 and 58.7). Using all available data, rather than concentrating on vessel sightings, suggests that observed IUU fishing is more persistent in the northern part of the Indian Ocean and has also occurred in Subarea 48.6 (where there have been no IUU vessel sightings reported).

3.5   Evidence of IUU fishing appears to occur in both open and closed SSRUs, and suggests that in some instances even the presence of licensed vessels in an SSRU may not deter, or result in the reporting of, unidentified vessel activity. The Working Group noted that

under CM 10-02, vessels were required to report all other vessels sighted in the Convention Area to their Flag State, and that analysis of this data would assist with analysing the likelihood of detection of vessels operating in the same area.

3.6   The Working Group considered that haul position data from licensed vessels may inform the potential for vessel sighting reports in instances where IUU vessels were known to be in the vicinity of licensed vessels. The Working Group also requested that, rather than WG-FSA, SCIC should undertake to examine VMS and C2 data to further clarify the potential proximity of licensed vessels to other vessels during steaming and fishing operations. Some Members felt that this should be done in SSRU 5841E for January and February of 2011 where an IUU vessel (formerly *Paloma V*) was apparently fishing in a similar area to CCAMLR Member vessels.

3.7   The Working Group agreed that the spatial and temporal characterisation of potential IUU activity presented in CCAMLR-XXXII/BG/09 Rev. 1 was useful and that the Secretariat should continue to collect, check for accuracy and report these data through time. The Working Group agreed that IUU fishing is still a problem in several areas and that it causes difficulties for developing stock assessments and should be examined in sensitivity analyses (e.g. paragraph 6.93).

3.8   Dr A. Petrov (Russia) noted that there is no information on IUU vessels from closed SSRUs, especially from the Indian Ocean sector of Antarctica. Dr Petrov believed that the opening of closed SSRUs will contribute to the fight against IUU fishing.

Anomalous catch data

3.9   The Working Group noted the discussion by WG-SAM-13 on potential hypotheses to account for the anomalous pattern in observed catch data provided from three Insung Corporation vessels fishing in Divisions 58.4.1 and 58.4.2 and Subarea 48.6 from 2009 to 2011, including the results of a Korean Government workshop held in Busan, Republic of Korea (Annex 4, paragraphs 4.17 to 4.24). In particular it noted the request by WG-SAM-13 for Members to consider ways to evaluate hypotheses or propose alternative hypotheses to help understand the patterns of catch and effort reported.

3.10   WG-FSA-13/57 Rev. 1 presented an evaluation of two additional hypotheses regarding how to explain the anomalous pattern in observed CPUE data, namely:

(i)   'area misreporting': catches may be underreported initially and later assigned to other areas subsequently fished on a trip (i.e. a spatial reallocation); or

(ii)   'catch misreporting': catches may be reported incorrectly both in space and also with respect to total catches on a trip (i.e. a total catch adjustment).

3.11   Some Members agreed that standardised catch modelling such as that provided in WG-FSA-13/57 Rev. 1 was useful and could be used to provide alternate catch histories as a sensitivity in stock assessments where data indicative of total fisheries removals are unavailable or where available data are judged to be unsuitable for scientific analysis. They considered that the combination of factors, including:

(i)   rapid changes in catch rates corresponding to the vessels' passage between areas with different catch limits

(ii)   the temporal and spatial sequence of high catch rates always preceded by low catch rates

(iii) the fact that all vessels showing such patterns were from the same company

(iv)   that the unlikely pattern has occurred three times,

made it unlikely that all the catch rates observed occurred by chance encounter with areas of high fish density. They therefore considered that the hypotheses presented in WG-FSA-13/57 Rev. 1 were the more likely explanations. They recommended that examination of the correspondence between VMS data and reported fishing locations for the vessels in question would be useful in evaluating the patterns reported in this regard, and that this should be undertaken by the Secretariat for further review by the Scientific Committee and/or by SCIC.

3.12   Other Members considered that the methods described in WG-FSA-13/57 Rev. 1 ignored important factors that affected the CPUE fluctuations such as population density, sea-ice conditions, development of fishing gears, and captains' and crews' skills. Particularly, sea-ice condition plays a large part in the CPUE fluctuations in Divisions 58.4.1 and 58.4.2 and Subarea 48.6. In addition, few vessels were able to operate in that period due to harsh sea conditions. Therefore, sufficient data are not available for comparison of CPUE patterns between vessels. Reanalysed catch data, therefore, could not fully reflect the population density in each SSRU. Furthermore, similar CPUE patterns appeared in Subarea 88.1.

3.13   An extreme value analysis of anomalous CPUE patterns by vessels in Subarea 48.6 (WG-FSA-13/63) indicated that the probability of these high CPUE values arising by chance was very low.

3.14   The Working Group noted that it was difficult to determine which of the various hypotheses proposed to account for anomalous reported CPUE was most likely to be correct.

3.15   Dr Petrov said that he did not change his opinion and stance on the issue of high CPUE presented in the Russian paper WG-SAM-13/16 and that WG-FSA-13/57 Rev. 1 is based on two hypotheses and speculative opinion.

Ross Sea data

3.16   Several papers provided updated data inputs for the Ross Sea and Subarea 88.2 stock assessments and provided ancillary analyses to better interpret assessment results. WG-FSA-13/48 repeated a standardised CPUE analysis, last presented in 2006, suggesting that in Subarea 88.1, the standardised CPUE trend was stable with a slight decline since 2008. Although highly variable, there was some evidence of an initial decline in CPUE in Subarea 88.2 followed by a more stable recent period.

3.17   A time series of standardised age structure showed a decrease in median age with a concurrent increase in the proportion of males in the catch in the north of Subarea 88.1. The change arises from a combination of two factors: the increasing prevalence in the catch of a

mode of smaller fish on the Ross Sea slope and age truncation in the right-hand limb of the age distribution on the slope and in the north. The mode of smaller fish may reflect abundant age cohorts of smaller fish or a shift in fishing effort to shallower water on the slope. Right-hand limb truncation is expected as the stock is reduced to the target biomass. The latter change is not apparent in the annual length distributions because with an asymptotic growth curve and variability in size at age, as old fish are removed from the population, the median age may decrease with no corresponding change in length.

3.18   The Working Group further noted that the depth distribution of fishing effort in Subarea 88.1 has become increasingly bimodal in recent years, and suggested that the median depth of fishing may not be a useful descriptor of the depth distribution.

3.19   It was noted that in Subarea 88.2 otoliths from some years where fishing by non–New Zealand flagged vessels occurred have not been aged, so year-specific age–length keys (ALKs) are not available. However, the estimated ALKs do show interannual variability in catch-at-age estimates. The Working Group recommended that Members age fish collected from Subarea 88.2 following agreed protocols (SC-CAMLR-XXXI, Annex 7, paragraphs 10.4 to 10.13) to increase the sample sizes for annual ALKs. Further discussion of this issue occurred under Item 4 (paragraph 4.92).

3.20   The process by which data used in the Ross Sea and Subarea 88.2 assessments (C2, observer and tagging databases) were processed and prepared for input into CASAL was described in WG-FSA-13/56; the R scripts used in the processing have been provided to the Secretariat. The Working Group welcomed the description of data preparation for assessments and encouraged other Members conducting assessments to provide similar documentation.

3.21   The tagging program in the Ross Sea and Subarea 88.2 is now approaching 40 000 tagged fish released and 2 000 recaptured fish (WG-FSA-13/49). The size distribution of tagged fish closely matched the size distribution of the catch since 2011.

3.22   The Working Group noted that recaptures of fish that have moved long distances are influential in understanding potential stock dynamics and that a high level of scrutiny is needed to verify the correct tag linking. It further noted that analysis of recaptures in the north of the Ross Sea and their associated biological characteristics suggests that residence time may vary by sex and condition, and welcomed the proposal by New Zealand to analyse residence times for presentation at a future meeting. The Working Group also recalled that the routine collection of gonad weight from biologically sampled fish would aid in understanding the biological factors that may influence stock movement patterns in exploratory fisheries (SC-CAMLR-XXIX, Annex 8, paragraph 8.14 and Table 16).

3.23   The use of tagging data has been integral to the parameterisation of spatial population models (SPMs) for the Ross Sea. Previous models presented to CCAMLR (WG-SAM-13/35) used medium-scale–resolution model space restricted to either fished cells or all cells in the region. WG-SAM-13 suggested a third intermediate model be developed which restricted the stock to cells where at least 5% of the depth is deemed suitable as habitat for toothfish.

3.24   The resulting model (WG-FSA-13/53) fits the data equally well because the model utilises fishery-dependent data and therefore has no information about the distribution of toothfish in areas where no fishing has occurred. The Working Group agreed that further

research would be useful to improve the parameterisation of the model, especially research informing the timing and location of spawning or ontogenetic movements and the distribution and abundance of fish in unfished areas.

3.25   Key uncertainties in the stock assessment and in SPMs of Antarctic toothfish (*D. mawsoni*) in Subareas 88.1 and 88.2 were identified by WG-FSA-13/55. These included understanding movement patterns associated with spawning, developing toothfish distribution and abundance information in unfished areas and providing better estimates of tagging mortality. Research to address these uncertainties could include making collection of gonad weight measurements routine on all fishing vessels, surveying likely spawning grounds during winter, monitoring tagged fish for survival using electronic tags and obtaining fishery or survey data from areas not fished to date. The Working Group recommended that these uncertainties be prioritised, so that the Scientific Committee can consider how best to develop coordinated proposals to address these research needs.

3.26   Tagging data to be used in the Ross Sea and Subarea 88.2 stock assessments were selected using a case-control data comparison method of tag-detection and tag-mortality rates (Annex 4, paragraph 4.7; WG-FSA-13/50). The Working Group noted that the method was shown to be responsive to the tag-detection rate as many thousands of fish were scanned, but not sensitive to the tag-mortality rate due to the small numbers of tags released and very small numbers of tags recovered. The decision of which index to use in selecting high-quality data for inclusion in the assessments was addressed along with the assessment under Item 5.

3.27   The tagging program in the Ross Sea and Subarea 88.2 was further reviewed given changes implemented in 2012 (WG-FSA-13/54). The recording of observer or crew for tag releases and recoveries showed that overall observers tag nearly 75% of released fish, and about 40% of recaptured tags are reported by observers (whilst 60% are reported by crew). The actual proportion of tags released and recovered varied substantially by vessel and suggests that both observers and crew should be provided training associated with tagging and recovering tags. The Working Group noted that on vessels where most tags are recovered by observers, it is not clear if the actual detection rate may vary depending on the time observers spent actually examining fish for tags. New Zealand has also provided custom toothfish rulers (2 m long, incremented in cm with an adhesive backing) to aid in accurate length measurements, as there was some evidence that vessels may use two 1 m rulers incremented in mm which could result in measurement translation errors. These rulers will be provided in the tagging kits provided by CCAMLR.

3.28   In 2012, the Working Group recommended that diagrams be developed to aid in communicating the tagging suitability criteria without the heavy reliance on text or jargon. The Working Group agreed that the diagrams should be included in the tagging protocol and that the use of tagging release data sheets provided in WG-FSA-13/54 and an easy-to-read tagging ruler should improve data quality. The Working Group welcomed a draft tagging training module and recommended that upon review it be made available to vessels electronically, as part of the tagging kits, to Members' observer programs and, potentially, on the CCAMLR website. The Working Group noted the positive feedback from South Africa on the usefulness of an earlier draft of the tagging training manual.

Research surveys

3.29   The Working Group noted the results of the 2013 demersal fish survey conducted in Subarea 48.3 (WG-FSA-13/17). Notably, the biomass for *C. gunnari* was the highest since 1990, with large aggregations observed to the northwest of South Georgia. The Working Group noted that successful sampling of the area to the southeast of the island was rarely possible and recommended that this be considered in stratification of future surveys. It also noted that there was no evidence of strong recruitment of 1+ or 2+ toothfish observed in the survey. These data were included in the preliminary assessments for *C. gunnari* (WG-FSA-13/27) and *D. eleginoides* (WG-FSA-13/30) in Subarea 48.3.

3.30   The Working Group noted that Australia had undertaken a random stratified trawl survey in Division 58.5.2 during April–May 2013 (WG-FSA-13/21). It noted that total catches of most finfish species were within 95% confidence intervals derived from the seven equivalent surveys undertaken between 2006 and 2012, with the exception of *C. gunnari*, which was seven times more abundant than the long-term mean. These data were included in the preliminary assessments for *C. gunnari* (WG-FSA-13/23) and *D. eleginoides* (WG-FSA-13/24) in Division 58.5.2.

Catch and effort analysis

3.31   The Working Group noted that WG-FSA-13/63 presented an analysis of catch and effort data for Subarea 48.6, updated from that presented in WG-SAM-13/29. The Working Group noted that comparisons between standardised CPUE using a generalised linear model (GLM), as opposed to a generalised additive model (GAM), showed a similar overall pattern, but different results in *D. eleginoides* for the 2010/11 data. The Working Group thanked the authors for their thorough analysis, and agreed with the conclusions that for Subarea 48.6, standardised CPUE was unlikely to be useful as an index of stock dynamics or abundance, but rather that the current tag-recapture program was more likely to result in a robust assessment.

3.32   Some Members considered that when the data used in standardised CPUE were limited, i.e. from one or two vessels for each year, it may not reflect reality (WG-SAM-13/16 and 13/39).

Tagging data analysis

3.33   The Working Group noted that WG-SAM had requested the Secretariat provide an analysis of within-season recaptures of tagged toothfish (Annex 4, paragraph 2.11). WG-FSA-13/01 presented this analysis, indicating that within-season recaptures were distributed heterogeneously across *Dissostichus* spp. fisheries, with high levels of within-season recaptures in the northern SSRUs in Subarea 48.6 and in SSRU 882H. The Working Group noted that there appears to be a relationship between the amount of habitat at fishable depths and rates of within-season recaptures, with high rates observed on seamounts. The Working Group noted that locations with high within-season recaptures may provide data enabling comparison between biomass estimated by local depletion and Petersen tag-recapture analysis, and requested that such analyses be conducted by the Secretariat for presentation at the next meeting of WG-SAM.

3.34   The Working Group noted the analysis of tag recaptures in Subarea 48.3 presented in WG-FSA-13/29, including an application of the 'select' method (Mormede and Dunn, 2013), to determine consistency in tag releases and reporting across the fleet. The Working Group welcomed the application of the select method for the first time outside Subareas 88.1 and 88.2 and noted that the analysis showed relatively high consistency in relative tag-detection indices across the fleet in this subarea. It also noted that apparently tag movements between releases and recaptures had increased in recent seasons, with some tag recaptures exceeding 100 n mile movements within a season. It recommended that UK scientists continue to investigate whether this pattern is due to data errors or a change in toothfish behaviour in recent years.

STOCK ASSESSMENTS

C. gunnari South Georgia (Subarea 48.3)

4.1   The fishery for *C. gunnari* in Subarea 48.3 operated in accordance with CM 42-01 and associated measures. In 2012/13, the catch limit for *C. gunnari* was 2 933 tonnes. Fishing early in the season was conducted by two vessels using midwater trawls and the total reported catch was 1 354 tonnes as of 20 September 2013. The fishery resumed at the time of the WG-FSA meeting. Details of this fishery and the stock assessment of *C. gunnari* are contained in the Fishery Report (www.ccamlr.org/node/75667).

4.2   WG-FSA-13/27 presented a preliminary assessment of *C. gunnari* in Subarea 48.3. The assessment was based on a random stratified bottom trawl survey of the South Georgia and Shag Rocks shelves that the UK undertook in January 2013 as part of its regular monitoring program (WG-FSA-13/29; paragraph 3.29). A total catch of 42.9 tonnes was reported from the research survey, with an exceptionally large catch of 22 tonnes of *C. gunnari* taken in a single haul in the northwest stratum.

4.3   A bootstrap procedure was applied to the survey data to estimate the demersal biomass of *C. gunnari* in this subarea. Since the results of the bootstrap procedure were highly sensitive to the treatment of the single high-abundance station, the station with the exceptionally large catch was omitted from the analysis as a precautionary approach to biomass estimation.

4.4   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-13/27. The bootstrap procedure estimated the median demersal biomass at 106 548 tonnes, with a one-sided lower 95% confidence interval of 49 640 tonnes. The harvest control rule, which ensures 75% biomass escapement after a two-year projection period, yielded a catch limit of 4 635 tonnes for 2013/14 and 2 659 tonnes for 2014/15.

4.5   The Working Group reflected on the analysis in WG-SAM-13/31 Rev. 1 which showed that the projected catch into the next year has been consistently lower than the catch estimates from that year's survey, when surveys were conducted within the same season. This analysis, enabled by a time series of annual surveys, was considered to be very valuable.

Together with WG-FSA-12/26, it indicated that the current harvest control rule can be considered to be precautionary in accounting for uncertainty at several steps of the stock- and catch-estimation process.

4.6   To reduce the risk of depletion when biomass levels are estimated to be very low, the Working Group agreed that it would be valuable to implement additional limit reference points, such as the ones in Division 58.5.2 (WG-FSA-11/34; SC-CAMLR-XXX, paragraph 3.69). The Working Group discussed ways to scientifically determine appropriate biomass and catch-limit reference points, and suggested that the biomass reference level would likely be below the lowest biomass estimated from past surveys that did not appear to have substantially reduced recruitment in subsequent years. The Working Group agreed that an evaluation of the utility of candidate limits should be presented for consideration by WG-SAM before the next assessment of the stock.

Management advice

4.7   The Working Group recommended that the catch limit for *C. gunnari* should be set at 4 635 tonnes for 2013/14 and 2 659 tonnes for 2014/15 based on the outcome of the short-term assessment and forecast (see Table 3 for summary of catch limits).

C. gunnari Heard Island (Division 58.5.2)

4.8   The fishery for *C. gunnari* in Division 58.5.2 operated in accordance with CM 42-02 and associated measures. In 2012/13, the catch limit for *C. gunnari* was 679 tonnes. Fishing was conducted by one vessel using a semipelagic trawl and the total reported catch up to 20 September 2013 was 644 tonnes. Details of this fishery and the stock assessment of *C. gunnari* are contained in the Fishery Report (www.ccamlr.org/node/75667).

4.9   The results of the bottom trawl survey undertaken in April 2013 were summarised in WG-FSA-13/21 (see also paragraph 3.30). The Working Group noted that *C. gunnari* were very abundant in 2013, with catches four times higher than those of 2012 and seven times the long-term average.

4.10   A short-term assessment was conducted in the generalised yield model (GYM), using the one-sided bootstrap lower 95% confidence bound of total biomass of 6 098 tonnes from the 2013 survey and fixed model parameters. The length–weight relationship was updated using the survey data; other parameters were unchanged from previous assessments. The best fit of CMIX to the data was achieved when the population was estimated to consist of four year classes from 1+ to 4+, with the large 2+ cohort observed in 2012 still dominating the population as the 3+ cohort.

4.11   The 2013 survey indicates that the stock in Division 58.5.2 is sufficiently abundant to support a fishery in 2013/14. However, older fish in the 4+ and 5+ cohorts, which were detected in the 2011 and 2012 surveys, have not survived to be recorded in 2013. A regime of a single abundant cohort dominating the population in Division 58.5.2 appears to be returning.

4.12   Two catch scenarios were examined. In scenario 1, the initial biomass estimate of 6 098 tonnes was apportioned across the 1+, 2+ and 3+ year classes according to their length density and projections for two years of catch, which resulted in 75% escapement of the biomass calculated. For scenario 2, the biomass contribution due to the 3+ cohort (5 610 tonnes, 92% of 6 098 tonnes) was projected for one year assuming no survival thereafter, and the biomass of the 1+ and 2+ cohorts (488 tonnes, 8% of 6 098 tonnes) were projected separately for two years. Fishery catches of 400 tonnes after the survey were also included in the model, assumed to have been taken from the 2+ and 3+ cohort in proportion to their relative abundance in the survey.

4.13   Estimates of yield under scenario 1 indicate that 764 tonnes of icefish could be taken in 2013/14 and 571 tonnes in 2014/15 allowing 75% escapement of biomass over two years.

4.14   However, as has been seen in previous years, the abundant 3+ year class is unlikely to be present in 2014/15, and therefore under scenario 2, a catch of 1 267 tonnes could be taken in 2013/14 (less than the aggregate catch across the two-year projection of 1 335 tonnes), ensuring 75% escapement of the 3+ cohort prior to them disappearing, with the expectation that there will be no commercial fishery in 2014/15.

4.15   Allowing the catch to be taken in a single season has the benefit of enabling the fishery to have access to an abundant cohort while it is still present. Further, this harvest strategy would reduce potential impacts on the current 1+ and 2+ cohorts, which the survey indicates are insufficiently abundant to support the 598 tonnes of catch estimate under scenario 1 in 2014/15.

Management advice

4.16   The Working Group recommended that the Scientific Committee consider a catch limit for *C. gunnari* in 2013/14 of 1 267 tonnes, with a 30-tonne research and by-catch limit in 2014/15, unless revised advice from the Working Group following the 2014 survey indicates that a fishery is viable.

D. eleginoides South Georgia (Subarea 48.3)

4.17   The fishery for *D. eleginoides* in Subarea 48.3 operated in accordance with CM 41-02 and associated measures. In 2012/13, the catch limit for *D. eleginoides* was 2 600 tonnes. Fishing was conducted by six vessels using longlines and the total reported catch up to 20 September 2013 was 2 098 tonnes. Details of this fishery and the stock assessment of *D. eleginoides* are contained in the Fishery Report (www.ccamlr.org/node/75667).

4.18   WG-FSA-13/30 presented the preliminary assessment of *D. eleginoides* in Subarea 48.3. The CASAL assessment model was fitted to catch-at-age, catch rates, tag-recapture and survey abundance data. Despite removing a survey station with an exceptionally large catch in the 1990 survey, the survey indices data were not fitted well, in particular the most recent years of low abundances. The Working Group recommended investigating the

re-estimation of process error for the survey separately for the next assessment. The Working Group also recommended that otoliths collected from the survey be aged to estimate annual ALKs for the survey length-composition data.

4.19   The Working Group considered two alternate model specifications for the fleet structure, with the commercial catch information and standardised CPUE either split into two time periods in a '2-fleet model' or into three time periods in a '3-fleet model'. Model estimates from the 2-fleet and 3-fleet models were similar, with the exception of year–class strength (YCS) estimates which differ markedly in 1990 but follow similar trends in all other years. The 3-fleet model provided overall better fits to the observations, however, some model diagnostics indicated that this model structure was inferior, with MCMC chains showing poor convergence and having a higher level of autocorrelation. There was also a slightly larger, albeit overall small, discrepancy between the B_0 estimates from the MCMC and MPD estimation compared to the 2-fleet model. The Working Group recommended that the 2-fleet model should be used to provide management advice.

4.20   The assessment results from this year's analyses are consistent with those of 2011. The 2-fleet model estimated B_0 at 87 665 tonnes, with the SSB status in 2013 at 0.52 of B_0.

4.21   The Working Group discussed how to proceed with the projections undertaken to determine the precautionary yield that would satisfy the CCAMLR decision rules. The estimated recruitment pattern indicated a period up to 1995 with overall higher recruitment, followed by years with overall lower recruitment that were interspersed with single years of higher recruitment. Based on this observed recruitment pattern, WG-FSA agreed to use the average recruitment and CV from 1992 to 2006 for the stock projections with a lognormal empirical randomisation method of recruitment. This resulted in a precautionary catch limit of 2 400 tonnes.

4.22   The Working Group discussed potential stock linkages between *D. eleginoides* in Subareas 48.3 and 48.4. Following the general recommendation for assessed fisheries, the Working Group recommended that a paper on stock structure in these subareas be submitted for discussion during the next WG-SAM meeting.

Management advice

4.23   The Working Group recommended that the catch limit for *D. eleginoides* in Subarea 48.3 should be set at 2 400 tonnes for 2013/14 and 2014/15 based on the outcome of this assessment.

4.24   Following previous management agreements, the catch limit would be further subdivided between the Management Areas A–C:

Management Area A: 0 tonnes
Management Area B: 720 tonnes in each season
Management Area C: 1 680 tonnes in each season.

Dissostichus spp. South Sandwich Islands (Subarea 48.4)

4.25   The fishery for *Dissostichus* spp. in Subarea 48.4 operated in accordance with CM 41-03 and associated measures. In 2012/13, fishing was conducted by two vessels using longlines. In the Northern Area, the catch limit for *D. eleginoides* was 63 tonnes and the management area was closed on 4 April 2013; the total reported catch of *D. eleginoides* was 62 tonnes. In the Southern Area, the catch limit for *Dissostichus* spp. was 52 tonnes and the total reported catch up to 20 September 2013 was 50 tonnes. Details of this fishery and the stock assessment of *Dissostichus* spp. are contained in the Fishery Report (www.ccamlr.org/node/75667).

4.26   The assessment and management of *Dissostichus* spp. fisheries in Subarea 48.4 has, to date, been based on separate assessments for the north and south of the management area. The assessment for the Northern Area comprised a single-species integrated assessment for *D. eleginoides*, using CASAL, whilst for the Southern Area a Petersen biomass estimate was calculated for both *D. eleginoides* and *D. mawsoni* combined. WG-FSA-12 (SC-CAMLR-XXXI, Annex 7, paragraph 5.32) recommended that species-specific assessments should be developed for the subarea to provide more appropriate assessment and management of the fisheries.

D. eleginoides South Sandwich Islands (Subarea 48.4)

4.27   A preliminary CASAL assessment for *D. eleginoides* (WG-SAM-13/24) was updated with data for 2013 and further developed to incorporate the recommendations of WG-SAM-13 (Annex 4) which included the investigation of the removal of catch-at-age data for 2009 and the investigation of alternative data-weighting approaches.

4.28   The 2009 age-composition data indicated the catch in that year to be dominated by just two or three age classes and was inconsistent with other years for which age data indicated a broader spread of ages. Additional analyses were conducted during the meeting to investigate both the individual and combined effects on the assessment of removing the 2009 age data and of alternative data-weighting approaches.

4.29   The assessment presented to the Working Group employed an alternative data-weighting approach based on the methods described in Francis (2011a, 2011b). Point estimates of the assessment results were largely unchanged by the revised approach. However, the Working Group noted that, in contrast to other instances in which these data-weighting approaches had been applied, the method produced reduced variability in MCMC posterior distributions of biomass leading to more constrained estimates of future biomass in the projections. The Working Group considered that the existing data-weighting procedures, as applied in previous assessments of this stock, should be retained pending further investigation of data weighting and its effects on the stock assessment.

4.30   The assessment described in WG-FSA-13/31 was re-run using the previous data-weighting approaches and revised projections conducted. The resulting long-term catch that satisfied the CCAMLR harvest control rules was 45 tonnes. Model results and figures are provided in the Fishery Report.

4.31   *Dissostichus eleginoides* biomass estimates using CASAL and the Petersen method were compared. The application of CASAL estimated a total biomass of 1 600 tonnes while the Petersen method estimated 1 400 tonnes. The Working Group highlighted the similarities in the results from both these methods.

4.32   The Working Group noted that the maturity ogive used in the assessment was based on the assumption that fish of stage II and above were fully mature. The Working Group considered that fish of at least stage III were a more appropriate indication of full maturity and recommended that the maturity ogive be re-estimated for future assessments.

4.33   In addition, the Working Group made a number of recommendations for future work. These included the incorporation of size-dependent tag mortality, as currently applied in Subarea 48.3, estimation of growth parameters externally to the model, and revision of the maturity data available to estimate a maturity ogive in this area. Special attention should be paid to the maturity stage chosen as the cut-off for considering maturity and also to the GSI index to identify the main reproductive season.

Management advice

4.34   The Working Group recommended that the catch limit for *D. eleginoides* in Subarea 48.4 should be set at 45 tonnes for 2013/14 based on the outcome of the assessment.

D. mawsoni South Sandwich Islands (Subarea 48.4)

4.35   WG-FSA-13/64 implemented a tag-based Petersen estimator to provide the first species-specific biomass estimates for *D. mawsoni* in Subarea 48.4. The catch limit for 2013/14 was estimated by applying the same catch rate as in previous years, which is based on the harvest rate of *D. eleginoides* in Subarea 48.3 ($\gamma = 0.038$). Accordingly, a total catch limit of 24 tonnes was recommended for 2013/14.

4.36   The Working Group recalled the analysis in WG-FSA-13/01 which suggested that high within-season recaptures in some areas are related to seamounts. This should also be considered in Subarea 48.4. It also recommended that γ be estimated using biological parameters for *D. mawsoni* from this area in the future.

Management advice

4.37   The Working Group recommended that the catch limit for *D. mawsoni* in Subarea 48.4 should be set at 24 tonnes for 2013/14 based on the outcome of the assessment.

D. eleginoides Heard Island (Division 58.5.2)

4.38   The fishery for *D. eleginoides* in Division 58.5.2 operated in accordance with CM 41-08 and associated measures. In 2012/13, the catch limit for *D. eleginoides* was

2 730 tonnes. Fishing was conducted by four vessels using bottom trawls, longlines and pots and the total reported catch up to 20 September 2013 was 2 413 tonnes. Details of this fishery and the stock assessment of *D. eleginoides* are contained in the Fishery Report (www.ccamlr.org/node/75667).

4.39   WG-FSA-13/24 presented an updated assessment for *D. eleginoides* in Division 58.5.2 with data until the start of August 2013. Compared to the last assessment in 2011, the assessment updated the growth model and compared the effects of a range of alternative fishery structures and model assumptions for YCS on stock assessment estimates and projected catch limits that satisfy the CCAMLR decision rules.

4.40   The new fishery structure was based on a method in WG-SAM-13/18 that suggested a simplification of the longline hauls into two sub-fisheries that were depth-stratified but not regionally explicit. Alternative trawl sub-fisheries were evaluated within the assessment model in different scenarios. All evaluated scenarios with alternative trawl sub-fishery structures produced similar SSB patterns and estimates of current status, however, the selectivity functions for the different trawl sub-fisheries varied substantially, indicating that a separation of the trawl sub-fisheries was appropriate. The preferred model from WG-FSA-13/24 included estimation of selectivity functions to the observations of three separate trawl sub-fisheries and estimated YCS from 1992 to 2009 (Figure 1). Using the CCAMLR decision rules, this model recommended a catch limit of 3 005 tonnes for 2013/14 and 2014/15 (Figure 2).

4.41   The Working Group noted that the recommendations from WG-FSA in 2009 and 2011 (SC-CAMLR-XXVIII, Annex 5, paragraph 5.151; SC-CAMLR-XXX, Annex 7, paragraph 6.41) to provide an updated model including tag-recapture data in the assessment model in order to characterise the abundance and dynamics of the larger adult fish had not been presented. It reiterated the importance of progressing this work as the fishery is changing from trawl to longline and there is an increasing need to directly monitor the adult stock. The Working Group also noted that age data for the commercial fleets for the years 2009 to 2013, and for the survey for the years 2012 and 2013, had not been available for the assessment; the absence of age data is increasing uncertainty in the assessment estimates, particularly in recent YCS. The Working Group noted that Australia is about to start a research program to analyse and incorporate tagging data into the stock assessment, and to conduct high throughput ageing of otoliths from 2012 to 2013 and forthcoming seasons.

4.42   The Working Group noted that, while the catch advice of 3 005 tonnes was consistent with the CCAMLR decision rules, SSB is projected to drop below 50% B_0 in 2017 and remain below 50% B_0 for the remaining projection period before increasing to above the target reference point of 50% SSB_0 in the last year of the projection period (Figure 2). Median SSB was projected to be around 40% B_0 for around 10 years between 2020 and 2030.

4.43   These projections were run with the assumption that the future catch will be taken entirely by longline, due to the retirement of the only remaining trawler of this fishery in 2013/14. Sensitivity analyses, for which the projected catch was evenly split between trawl and longline, indicated that the projected SSB pattern was largely the result of the change from trawl to longline fishing in which cohorts that were exploited at the smallest size by trawls are exploited again at the larger sizes by the longlines, with an eventual improvement resulting from the increase in yield-per-recruit through longline fishing.

4.44   The Working Group noted that maintaining a catch level in the long term that results in this pattern may be less precautionary than a catch level that results in a less steep decline and/or a prolonged period below the target level.

4.45   When evaluating the stock assessment model structure, the Working Group noted that two trawl sub-fisheries were fished only sporadically and in varied locations between years. The likelihood profiles of these sub-fisheries presented in WG-FSA-13/24 indicated that they did not appear to contribute substantially to the estimation of parameters, but rather were likely to be increasing uncertainty in the estimates of B_0 and current status. Removing their observations and setting their selectivity equal to that of the trawl 1 sub-fishery improved the fits to the remaining datasets in a revised model.

4.46   A review of the YCS estimates from the fit of the revised model indicated that there was no information on the YCS of the 2009 year class (Figure 1a). This was likely to result from the lack of recent age data. Consequently, the 2009 year class was excluded from the estimation and set to the average value R_0 in further model fits (Figure 1b).

4.47   The Working Group noted that the model was fitted and projections made without a stock-recruitment relationship; consequently, average recruitment was assumed to remain constant at all stock levels projected by the model scenario of WG-FSA-13/24. The Working Group noted that in a circumstance where status is estimated to remain below 50% for a prolonged period, this may not result in catch limits that sufficiently account for uncertainty in future recruitments. The Working Group noted that no stock-recruitment relationship had been directly estimated for *Dissostichus* spp., however, it requested a model fit in which a stock-recruitment relationship was fitted with a steepness of 0.75, based on WG-FSA-SAM-06/08 and the relationship also used in projections.

4.48   The final model agreed by the Working Group removed observations of the two sporadic trawl sub-fisheries, estimated YCS from 1992 to 2008 and included a stock-recruitment relationship with a steepness of 0.75.

4.49   Fits and projections of this final model, applying the CCAMLR decision rules, resulted in a higher minimum median spawning biomass and slower projected increase in biomass from the year 2020 characterised by a flattening of the SSB trajectory when compared to that presented in WG-FSA-13/24.

4.50   Estimates of B_0 and catch limits that satisfy the CCAMLR decision rules varied between CASAL version 2.22 v3982 and version 2.30 v4982 (Table 4). In order to evaluate the uncertainty resulting from the version of CASAL applied, the Working Group conducted sensitivity tests of the estimated values of B_0 and stock status when initialising runs of the two CASAL versions at two initial B_0 estimates. Table 3 presented the B_0 estimates resulting from the model runs. It was noted that CASAL version 2.22 v3982 resulted in a 7.6% difference in the estimates of B_0, version 2.30 v4982 in a 0.2% difference.

4.51   In these instances, the long-term catch limits that satisfied the CCAMLR decision rules were estimated at 2 770 tonnes when using CASAL version 2.22 v3982, and 2 500 tonnes when using CASAL version 2.30 v4982 (Figures 3 and 4). Using the latter CASAL version, the projected yield of 2 770 tonnes did not satisfy the CCAMLR decision rules (Figure 5). Sensitivity runs requested by the Working Group at constant projected catch levels of 1 000 and 2 000 tonnes are shown in Figures 6 and 7.

4.52   The Working Group agreed that in order to provide advice on the dynamics of the stock in Division 58.5.2, the assessment results from the fit of the most recent CASAL version with the lowest objective function and more stable estimates could be used as a basis for advice. However, the Working Group expressed concern at the potential for differing versions of the CASAL model to produce such variable estimates (see also paragraphs 4.93 to 4.98 which discuss CASAL version control).

4.53   WG-FSA requested the following further work to refine the assessment and expand data inputs into the assessment during the intersessional period between assessments in order of priority and present a report on progress at WG-SAM-14:

(i)   update the age data used in the assessment to include all recent years for which the information is available

(ii)   review the tagging data available for inclusion on the assessment, including:

(a)   an analysis of the spatial and temporal patterns of releases and recaptures, including linkage with other stocks

(b)   localised and stock-based estimates of abundance using Petersen estimators

(c)   sensitivity tests when including tag-recapture information in the CASAL stock assessment

(iii)   compare MCMC runs with covariance matrix resampling for stock projections for this stock

(iv)   evaluate the consequence, including information from ALKs and externally estimated growth functions that account for length-based selectivity in the model.

Management advice

4.54   Dr Welsford noted the difficulty in understanding and explaining the differences in the results of the scenarios developed during WG-FSA-13. He considered that the Working Group had had insufficient time to review and select a single scenario upon which to provide management advice for the *D. eleginoides* fishery in Division 58.5.2.

4.55   Drs S. Hanchet and S. Mormede (New Zealand) were concerned that even at a catch limit of 2 500 tonnes the biomass drops to 45% for at least 10 years. The subsequent recovery of the stock relies on the assumption that future recruitment will be at the long-term median level subject to the stock-recruit relationship, but eight out of the last 11 YCS estimates were below average, and it is unknown whether future YCS will return to the long-term average. Furthermore, there is currently no index of SSB so the estimate of current SSB is uncertain and this uncertainty will increase into the future as the fishery completes its transition to a 100% longline fishery. A precautionary catch limit of between 2 000 and 2 500 tonnes should be set for 2013/14 and a revised assessment tabled together with a method for developing an index of SSB at WG-SAM-14.

4.56   Dr Darby noted that the catch estimate of 2 500 tonnes was consistent with the CCAMLR decision rule and is based on an estimate derived from a converged run of the CASAL model. The catch estimate of 2 770 tonnes was derived from a CASAL version which failed to reach a unique solution when initiated at different starting estimates of B_0.

D. eleginoides Kerguelen Islands (Division 58.5.1)

4.57   The fishery for *D. eleginoides* in Division 58.5.1 is conducted in the French EEZ. In 2012/13, the catch limit for *D. eleginoides* was 5 100 tonnes. Fishing was conducted by seven vessels using longlines and the total reported catch up to 20 September 2013 was 3 239 tonnes. Details of this fishery and the stock assessment of *D. eleginoides* are contained in the Fishery Report (www.ccamlr.org/node/75667).

4.58   There were no papers presented this year on the stock assessment of *D. eleginoides* at Kerguelen (national EEZ in Division 58.5.1). Mr R. Sinegre (France) noted that France has just finished the POKER 3 survey, and is in the process of updating the stock assessment in the coming year. Mr Sinegre presented some preliminary results on the stock assessment. Updated work included reducing the number of fisheries and seasons, updating data weighting to the Francis method and including a biomass estimate and length-frequency distributions from the latest POKER survey (2013).

4.59   The Working Group welcomed the update and recommended that the updated stock assessment be presented at WG-SAM-14. The Working Group also recalled last year's WG-FSA recommendations (SC-CAMLR-XXXI, Annex 7, paragraphs 4.24 to 4.27) to provide a more robust assessment, in particular specific recommendations on the stock assessment model (SC-CAMLR-XXXI, Annex 7, paragraph 4.24), and noted that some have already been addressed. It made the following recommendations:

(i)   investigate parameters at bounds and contributions to the penalties

(ii)   investigate sensitivities using YCS fixed at 1, YCS estimated to 2009 only, and/or excluding CPUE data to the base case

(iii)   age fish from POKER surveys and fisheries catches and include them in the model as they become available (as per WG-FSA-11 advice (SC-CAMLR-XXX, Annex 7))

(iv)   explore IUU fishing effects on unfished biomass estimate (as per WG-FSA-11 advice (SC-CAMLR-XXX, Annex 7)).

Management advice

4.60   In the absence of a new stock assessment, the Working Group recalled last year's WG-FSA recommendation that 'until a more robust stock assessment is undertaken, the model described in WG-FSA-12/09 could be used to provide management advice for the 2012/13 season, and that the current catch limit of 5 100 tonnes could be used as management advice for 2012/13' (SC-CAMLR-XXXI, Annex 7, paragraph 4.25).

4.61   No new information was available on the state of fish stocks in Division 58.5.1 outside areas of national jurisdiction. The Working Group therefore recommended that the prohibition of directed fishing for *D. eleginoides*, described in CM 32-02, remain in force.

D. eleginoides Crozet Islands (Subarea 58.6)

4.62   The fishery for *D. eleginoides* at Crozet Islands is conducted in the French EEZ which includes parts of Subarea 58.6 and Area 51 outside the Convention Area. In 2012/13, the catch limit for *D. eleginoides* was 700 tonnes. Fishing was conducted by six vessels using longlines and the total reported catch up to 20 September 2013 was 504 tonnes. Details of this fishery and the stock assessment of *D. eleginoides* are contained in the Fishery Report (www.ccamlr.org/node/75667).

4.63   WG-FSA-13/05 presented the results of a first stock assessment of *D. eleginoides* at Crozet Islands (Subarea 58.6 inside the French EEZ). The Working Group welcomed this new stock assessment and thanked the authors for bringing it to CCAMLR. The data included in the model were commercial catches, commercial catch-at-length, tag releases and recaptures. Sensitivity runs were carried out with estimations of IUU and killer whale (*Orcinus orca*) depredation, as well as the impact of data weighting on model results. The Working Group noted issues with data weighting in the model, the model fits, and some parameters estimated at bounds. These issues were investigated by a subgroup and a more stable model run was obtained by applying the data-weighting methods described in Francis (2011a, 2011b) to model run 3.2 of the Crozet stock assessment. MCMCs were carried out and the potential yield that would satisfy the CCAMLR decision rules was calculated as 2 500 tonnes (including 10% killer whale depredation). The current catch limit applied is 700 tonnes. The Working Group suggested that it could be useful to compare the results from the model with a calculation of biomass through CPUE analogy method.

4.64   The Working Group recommended that the reasons driving the changes in sampled trawl length frequencies between years be investigated further, and a sensitivity be run without trawl length-frequency data. The Working Group also questioned how the estimates of initial and current biomass were influenced by the IUU catch and killer whale depredation assumptions, and recommended that this be investigated further with the updated model. It also recommended, as for other stocks, that fish be aged to include annual ALKs and age frequencies in the model, preferably spanning the period of the fishery.

Management advice

4.65   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 32-02, remain in force in 2013/14.

D. eleginoides Prince Edward and Marion Islands

4.66   The Fishery Report for the fishery in the South African EEZ in Subareas 58.7, 58.6 and Area 51 was updated. Dr Leslie informed the Working Group that the operational management procedure (OMP) used to provide management advice is in the process of being updated, and will then be used as the basis for management advice for the fishery in this area in 2013/14.

Exploratory fisheries

Dissostichus spp. (Subarea 88.1)

4.67   The exploratory fishery for *Dissostichus* spp. in Subarea 88.1 operated in accordance with CM 41-09 and associated measures. In 2012/13, the catch limit for *Dissostichus* spp. was 3 282 tonnes. Fishing was conducted by 18 vessels using longlines. The fishery closed on 25 January 2013 and the total reported catch was 3 155 tonnes (see also paragraph 5.2). Details of this fishery and the stock assessment of *Dissostichus* spp. are contained in the Fishery Report (www.ccamlr.org/node/75667).

4.68   An update of the Bayesian sex- and age-structured stock assessment model for *D. mawsoni* in the Ross Sea region (Subarea 88.1 and SSRUs 882A–B) was presented in WG-FSA-13/51. The assessment was based on that of 2011 but updated with data for 2012 and 2013, and incorporated a revised maturity ogive for males and revised data-weighting procedures based on the methods described in Francis (2011a, 2011b). In addition, an alternative data selection method, as described in WG-SAM-13/34, had been employed. The alternative method resulted in fewer tag data being selected for input to the assessment and provided a more precautionary estimate of stock abundance.

4.69   A sub-adult survey (WG-SAM-13/32) has operated in the Ross Sea since 2011 and now has two years of data. Sensitivity analyses conducted to incorporate the sub-adult survey index in the assessment indicated that estimates of recruitment were more stable when the survey was included in the assessment. The Working Group noted the contribution to the assessment of this survey series and recommended that it be continued in future years.

4.70   CASAL provides the option to apply an annual shift to the fitted selection patterns depending on the mean annual depth of fishing. The Working Group noted that MCMC diagnostics for the depth-shift parameters showed they were poorly fitted by the model. Comparative assessment runs for which the depth-shift parameters were removed provided almost identical results with a substantial reduction in the number of parameters estimated.

4.71   The Working Group supported the advice of WG-SAM-13 (Annex 4, paragraphs 3.25 and 3.26) and recommended that the sub-adult survey be continued, with a catch limit of 43 tonnes allocated from the Ross Sea shelf catch limit in 2013/14. The Working Group further recommended that the depth-shift parameters should be omitted from future assessments, and that length-based tag mortality, as applied for *D. eleginoides* in Subarea 48.3, be investigated as a sensitivity.

4.72   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 3 044 tonnes. At this yield, there is a less than 10% chance of spawning biomass dropping to less than 20% of the initial biomass.

Management advice

4.73   The Working Group recommended that the catch limit for *D. mawsoni* in Subarea 88.1 should be set at 3 044 tonnes for 2013/14 and 2014/15, based on the outcome of the assessment.

Dissostichus spp. (SSRU 882A)

4.74   SC-CAMLR-XXXI (paragraph 9.30) agreed that SSRU 882A could potentially be opened and managed as part of the Ross Sea fishery so that additional information could be collected to further inform stock assessments and management advice for this region. WG-FSA-13/55 identified a number of research priorities for the Ross Sea region to directly inform gaps in current understanding of the biology and dynamics of toothfish stocks in this region. One of the priority areas identified by the Working Group was research in the south of SSRU 882A to better understand toothfish distribution and movement on the Ross Sea slope and the potential implications for stock structure and potential bias in the stock assessment.

4.75   WG-FSA-13/13 proposed a mechanism to determine catch limits for this area within the scope of CM 41-10.

4.76   The Working Group recommended the following as an appropriate basis for research fishing in SSRU 882A.

(i)   A maximum catch of 60 tonnes would apply inside a research block (76.647S–75.790S and 169.660W–166.967W) that bounds an area in which around 146 tagged fish were released during research in 2010/11 and 2011/12. Fish should be tagged at a rate of three fish per tonne. No limit on the spatial separation of sets would apply.

(ii)   A maximum catch of 226 tonnes could be taken from the remaining area of SSRU 882A south (i.e. south of 73°S). All lines should be separated by a minimum of 5 n miles (for each individual vessel) and fish should be tagged at a rate of three fish per tonne.

(iii)   All catches taken both inside and outside the research block are part of the Ross Sea slope catch limit (SSRUs 881H, I, K). Uncaught portions of catch limits in SSRU 882A south can be taken from elsewhere in SSRUs 881H, I, K.

(iv)   The research design and associated maximum catches should apply for two years. The results will be evaluated and further research will be conditional on the results of the evaluation and on the suitability of the data for inclusion in the 2015 stock assessment and management advice.

4.77   A primary aim of fishing within the research block is to recapture tagged fish that were released in 2010/11 and 2011/12, as well as other tags potentially indicative of fish movements from other areas. It is estimated that 95 tagged fish from the research in 2010/11 and 2011/12 will be available for recapture. The Working Group agreed the maximum catch would be 60 tonnes.

4.78   The primary aim of fishing outside of the research block is to provide information on the distribution and movement of fish in the Ross Sea region, in particular the movement from SSRU 881K where more than 6 500 fish have been tagged since 2001. The maximum catch outside the research block would be 226 tonnes.

4.79   The Working Group noted that the stated objective of research in this area was to provide additional data to improve stock assessment and management and emphasised the importance of achieving a high tag overlap and conducting the tagging of fish in accordance with the guidelines described in WG-FSA-13/49. The Working Group also encouraged all Members to undertake biological sampling at a higher frequency in these areas, including toothfish otoliths and to contribute to the development of annual ALKs and to ensure that data are of the highest quality.

4.80   The Working Group noted that catch limits for the Ross Sea region are managed under two conservation measures (CMs 41-09 and 41-10). The Working Group recommended that the Scientific Committee consider revising the boundary between Subareas 88.1 and 88.2. Alternatively, the scope of CMs 41-09 and 41-10 could be revised such that the Ross Sea (Subarea 88.1 and SSRU 882A–B) is managed within a single conservation measure.

4.81   The Working Group further noted that 23 vessels have notified to fish in Subarea 88.2 in 2013/14, and that a maximum catch of 60 tonnes might be difficult to manage where a large number of vessels may be competing for catch in an Olympic fishery.

Dissostichus spp. (Subarea 88.2)

4.82   The exploratory fishery for *Dissostichus* spp. in Subarea 88.2 operated in accordance with CM 41-10 and associated measures. In 2012/13, the catch limit for *Dissostichus* spp. was 530 tonnes. Fishing was conducted by 16 vessels using longlines. The fishery closed on 13 February 2013 and the total reported catch was 476 tonnes (see also paragraph 5.2). Details of this fishery and the stock assessment of *Dissostichus* spp. are contained in the Fishery Report (www.ccamlr.org/node/75667).

4.83   WG-FSA-11 (SC-CAMLR-XXX, Annex 7) noted that until 2011 assessments for SSRUs 882C–G and 882H were undertaken independently. In 2011 the Working Group adopted the combined assessment on the basis that the hypothetical life history and ocean circulation in this region indicate links between these areas.

4.84   WG-FSA-13/52 presented an updated combined assessment across the shelf region (SSRUs 882C–G) and the north region (SSRU 882H) from 2002/03 to 2012/13. The revised data selection method (WG-SAM-13/34) was used to select the data used in the assessment.

4.85   The Working Group noted that age data for this area were based on limited information (WG-FSA-13/48) and the recommendation in the paper that age compositions be

given a low weighting in the assessment. The results of alternative assessment options, which included down-weighting of the age composition data, the use of alternative data selection methods and the application of annual ALKs, where available, were presented.

4.86   The proposed final assessment was based on the model configuration with down-weighted age-composition data and annual ALKs. B_0 was estimated at 6 590 tonnes and the ratio of $B_{current}$ to B_0 was 65%. The estimated value of B_0 was lower than that estimated in previous assessments. The reduction was due in part to the addition of the last two years of tag release and recapture data and in part to the down-weighting of the catch-at-age data. The precautionary yield that satisfied the CCAMLR decision rules was 266 tonnes.

4.87   The Working Group noted that all the tag data included in the assessment come from the north and that exploitation of the stock in this region has been concentrated around specific seamounts. As a consequence, recent changes in biomass as estimated in the model may represent only the localised biomass and dynamics of the stock at these locations in the northern area and may not be representative of the population over the whole region (SSRUs 882C–G). WG-FSA-13/01 noted the high incidences of within-season recaptures for this area which would be consistent with fishing effort being restricted to a small area.

4.88   The Working Group acknowledged that recent changes in biomass as estimated in the assessment are likely to be representative of biomass in the north only where tagged fish have been recaptured at a higher rate in recent years. Only limited data are available for the shelf and slope areas where fishing has been conducted on an intermittent basis. The Working Group also noted that there had been a decline in CPUE and truncation in the age structure in the north (paragraph 3.16; WG-FSA-13/48).

4.89   The proposed catch limit of 266 tonnes in 2013/14 implies a reduction in catch limit of around 50%. The Working Group was unable to reach consensus on the most appropriate approach to determine catch limits for 2013/14 and identified three options:

> Option 1 – To apply a catch limit of 266 tonnes across all SSRUs (882C–H).

> Option 2 – To apply the catch limit of 266 tonnes to the northern area alone and to determine an appropriate level of catch for the shelf through some other approach.

> Option 3 – to reapply the management measures that had applied in 2012/13.

4.90   Dr Petrov noted that at WG-SAM-13 some Members expressed doubt about the need to use the method (WG-SAM-13/34) presented for stock assessment in 2013 due to a lack of representativeness of the data (Annex 4, paragraph 4.8). However, the method and calculations for assessment of stocks were presented in WG-FSA-13/52.

4.91   Some Members felt that under the current conservation measure, stock depletion in the north is occurring at a faster rate than would be considered acceptable, as indicated by the increase in tag recaptures in recent years, and that a catch in excess of 266 tonnes in the north would not be sufficiently precautionary to prevent overexploitation of the stock.

4.92   The Working Group recommended that this assessment be reconsidered by WG-SAM-14 with specific consideration of the potential for localised depletion and tag mixing and stock identity. The Working Group also recommended that all Members

contribute, where possible, to the development of annual ALKs. In particular, Norway, Russia and the UK were identified as nations that may have historic otolith samples that could be aged. The Working Group recalled the recommendation of the Ageing Workshop for *D. eleginoides* and *D. mawsoni* (SC-CAMLR-XXXI, Annex 7, paragraph 10.13) that intercalibration of otolith readings should be conducted.

Generic issues

CASAL version control and validation

4.93 The Secretariat routinely verifies that stock assessments using CASAL are reproducible, after the deadline for the submission of WG-FSA meeting papers and prior to the meeting (WG-FSA-06/08, paragraph 6.1). The verification is performed in two steps:

(i) Parameter files verification: the files population.csl, estimation.csl and output.csl used in each assessment reported in meeting papers are used as inputs to a CASAL run performed by the Secretariat. If no errors are reported during the process, the files are considered as verified.

(ii) MPD estimate verification: the 'B_0' estimate produced by a given model run is compared to that reported in the accompanying meeting paper.

4.94 Verifications were performed for input parameter files, output files and initial assessment results from the CASAL assessments submitted to WG-FSA in 2013 (Table 5). Estimates of B_0 were computed for each assessment and each configuration for which files were provided to the Secretariat (Table 6).

4.95 The B_0 estimates of the verification runs were usually identical or within 1.3% of the reported B_0, with the exception of one scenario run for *D. eleginoides* in Division 58.4.4 (Table 6) and the reported model run of scenario 2.4 for *D. eleginoides* in Division 58.5.2 (WG-FSA-13/24) and the final model adopted during the Working Group meeting for this division.

4.96 The Working Group was concerned about these differences in B_0 estimates between CASAL versions and failed to find reasonable explanations in its discussions. The CASAL Manual (Bull et al., 2012) in Chapters 15.6 and 15.7 lists all changes since CASAL v2.20-2008/02/14, however, none of these changes addressed issues that were relevant to the examined model runs and could explain the observed difference in B_0 estimates.

4.97 The Working Group discussed CASAL version control and recommended that the Secretariat define by 1 April of a given year which CASAL version be used for the *Dissostichus* spp. stock assessments presented for consideration by the Working Group later in the same year; a webpage detailing the version number that Members should be using could be used to facilitate this.

4.98 The Working Group also recommended that the Secretariat should hold stock assessment test datasets that are used to check new CASAL versions as described in SC-CAMLR-XXVII, paragraph 2.1, and report its finding to WG-FSA before a new CASAL version is adopted for use.

Stock structure

4.99 The Working Group noted that with the increasing number of tagged fish recaptured from the fisheries exploiting toothfish, evidence of tag movement between 'stocks' has been increasingly observed.

4.100 In order to consider the impact of this on individual stocks, the Working Group requested more information be provided to WG-SAM on areas with potential stock linkages, in particular Subareas 48.3 and 48.4; 88.1, 88.2 and 88.3; 58.6 and 58.7; and Divisions 58.5.1 and 58.5.2. This information will allow WG-FSA to review the current structure of the stocks for which it is providing management advice.

4.101 Reviews should consider, inter alia, three types of information:

(i) biological characteristics of toothfish located in each of the areas, including their length distributions, life-history parameter, genetics, parasites and otolith microchemistry

(ii) a review of release and recapture locations of tagged fish within and across stocks

(iii) an evaluation of the consequences of (i) and (ii) on management advice. This evaluation would consider the impact of joining stocks or maintaining separate assessments on sustainable and precautionary management.

Data weighting

4.102 A range of data-weighting approaches have been applied in the assessments submitted to WG-FSA. These include external and iterative re-estimation of process error associated with individual data sources (e.g. Hillary et al., 2006; Candy, 2008), and application of the Francis methodology (Francis, 2011a, 2011b). In general, the Working Group considered that the iterative reweighting and the Francis method may provide suitable approaches for use in the CASAL assessments conducted at WG-FSA, however, they can result in variable levels of variance within the MCMC uncertainty analysis with no consistent pattern between assessments.

4.103 The Working Group recommended that a review of weighting and screening of assessment data be considered as a special topic for WG-SAM, and for WG-SAM to provide guidance on a standardised approach. It would be also useful to combine such a review with a comparison of MCMC and covariance resampling projection methods used in generating uncertainty when determining catch levels consistent with the CCAMLR decision rules.

Cryptic biomass

4.104 The Working Group noted that in previous years WG-SAM had requested that all assessments in which dome-shaped fishing selectivity curves were fitted should be run with sigmoid fishing selectivity functions in order to investigate the impact of cryptic biomass on

management advice. However, analyses conducted during the Working Group meeting indicated that this method confounds the estimation of cryptic biomass with changes in the estimation of other assessment parameters.

4.105 The Working Group recommended that WG-SAM should evaluate (i) appropriate methods for the estimation of cryptic biomass, and (ii) its consequences on stock assessment results and decision rules.

Research surveys in the Ross Sea

4.106 The Working Group considered WG-FSA-13/55, and discussed possible research surveys or experiments to address priority research questions in the Ross Sea region fishery to reduce uncertainty in the stock assessment. WG-FSA-13/53 described how data collected from properly designed research fishing will directly inform gaps in current understanding, particularly in the context of the existing stock assessment and the further development of the spatial population model for *D. mawsoni*. The Working Group agreed that the following research ideas were particularly important:

(i)   research fishing in the northern Ross Sea region during winter, to address current uncertainties in toothfish life-cycle movements and spawning dynamics

(ii)   research in the south of SSRU 882A (on the slope) to better understand toothfish distribution and movements on the Ross Sea slope and potential implications for stock structure and potential bias in the stock assessment

(iii) spatially stratified longline surveys in previously unfished SSRUs (e.g. 882A–B north, 881D and 881F) to inform the parameterisation of the SPM and reduce potential bias in the stock assessment.

4.107 The Working Group requested that the Scientific Committee endorse the importance of these research priorities for the Ross Sea region and request research proposals be developed by Members for consideration by the Scientific Committee.

NEW AND EXPLORATORY FISHERIES

5.1   Exploratory longline fisheries for *Dissostichus* spp. were conducted in Subareas 48.6, 88.1 and 88.2 and Divisions 58.4.1, 58.4.2 and 58.4.3a in 2012/13, and the season's catches from these fisheries are summarised in Table 1 (see also Table 7 for a list of participating Members and vessels). Detailed information is provided in the Fishery Reports. No new fishery was conducted.

5.2   The Secretariat monitored all fisheries in 2012/13 using the catch and effort reporting system and notifications of vessel movements (CCAMLR-XXXII/BG/06 Rev. 1). During that season, the exploratory fisheries in Subareas 88.1 and 88.2 were closed by the Secretariat when the catches of *Dissostichus* spp. approached the relevant catch limits:

(i)   in Subarea 88.1, SSRUs B, C, G closed on 11 December 2012, and SSRUs H, I, J, K, L and the whole fishery closed on 25 January 2013; the total catch of *Dissostichus* spp. in these management areas ranged from 93 to 99% of the catch limits

(ii)   in Subarea 88.2, SSRU H closed on 2 February 2013, and SSRUs C, D, E, F, G and the whole fishery closed on 13 February 2013; the total catch of *Dissostichus* spp. in these management areas ranged from 88 to 95% of the catch limits.

5.3   All vessels fishing in exploratory fisheries are required to tag and release *Dissostichus* spp. in accordance with the tagging protocol and requirements (CM 41-01) and rates specified in CMs 41-04 to 41-07 and 41-09 to 41-11. In 2012/13, all vessels met the required tagging rates (Table 7), and all but one vessel achieved, or exceeded, the required tag-overlap statistic (Table 8). The vessel which did not achieve the required tag-overlap statistic in 2012/13 (*Simeiz* in Subarea 88.1) had tagged predominantly small-sized fish (Figure 8). The Working Group noted that tagging was carried out continuously during fishing as per CM 41-01 (Figure 9).

5.4   The Working Group expressed concern at the low tag-overlap statistic achieved by the *Simeiz* in Subarea 88.1, and the impact of low overlap statistics in assessments. The importance of tagging fish in proportion to the lengths of fish caught has been discussed extensively (e.g. SC-CAMLR-XXVIII, Annex 5, paragraph 5.16; SC-CAMLR-XXXI, Annex 7, paragraphs 5.133 to 5.143). Procedures for tagging large fish have also been discussed previously (e.g. SC-CAMLR-XXVIII, Annex 5, paragraph 5.17; WG-FSA-07/36). The Working Group noted the *Simeiz* is the vessel proposed for conducting research fishing in Subarea 48.2 in 2013/14 (paragraphs 6.70 to 6.79).

5.5   A total of 6 016 *Dissostichus* spp. were tagged and released in these fisheries in 2012/13, and 307 tagged fish were recovered during that season. The time series of numbers of *Dissostichus* spp. tagged and released, and subsequently recaptured, in these fisheries is summarised in Table 9.

5.6   Vessels engaged in exploratory fisheries in Subarea 48.6 and Divisions 58.4.1, 58.4.2 and 58.4.3a were required to undertake research fishing (CM 21-02, paragraph 6). Research in 2012/13 was reviewed by WG-SAM in June 2013 (Annex 4, paragraphs 2.1 to 2.37). Updated information was reviewed by WG-FSA (see Item 6).

New and exploratory fisheries notified for 2013/14

5.7   Ten Members submitted notifications for a total of 26 vessels for exploratory fisheries for *Dissostichus* spp. in Subareas 48.6, 88.1 and 88.2 and Divisions 58.4.1, 58.4.2 and 58.4.3a in 2013/14 (Table 10; CCAMLR-XXXII/11 to XXXII/20); there were no notifications submitted for the exploratory fishery in Division 58.4.3b, or for new fisheries.

5.8   The research plans associated with the notifications for exploratory fisheries in Subarea 48.6 and Divisions 58.4.1, 58.4.2 and 58.4.3a were submitted to WG-SAM

(WG-SAM-13/08 to 13/13 Rev. 1). WG-SAM's consideration of these plans is reported in Annex 4, paragraphs 2.1 to 2.37. Revised research plans were reviewed by WG-FSA (see Item 6).

DATA-POOR FISHERIES

6.1   The Working Group considered general progress on research in data-poor exploratory fisheries reported by WG-SAM (Annex 4, paragraphs 2.1 to 2.8). The Working Group agreed with the recommendation that research plans currently submitted as a part of a notification to fish in a data-poor exploratory fishery should be submitted as stand-alone papers to WG-SAM. It also recognised that research plans were subject to a number of changes during the course of discussions at WG-SAM, WG-FSA, the Scientific Committee and the Commission, as well as bilateral arrangements between Members fishing in the research area and agreed that a mechanism needed to be developed so that the final research plans were fully documented. The Working Group requested the Scientific Committee develop such a mechanism.

6.2   The Working Group also agreed that it was important to document the development of research in the various data-poor fisheries over time. It considered that a report of the research conducted in each research block of a data-poor fishery could be included as an annex to the fishery report for that area. A summary of research carried out in each research block for each year to date, including details such as seabed area, CPUE, catch, tags released, tags recaptured and available tags, is given in the appendices to the data-poor Fishery Reports.

6.3   The Working Group also advised the Scientific Committee that the research plans being evaluated under CMs 21-02 and 24-01 represent a wide range of fisheries and statistical areas within the Convention Area, including open and closed SSRUs, new and exploratory fisheries, closed areas, and depleted and recovering fisheries. It noted that all research plans for *Dissostichus* spp. have benefited from the process identified in the data-poor exploratory fisheries. It also noted that although the standard of research plans had been substantially improved since last year, that there were still a minority of Members submitting proposals which did not include a fully developed research plan, or were not in the correct format and lacked the details necessary for evaluation. In addition, there were several instances where the advice of WG-SAM had not been included in the revised research proposal submitted to WG-FSA.

6.4   Through discussion among research plan proponents, the Working Group developed an annotated flowchart to show the different stages of research leading to an assessment following the recommendations from WG-SAM (Annex 4, paragraphs 2.1 to 2.8) for research on *Dissostichus* spp. The flowchart outlined the framework for research plan development and process for progress towards an integrated stock assessment. The flowchart is comprised of three phases: a prospecting phase, biomass estimation phase and an assessment development phase (Figure 10). A summary of the research proposals, Members, and research blocks and the current phase of research in each area are indicated in Table 11 and location of research blocks in Figure 11.

6.5   The Working Group supported the advice of WG-SAM-13 (Annex 4, paragraph 2.7) regarding the framework for research plans in data-poor fisheries. Detailed descriptions of the

phases of the framework and advice concerning analytical approaches for research plan development can be found in working group reports (e.g. WG-SAM-13 (Annex 4, paragraph 2.7) and WG-SAM-11) and the important characteristics of each phase of the plan are provided in Figure 10. The main decision criteria for a research block to advance between phases are listed as questions, but the flowchart recognises that as information accumulates for each research block, information on local biomass may be available and should be considered simultaneously from several sources, including a preliminary stock assessment. Therefore, the phase of the research can, for example, be considered as intermediate between the biomass estimation phase and the assessment development phase.

6.6   The flowchart also makes explicit the annual review process within each phase, indicating that individual research blocks may remain in a single phase for more than one year.

6.7   Several Members requested a relaxation of by-catch rules in their research plans. The Working Group noted that this had been discussed by WG-SAM in 2013 in the context of research fishing in Subarea 48.6 (Annex 4, paragraph 2.17). The Working Group agreed that by-catch issues should not unduly affect the research plans, but that vessels should still be encouraged to avoid areas of high by-catch by the use of a move-on rule. Therefore, the Working Group recommended that paragraph 6 of CM 33-03 should not apply to research in the data-poor fisheries.

6.8   The Working Group also recommended that paragraph 5 of CM 33-03 should continue to apply to all the data-poor fisheries with a 1 tonne threshold – except for research plans where another threshold had already been agreed (e.g. France in Division 58.4.3a). The Working Group also requested the Secretariat examine the distribution of by-catch rates for rajids, macrourids and other species, for each of the research blocks and research proposals so that appropriate thresholds for the trigger rule can be determined for presentation at the next meeting of WG-SAM.

6.9   Several Members requested a relaxation of the minimum separation distance between lines in their research plans. The Working Group noted that this had been discussed by WG-SAM in 2013 in the context of research fishing in Subarea 48.6 (Annex 4, paragraph 2.13). The Working Group agreed that some spreading mechanism was desirable in the biomass estimation phase to ensure that the research covered the spatial extent of tags that had previously been released in the research area. The Working Group recalled that the minimum separation rule had been reduced over time from a separation of 5 n miles to 3 n miles, to the current rule which was for a separation of 3 n miles for only 50% of the lines. The Working Group recommended that the current rule remain in place and that the skippers of the vessels denote the research lines which meet the 3 n mile separation rule in the C2 logbook by the code R1 and the remaining lines by the code R2.

6.10   The Working Group also agreed that the current rule should be vessel specific (i.e. vessels do not have to keep track of where other vessels have set their lines in a particular season) but not trip specific (i.e. if a vessel returns to a research block in a subsequent trip within the same season, the sets from the earlier trip apply with respect to the line-spacing requirements specified in CM 41-01). The Working Group considered that the current rule would help reduce the likelihood of within-season recaptures, which are not currently used in the stock assessment models. The Working Group also agreed that in the initial prospecting phase a wider separation between lines (e.g. 5 n miles) was generally more desirable to

provide survey-relative density. The Working Group agreed with the advice of WG-SAM that research proponents could propose an alternative method of ensuring spatial coverage of the research blocks in their research plans.

6.11   The Working Group noted that seabed area calculations used by research proponents are currently based on a planimetric projection (i.e. assume the world is flat). The Working Group discussed the extent to which estimating biomass using the CPUE analogy method would more appropriately utilise a projection which incorporates the seabed topography. The Working Group noted that estimates based on seabed topography would vary depending on the spatial scale at which topographic variability is represented, and that the effect on fish abundance of increased seabed area arising from topographic variability is not known. The Working Group further noted that in the few instances examined, the difference between planimetric versus seabed area measurements was very small (less than 1%) and that biomass estimates using the CPUE analogy method are subject to much higher levels of uncertainty. The Working Group agreed that using planimetric estimates is likely to be adequate. The Working Group requested the Secretariat recalculate seabed areas for the 600–1 800 m depth zone for all subareas, divisions, SSRUs and research blocks for the next meeting of WG-SAM.

6.12   The Working Group agreed that the estimates of biomass provided in research proposals submitted to WG-FSA-13 appeared to be excessively high for some SSRUs and research blocks from the Petersen estimator and the CPUE analogy method. For example, the vulnerable toothfish biomass in four research blocks in Subarea 48.6 was calculated to be 75 000 tonnes (WG-FSA-13/37), which is higher than the total vulnerable biomass of *D. mawsoni* in the Ross Sea region.

6.13   The Working Group recalled the discussion of tags available for recapture at WG-SAM (Annex 4, paragraph 2.7iv) and agreed that many tags which had been released in the years when the tag-overlap statistic was low were unlikely to be available for recapture. It also noted that there could be other reasons why tags from some vessels have never been recaptured, such as inexperienced taggers and fish in poor condition for tagging etc. It agreed that, as a minimum threshold to data selection, only tags from vessels from which at least one of their tags had subsequently been recaptured (effective tag releases) should be used for the estimation of local abundance using the Petersen estimator and for subsequent calculations on expected recaptures under different catch limits, and in stock assessments. This method was used for the purposes of estimation of research catch limits for 2013/14 pending development of alternative methods.

6.14   The Working Group noted the development of the data select method by New Zealand for the Ross Sea region (WG-FSA-13/50) and agreed that alternative methods for identifying which tags should be used for biomass estimation in the data-poor fisheries be evaluated. It requested that the Secretariat carry out a meta-analysis of tag-recapture data to determine a more appropriate method for selecting tags available for recapture in the data-poor fisheries. This could include a meta-analysis of all tag-recapture data across the exploratory fisheries using the data select method.

6.15   The Working Group also discussed the very high biomass estimates which had been obtained using the CPUE analogy method. Several Members had used SSRU 882H as the reference area as advised at a previous WG-SAM meeting (SC-CAMLR-XXX, Annex 5, Table 2). However, the Working Group noted that this was a seamount fishery based on large

adult *D. mawsoni*, and that biomass estimates for this fishery had changed considerably in the 2013 update of the Subarea 88.2 stock assessment (WG-FSA-13/52). The Working Group agreed that estimates of biomass and CPUE from this fishery were unsuitable as a reference for other *D. mawsoni* fisheries on the Antarctic continental slope but may be appropriate as a reference area for *D. mawsoni* in SSRUs or research blocks comprising only seamounts.

6.16   The Working Group agreed that the Ross Sea region comprised a more appropriate reference area for any research blocks on the slope of the Antarctic continent and recommended that it be used for research proposals for *D. mawsoni* in slope fisheries in Subarea 48.6S, in Subarea 48.5 and in Divisions 58.4.1 and 58.4.2. The Working Group agreed that research survey proponents should use *D. mawsoni* in Subarea 48.4S and/or *D. mawsoni* in SSRU 882H as a reference area for analogy with the seamount fisheries for *D. mawsoni* in Subarea 48.6. The Working Group also agreed that research survey proponents should continue to use *D. eleginoides* in Subarea 48.4N as a reference area for analogy with other *D. eleginoides* fisheries in Subarea 48.6N and Divisions 58.4.3a and 58.4.4.

6.17   For the current calculations, the Working Group agreed to use the median CPUE (kg/km) from all vessels and gear methods from the past three years in the reference and research areas. It also noted that there were problems in standardising the measure of effort between trotlines and other gear types. It also agreed to use estimates of seabed area from WG-SAM-11 (SC-CAMLR-XXX, Annex 5, Table 2) and 2012 estimates of vulnerable biomass from the reference areas. A summary of these values for each of the reference areas is given in Table 12.

6.18   The Working Group reiterated its advice from previous years that estimates of biomass arising from the use of this method were highly uncertain. However, it is currently unable to provide estimates of variance associated with this approach. Instead, the Working Group recommended that research catches should be evaluated in the context of multiple median biomass estimates arising from different methods (e.g. Petersen estimator or using alternate plausible reference areas for the CPUE analogy method), and that precautionary exploitation rates at the scale of the stock or SSRU should use the most plausible biomass estimate, or reflect uncertainty by considering multiple alternate biomass estimates. The Working Group recommended Members review the methodology and endeavour to provide estimates of variance which could be used in future years. In developing such estimates of biomass and variance, the Members should consider the advice of WG-SAM-11 (SC-CAMLR-XXX, Annex 5, paragraphs 2.1 to 2.44).

6.19   Several Members requested some flexibility in their research for situations when ice restricted access to research blocks. The Working Group noted that this had been discussed by the Commission in 2012 (CCAMLR-XXXI, paragraph 5.35). The Working Group agreed that research in Antarctic waters was always challenging and that contingencies for bad ice years are a necessary part of any research plan. However, it also noted that ice charts included in the research proposals indicated that the research blocks were ice free in most years, and that there were several research blocks in each of the areas where research was being proposed which should allow for some variation in ice conditions between years.

6.20   Some Members requested that flexibility in the research due to bad ice conditions should be discussed from a point of view of operation at the Commission.

6.21   The Working Group noted that research fishing conducted outside the research blocks would provide little useful additional information on stock abundance. However, it also noted that if ice covered part of the research block, then research fishing could be extended to include those fine-scale rectangles immediately adjacent to the existing research block.

6.22   The Working Group noted that the numbers of research blocks spread across the Convention Area, and the overall increase in research catch limits, meant there was a high likelihood that Members' vessels would be unable to access all research blocks in 2013/14. It agreed that the development of multi-Member research plans would increase the likelihood that data would be collected and provided in time for consideration by the Working Group in 2014 and requested that the Scientific Committee consider mechanisms for facilitating multi-Member multi-vessel research plans.

Development of advice on catch limits

6.23   The Working Group discussed appropriate catch limits for research proposals confined to research blocks, i.e. in phase 2 of the data-poor fisheries research planning framework (biomass estimation phase) as illustrated in Figure 10. Consistent with the advice of WG-SAM-13 (Annex 4, paragraph 2.7), catch limits are intended to provide sufficient tag recaptures to achieve a stock assessment within a reasonable time period (3–5 years) while providing reasonable certainty that exploitation rates at the scale of the stock or SSRU will not exceed appropriate levels as estimated in areas with assessed fisheries (e.g. 3–4%) (Welsford, 2011; WG-SAM-13/37).

6.24   To provide catch limit advice, the Working Group first estimated local biomass within each research block using all available methods, including the CPUE analogy method, Petersen estimates arising from tag recaptures and stock assessment outputs where these were available (Tables 13 and 14). For Petersen estimates, those derived from higher numbers of recaptures and from more recent tag recaptures were judged to be more reliable than those derived from older and fewer recaptures. Estimates arising from stock assessment outputs were used in areas where stock assessments are under development, recognising that these are still data-poor fisheries and that utilising a stock assessment for interim advice does not imply that the assessment has been approved as robust to provide precautionary yields consistent with CCAMLR decision rules.

6.25   The Working Group then estimated the number of tags available for recapture within each research block in 2013 (using only 'effective tag releases' as defined above (paragraph 6.13)) and compared the number of observed recaptures in 2013 with the number that would be expected under different assumptions of local biomass estimated using alternate methods. The Working Group agreed that where alternate methods yielded conflicting estimates of local biomass, comparing expected versus observed recaptures may inform selection of the more plausible biomass estimate.

6.26   The Working Group examined the effects of different catch levels on local exploitation rates and on the expected number of tag recaptures in 2013/14. Wherever possible, the Working Group attempted to define catch limits that would achieve 10 or more recaptures in

2013/14 without exceeding local exploitation rates of around 4%. Where multiple plausible local biomass estimates were available, the more precautionary option was selected unless other evidence supported a higher local biomass.

6.27   The Working Group recalled the advice of WG-SAM that precautionary exploitation rates should be evaluated at the scale of the stock or SSRU (Annex 4, paragraph 2.7vii), such that where research blocks contain only a small proportion of the total fishable area in the SSRU (as shown in Table 13) this provides higher levels of precaution.

6.28   The Working Group agreed that the catch limits in Table 13 are appropriate to achieve the aims of this research and recommended that these be considered as management advice by the Scientific Committee for catch limits for the 2014 season.

Subarea 48.6

6.29   The exploratory fishery for *Dissostichus* spp. in Subarea 48.6 operated in accordance with CM 41-04 and associated measures. In 2012/13, the catch limit for *Dissostichus* spp. was 200 tonnes to the north of 60°S and 200 tonnes to the south of 60°S. Research fishing was conducted in four research blocks by two vessels using longlines and the total reported catch up to 20 September 2013 was 237 tonnes. Details of this fishery are contained in the Fishery Report (www.ccamlr.org/node/75667).

6.30   WG-FSA-13/37 and 13/47 described proposals for fishing in Subarea 48.6 by one Japanese and one South African vessel. Both proponents of this research incorporated the following modifications recommended during WG-SAM-13 (Annex 4, paragraphs 2.9 to 2.21):

(i)   incorporated uncertainties into the estimates of biomass in *Dissostichus* spp.

(ii)   included an additional research block (48.6e), where tagged fish have also been released in the past

(iii)   introduced species-specific toothfish catch limits to reduce the risk of overcatch of *D. eleginoides*

(iv)   discussed the minimum line separation

(v)   revisited the *Macrourus* spp. by-catch rules.

6.31   WG-FSA-13/37 and 13/47 provided revised versions of previous papers presented at WG-SAM-13 (13/09 and 13/11) incorporating all those recommendations listed above. WG-FSA-13/37 provided a re-estimated biomass for *Dissostichus* spp. incorporating uncertainty. This paper also noted that the incorporation of an additional area (48.6e) is feasible, given the analysis of summer ice conditions. Both papers proposed a catch limit for *D. eleginoides* in Subarea 48.6N. Both research proposals agreed that the *Macrourus* spp. by-catch move-on rule should be relaxed in order to make the fishing operation possible in this area. This issue was discussed earlier (paragraphs 6.7 to 6.10).

6.32   The Working Group noted the need for the determination of threshold catch limits for *D. eleginoides* in Subarea 48.6N. A lack of catch limits for *D. eleginoides* in this area has the potential to lead to overexploitation. Thus, research fishing should be conducted in areas where the probability of having by-catch of *D. eleginoides* is low, or at greater depths where *D. mawsoni* predominates in the catch.

6.33   The Working Group recommended avoiding the use of standardised CPUE indices for monitoring the abundance of *Dissostichus* spp. in Subarea 48.6. Estimates of abundance for these species in this area should be based on tag data where available, because standardised CPUE does not provide an adequate index of abundance (WG-FSA-13/63).

6.34   The Working Group discussed the incorporation of an additional research block (48.6e) into the research plan. It noted that tags had been released in this research block in 2011, and that 352 tags are estimated to be available for recapture at present (Table 13). The Working Group agreed that the usefulness of these initial tag releases will decline over time as the fish die from natural mortality and the fish move out of the release area. It also agreed that this provided a second research block in Subarea 48.6S which provided an alternative location for research in bad ice years. It therefore recommended that this research block be included in the research plan for 2013/14.

6.35   Ukraine submitted a proposal for exploratory fishing in Subarea 48.6 to WG-SAM-13 (WG-SAM-13/13). WG-SAM recommended that a revised version of this paper be resubmitted to WG-FSA-13. This paper was not resubmitted, thus the Working Group was not able to provide any recommendation about this proposal. The Working Group agreed that proposals for participation in data-poor fisheries must have a research plan.

6.36   The Working Group re-estimated catch limits for *D. eleginoides* in research blocks 48.6a and 48.6b and for *D. mawsoni* in research blocks 48.6b, 48.6c, 48.6d and 48.6e. These catch limits in each research block were estimated considering a minimum of 10 tags expected to be recaptured during the next fishing season and to achieve a maximum local exploitation rate of 4% (Table 13).

6.37   The Working Group recognised that South Africa and Japan had applied species-specific catch limits as described in WG-FSA-12/60 Rev. 1, Table 9, to facilitate their collaborative research in this subarea in 2012/13.

6.38   The Working Group gave regard to the catch limits agreed by South Africa and Japan last year. The Working Group evaluated the appropriateness of last year's catch limit, using the CPUE analogy method from Subarea 88.2, and recommended a catch limit of 170 tonnes for *D. mawsoni* in research block 48.6b, consistent with last year. This catch limit corresponds to an expected exploitation rate of 2.5% and an expectation of 27 recaptures of tagged fish during the next fishing season.

6.39   The Working Group recommended a catch limit of 50 tonnes for *D. mawsoni* in research block 48.6c, using the CPUE analogy method from Subarea 88.2. This catch limit corresponds to an expected exploitation rate of 1.4% and an expectation of 10 recaptures of tagged fish during the next fishing season.

6.40   The Working Group recommended a catch limit of 190 tonnes for *D. mawsoni* in research block 48.6e, using the CPUE analogy method from the Ross Sea. This catch limit corresponds to an expected exploitation rate of 2.9% and an expectation of 10 recaptures of tagged fish during the next fishing season.

6.41   Provisional catch limits for *D. eleginoides* in research blocks 48.6a and 48.6b were based on a reanalysis of Petersen estimates presented in WG-FSA-13/37 and on the CPUE analogy method as presented in WG-FSA-13/63. Some Members recommended a catch limit of 14 tonnes (expected exploitation rate of 4% and 15 expected recaptures) based on a Petersen estimator.

6.42   Drs K. Taki (Japan) and Leslie argued this catch limit was too low and it has the potential to compromise the completion of the proposed research. They noted this catch limit may be underestimated because of the high tagging rate and the restricted area fished could have led to a positively biased number of tag returns. They considered that application of the CPUE analogy method with Subarea 48.4N as the reference area should form the basis for setting the catch limit using the method outlined in WG-FSA-13/63 to determine CPUE for *D. eleginoides*. Application of this biomass estimate yields a catch limit of 28 tonnes which corresponds to an expected exploitation rate of 4% and an expectation of 15 recaptures of tagged fish (Table 13).

6.43   The Working Group did not reach consensus on the catch limit for *D. eleginoides* in research blocks 48.6a and 48.6b and recommended a catch limit of 14 to 28 tonnes.

6.44   The Working Group noted that coordination between the Japanese and the South African vessels will be important to accomplish *D. eleginoides* by-catch limits. The Working Group also noted that an upper threshold on the number of *D. eleginoides* tagged on one line may be desirable in order to ensure that tagging is carried out in a kind and careful manner that helps to achieve high survival rates and also avoids a high proportion of the tags in an area being in one location and therefore avoids excessive spatial bias (clumping) of tag releases.

6.45   The Working Group did not reach consensus on the catch limit for *D. mawsoni* in research block 48.6d. The Working Group recommended a catch limit of 100–150 tonnes.

6.46   Some Members recommended a catch limit of 100 tonnes based on the CPUE from the Ross Sea analogy method, corresponding to an expected local exploitation rate of 4% and an expected tag recapture of 30 fish in 2013/14.

6.47   Drs Taki and Leslie noted there have been no tag recoveries from this area to date despite an estimated 743 tags available for recapture resulting in an expectation of a high number of tag recoveries. The lack of tag recoveries could indicate large stock size and/or movement between research blocks and that the local exploitation rate may be overestimated leading to an underestimated catch limit. Dr Taki therefore proposed that the status quo catch limit of 150 tonnes be maintained.

6.48   The Working Group requested the Scientific Committee consider how advice on catch limits for *Dissostichus* spp. be developed where the spatial distribution of the two species overlap and one species essentially forms a by-catch of a fishery that is targeting the other

species. This is a particular issue for the mixed *D. mawsoni* and *D. eleginoides* fishery in the north of Subarea 48.6, but also applies to other areas where the two species overlap (e.g. Subarea 48.4, Division 58.4.3b and the north of Subarea 88.1).

Divisions 58.4.1 and 58.4.2

6.49   The exploratory fishery for *Dissostichus* spp. in Division 58.4.1 operated in accordance with CM 41-11 and associated measures. In 2012/13, the catch limit for *Dissostichus* spp. was 210 tonnes. Research fishing was conducted in two research blocks and other areas (designated for a depletion experiment) by two vessels using longlines and the total reported catch up to 20 September 2013 was 48 tonnes. Details of this fishery are contained in the Fishery Report (www.ccamlr.org/node/75667).

6.50   The exploratory fishery for *Dissostichus* spp. in Division 58.4.2 operated in accordance with CM 41-05 and associated measures. In 2012/13, the catch limit for *Dissostichus* spp. was 70 tonnes. Research fishing was conducted in the research block by one vessel using longlines and the total reported catch up to 20 September 2013 was 4 tonnes. Details of this fishery are contained in the Fishery Report (www.ccamlr.org/node/75667).

6.51   The Working Group considered WG-FSA-13/15, describing a proposal by Spain to continue a fishing experiment in Division 58.4.1 in 2013/14 using a combined depletion experiment and tag-recapture design. The Working Group noted that the updated paper had provided detailed diagrams of set sequence and locations as requested by WG-SAM-13 (Annex 4, paragraph 2.30), but that subsequent sets should be more constrained to where the high catch rates were originally encountered. The Working Group agreed that the characterisation of historical ice conditions and definition of potential future research blocks was also useful. The Working Group endorsed the advice of WG-SAM-13 (Annex 4, paragraph 2.29) that in 2013/14, returning to the two locations at which depletion experiments were conducted in 2012/13 was a high priority in order to recapture tags. The Working Group agreed that if tags are recaptured, then it should be possible in 2013/14 to compare the results of depletion-based, tag-based and CPUE-analogy-method-based estimates of local biomass for these locations, informing a useful review of how extending this experimental approach might lead to advice on stock status in these SSRUs. The Working Group also endorsed the advice of WG-SAM-13 (Annex 4, paragraph 2.29) regarding appropriate line stratification in the prospecting phase.

6.52   The Working Group supported the continuation of this research in 2013/14 and recommended that the following catches be set aside for this research in each of the following SSRUs in 2013/14 (see also Table 13):

    5841C: 42 tonnes
    5842D: 42 tonnes
    5841G: 42 tonnes
    5841H: 42 tonnes.

6.53   The Working Group considered WG-FSA-13/44, describing a proposal by the Republic of Korea to continue research in Division 58.4.1, research blocks C-a, C-b, E-a and E-b (WG-FSA-13/44, Figure 2 – research block map). The Working Group noted that the

planned research in 2012/13 had been largely unsuccessful due to adverse ice conditions, but that biological information described in WG-FSA-13/42, 13/43 and 13/45 was useful. The Working Group thanked Korea for providing analysis of fish condition affecting suitability for tagging, and thanked Korea for submitting details of its trotline and Spanish line gear configurations to the CCAMLR gear library. The Working Group also encouraged Korea to develop its capacity to age toothfish otoliths so that age-based assessments can be developed as the research proceeds.

6.54   The Working Group agreed that the proposed design to set paired trotline and Spanish line sets (each of half the normally prescribed length) in the same location was useful to enable gear standardisation and estimate potential differences in selectivity. The Working Group agreed that in the context of this experiment each pair of half-length lines would only count as a single set for purposes of the line separation rule in CM 41-01.

6.55   The Working Group noted that information presented in WG-FSA-13/44 included 'anomalous' CPUE data that had been flagged as being unsuitable for analysis (SC-CAMLR-XXXI, Annex 7, paragraph 5.11), and that interpretation of the information of this paper may be affected by the inclusion of these anomalous data.

6.56   The Working Group considered WG-FSA-13/38 and 13/39 describing a proposal by Japan to conduct research in Division 58.4.1, research blocks C-a, C-b, E-a, E-b and G and Division 58.4.2 block E (Figure 11). The Working Group recalled that these research blocks were originally defined and approved based on the comparable Japanese proposal in 2012 (WG-FSA-12/60) and that the approved methods and recommendations of WG-SAM (Annex 4, paragraph 2.7) were largely based on the approach utilised in these proposals (e.g. WG-SAM-13/37). The Working Group noted that additional analyses of historical ice conditions in these research blocks (see also WG-FSA-13/37) and of likely CVs of local biomass estimates associated with different numbers of recaptures, were informative.

6.57   The Working Group recommended that the following catch limits be endorsed for research blocks in Divisions 58.4.1 and 58.4.2 (noting that these should be separate from the catches set aside for research described in WG-FSA-13/15; see also Table 13):

58.4.1 C-a:	125 tonnes
58.4.1 C-b:	90 tonnes
58.4.1 E-a:	280 tonnes
58.4.1 E-b:	35 tonnes
58.4.1 G:	26 tonnes
58.4.2 E:	35 tonnes.

Division 58.4.3a

    58.4.3a Elan Bank

6.58   The exploratory fishery for *Dissostichus* spp. in Division 58.4.3a operated in accordance with CM 41-06 and associated measures. In 2012/13, the catch limit for *Dissostichus* spp. was 32 tonnes. Research fishing was conducted in the research block by two vessels using longlines and the total reported catch up to 20 September 2013 was 16 tonnes. Details of this fishery are contained in the Fishery Report (www.ccamlr.org/node/75667).

6.59   The Working Group noted that two vessels, the *Shinsei Maru No. 3* (Japan, WG-FSA-13/40) and the *Saint André* (France, WG-FSA-13/04), undertook research on *D. eleginoides* on Elan Bank (Division 58.4.3a) during 2012/13, with a research catch limit of 32 tonnes shared between vessels.

6.60   The Working Group noted that the *Saint André* had conducted research after the deadline for submission of WG-FSA papers, and so Dr A. Relot (France) presented results from the *Saint André*. Due to the high levels of skate by-catch and mortality, the *Saint André* was required to fish within a restricted area in the west of Elan Bank, as well as being required to release all live skates, implement a skate by-catch move-on rule and a maximum soak time.

6.61   The Working Group noted that the *Saint André* caught a total of 6.5 tonnes of *D. eleginoides* and recaptured 11 tagged fish. The *Shinsei Maru No. 3* caught 10 tonnes of *D. eleginoides*, and recaptured one tagged fish. It also noted that the research proponents had conducted preliminary biomass estimates based on the CPUE analogy method, Petersen tag-recapture and CASAL integrated assessment methods. Each method produced substantially different answers, and noting that a more complete dataset was available at the meeting than when WG-FSA-13/04 and 13/40 were submitted, the Working Group requested that these estimates be updated during the meeting, including consideration of the numbers of tags available for recapture, and more appropriate reference areas for the CPUE analogy method.

6.62   The Working Group noted that the strategy for limiting the *Saint André* to areas of historically lower skate by-catch had resulted in ~30% lower catch rates of skates, as well as a greater than 50% reduction in total numbers of skates caught. It also noted that the reported condition of skates had changed from 100% dead in 2011/12 to 100% in 'average' condition and all released alive in 2012/13. It requested that France provide details on what operational changes made on board the *Saint André* may assist with reducing skate mortality across the Convention Area.

6.63   The Working Group also recommended that the move-on rule and requirement to release all skates with a high likelihood of survival continue to apply to research fishing by the *Saint André* in 2013/14.

6.64   The Working Group noted that a maximum soak time of 30 hours had also applied to the *Saint André* to attempt to increase the survivorship of skates. It noted that the data collected in 2012/13 indicated that there was no obvious relationship between depth, soak time or number of skates caught, apart from the overall decrease in numbers of skates noted above.

6.65   The Working Group agreed that the same restrictions for maximum soak time apply in 2013/14. The Working Group also requested that, to provide a basis for evaluating the effect of soak time on skate condition, France consider conducting an experiment to collect data on the condition of skates across a range of depths and soak times in an analogous area such as in Subarea 58.6, and provide an analysis to the next meeting of WG-FSA.

6.66   The Working Group noted that the alternative biomass estimates for this division were uncertain, with the CPUE analogy method indicating a substantially higher biomass than the Petersen estimate (Table 12). However, it agreed that as the Petersen estimate was based on tags relased and recaptured only on the western end of Elan Bank, the total research catch

limit of 32 tonnes agreed last year was likely to result in sufficient tag recaptures to substantially refine the stock assessment next year, as well as constituting a sufficiently low-risk harvest rate for the coming season. The Working Group further recommended that Japan and France age otoliths from planned and past research catches to facilitate the development of season specific ALKs.

6.67   The Working Group recommended a total research catch limit of 32 tonnes for Division 58.4.3a for 2013/14 and presentation of updated biomass estimation and integrated assessment at WG-FSA-14 by the research proponents.

6.68   The Working Group noted that due to the constraints on the locations on research fishing agreed in the Commission last year, effort was mainly concentrated in the west of Division 58.4.3a. Recalling the positive example of research on Ob and Lena Banks (Divisions 58.4.4a and 58.4.4b) using a spatial grid design, it agreed that spreading effort across the relatively small fishable area in this division was likely to provide more robust data for stock assessment. Therefore it recommended that a minimum of five research sets, separated by at least 3 n miles, be conducted by each vessel east of the 70°E meridian. Thereafter research sets, as defined in CM 41-01, could continue within the research block defined in 2012.

6.69   The Working Group recommended that at least 10 tonnes of catch be available to each Member fishing in Division 58.4.3a to maximise the opportunity that both vessels are able to complete the minimum number of research sets in 2013/14.

Subarea 48.2

6.70   The Working Group considered a proposal by Ukraine to undertake exploratory fishing on *Dissostichus* spp. in the depth range 600 to 2 000 m in Subarea 48.2 in 2013/14, 2014/15 and 2015/16 in accordance with CMs 24-01 and 41-01 (WG-FSA-13/46). The aim of the program is to provide CCAMLR with the data necessary to estimate biomass of *Dissostichus* spp. in Subarea 48.2.

6.71   An earlier proposal had been reviewed at the meeting of WG-SAM (WG-SAM-13/15). A number of suggestions for improving the survey were made and resubmission was encouraged (Annex 4, paragraphs 3.14 to 3.21). However, the revised proposal was virtually unchanged.

6.72   The Working Group noted that the proposed research plan did not follow the CCAMLR template, was incomplete and was therefore difficult to assess, and recommended that future research plans should closely follow the standard format.

6.73   The proposal was revised at the WG-FSA meeting taking into account some of the concerns raised by WG-SAM. Dr L. Pshenichnov (Ukraine) explained that in the revised proposal:

(i)   fishing would be conducted on two oceanic banks north of the South Orkney Islands

(ii)   the extension of the western bank is 5 893 km^2; that of the eastern bank, 12 735 km^2

(iii)   the type of longline would be trotline

(iv)   distance between sets would be at least 5 n miles

(v)   each line would carry 2 500 hooks

(vi)   in the rare cases that the rough bottom topography may require shorter lines, 2 000 hooks or less will be used.

6.74   He also explained that the tagging rate would be five fish per one tonne of fish caught and the tag-overlap statistic would be >60%, preferable higher. The weighted line has a sink rate large enough to minimise risk of seabirds to become attracted to the baited line. In addition to the CCAMLR scientific observer, a national observer will also be on board the vessel. The survey will be conducted in north–south direction in 2014 and west–east direction in 2015. Experience obtained during the 2014 survey may lead to alterations in the conduct of the survey in 2015. The direction of the survey in 2016 is yet to be decided. The catch will be limited to 25 sets and 50 tonnes.

6.75   The Working Group considered that it was still unclear as to exactly what research is to be undertaken in the course of the surveys and noted that no reference had been made to a previous survey by Chile in 1998 (Arana and Vega, 1999).

6.76   The Working Group recommended:

(i)   The target tag-overlap statistic be increased to at least 80%. The reason was that the vessel proposed for the survey had a poor record with respect to tag-overlap statistics in the Ross Sea in the previous season. Ukraine related the problem of poor tag-overlap statistics to an inexperienced observer present during the cruise and his difficulty to tag large fish. The Working Group stressed (again) that tagging is the responsibility of the vessel and not of the scientific observer.

(ii)   A risk assessment be conducted with respect to potential impacts on VMEs and other components of the ecosystem (Annex 4, paragraph 3.20) while by-catch of seabirds is minimised by a fast sinking rate of the weighted line.

6.77   Some Members noted that the papers and information provided by Ukraine did not constitute a research plan as required by CM 24-01, Annex 24-01/A, format 2. They considered that providing research proposals in the format which is detailed in CM 24-01/A, format 2, was essential to enable a proper evaluation of the merit of the research on *Dissostichus* spp. by WG-SAM and WG-FSA, so that the Scientific Committee had a basis for approving any research plans.

6.78   Dr Pshenichnov stated that the scientific research plan proposed by Ukraine for Subarea 48.2 fully meets the requirements of CMs 24-02 and 21-02 and was submitted using the format (CM 24-01, Annex 24-01/A, format 2) conforming with the review procedure at WG-SAM-13, and subsequent to recommendations made by WG-SAM, the revised proposal was submitted to WG-FSA. He clarified that:

(i)   the area of proposed research was reduced and potential catches to be taken during the research were identified

(ii)   all recommendations were included in the research plan

(iii) Ukraine's proposed fishing effort amounts to 25 sets (trotline), and the catch to be taken in this area, which is more than two times smaller than first proposed, would be less than 50 tonnes

(iv)   the catch limit is calculated according to the recommendation contained in SC-CAMLR-XXX, Annex 5, Table 2

(v)   Ukrainian scientists expect that the research could be carried out over three seasons (three years) with a further increase in the size of the study area, which would make it possible to obtain data from a previously unstudied area and estimate the biomass of *Dissostichus* spp. and their anticipated depth distribution in the proposed study area

(vi)   the research goals contained in the Ukrainian research plan and the expected results are priorities for the work of the Scientific Committee and the Commission.

6.79   Some Members recommended that a complete proposal for research by Ukraine be submitted for review by WG-SAM and WG-FSA next year, taking account of the advice provided in WG-SAM-13 and WG-FSA-13, and in the correct format as described in CM 24-01, Annex 24-01/A, format 2, before any Ukrainian fishing vessel is approved to conduct research on *Dissostichus* spp. in Subarea 48.2.

Subarea 48.5

6.80   Research fishing for *Dissostichus* spp. in Subarea 48.5 was conducted by Russia using longlines (WG-FSA-13/11). A total reported catch of 60 tonnes was taken in eight research sets.

6.81   The Working Group noted that the research plan for Subarea 48.5 (WG-FSA-13/09) incorporated the advice from WG-SAM (Annex 4, paragraphs 3.6 and 3.7).

6.82   The research plan presents three options for 2013/14 to give flexibility depending on ice cover. Options 2 and 3 are unchanged from WG-FSA-12/12, whereas Option 1 is revised on the basis of the research conducted during 2012/13.

6.83   There was some discussion on the suitability of the survey area specified in Option 3 due to concerns of vessel safety and the perceived limited opportunity to undertake multi-year research. The Working Group recalled advice with respect of ice conditions contained in the report of WG-FSA-12 (SC-CAMLR-XXXI, Annex 7, paragraphs 5.105 and 5.106).

6.84   The survey area proposed under Option 1 in WG-FSA-13/09 included a small area of the slope to the east of the fast-ice and adjacent to the survey area for Option 2 and a larger area to the west of the fast-ice. The Working Group recommended that the area adjacent to Option 2 be combined with the survey area proposed for Option 2.

6.85   The Working Group supported the proposal to define a research block encompassing the area surveyed during 2012/13 which would be in the biomass estimation phase (Figure 10). The remainder of the survey area under Option 1 is still in the prospecting phase (Figure 10).

6.86   The Working Group recommended that that research block be bounded by 74°42'S–74°32'S and 27°15'W–28°40'W with a catch limit of 60 tonnes, which corresponds to an estimated exploitation rate of 2.3% and an expectation of 5–6 recaptures of tagged fish (Table 13). To ensure a spread of effort within the research block, 50% of the longlines must be separated by a minimum of 3 n miles and the remaining 50% can be set anywhere within the research block (CM 41-01).

6.87   The remaining area under Option 1 in the Prospecting Phase will be effort limited. The Working Group recommended a maximum of 40 longline sets of not more than 3 600 hooks per set and sets should be separated by a minimum of 5 n miles. In addition, a maximum catch limit of 213 tonnes shall apply (Table 13).

6.88   Options 2 and 3 are both effort-limited prospecting surveys and shall use longline sets of not more than 3 600 hooks per set and sets should be separated by a minimum of five (5) n miles. Option 2 shall have a maximum of 40 sets and a catch limit of 48 tonnes. Option 3 shall have a maximum of 80 sets and a catch limit of 112 tonnes.

6.89   The Working Group stressed the importance of collecting more than the standard requirement of biological data (length frequency, sex ratio, maturity and age) from research in areas such as this that are in a relatively pristine state as this will enable the tracking and documentation of future population changes in response to exploitation. The Working Group noted that the requirement for a minimum tag overlap of 60% was the minimum under the conservation measure, but recommended that research vessels should attempt to achieve a considerably higher tag-overlap statistic.

Division 58.4.4

6.90   Research fishing for *Dissostichus* spp. in Division 58.4.4 was conducted by Japan using longlines and the total reported catch in 2012/13 was 31 tonnes taken in the allocated research blocks (SC-CAMLR-XXXII/BG/01).

6.91   Three papers were submitted for review regarding the research plan in Division 58.4.4 by Japan (WG-FSA-13/34, 13/35 and 13/36). WG-FSA-13/34 described the biological data collected during 2013 in SSRUs C and D, including CPUE, length, weight, condition and suitability to tag. Overall, 30% of fish were single hooked and in good condition to tag across the size distribution. Three tagged fish were recaptured in 31 tonnes of landed catch and all three fish had been at liberty for at least two years. There were no instances of cetacean depredation.

6.92   WG-FSA-13/35 presented an update on the stock assessment of *D. eleginoides* in Division 58.4.4 SSRU C on Ob and Lena Banks. It followed advice of WG-SAM-13 (Annex 4, paragraphs 3.27 and 3.28). The Working Group noted that this model was still in development and showed evidence of lack of convergence, although the base-case 2013 MPD biomass estimate was similar to the raw Petersen biomass estimate. However, the MCMC traces were unstable and indicated much higher biomasses than the MPD runs, and the models including IUU catch provided conflicting information.

6.93   The Working Group carried out further sensitivities on the run with 25% of the assumed IUU fishing in Division 58.4.4 occurring in SSRU C. It concluded that the tag data suggested lower stock biomass than can be achieved with the assumed level of IUU fishing, that length frequencies were largely uninformative and that estimating the growth parameters inside the model was likely the cause of the instability in the MCMC trace. The Working Group concluded that this model (25% IUU) was unsuitable to provide advice at this stage. The Working Group recommended:

(i)   the use of the biomass estimates derived from the base-case model

(ii)   that the growth parameters be estimated outside the model in the future

(iii)   that the amount of IUU fishing in this area and other areas be estimated within the model

(iv)   the sensitivity of scenarios to alternative selectivities by the IUU fleet be evaluated, noting that gillnetting is thought to be the dominant catch method used by IUU vessels

(v)   that fish be aged with the aim of providing annual ALKs and age frequencies in future models.

6.94   The Working Group also noted that as this stock assessment becomes more robust, the Working Group will need to consider the mechanism by which data-poor fisheries with research plans are transitioned into open exploratory fisheries with approved assessments. The Working Group noted that the Division 58.4.4 research plan is now catch-limited (biomass estimation – assessment development phase) (Table 11).

6.95   The Working Group noted the revised research plan and proposed local biomass estimates described in Table 13, using a revised number of tags released and available for a Petersen estimate (548 tonnes), and the base-case integrated model estimate of B_{2013} (635 tonnes).

6.96   The Working Group recommended the integrated model estimate be used to estimate the catch in SSRU C that would not exceed 4% exploitation rate. The Working Group recommended a catch limit of 25 tonnes for SSRU C with an expected recapture of nine tags.

6.97   The Working Group recommended the following catch limits. The catch limit for SSRU D, which has no stock assessment, was assigned by scaling up the biomass estimated in SSRU C by the seabed analogy method. This resulted in a recommended catch limit of 35 tonnes for SSRU D. Accordingly, the total catch limit for combined SSRUs C and D is 60 tonnes.

6.98   The Working Group agreed that in 2013/14, the *Shinsei Maru No. 3* would first complete research sets in each grid square as in 2012/13, and then be able to fish anywhere within the research block until the research catch limit is reached.

Subarea 88.3

6.99   The Working Group considered WG-FSA-13/12 which was a proposal by Russia to open Subarea 88.3 as an exploratory fishery. The Working Group recalled its discussion of this topic at its 2012 meeting (SC-CAMLR-XXXI, Annex 7, paragraphs 5.144 to 5.148). The Working Group agreed that any proposal to fish in this subarea should conform to the research plans identified in CM 24-01, Annex 24-01/A, format 2, and be considered within the data-poor fisheries framework. It encouraged Members to include Russian data when designing such research proposals.

VMEs

Ross Sea

7.1   WG-FSA-13/41 provided a revision of a paper submitted to WG-FSA in 2012 (WG-FSA-12/27). The original paper had been discussed at WG-FSA-12.

7.2   The paper compared the comparative catch rates of VME species by Spanish longlines and autolines in Subarea 88.1. The authors found that both the probability of observing by-catch and the weight of by-catch, when observed, declined with increasing depth for both gears, but at different rates. Within a series of large spatial blocks, the authors estimated the difference in rate at which the VME taxa were assumed to drop off the autoline gear compared to the Spanish gear while the gear was being retrieved. By using a Bayesian approach, the authors estimated that despite considerable uncertainty of the estimate, five times more VME indicator units were likely to have dropped off the autoline at 600 m depth compared to the Spanish system. The authors suggested that limiting the use of autolines might reduce the by-catch of VME taxa and might provide a precautionary approach to mitigating impact on VMEs.

7.3   The Working Group reiterated many of the criticisms it had expressed with respect to WG-FSA-12/27 in 2012 (SC-CAMLR-XXXI, Annex 7, paragraphs 6.1 to 6.3). Although the authors had addressed the Working Group's concerns about the modelling of zero values when estimating comparative catch rates, they had not addressed the main Working Group's criticism. Many Members of the Working Group felt that the model used as a basis of the analysis was inappropriate to estimate the impact of bottom longlines on VME taxa.

7.4   The analysis assumes that the observation of VME taxa by-catch at the surface (after a model adjustment) is indicative, or related to, the effects of the gear on the seabed. The Working Group disagreed with this assumption because the actual effects of any of these fishing gears on the benthic organisms encountered are unknown and are likely to require empirical (video) observations. The Working Group noted that theoretical models of drop-off rates cannot be used as a basis for advice on the impact of the gear without experimental data.

7.5   The Working Group noted that the analysis assumes that all fishing effort within the large areas defined (tens of thousands of square kilometres) encounters the same benthic communities. However, analyses to date (e.g. WG-FSA-10/30) have demonstrated that VME taxa are likely to be clustered and can vary dramatically at much smaller scales (tens of square kilometres). This was the rationale behind the previous Working Group suggestion that the authors consider using a spatial case-control study design (WG-FSA-12/47 Rev. 1; SC-CAMLR-XXXI, Annex 6, paragraph 6.3).

7.6   The Working Group further noted that more data (and perhaps more reliable data, as observers had become used to recording VME catches) exist from 2012 and 2013 that could be included in such an analysis. Catchability is likely to be different among different VME taxa so that combining weights (or volumes) of VME taxa is unlikely to be appropriate, especially as different taxa may have different spatial distribution patterns.

7.7   The model applied corrected by-catch observations across depth by applying a depth correction factor to inflate catches. The Working Group noted that the inflation factor and the formulation in which it was applied were based on a fixed depth but applied as a depth-related factor and could find no basis for this. In addition, the Working Group noted that the authors had not included the catches of the target fish species and/or by-catch species in the analysis which would impact haul times and potentially drop-off rates. The Working Group reiterated its opinion that experimental data is needed to condition such models.

7.8   The implications of this work also need to be evaluated relative to the already established CCAMLR bottom longline impact assessment method and conclusions of the Scientific Committee regarding cumulative impacts. The actual amount of by-catch CPUE (even resulting from the worst-case scenario of the model) is small. This should be contrasted with the known relative impacts on the ecosystem of the two gears. For instance, changes in gear type may have other implications for other parts of the ecosystem.

South Georgia

7.9   WG-FSA-13/58 identified six areas with relatively high densities of VME indicator taxa on the South Georgia shelf, during a demersal fish and ecosystem survey which deployed dredge sampling gear at depths of less than 500 m in April–May 2013. These areas were characterised by a high diversity of benthic organisms while being dominated by two VME indicator groups, Porifera and Ascidiaceae.

7.10   The Working Group recommended the authors forward the proposal for consideration by WG-EMM-14, noting that CMs 22-06 and 22-07 do not apply in Subarea 48.3 (CM 22-06, paragraph 1, and CM 22-07, paragraph 1).

Register of VMEs

7.11   The Secretariat presented information on registered VMEs and VME Risk Areas and fine-scale rectangles using a prototype web-based GIS which is being developed jointly with the British Antarctic Survey. This web-based GIS will provide state-of-the-art capacity for displaying geo-referenced data relevant to CCAMLR (WG-EMM-12/70). The prototype is

currently located at gis.ccamlr.org and contains basic data layers (e.g. management areas, bathymetry, sea-ice). The project is being implemented in two stages, with stage 1 nearing completion and stage 2 being implemented in 2014. The Working Group welcomed this development as it provided a standardised way to display spatial data both in publications and during working group meetings.

7.12   The Working Group noted that no new VME notification had been submitted under CM 22-06 in 2012/13. Since 2008, the Secretariat has received a total of 46 notifications of encounters with VMEs: 22 notifications in Subarea 48.1; 13 in Subarea 48.2; two in Division 58.4.1; and nine in Subarea 88.1 (see Report on Bottom Fisheries and VMEs at www.ccamlr.org/node/75667). All notified VMEs are currently afforded protection through specific area closures in Division 58.4.1 and Subarea 88.1 (CM 22-09), and general closures to bottom fishing activities in Subareas 48.1 and 48.2 (CMs 32-02 and 32-03).

7.13   The Working Group noted that five VME indicator notifications were submitted in accordance with CM 22-07 in 2012/13. These notifications were made in Subareas 88.1 (one) and 88.2 (four), and resulted in the declaration of a new VME Risk Area in Subarea 88.1. Since 2008, the Secretariat has received a total of 155 VME indicator notifications from exploratory bottom fisheries: one notification in Subarea 48.2, two in Subarea 48.6, 104 in Subarea 88.1 and 48 in Subarea 88.2. No notification has been received from exploratory fisheries in Divisions 58.4.1, 58.4.2, 58.4.3a and 58.4.3b. These VME indicator notifications have led to the declaration of 64 VME Risk Areas: 48 risk areas in Subarea 88.1 and 16 risk areas in Subarea 88.2. In addition, six VME fine-scale rectangles in Subarea 88.1 and two in Subarea 88.2 have been identified.

7.14   Details of registered VMEs and VME Risk Areas and fine-scale rectangles, and analysis of the impact of bottom fishing on VMEs, are contained in the Report on Bottom Fisheries and VMEs (www.ccamlr.org/node/75667).

SCHEME OF INTERNATIONAL SCIENTIFIC OBSERVATION

8.1   In accordance with CCAMLR's Scheme of International Scientific Observation (SISO), scientific observers were deployed on all vessels in all finfish fisheries in the Convention Area in 2012/13. Information collected by scientific observers was summarised in WG-FSA-13/68 Rev. 1.

SISO review

8.2   The Working Group reviewed recommendations from the external SISO review by an expert panel carried out intersessionally focusing on items that were WG-FSA issues or relevant to the work of WG-FSA. SC-CAMLR-XXXII/07 Rev. 1 summarised the findings of this review.

8.3   The Working Group noted that the review made recommendations across a range of topics in SISO, however, it primarily considered those recommendations that related to the work of WG-FSA, in particular ensuring that observer data are of the highest quality and consistent across the Convention Area.

8.4   Dr Petrov noted that the issue of state accreditation for scientific observer training programs, as recommended in SC-CAMLR-XXXII/07 Rev. 1, should be considered by the Commission and that, in his opinion, the proposal is in conflict with Article XXIV of the Convention, which emphasises that all Members may appoint a scientific observer or an inspector in the Convention Area.

8.5   The Working Group noted the recommendation to change the requirement for observer data to be submitted within one month of the last fishing day rather than within one month of return to port. The Working Group concluded that data could be submitted from the vessel while still at sea when the vessel exits a subarea, for preliminary checking and loading into the CCAMLR database with an embargo on release until approved by the Designating and Receiving Members. It noted that such a procedure would improve timely access to observer data, as well as ensuring that data-checking procedures that Members may conduct after a voyage are accommodated. The Working Group also recommended the use of a more compact format for data transmission from the vessels, such as XML, to facilitate timely data submission.

8.6   The Working Group noted recommendations to revise and update Annex 1 of the Text of the Scheme of International Scientific Observation and for CCAMLR to progressively reassess the tasks and functions for observers reflecting the contemporary status of the scheme. The Working Group recommended that such reviews take place biennially to alternate with the stock assessment cycle, and that WG-EMM and WG-FSA could consider these priorities in parallel. In addition, the Working Group agreed with the recommendation for more wide-ranging reviews of SISO on a five-yearly timescale.

8.7   The Working Group endorsed the recommendation that all sampling requirements additional to the 'standard' set of measurements be agreed by all parties prior to embarkation of an observer and that a summary of any additional sampling should be highlighted in the cruise report. It also noted a need to clearly define the role, responsibilities and priorities of the observer with respect to data collection.

8.8   The Working Group noted the recommendation to allow a longer period (until the next season after the changes are endorsed) between changes to observer sampling being included in documentation provided across all CCAMLR fisheries. However, the Working Group agreed that changes that do not require structural changes to the e-logbook (e.g. revised sampling targets for routine measurements in the observer sampling requirements document) should be able to be implemented in the season following their adoption. Other changes that may require substantive changes may require a longer time frame for implementation and change.

8.9   The Working Group agreed that the recommendations and solutions in Annex 1 of the Text of the Scheme of International Scientific Observation relating to observer tasking and workloads were constructive.

8.10   In respect to Appendix 2 of SC-CAMLR-XXXII/07 Rev. 1, the Working Group noted that although this was a good summary of priorities, there was a further need for an easily accessible document detailing sampling requirements on an annual basis. It also noted that paragraph 2(ii) of Appendix 2 of SC-CAMLR-XXXII/07 Rev. 1 should be altered to make it clear that observers are required to collect otoliths, but not age estimates.

8.11   The Working Group agreed with the recommendation from the review that a mechanism to implement the CCAMLR Observer Training Accreditation Scheme (COTPAS) would be of benefit to the work of WG-FSA, especially in providing greater confidence that all observer data was collected in a similar way.

8.12   The Working Group noted that it was unable to consider all the relevant recommendations in the SISO review, and requested that the Scientific Committee implement a suitable mechanism to ensure all the recommendations are evaluated.

Observer sampling requirements

8.13   To communicate the sampling requirements for longline fisheries, the Working Group developed a table of observer sampling requirements for *Dissostichus* spp. by division (Table 15) for 2013/14. The Working Group agreed that this table should be a stand-alone document accessible on the CCAMLR website and updated annually after the Scientific Committee and Commission advice is finalised, to facilitate revision of sampling targets in different fisheries and for measurements routinely collected by observers. The Working Group recalled that similar information was included in CM 41-01 until 2011.

8.14   The Working Group noted previous recommendations of the importance of gonad weight data (paragraphs 3.22 and 3.25; SC-CAMLR-XXIX, Annex 8, paragraph 8.14) and recommended that all Members with motion-compensating scales on board their vessels begin routine collection of gonad weight data as part of biological sampling in 2014, but that the Scientific Committee consider implementing a requirement for observers to collect gonad weight data in all exploratory fisheries and in research plans under CM 24-01 and that this requirement could be implemented through the observer sampling requirements document (Table 15). The Working Group also recommended that information about the use, reliability and cost of motion-compensating balances for measuring gonad weights would be useful in choosing appropriate equipment for this task and encouraged these data be submitted in a timely manner for consideration next year.

Tagging training

8.15   The tagging training module (paragraph 3.28; SC-CAMLR-XXXI, Annex 7, paragraphs 5.175 and 5.181) was updated during the meeting and the Working Group recommended that it be made available to Member technical coordinators electronically (perhaps via the Scientific Committee representatives) for trial and feedback from the various observer programs and from vessel crew. Feedback from Members after the main fisheries have occurred (e.g. April) would be useful to determine the translation need for this training product, especially for vessel crew, so that a final version can be made available in time for distribution with tagging supplies in 2014.

8.16   The Working Group noted that the diagrams requested for the assessment of tagging suitability have been added to the tagging checklist (SC-CAMLR-XXXI, Annex 7, paragraph 5.169), and recommended that this document be laminated and made available to vessels for display near tagging stations as part of the tagging supplies kit (translated versions available from SC-CAMLR-XXXI, Annex 7, Appendix D).

8.17   WG-FSA-13/54 reviewing CCAMLR tagging programs was presented and appears under paragraphs 3.27 and 3.28.

NON-TARGET CATCH IN CCAMLR FISHERIES

Fish

9.1   Skates (Rajiformes) are a frequent by-catch in some toothfish fisheries (see, for example, WG-FSA-13/04). Data for skates in the CCAMLR area are both limited and of variable quality. In the absence of sufficient data for reliable stock assessments for the various skate species, the Working Group noted that ecological risk assessments (ERA) and productivity susceptibility analyses (PSA) could usefully be investigated, especially using spatially explicit approaches. It was highlighted that assessing skates could be species-specific or for the complex as a whole. Such assessments could be used by CCAMLR to direct future conservation efforts at the by-catch species that are most at risk from fishing. Such methods would benefit from an improved knowledge of selected life-history parameters (e.g. fecundity, length/age-at-maturity) and more accurate knowledge of spatial and bathymetric distributions, and it was recommended that such information is collected.

9.2   WG-FSA-13/28 provided a literature review of the current knowledge of elasmobranchs in the Southern Ocean and additional data are available from the CCAMLR database. Appropriate data checks are required to maximise the utility of the latter, and there needs to be future consideration of which further data could usefully (and pragmatically) be collected.

9.3   Tagging programs for skates are one of the data sources held by CCAMLR, and WG-FSA-13/22 provided an up-to-date analysis of the Australian skate tagging program in Division 58.5.2. Similarly to previous studies reported to WG-FSA, the overall return rate for skates was low (<1%). There are several factors that could contribute to this low return rate, such as a high mortality of tagged fish, high rates of tag loss, low rates of tag detection/reporting, emigration, or large population size. WG-FSA-13/22 noted that 68% of skates double-tagged on release only had a single T-bar tag on recapture, suggesting tag loss may be an issue. Tag type and/or tagging protocols (which may affect both tag retention and post-tag survival) could usefully be re-evaluated. Skate tagging programs elsewhere in the world have often used dart tags, Petersen discs or Rototags (WG-FSA-13/33), and return rates in these studies have generally been higher, although return rates are a factor of both the exploitation rate and tag-loss rate. The Working Group recommended that: skate tag-return data are fully examined from across the Convention Area to better check data quality and to evaluate tag loss (shedding); studies to better examine the retention of the current T-bar tags in comparison to alternative tags for skates should be encouraged (with the Working Group also noting that such studies could be undertaken more effectively in less remote sea areas); and, further studies on post-tagging survival (short and longer term) could also be usefully undertaken. Australia noted that it intends to compare the performance of T-bar tags and Rototags in 2014.

9.4   Given the apparent negative growth noted from some recaptures in WG-FSA-13/22, the accuracy of length measurements for skates was discussed by the Working Group. The length data presented in WG-FSA-13/22 had no asymptote, suggesting that the fishery does

not sample the largest skates. Skates can be measured in various ways (total length, disc width, disc length, pelvic length) and recording multiple dimensions for tagged and recaptured fish may help improve data quality. Other approaches to ensure improved data collection and data checks should also be investigated.

9.5   WG-FSA-13/18 reported on accidental catches of *C. gunnari* taken in two hauls by a krill vessel operating off the northwestern slope of the South Orkney Islands shelf (Subarea 48.2) in April 2013. One tow contained 4.6 tonnes and another 0.4 tonnes.

Seabirds and marine mammals

9.6   WG-FSA-13/68 Rev. 1 summarised incidental mortality of seabirds and marine mammals in the CAMLR Convention Area during 2013. The total extrapolated incidental mortality of seabirds in all longline fisheries in the area during 2013 was 141 seabirds (the lowest ever recorded). There were two reported mortalities of southern elephant seals (*Mirounga leonina*) in longline fishing in Division 58.5.2 during 2013.

9.7   WG-FSA-13/06 examined the incidental catches of seabirds in the French EEZ of Kerguelen (Division 58.5.1) and Crozet (Subarea 58.6) and the Working Group noted that this data indicated that seabird mortality has decreased from 1 297 (2007/08) to 124 seabirds (2012/13, season ongoing), which is a decrease of c. 90%.

9.8   WG-FSA-13/19 proposed extending the fishing season in the Patagonian toothfish longline fishery in Division 58.5.2 by two weeks (so including the period 1–14 November) on a trial basis during 2013/14 and 2014/15. This document detailed that only 12 incidences of seabird by-catch had been reported in this division since 2003 (for the whole season including extensions), that current seabird by-catch mitigation measures would be continued, and that the season extension would still be subject to a total catch limit of three seabirds per vessel. WG-FSA-13/20 proposed extending the trial of daytime setting of longlines between 15 and 30 April in the same fishery to encompass the 2013/14 and 2014/15 fishing seasons. No seabird mortality has been observed during April longline fishing in either day or night sets. However, fishing effort has been low during the pre-season extension period to date and further trials are necessary to determine if mitigation is effective. The Working Group was supportive of these proposals.

9.9   WG-FSA-13/32 discussed season extensions in the Patagonian toothfish fishery in Subarea 48.3. No seabirds were killed during the extension in either 2012 or 2013, and it had been proposed that the start date of the main season be brought forward to 16 April, and that two further trial extensions (starting 6 April in 2014 and 1 April in 2015) be allowed. The extensions would have the same conditions as previous extensions, including a by-catch limit of three seabirds per vessel. The Working Group was supportive of these proposals.

BIOLOGY AND ECOLOGY

D. mawsoni

10.1   The Working Group welcomed the thorough presentation of the results of the first year of Russian research in the Weddell Sea (WG-FSA-13/11), including data on size frequency and diet, as well as details of the ageing of fish from that research (WG-FSA-13/16). In particular, the Working Group noted the importance of obtaining data on the age-structure of the unfished population of *D. mawsoni* in the Weddell Sea.

10.2   The Working Group noted the potential benefits of collaboration between Members undertaking age determination of *D. mawsoni* otoliths and encouraged those Members to collaborate to ensure comparability and repeatability between ageing studies.

10.3   Analysis of the genetics of *D. mawsoni* from an extensive geographic range, including from the Ross Sea, Indian Ocean and Atlantic sectors, was presented in WG-FSA-13/07. This revealed a lack of differentiation between stocks, in contrast to previous work that indicated that *D. mawsoni* in the Ross Sea showed genetic differentiation. The Working Group encouraged the use of genetic sampling to better understand the stock structure and evolutionary biology of *D. mawsoni*, particularly where genetic markers can reveal the time period through which a lack of genetic differentiation might arise.

10.4   The potential spawning areas and timing of *D. mawsoni* in the Pacific, Indian and Atlantic sectors were presented in WG-FSA-13/25 and indicated that spawning probably occurs over an extended period during winter with the exact timing varying by location. This analysis showed that:

(i)   in the Pacific Antarctic sector, spawning could occur in SSRUs 882H and D in the Amundsen Sea and in SSRU 5841E in the Mawson Sea in the Indian Ocean sector

(ii)   in the Ross Sea, spawning of *D. mawsoni* probably occurs from June to August, in the northern underwater rises and seamounts, located at 69°–75°S at a depth of 1 300–1 600 m, especially in SSRUs 881H and I.

10.5   An analysis of the reproductive potential of *D. mawsoni* in SSRU 5841C during 2013 (WG-FSA-13/43) provided broadly consistent results with those in WG-FSA-13/25, however, the Working Group noted that while there had been a large number of papers on fish maturity studies presented to the Working Group, a lack of common terminology and nomenclature for macroscopic and histological staging made an overall synthesis of maturity data problematic. The Working Group recalled that macroscopic staging had proved problematic and encouraged the routine measurement of gonad weight by observers which would be desirable, but would only be possible on vessels where motion-compensated scales are available.

10.6   The analysis of diet of *D. mawsoni* from the Indian Ocean and Weddell Sea was presented in WG-FSA-13/11, 13/42 and 13/43 and indicated a broadly consistent pattern of occurrence of by-catch species as well as squid and some invertebrates. The Working Group agreed that a combination of direct analysis of prey remains (WG-FSA-13/11 and 13/43), as well as the use of biochemical markers and isotopes (WG-FSA-13/42) was likely to provide the best understanding of diet and trophic interactions involving *D. mawsoni*.

Subarea 48.3

10.7   Ms A. Zavatteri (Argentina) and Dr Marschoff presented a series of papers describing the results of multidisciplinary research in Subarea 48.3, including bottom trawls, acoustics and oceanographic sampling conducted by Argentina (WG-FSA-13/58, 13/59, 13/60, 13/61, 13/62 and 13/65). The Working Group welcomed these papers and noted:

(i)   the presence of a spatially restricted population of Pike icefish (*C. esox*), a species usually associated with the southern Patagonian shelf, on the inshore shelf area north of South Georgia

(ii)   that comparison of the time series of length-frequency data of *C. gunnari* from the early 1990s to 2013 indicated a steady increase in the proportion of adult fish in the population, suggesting that the stock collapse in the early 1990s was due to recruitment failure, possibly due to overfishing

(iii)   indications of a strong 0+ class (4–10 cm) of *C. gunnari* that was not evident in the UK trawl survey (WG-FSA-13/17) could indicate strong recruitment but might also be attributed to differences in timing of the surveys, selectivity of gear (including the use of a smaller mesh net liner on the Argentinian survey) and/or temporal changes in the vertical distribution of these small fish associated with low food availability in the water column (a shift from a pelagic to a benthic habitat in response to low plankton availability) meaning that they are more likely to be sampled with a bottom trawl

(iv)   that details of the presence of VME indicator taxa presented in WG-FSA-13/58 should be forwarded to WG-EMM for further consideration.

10.8   The Working Group noted that a review of decadal trends in the fish assemblage from UK research surveys in Subarea 48.3 (WG-FSA-13/26) indicated that there was evidence of:

(i)   a temporally consistent pattern of species diversity, including low species diversity at Shag Rocks compared to the South Georgia shelf and particular locations of higher diversity associated with fjords

(ii)   little change in the species occurrence composition over the past three decades, however, *Patagonotothen ramsayi* (a Patagonian shelf species) had been noted at Shag Rocks in the last five years

(iii)   an increasing trend in overall CPUE that was primarily driven by a steady increase in catches of marbled rockcod (*Notothenia rossii*), indicating a slow recovery of this species following overfishing in the 1970s.

10.9   The Working Group encouraged other Members with time series of surveys to provide similar reviews and to investigate comparison with the time series of fish assemblage data from other parts of the Convention Area. The Working Group also noted that temporal changes in fish assemblages could usefully be viewed in conjunction with the long time series of the fish diet of seals and penguins at South Georgia to provide insights into ecosystem dynamics of the region.

10.10 The Working Group agreed that, in addition to the effects of historic overfishing, consideration should be given to potential environmental/oceanographic changes that might be driving more recent changes in fish assemblages.

10.11 The Working Group thanked the authors of a whale photo-identification manual (WG-FSA-13/08), and noted that this provided a comprehensive and accessible guide that allowed the collection of photographs of whales by vessel crew and observers that could be cross-referenced with photo archives for the Convention Area and adjacent waters. The Working Group noted that collection of the identification data of individual whales associated with fishing vessels could provide insights into the patterns of depredation, as well as on the range and movements of individual whales, and requested that this guide be made available to observers via the CCAMLR website.

FUTURE WORK

11.1 The Working Group considered a proposal to hold a stock assessment training workshop in 2014 at the CCAMLR Secretariat in the week prior to the meeting of WG-FSA. The workshop would provide hands-on training in stock assessment with focus on CCAMLR fisheries and CASAL, and would be 2–3 days in duration. The workshop may include experts from outside the regular CCAMLR meetings.

11.2 The Working Group agreed to form a CCAMLR webgroup to explore the requirements for such training and develop the workshop arrangements.

11.3 The Working Group requested the Scientific Committee to consider its recommendation for the work of WG-SAM when determining the priorities for that working group in 2014.

Notification of scientific research

11.4 A revised proposal submitted by Chile (WG-FSA-13/10) for a three-year research study commencing in 2014 using a midwater trawl survey on finfish in Subareas 48.1 and 48.2 was reviewed by the Working Group. The Working Group noted that considerable progress has been made in the revised proposal and most of the requests made by WG-SAM-13 have been addressed. The sampling methodology will be a random stratified midwater trawl survey. The trawl will have a vertical opening of about 30 m and each tow will have a duration of 30 min. The acoustic transects will be made independently during the non-fishing periods.

11.5 The Working Group agreed that the plan to compare the fish assemblage sampled with bottom trawl versus a midwater trawl in a small area to the west of Elephant Island, where there is no evidence of VME occurrence, would be of great interest.

11.6 In response to a request from the Working Group for a clearer understanding of the distribution of the effort, Prof. P. Arana (Chile) indicated that area and distribution of hauls

will be similar to that of the *Polarstern*'s previous cruises in 2007 and 2012. He also informed the Working Group that invitations to participate have been offered to Drs C. Jones (USA) and Kock.

OTHER BUSINESS

Accessibility and availability of working group papers

12.1   The Working Group noted that the new CCAMLR website had delivered a greater awareness of the large archive of working group papers and welcomed the proposal in SC-CAMLR-XXXII/10 on how these papers might be made publically available. This paper provided a revision of WG-SAM-13/17 and incorporated the comments of both WG-SAM and WG-EMM, particularly in respect of (i) the issue of prior publication where making working group papers available in the public domain might compromise the subsequent publication in the peer-reviewed literature, and (ii) a disclaimer that makes it clear that the paper has not been reviewed by CCAMLR, that the content of the paper does not necessarily reflect the views of CCAMLR and that the paper should be considered in the context of the relevant meeting report.

12.2   The Working Group discussed a range of issues associated with this paper. However, the Working Group identified this as an important issue and agreed that a mechanism be developed to ensure the information on which the outcomes of the working groups are based are made more available to a wider audience. The Working Group could not agree on any recommendations on how to facilitate this and recommended that the Scientific Committee consider this issue that relates to all of its working groups.

CCAMLR response to WG-FSA-13/P02

12.3   The Working Group discussed WG-FSA-13/P02 regarding CCAMLR's management of toothfish stocks in the Southern Ocean, and in particular the Ross Sea. The paper focused on issues related to CCAMLR decision rules, population dynamics including estimates of population size and future uncertainty in stock status, and the ecosystem effects of fishing.

12.4   The Working Group identified a number of inconsistencies throughout the paper and an apparent lack of understanding of many of the issues discussed, including how CCAMLR decision rules are formulated and applied, misconceptions about CCAMLR's ecosystem approach to fishing and many incorrect assumptions about the workings of the Ross Sea stock assessment itself and the science supporting its application. A lack of engagement with CCAMLR Member scientists exacerbated these issues as it restricted the author's access to working group literature; much of the detail is only available in working group documents and reports.

12.5   The Working Group requested that appropriate experts develop a manuscript in the form of a background paper to the Scientific Committee for discussion. Following discussion at the Scientific Committee, the authors will seek to have it published in the same journal (*Antarctic Science*) as an informed perspective to the Abrams manuscript detailing the mechanisms CCAMLR has in place to manage fisheries: embracing the precautionary

approach through its decision rules, focus on the ecosystem effects of fishing, utilisation of robust peer review, proactive seabird and by-catch mitigation policies and binding conservation measures. In addition, the Working Group agreed that the paper should characterise the large volume of work underpinning the Ross Sea stock assessment, how it is implemented using the precautionary approach and how key uncertainties have been addressed or are planned to be addressed through active research programs, for example, the ongoing surveys of the sub-adult toothfish, structured tagging programs and the development of spatial population operating models.

12.6   Therefore, a brief background paper will be submitted to the Scientific Committee at its 2013 meeting addressing the key points raised in the paper pertaining to CCAMLR fisheries science in general, CCAMLR toothfish fisheries and, in particular, the Ross Sea toothfish fishery. The authors invite members of the Scientific Committee to discuss, contribute to and add their affiliation to the paper in order that it reflects the views of as many CCAMLR scientific experts as possible. The intention is to make this paper available to *Antarctic Science* immediately, so as to provide an informed alternative and balanced perspective on the Ross Sea stock assessment and the performance of CCAMLR's fishery management systems.

ADVICE TO THE SCIENTIFIC COMMITTEE AND ITS WORKING GROUPS

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

13.2   The Working Group provided advice to the Scientific Committee and other working groups on the following topics.

(i)   Fishery reports –

   (a)   review of procedure for updating and publishing (paragraph 2.5).

(ii)   IUU fishing activities –

   (a)   request that SCIC examine VMS and C2 data to further clarify the proximity of vessels during steaming and fishing operations (paragraph 3.6).

(iii)   Assessed fisheries –

   (a)   *C. gunnari* in Subarea 48.3 (paragraph 4.7)

   (b)   *C. gunnari* in Division 58.5.2 (paragraph 4.16)

   (c)   *D. eleginoides* in Subarea 48.3 (paragraphs 4.23 and 4.24)

   (d)   *Dissostichus* spp. in Subarea 48.4 (paragraphs 4.34 and 4.37)

   (e)   *D. eleginoides* in Division 58.5.1 (paragraph 4.61)

(f)   *D. eleginoides* in Division 58.5.2 (no advice, see paragraphs 4.54 to 4.56)

(g)   *D. eleginoides* at Crozet Islands (paragraph 4.65)

(h)   *D. eleginoides* at Prince Edward and Marion Islands (no advice, see paragraph 4.66)

(i)   *Dissostichus* spp. in Subarea 88.1 and SSRUs 882A and 882B (paragraphs 4.71, 4.73, 4.76, 4.80 and 4.107)

(j)   *Dissostichus* spp. in Subarea 88.2 (SSRUs 882C–G and 882H) (paragraphs 4.89 and 4.92)

(k)   CASAL version control and validation (paragraphs 4.97 and 4.98)

(l)   data weighting (paragraph 4.103)

(m)   cryptic biomass (paragraph 4.105)

(n)   summary of catch limits (Table 3).

(iv)   Data-poor fisheries for *Dissostichus* spp. –

(a)   submit research plans separately from the notifications (paragraph 6.1)

(b)   development and revision of research plans (paragraph 6.3)

(c)   by-catch in research blocks (paragraphs 6.7, 6.8, 6.63 and 6.65)

(d)   minimum separation distance between research sets (paragraph 6.9)

(e)   research fishing outside research blocks (paragraph 6.21)

(f)   requirements for multi-Member, multi-vessel research plans (paragraph 6.22)

(g)   catch limits for *Dissostichus* spp. (paragraphs 6.28, 6.39, 6.40, 6.43, 6.45, 6.48, 6.52, 6.57, 6.67 to 6.69 and Table 13).

(v)   Research fishing in other areas –

(a)   *Dissostichus* spp. in Subarea 48.2 (paragraph 6.76)

(b)   *Dissostichus* spp. in Subarea 48.5 (paragraph 6.86 to 6.88)

(c)   *Dissostichus* spp. in Divisions 58.4.4a and 58.4.4b (paragraphs 6.95 to 6.98)

(d)   *Dissostichus* spp. in Subarea 88.3 (no advice, see paragraph 6.99).

(vi)   Scheme of International Scientific Observation –

(a)   sampling requirements (paragraph 8.13).

(vii) Other matters –

(a)   future work (no advice, see paragraphs 11.1, 11.3, 11.4 and 11.5).

ADOPTION OF THE REPORT

14.1   The report of the meeting was adopted.

CLOSE OF MEETING

15.1   At the close of the meeting Dr Belchier thanked all the participants for their constructive engagement that had put in place a very valuable process to review and improve stock assessments and research proposals. He particularly thanked the two subgroup coordinators who had taken on a range of difficult issues and made tangible progress. He also thanked the rapporteurs and the Secretariat for their support to the work of WG-FSA.

15.2   On behalf of the Working Group, Dr Kock (the self-confessed 'dinosaur of WG-FSA') thanked Dr Belchier for the great job he had done in leading the Working Group through some difficult areas, which he acknowledged from his own experience was not always an easy task.

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Table 1: Total reported catches (tonnes) of target species in fisheries in the Convention Area in 2012/13 (to 20 September 2013 unless otherwise indicated, refer to the *Statistical Bulletin* for previous years).

Target species	Region	CM	Catch (tonnes) of target species		Reported catch (% limit)
			Limit	Reported	
Champsocephalus gunnari	48.3	42-01	2 933	1 354	46
	58.5.2	42-02	679	644	95
Dissostichus eleginoides	48.3	41-02	2 600	2 098	81
	48.4 north of 57°20'S	41-03	63	62	98
	58.5.1 French EEZ[a]	n/a	5 100	3 239	-
	58.5.2	41-08	2 730	2 413	88
	58.6 French EEZ[a]	n/a	700	504	-
	58 South African EEZ[b]	n/a	320	211	-
Dissostichus spp.	48.4 south of 57°20'S	41-03	52	50	96
	48.6	41-04	400	237	59
	58.4.1	41-11	210	48	23
	58.4.2	41-05	70	4	6
	58.4.3a	41-06	32	16	50
	58.4.3b	41-07	0	No fishing	-
	88.1	41-09	3 282	3 155[c]	96
	88.2	41-10	530	476	90
Euphausia superba	48.1, 48.2, 48.3, 48.4	51-01	620 000	212 798	34
	58.4.1	51-02	440 000	No fishing	-
	58.4.2	51-03	452 000	No fishing	-

[a] Reported in fine-scale data to July 2013
[b] Whole EEZ
[c] Does not include the catch taken during the pre-recruit research survey
n/a Not specified by CCAMLR

Table 2: Landings of *Dissostichus eleginoides* (estimated live weight) reported in Catch Documentation Scheme (CDS) fisheries operating outside the Convention Area in the calendar years 2011 to 2013 (to 16 September 2013, refer to the *Statistical Bulletin* for previous years).

Ocean sector	FAO Area	Estimated live weight (tonnes)		
		2011	2012	2013
Southwest Atlantic	41	8 020	7 570	4 991
Southeast Atlantic	47	196	126	-
Western Indian	51	669	298	296
Eastern Indian	57	-	-	-
Southwest Pacific	81	412	377	419
Southeast Pacific	87	4 266	5 685	2 709
Total		13 563	14 057	8 415

Table 3: Recommended catch limits (tonnes) for target and by-catch species in finfish fisheries in Subareas 48.3, 48.4, 88.1 and 88.2 and Division 58.5.2 in 2013/14. ✓ – applicable; shaded area – closed.

Fishery for *Dissostichus eleginoides* in Subarea 48.3 (biennial assessment, advice carried forward to 2014/15)

Fishery area	Target species	By-catch species		
	D. eleginoides	Macrourids	Rajids	Move-on rule
Management area A	0			
Management area B	720	-	-	✓
Management area C	1 680	-	-	✓
Whole fishery	2 400	120	120	✓

Fishery for *Dissostichus eleginoides* in Division 58.5.2 (biennial assessment)

Fishery area	Target species	By-catch species	Move-on rule
	D. eleginoides		
Whole fishery	Refer paragraphs 4.54 to 4.56	Refer CM 33-02	✓

Fishery for *Champsocephalus gunnari* in Subarea 48.3

Fishery area	Target species	By-catch species	Move-on rule
	C. gunnari		
Whole fishery	4 635	Refer CM 33-01	✓

Fishery for *Champsocephalus gunnari* in Division 58.5.2

Fishery area	Target species	By-catch species	Move-on rule
	C. gunnari		
Whole fishery	1 267	Refer CM 33-02	✓

Fishery for *Dissostichus* spp. in Subarea 48.4

Fishery area	Target species	By-catch species		
	Dissostichus spp.	Macrourids	Rajids	Move-on rule
Whole fishery	*D. eleginoides* 45	11	3.5	✓
Whole fishery	*D. mawsoni* 24			

Exploratory fishery for *Dissostichus* spp. in Subarea 88.1

Fishery area	Target species	By-catch species			
	Dissostichus spp.	Macrourids	Rajids	Other species	Move-on rule
SSRUs A, D, E, F, M	0				
SSRUs B, C, G	397	40	50	60	✓
SSRUs H, I, K	2 247	320	112	60	✓
SSRUs J, L	357	70	50	40	✓
Whole fishery	3 044*	430	152	160	✓

*   A research catch limit of 43 tonnes is set aside for the sub-adult research survey (paragraph 4.71).

Exploratory fishery for *Dissostichus* spp. in Subarea 88.2

Fishery area	Target species	By-catch species			
	Dissostichus spp.	Macrourids	Rajids	Other species	Move-on rule
SSRUs A, B, I	0				
SSRUs C, D, E, F, G	Refer paragraphs 4.89 and 4.92		Refer CM 33-01		✓
SSRU H					✓
Whole fishery	266–530				✓

Table 4: MPD estimates of B_0 (tonnes), spawning biomass estimated in 2013 (B_{2013}) and objective functions for two initialisation B_0 and two CASAL versions (2.22 v3982 and 2.30 v4982) for the CASAL assessment of *Dissostichus eleginoides* in Division 58.5.2.

Initialisation B_0 (tonnes)	CASAL 2.22 v3982				CASAL 2.30 v4982			
	B_0	B_{2013}	B_{2013}/B_0	Objective function	B_0	B_{2013}	B_{2013}/B_0	Objective function
90 000	87 537	51 590	0.59	3 629	86 372[1]	50 028	0.58	3 389
120 000	94 794[1]	59 284	0.63	3 431	86 610	50 397	0.58	3 488

[1] Model fit with the lowest objective function.

Table 5: CASAL assessments reported to WG-FSA, Working Group paper reference and 'rev.' version of CASAL used by authors (Secretariat version: rev. 4982).

CASAL assessment		Paper number	CASAL rev.
Species	Area		
D. eleginoides	Division 58.4.3a	WG-FSA-13/04	3600
	Division 58.4.4	WG-FSA-13/35	4923
	Division 58.5.2[1]	WG-FSA-13/24	4982
	Subarea 48.3[2]	WG-FSA-13/30	4686
	Subarea 48.4[3]	WG-FSA-13/31	4686
	Subarea 58.6[4]	WG-FSA-13/05	4686
D. mawsoni	Subarea 88.2 (C–H)	WG-FSA-13/52	4923
	Ross Sea	WG-FSA-13/51	4923

[1] Scenario 2.4 was updated omitting observations for the sub-fisheries Trawl2 and Trawl3, limiting the period of fitting YCS to 1992–2008, and adding a Beverton-Holt stock-recruitment relationship with steepness $h = 0.75$.

[2] The final assessment was based on the '2-fleet' model with commercial catch-at-age and CPUE data separated into two time blocks (1988–1997, 1998–2013). Projections were conducted assuming a lognormal empirical distribution about a truncated time series of YCS (1992–2006).

[3] The final assessment included catch-at-age data for 2011 and 2012 and employed the data-weighting approaches described in Hillary et al. (2006).

[4] Model run 3.2 of WG-FSA-13/05 was updated using the weighting method of Francis (2011a, 2011b); all other parameters were left unchanged. MCMCs were subsequently run on the updated model.

Table 6: Final B_0 (tonnes) estimates reported to WG-FSA and comparison with Secretariat estimates.

Model run	Reported B_0	Secretariat B_0	Difference (%)
D. eleginoides			
Division 58.4.3a	1 403	1 404	0.1
Division 58.4.4			
Base	635	635	0.0
IUU 25%	4 852	4 852	0.0
IUU 100%	17 786	16 580	−6.8
YCS	810	810	0.0
Division 58.5.2	86 372	86 372	0.0
Subarea 48.3	87 665	87 665	0.0
Subarea 48.4	1 311	1 311	0.0
Subarea 58.6	68 323	68 323	0.0
D. mawsoni			
Subarea 88.2 (C–H)			
R1	10 510	10 599	0.8
R2	12 990	13 077	0.7
R3	7 570	7 665	1.3
R4	6 320	6 392	1.1
R5	7 190	7 279	1.2
Ross Sea			
R1	83 920	83 917	0.0
R2	68 820	68 818	0.0
R3	69 460	69 462	0.0

Table 7: Tagging rates (number of fish per tonne of green weight caught) for vessels in the exploratory fisheries for *Dissostichus* spp. in 2012/13 (to 20 September 2013). The minimum required tagging rates are listed in brackets. (Source: catch and effort data (C2) and observer data.)

Flag State	Vessel name	Subarea or division (minimum tagging rate)					
		48.6 (5)	58.4.1 (5)	58.4.2 (5)	58.4.3a (5)	88.1 (1)	88.2 (1)
France	*Saint André*				9.2		
Japan	*Shinsei Maru No. 3*	5.7		5.6	6.0		
Korea, Republic of	*Hong Jin No. 701*					1.1	1.3
	Hong Jin No. 707					1.0	
	Insung No. 3		9.5			1.5	
	Insung No. 5					1.6	
	Kostar					1.1	1.1
	Sunstar					1.2	1.1
New Zealand	*Antarctic Chieftain*						1.1
	Janas					1.0	1.1
	San Aotea II					1.8	
	San Aspiring					1.2	
Norway	*Seljevaer*					1.1	1.2
Russia	*Palmer*						1.0
	Sparta					1.1	1.2
	Ugulan					1.0	
	Yantar 31					1.1	2.1
	Yantar 35					1.1	1.6
South Africa	*Koryo Maru No. 11*	5.2					
Spain	*Tronio*		5.2			1.0	
UK	*Argos Froyanes*					1.0	1.1
	Argos Georgia					1.1	
Ukraine	*Simeiz*					1.2	1.7

Table 8: Tag-overlap statistic (%) (CM 41-01, Annex 41-01/C, paragraph 2ii) for vessels in the exploratory fisheries for *Dissostichus* spp. in 2012/13 (to 20 September 2013). The minimum required statistic was 60% for each species of *Dissostichus* with a catch >10 tonnes in a fishery. Catches of *D. mawsoni* ≤10 tonnes are indicated by an asterisk; catches of *D. eleginoides* did not exceed 10 tonnes. (Source: catch and effort data (C2) and observer data.)

Flag State	Vessel name	Subarea or division					
		48.6	58.4.1	58.4.2	58.4.3a	88.1	88.2
D. mawsoni							
France	*Saint André*				*		
Japan	*Shinsei Maru No. 3*	79		*			
Korea, Republic of	*Hong Jin No. 701*					82	*
	Hong Jin No. 707					82	
	Insung No. 3		*			91	
	Insung No. 5					91	
	Kostar					94	82
	Sunstar					85	*
New Zealand	*Antarctic Chieftain*						86
	Janas					91	82
	San Aotea II					80	
	San Aspiring					93	
Norway	*Seljevaer*					76	*
Russia	*Palmer*						75
	Sparta					*	75
	Ugulan					74	
	Yantar 31					83	*
	Yantar 35					78	*
South Africa	*Koryo Maru No. 11*	68					
Spain	*Tronio*		68			90	
UK	*Argos Froyanes*					91	100
	Argos Georgia					78	
Ukraine	*Simeiz*					43	*

Table 9: Number of *Dissostichus* spp. (a) tagged and released, and (b) recaptured in exploratory fisheries for *Dissostichus* spp. (Source: scientific observer data.)

(a) Number tagged and released

Subarea or division	Season													Total
	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	
48.6				4	62	171	129		941	1 213	1 308	1 948	1 359	7 135
58.4.1					462	469	1 507	1 134	1 127	627	747	812	260	7 145
58.4.2					342	136	248	673	277	291	408	269	21	2 665
58.4.3a					199	104	9	41	113		14	235	116	831
58.4.3b					231	175	289	417	356	60	62	51		1 641
88.1	326	960	1 068	2 250	3 209	2 972	3 608	2 574	2 943	3 066	3 073	3 751	3 752	33 552
88.2		12	94	433	355	444	278	389	603	325	667	543	508	4 651
Total	326	972	1 162	2 687	4 860	4 471	6 068	5 228	6 360	5 582	6 279	7 609	6 016	57 620

(b) Number recaptured

Subarea or division	Season													Total
	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	
48.6						3	2		2	10	2	34	18	71
58.4.1							4	6	8	4	5			27
58.4.2									1	1				2
58.4.3a						6		2	2			9	12	31
58.4.3b					1	6	1	1	1	1				11
88.1	1	4	13	32	59	71	206	216	103	250	218	147	223	1 543
88.2				18	17	28	33	36	56	44	60	88	54	434
Total	1	4	13	50	77	114	246	261	173	310	285	278	307	2 119

Table 10: Notifications for exploratory fisheries for *Dissostichus* spp. in 2013/14.

Member and vessel	Subarea/division where fishing has been notified						
	48.6	58.4.1	58.4.2	58.4.3a	58.4.3b	88.1	88.2
France							
Saint André				✓			
Japan							
Shinsei Maru No. 3	✓	✓	✓	✓		✓	
Korea, Republic of							
Hong Jin No. 701						✓	✓
Hong Jin No. 707						✓	✓
Insung No. 3		✓				✓	✓
Insung No. 5						✓	✓
Kostar						✓	✓
Sunstar						✓	✓
New Zealand							
Antarctic Chieftain						✓	✓
Janas						✓	✓
San Aotea II						✓	✓
San Aspiring						✓	✓
Norway							
Seljevaer						✓	✓
Russia							
Palmer						✓	✓
Sarbay						✓	✓
Sparta						✓	✓
Ugulan						✓	✓
Yantar 31						✓	✓
Yantar 35						✓	✓
South Africa							
Koryo Maru No. 11	✓						
Spain							
Tronio		✓	✓			✓	✓
Ukraine							
Belobog						✓	✓
Poseydon I	✓					✓	✓
Simeiz						✓	✓
UK							
Argos Froyanes						✓	✓
Argos Georgia						✓	✓
Total Members	3	3	2	2	0	8	7
Total vessels	3	3	2	2	0	24	23

Table 11: Research phase for each research block described in research plans for 2014. Phase refers to the phase in the research plan flowchart (Figure 10). TOA – *Dissostichus mawsoni*; TOP – *D. eleginoides*.

Area or SSRU	Block – species	Subarea or SSRU	Research phase
48.5	Option 1-a – TOA	48.5	Biomass estimation
	Option 1* – TOA	48.5	Prospecting
	Option 2* – TOA	48.5	Prospecting
	Option 3* – TOA	48.5	Prospecting
48.6	a-b – TOP	48.6N	Biomass estimation
	b – TOA	48.6N	Biomass estimation
	c – TOA	486D	Biomass estimation
	d – TOA	486E	Biomass estimation
	e – TOA	486BC	Biomass estimation
58.4.1	C-a – TOA	5841C	Biomass estimation
	C-b – TOA	5841C	Biomass estimation
	E-a – TOA	5841E	Biomass estimation
	E-b – TOA	5841E	Biomass estimation
	G – TOA	5841G	Biomass estimation
	C*	5841C	Prospecting
	D*	5841D	Prospecting
	G*	5841G	Biomass estimation – Prospecting
	H*	5841H	Biomass estimation – Prospecting
58.4.2	E – TOA	5842E	Biomass estimation
58.4.4	C – TOP	5844C	Biomass estimation – Assessment development
	D – TOP	5844D	Biomass estimation
58.4.3a	Whole area – TOP	58.4.3a	Biomass estimation – Assessment development

* Refers to research plans in the prospecting phase for which research blocks are not defined.

Table 12: CPUE, vulnerable biomass and seabed area for reference areas (with stock assessments) used in the meeting for CPUE comparison. For Subarea 48.5 the CPUE by analogy method was used only in the research block (Option 1-a, Table 13). TOA – *Dissostichus mawsoni*; TOP – *D. eleginoides*.

Reference area	Species	CPUE kg/km (years)	Vulnerable biomass (year)	Seabed area (km^2)	Targeted areas for comparison
Ross Sea	TOA	177 (2010–2013)	64 209 (2013)	115 000	48.5, 48.6S, 58.4.1, 58.4.2
882H	TOA	99 (2010–2013)	5 000 (2013)	5 227	48.6N
48.4S	TOA	34 (2011–2013)	640 (2013)	11 033	48.6N
48.4N	TOP	53 (2011–2013)	1 025 (2012)	7 710	48.6N, 58.4.3a, 58.4.4

Table 13: Estimates of local biomass, local exploitation rate and tag recaptures associated with recommended research catch limits within research blocks (recommended research catches associated with the Spanish depletion experiment described in WG-FSA-13/15 and the prospecting phase of research in Subarea 48.5 (WG-FSA-13/09) are also shown, denoted by *). With two exceptions, all research catches are recommended by WG-FSA as an appropriate basis by which to conduct research in particular blocks or areas, to be revised and updated on an annual basis. Associated catch limits recommended for 2013/14 are in Table 14. The research blocks for which consensus advice from WG-FSA was not achieved are as follows: (i) two catch limits are shown for *Dissostichus eleginoides* (TOP) in research blocks 48.6a and b, arising from alternate biomass estimation methods; and (ii) a range of catch limits is shown for *D. mawsoni* (TOA) in research block 48.6d, arising from different interpretations of the plausibility of the CPUE-based biomass estimate in this research block.

Area or SSRU	Block – species	SSRU	Biomass estimation method	Local biomass	2013 tags predicted	2013 tags observed	2014 recommended catch limit	2014 local exploitation rate	Proportion of fishable depths (600–1 800 m) in SSRU contained in research blocks	2014 tags available	2014 tag recaptures estimated
48.5	Option 1-a		CPUE RSR	2 562	0.0	0	60	0.023		233	5.5
	Option 1*		n/a	n/a	n/a	n/a	213	n/a	n/a	n/a	n/a
	Option 2*		n/a	n/a	n/a	n/a	48	n/a	n/a	n/a	n/a
	Option 3*		n/a	n/a	n/a	n/a	112	n/a	n/a	n/a	n/a
48.6A, G	a, b – TOP	486A, G	Petersen	351	2.9	0	14	0.040	[1.000]*	366	14.6
			CPUE 484N	697	1.5	0	28	0.040	[1.000]*	366	14.7
	b – TOA	486A, G	CPUE 882H	6 886	8.7	6	170	0.025		1 079	26.6
48.6	c – TOA	486D	CPUE 882H	3 624	8.4	2	50	0.014		752	10.4
	d – TOA		CPUE RSR	2 515	15.3	0	100–150	0.40–0.060	0.650	743	29.5–44.3
	e – TOA	486B, C	CPUE RSR	6 622			190	0.029	0.444	352	10.1
58.4.1	C-a – TOA		CPUE RSR	3 140			125	0.040	0.697	114	4.5
	C-b – TOA		CPUE RSR	2 337			90	0.039		598	23.0
	E-a – TOA	5841E	CPUE RSR	7 061			280	0.040	0.432	226	9.0
	E-b – TOA		CPUE RSR	930			35	0.038	0.432	72	2.7
	G – TOA	5841G	Petersen	674		0	26	0.039	0.206	369	14.2
	C*			n/a	n/a		42	n/a	n/a	n/a	n/a
	D*			n/a	n/a		42	n/a	n/a	n/a	n/a
	G*			n/a	n/a		42	n/a	n/a	n/a	n/a
	H*			n/a	n/a		42	n/a	n/a	n/a	n/a
58.4.2	E – TOA		CPUE RSR	877	1.0		35	0.040		214	8.5
58.4.4a, b	C – TOA		CASAL	635	6.8	3	25	0.039	1.000	215.5	8.5
	D – TOA		CPUE 5844-C	870	0.8	0	35	0.040	1.000	39.2	1.6
58.4.3a	Whole		Petersen	372	15.0	11	32	0.086	1.000	353	30.4
	Whole		CPUE 484N	2 798	2.0	11	32	0.011	1.000	353	4.0

* To be updated

Table 14: Recommended catch limits (tonnes) for *Dissostichus* spp. in Subareas 48.5 and 48.6 and Divisions 58.4.1, 58.4.2, 58.4.4 and 58.4.3a in 2013/14.

Subarea/division	SSRUs	Catch limit (tonne)	
		D. eleginoides	*D. mawsoni*
48.5	-	-	433
48.6	North A and G	14–28	170
	South B–F	-	340–390
58.4.1	C	-	257*
	D		42*
	E	-	315
	G	-	42*
	H		42*
58.4.2	E	-	35
58.4.4	C	25	-
58.4.3a	A	32–25	-

* Includes 42 tonnes for depletion experiments.

Table 15: Observer sampling requirements for *Dissostichus* spp. 2013/14.

1. Observer sampling requirements for *Dissostichus* spp. in longline fisheries based on the data collection plan described in WG-FSA-10/32 (SC-CAMLR-XXIX, Annex 8, paragraph 5.34; SC-CAMLR-XXIX, paragraph 3.187). These sampling requirements serve as the default sampling requirements by subarea or division, unless alternative sampling requirements are agreed through the research plan review process. General sampling requirements are listed in Annex 1 of the CCAMLR Scheme of International Scientific Observation.

2. Biological measurements Type I: includes species, total length, sex, and gonad stage as per CM 41-01, Annex 41-01/B, paragraph 6.

3. Biological measurements Type II: includes species, total length, sex, gonad stage and total weight as per CM 41-01, Annex 41-01/B, paragraph 6.

4. Biological measurements Type III: includes otolith samples and all Type II data.

5. All recaptured toothfish should be sampled as Type III in addition to the sample number in the table.

Sample numbers in the table below indicate sampling of all fish up to the number listed in the table.

Fisheries in subarea/division	Species/group	Type I	Type II	Type III
48.2, 48.5, 58.4.4a, 58.4.4b, 88.3	*D. mawsoni*	70	30	10
	D. eleginoides	70	30	10
48.6, 58.4.1, 58.4.2, 58.4.3a	*D. mawsoni*	70	30	10
	D. eleginoides	70	30	10
88.1, 88.2	*D. mawsoni*	n/a	35	10
	D. eleginoides	n/a	35	10

Biological measurements to be recorded for each sample type for *Dissostichus* spp.

Sample type	Total samples per set	Total length	Sex	Gonad stage	Weight	Otoliths
Type I	100					
Type II	30					
Type III	10					

(a)
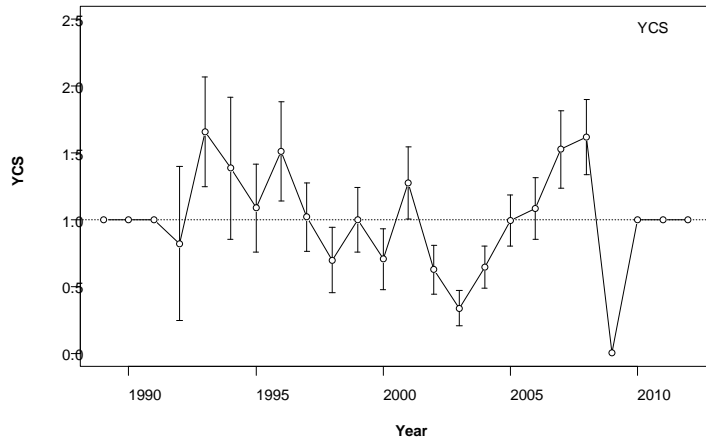
(b)
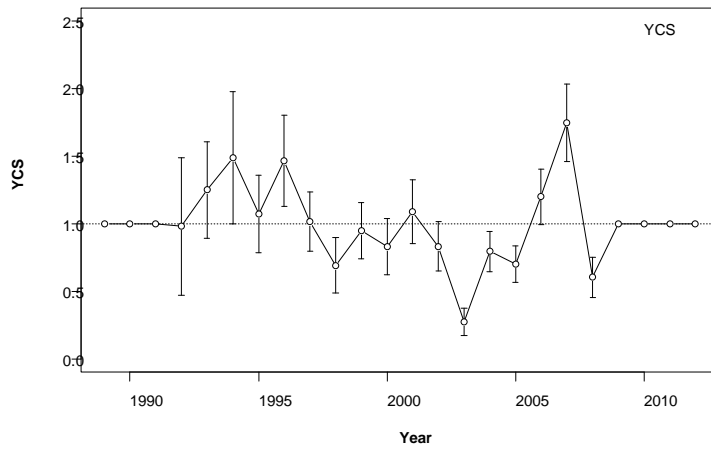
Figure 1: Estimated year-class strength (YCS) with SE (a) for preferred scenario in WG-FSA-13/24 with YCS estimated for 1992–2009; (b) for final model structure with YCS estimated for 1992–2008.

Figure 2:   Projected status of spawning stock biomass (SSB) relative to B_0 with constant projected catches of 3 005 tonnes, for model structure of preferred scenario in WG-FSA-13/24.

Figure 3:   Projected status of spawning stock biomass (SSB) relative to B_0 with constant projected catches of 2 770 tonnes, for final model structure using CASAL version 2.22 v3982.
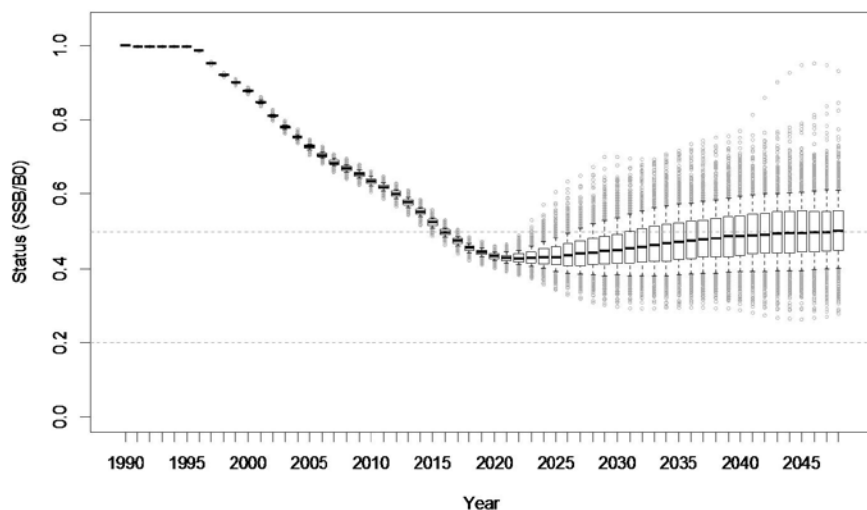
Figure 4:   Projected status of spawning stock biomass (SSB) relative to B_0 with constant projected catches of 2 500 tonnes, for final model structure using CASAL version 2.30 v4982.
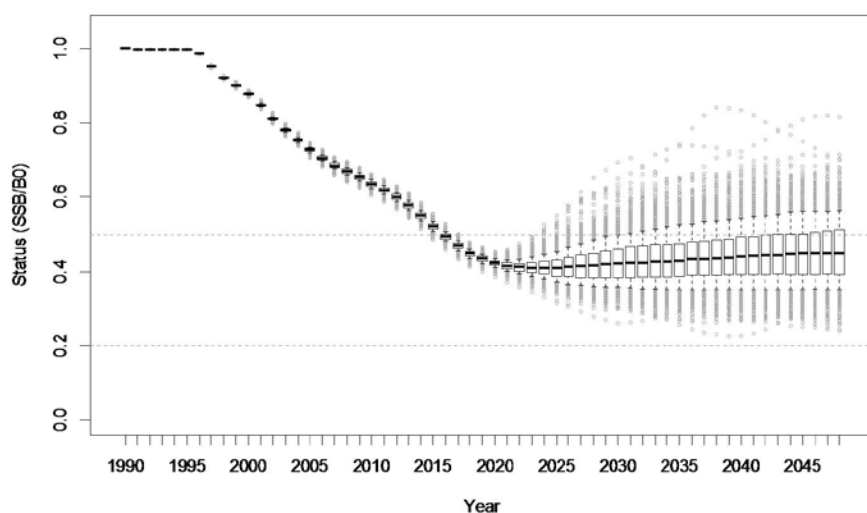
Figure 5:   Projected status of spawning stock biomass (SSB) relative to B_0 with constant projected catches of 2 770 tonnes, for final model structure using CASAL version 2.30 v4982.
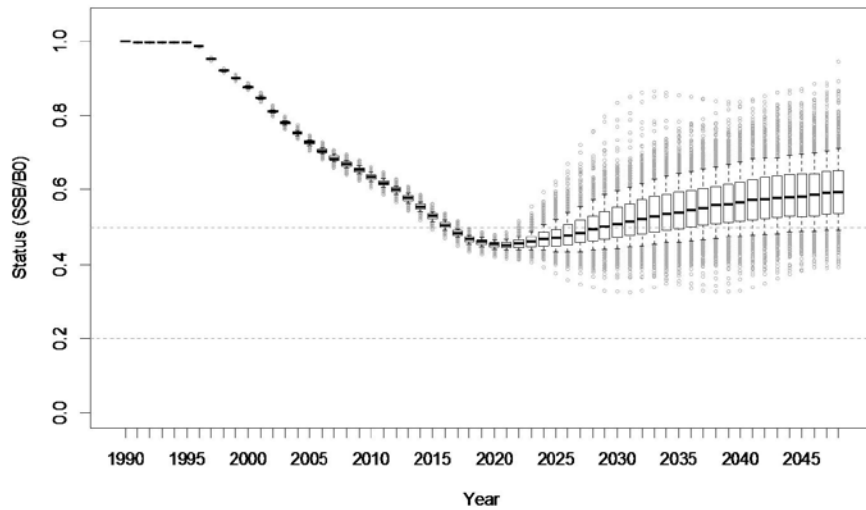
Figure 6: Projected status of spawning stock biomass (SSB) relative to B_0 with constant projected catches of 2 000 tonnes, for final model structure using CASAL version 2.30 v4982.
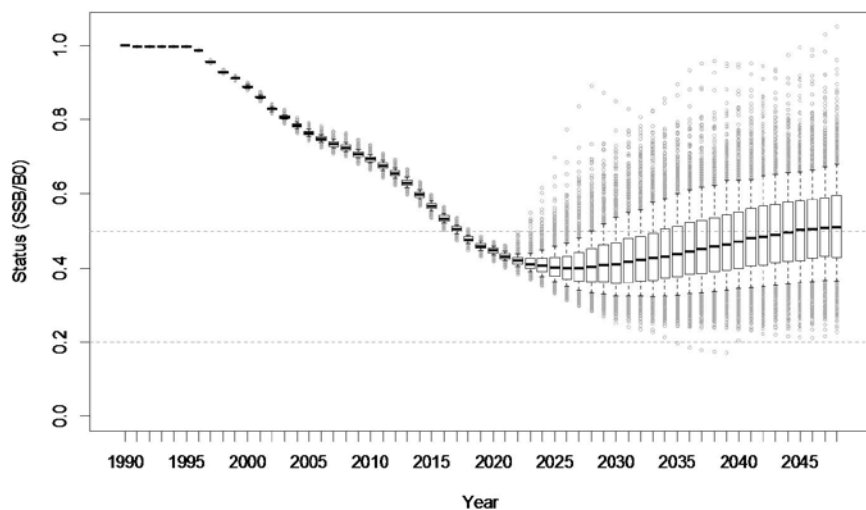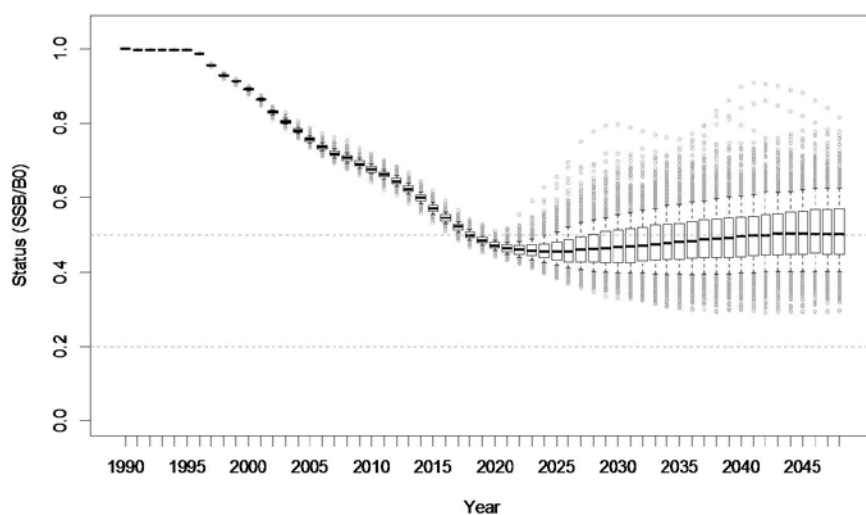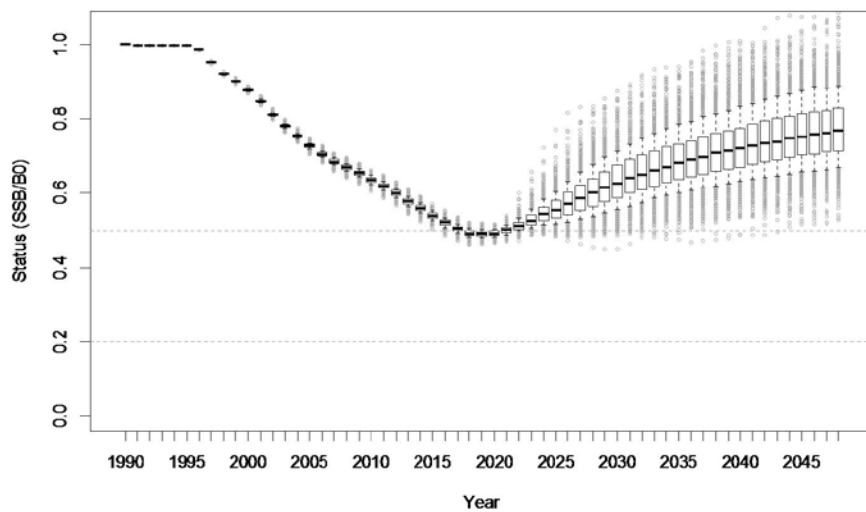

Figure 7: Projected status of spawning stock biomass (SSB) relative to B_0 with constant projected catches of 1 000 tonnes, for final model structure using CASAL version 2.30 v4982.
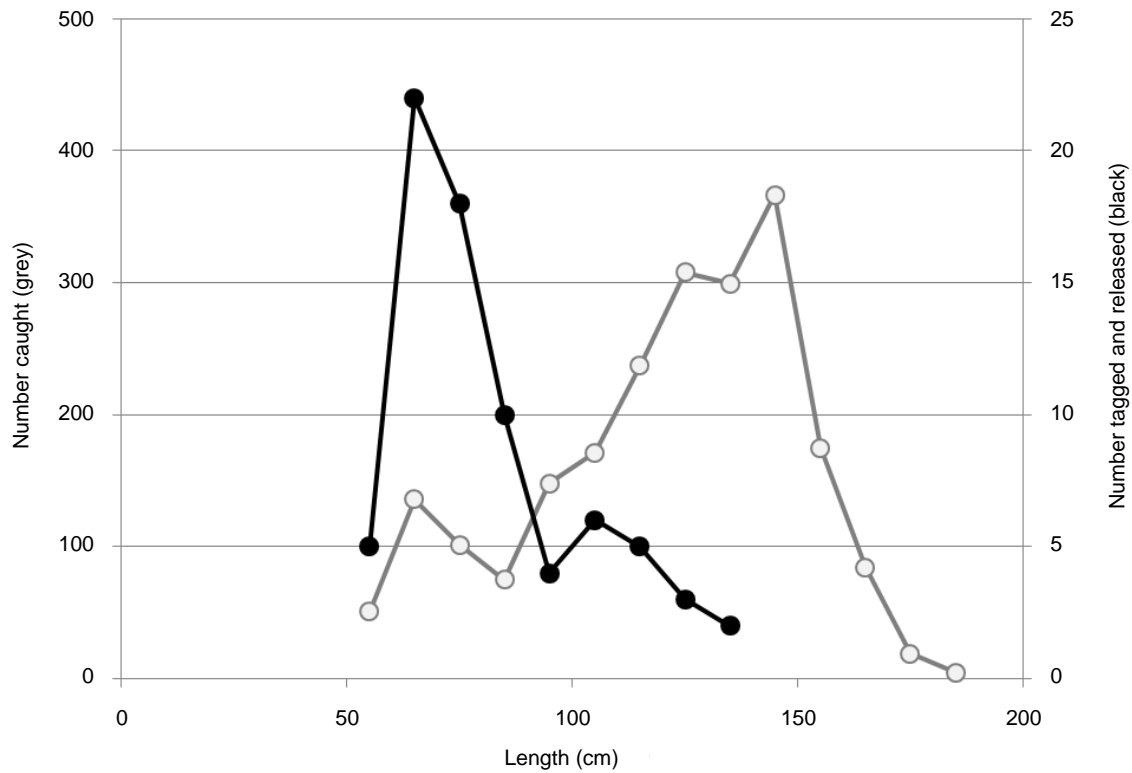
Figure 8: Length frequencies of *Dissostichus mawsoni* caught (grey line) and tagged and released (black line) by the *Simeiz* in Subarea 88.1 in 2012/13. The tag-overlap statistic is 43% (see Table 8).
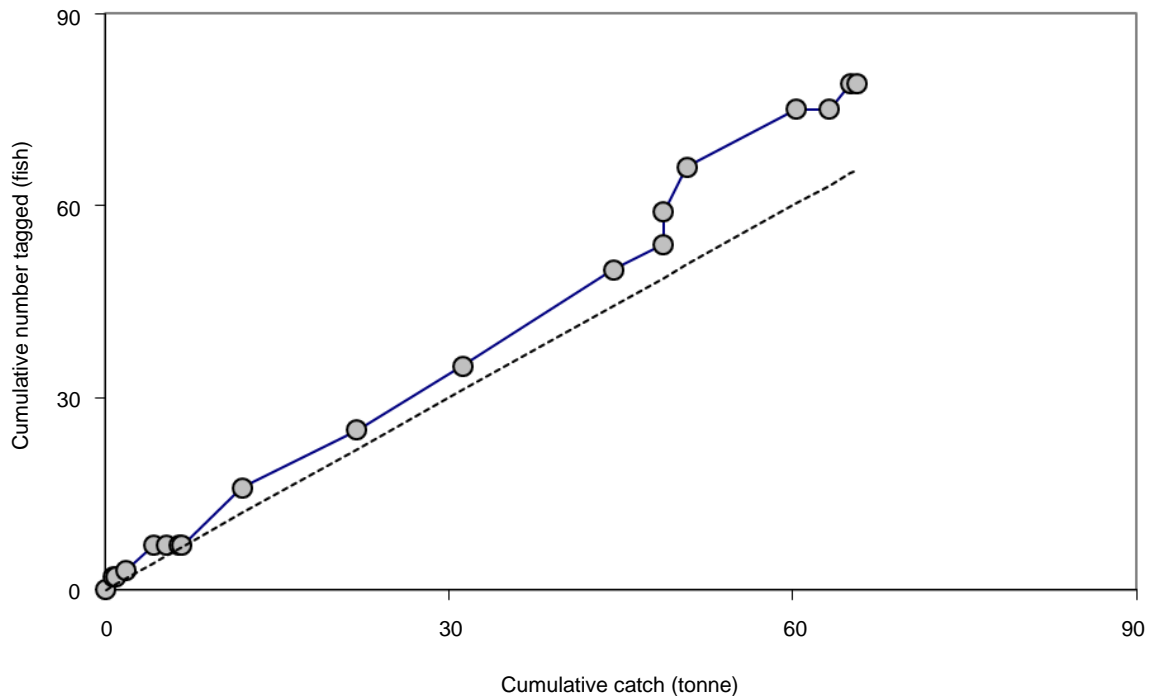
Figure 9: Cumulative catch of *Dissostichus mawsoni* versus cumulative number of fish tagged and released (grey line) by the *Simeiz* in Subarea 88.1 in 2012/13. The required minimum tagging rate was 1 fish per tonne of green weight caught (dashed line); the vessel exceeded the minimum rate throughout fishing and achieved an overall rate of 1.2 fish per tonne of green weight caught (see Table 7).
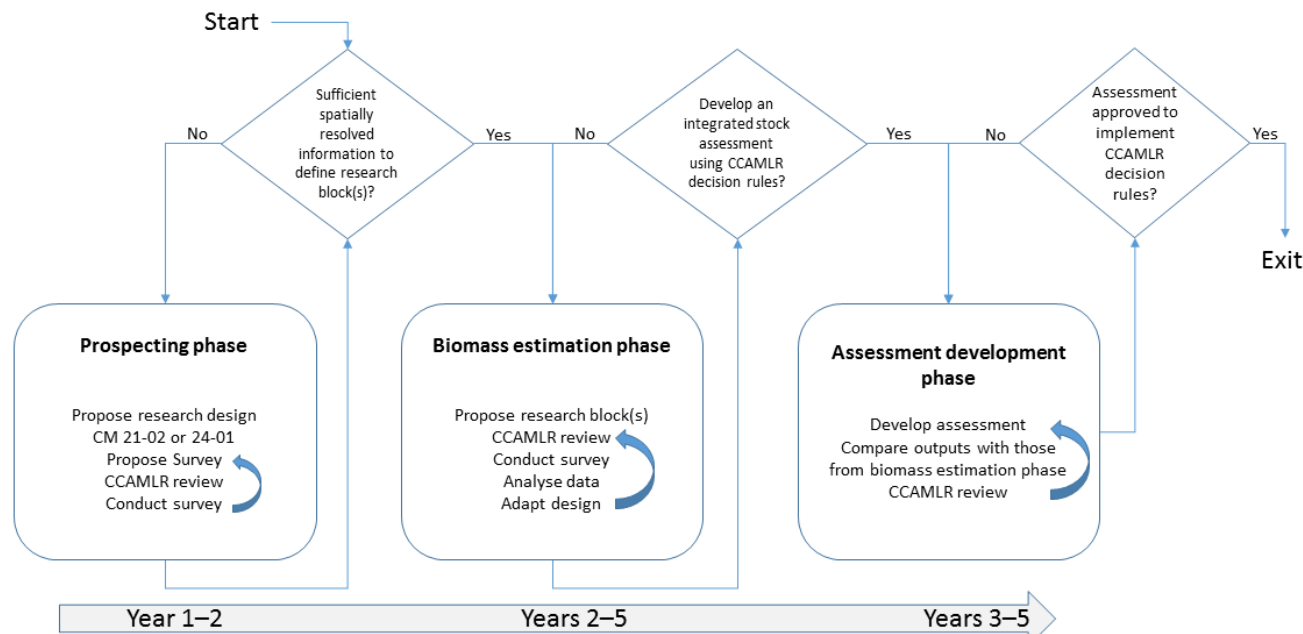
Prospecting phase
- See WG-SAM-11, paragraph 2.49, WG-SAM-13, paragraph 2.7.
- Research is effort limited, with a research catch limit based on an analogous high CPUE.
- Effort should be spatially distributed throughout the area (shorter line lengths and wider line spacing preferred) to characterise CPUE in the area.
- Tagging should be at a high rate
- Biological sampling should be at a high rate (length, weight, gonad weight, otoliths, diet).

Biomass estimation phase
- See WG-SAM-11, paragraph 2.49, WG-SAM-13, paragraph 2.7
- Each research block should be a defined area with fishable bathymetry 600–1 800 m, with locally high CPUE and likely annual access.
- Generate preliminary estimates of local biomass using CPUE x fishable area (WG-SAM-11, paragraph 2.49(ii)). Where tag recaptures are available also use the Chapman estimator.
- Research is catch limited. Catch based on the projection of at least six expected tag recaptures and not to exceed a precautionary exploitation rate at the scale of the stock or SSRU.
- Develop stock hypothesis and account for stock removals.
- Collect biological sampling to develop data for future stock assessment (length, weight, gonad weight, otoliths, diet).
- Conduct ancillary analyses to support stock assessment (e.g. length at age, IUU catch history, age at maturity, suitability of fish for tagging).

Assessment phase
- As a time series of biomass estimates is developed (e.g. from tagging data or depletion experiments), supporting data (e.g. length at age, IUU catch estimates) should be used in preliminary integrated stock assessments to estimate biomass and yield using CCAMLR decision rules.
- As these models are developed and reviewed, an increase in robustness of biomass and status estimates is expected between different estimation methods (e.g. CPUE x seabed area, Chapman estimator, CASAL stock status).

Figure 10: Research plan flowchart describing key aspects of the prospecting phase, biomass estimation phase and assessment phase, and the means of transiting between phases.
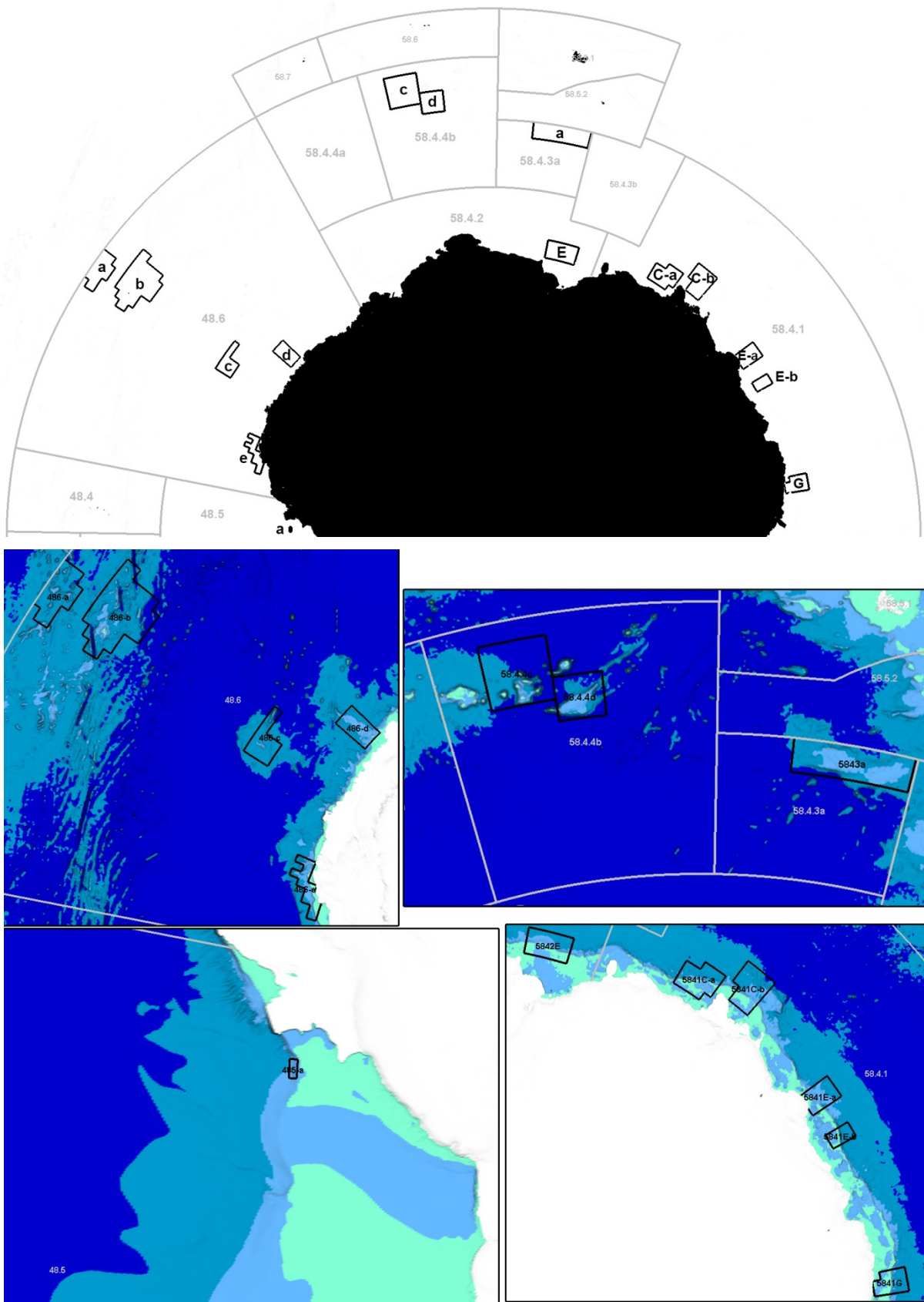
Figure 11: Location of research blocks (top) and close-ups, including the Gebco bathymetry.

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(Hobart, Australia, 7 to 18 October 2013)

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AGENDA

Working Group on Fish Stock Assessment
(Hobart, Australia, 7 to 18 October 2013)

1. Opening of the meeting

2. Organisation of the meeting and adoption of the agenda

   2.1 Organisation of the meeting
   2.2 Subgroup organisation and coordination

3. Review of available information

   3.1 Data requirements

4. Preparation for assessments and assessment timetable

   4.1 Report from the Working Group on Statistics, Assessments and Modelling (WG-SAM)
   4.2 Review of preliminary assessments
   4.3 Assessments and management advice
   4.4 Update Fishery Reports for established fisheries

5. New and exploratory fisheries

   5.1 Exploratory fisheries in 2012/13
   5.2 New and exploratory fisheries notified for 2013/14
   5.3 Update Fishery Reports for new and exploratory fisheries

6. Research to inform current or future assessments

   6.1 Review of proposals for research fishing in 2013/14
   6.2 Assessment and management advice for depleted and recovering stocks

7. Bottom fishing activities and vulnerable marine ecosystems (VMEs)

   7.1 Review of fishery and research-based VME notifications for 2012/13
   7.2 Report on Bottom Fisheries and Vulnerable Marine Ecosystems

8. Scheme of International Scientific Observation

9. Non-target catch in CCAMLR Fisheries

   9.1 Fish and invertebrate by-catch
   9.2 Marine mammal and seabird by-catch

10. Biology, ecology and interactions in fish-based ecosystems

11. Future work

    11.1 Organisation of intersessional activities in subgroups
    11.2 Intersessional meetings
    11.3 Notification of scientific research

12. Other business

13. Advice to Scientific Committee

14. Adoption of the report and close of the meeting.

LIST OF DOCUMENTS

Working Group on Fish Stock Assessment
(Hobart, Australia, 7 to 18 October 2013)

WG-FSA-13/01   An analysis of within-season recaptures of tagged toothfish
Secretariat

WG-FSA-13/02   Vacant

WG-FSA-13/03   Vacant

WG-FSA-13/04   A proposal for a research plan for the exploratory longline
fishery for *Dissostichus* spp. in 2013/14 in Division 58.4.3a
A. Rélot-Stirnemann (France)

WG-FSA-13/05   Preliminary stock assessment of Patagonian toothfish
(*Dissostichus eleginoides*) in the vicinity of Crozet Islands
(part of Subarea 58.6).
R. Sinegre and G. Duhamel (France)

WG-FSA-13/06   Assessment of incidental catches of seabirds in the French
EEZ included in Division 58.5.1 and Subarea 58.6
C. Marteau (France)

WG-FSA-13/07   Low genetic diversity and temporal stability in the
Antarctic toothfish (*Dissostichus mawsoni*) from near-
continental seas of the Antarctica
N.S. Mugue, A.F. Petrov, D.A. Zelenina, I.I. Gordeev and
A.A. Sergeev (Russia)

WG-FSA-13/08   Guidelines to whale photo-identification from fishing boats
derived from experience in Kerguelen (ASD 58.5.1) and
Crozet (ASD 58.6).
N. Gasco, P. Tixier and C. Guinet (France)

WG-FSA-13/09   Plan of research program of the Russian Federation in
Subarea 48.5 (Weddell Sea) in season 2013/14
A.F. Petrov, I.I. Gordeev and K.V. Shust (Russia)

WG-FSA-13/10   Research plan to investigate finfish distribution and
abundance in Subareas 48.1 and 48.2
Delegation of Chile

WG-FSA-13/11	Results of research program of the Russian Federation in Subarea 48.5 (Weddell Sea) in season 2012/13 A.F. Petrov, I.I. Gordeev and E.F. Uryupova (Russia)
WG-FSA-13/12	Proposal of the Russian Federation to open Subarea 88.3 for exploratory fishery of *Dissostichus* spp. Delegation of the Russian Federation
WG-FSA-13/13	Proposal of the Russian Federation to open SSRU 882A for exploratory fishery of *Dissostichus* spp. Delegation of the Russian Federation
WG-FSA-13/14	Review of *Dissostichus* spp. fishery in the adjacent seas of three Antarctic sectors in 2003–2010 A.F. Petrov (Russia)
WG-FSA-13/15	Research plan for the Spanish exploratory longline fishery for *Dissostichus* spp. in Divisions 58.4.1 and 58.4.2: Update of stage 2 (2013/14 season) and preliminary results of stage 1 (2012/13 season) according to WG-SAM advice R. Sarralde, L.J López Abellán and S. Barreiro (Spain)
WG-FSA-13/16	Size-age composition and growth of Antarctic toothfish *Dissostichus mawsoni* in the Weddell Sea E.N. Kyznetsova, A.F. Petrov and I.I. Gordeev (Russia)
WG-FSA-13/17	Report of the 2013 UK South Georgia Groundfish Survey (CCAMLR Subarea 48.3) M. Belchier, S. Gregory, K. Brigden, D. Johnston, N. Fallon and L. Featherstone (United Kingdom)
WG-FSA-13/18	On accidental catch of *Champsocephalus gunnari* while fishing of the Antarctic krill off the South Orkney Islands (Subarea 48.2) in 2013 L. Pshenichnov (Ukraine)
WG-FSA-13/19	Proposal to extend fishing season in the Patagonian toothfish longline fishery in CCAMLR Statistical Division 58.5.2 J. Barrington and B. Baker (Australia)
WG-FSA-13/20	Proposal to extend trial of daytime setting of longlines between 15 and 30 April in the Patagonian toothfish longline fishery in CCAMLR Statistical Division 58.5.2 J. Barrington and B. Baker (Australia)

| WG-FSA-13/21 | The 2013 annual random stratified trawl survey to estimate the abundance of *Dissostichus eleginoides* and *Champsocephalus gunnari* in the waters of Heard Island (Division 58.5.2). |
| | G.B. Nowara, T.D. Lamb and D.C. Welsford (Australia) |

WG-FSA-13/22   Skate tagging in the Heard Island and McDonald Island (Division 58.5.2) toothfish fishery up to 2013
G.B. Nowara, T.D. Lamb and D.C. Welsford (Australia)

WG-FSA-13/23   A preliminary assessment of mackerel icefish (*Champsocephalus gunnari*) in Division 58.5.2, based on results from the 2013 random stratified trawl survey
D.C. Welsford (Australia)

WG-FSA-13/24   Integrated stock assessment for the Heard Island and the McDonald Islands Patagonian toothfish (*Dissostichus eleginoides*) fishery (Division 58.5.2)
P. Ziegler, S. Candy and D. Welsford (Australia)

WG-FSA-13/25   Analytical data on determination of reproductive potential of Antarctic toothfish *D. mawsoni* in the Pacific (SSRUs 88.1, 88.2, 88.3), Indian Ocean (SSRUs 58.4.1 and 58.4.2) and Atlantic (SSRU 48.6) Antarctic areas
S.V. Piyanova and A.F. Petrov (Russia)

WG-FSA-13/26   Decadal trends in the South Georgia demersal fish assemblage
M. Belchier (United Kingdom)

WG-FSA-13/27   Preliminary assessment of Subarea 48.3 mackerel icefish, *Champsocephalus gunnari*, based on the January 2013 survey
C. Darby and T. Earl (United Kingdom)

WG-FSA-13/28   An overview of the elasmobranch fish of the Southern Ocean
J.R. Ellis, S.R. McCully, V.V. Laptikhovsky and R. Scott (United Kingdom)

WG-FSA-13/29   A brief characterisation of Patagonian toothfish tag survival and tag detection in CCAMLR Statistical Area 48.3
M. Soeffker and R. Scott (United Kingdom)

WG-FSA-13/30   Preliminary assessment of Patagonian toothfish in Subarea 48.3
R. Scott (United Kingdom)

WG-FSA-13/31	Preliminary assessment of Patagonian toothfish in Subarea 48.4 R. Scott and V. Laptikohvsky (United Kingdom)
WG-FSA-13/32	Review of the efficacy of the early season extension in the Patagonian toothfish fishery in Subarea 48.3 and proposal for further season extension M.A. Collins and K. Ross (United Kingdom)
WG-FSA-13/33	An overview of tagging skates (Rajiformes) and CCAMLR skate tagging data S.R. McCully, D. Goldsmith, G. Burt, R. Scott and J.R. Ellis (United Kingdom)
WG-FSA-13/34	Revised reports on abundance and biological information of toothfish in Division 58.4.4 a & b by *Shinsei Maru No. 3* in 2012/13 season K. Taki, T. Ichii, T. Iwami and M. Kiyota (Japan)
WG-FSA-13/35	Assessment models for Patagonian toothfish in Division 58.4.4, SRU C on Ob and Lena Banks for the years 1989/90 to 2012/13 K. Taki (Japan)
WG-FSA-13/36	Revised research plan for toothfish in Division 58.4.4 a & b by *Shinsei Maru No. 3* in 2013/14 Delegation of Japan
WG-FSA-13/37	Revised research plan for the 2013/14 exploratory longline fishery of *Dissostichus* spp. in Subarea 48.6 Delegation of Japan
WG-FSA-13/38	Revised research plan for the 2013/14 exploratory longline fishery of *Dissostichus* spp. in Division 58.4.1 Delegation of Japan
WG-FSA-13/39	Revised research plan for the 2013/14 exploratory longline fishery of *Dissostichus* spp. in Division 58.4.2 Delegation of Japan
WG-FSA-13/40	Revised research plan for the 2013/14 exploratory longline fishery of *Dissostichus* spp. in Division 58.4.3a Delegation of Japan
WG-FSA-13/41	The relative by-catches of taxa associated with vulnerable marine ecosystems by autolines and Spanish longlines T. Gerrodette and G.M. Watters (USA)

WG-FSA-13/42   Fatty acid and stable isotope analyses to identify diets of Antarctic toothfish caught in February–March 2013 in the southern Ross Sea (88.1.K) and the eastern Antarctic Sea (58.4.1.C)
I. Yeon, Y.J. Kwon, S.G. Choi, D.W. Lee and C.-K. Kang (Republic of Korea)

WG-FSA-13/43   Revised diet composition and feeding strategy of Antarctic toothfish, *Dissostichus mawsoni* in SSRU 58.4.1.C-a for the 2012/2013 Korean exploratory longline fishery
I. Yeon, Y.J. Kwon, S.G. Choi, K.J. Seok, D.W. Lee, J.M. Jeong, S.J. Ye, H.J. Kim and G.W. Baeck (Republic of Korea)

WG-FSA-13/44   Revised research plan for the exploratory longline fishery for *Dissostichus* spp. in SSRUs C and E in Division 58.4.1 in 2013/2014
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WG-FSA-13/45   Revised reproductive analysis of *Dissostichus mawsoni* in SSRU 58.4.1 C for the Korean exploratory longline fishery in 2012/2013
I.J. Yeon, J.S. Lee, Y.J. Kwon, M.A. Jeon, S.K, Choi, K.J. Seok, D.W. Lee, K.Y. Ku and H.J. Kim (Republic of Korea)

WG-FSA-13/46   Plan of research program of the Ukraine in Subarea 48.2 in 2014 (rev. 2 after WG-SAM recommendations)
Delegation of Ukraine

WG-FSA-13/47   Revised South African work plan for 2013/14 for the joint Japan/South Africa research on *Dissostichus* spp. in Subarea 48.6
R.W. Leslie and S. Somhlaba (South Africa)

WG-FSA-13/48   A characterisation of the toothfish fishery in Subareas 88.1 and 88.2 from 1997–98 to 2012–13
S. Hanchet, S. Mormede and A. Dunn (New Zealand)

WG-FSA-13/49   Descriptive analysis of the toothfish (*Dissostichus* spp.) tagging programme in Subareas 88.1 & 88.2 for the years 2000–01 to 2012–13
S. Parker, A. Dunn, S. Mormede and S. Hanchet (New Zealand)

WG-FSA-13/50   Pairwise tag performance: testing the sensitivity of the tag detection index and the mortality of tagged fish index
S. Mormede (New Zealand)

WG-FSA-13/51	Assessment models for Antarctic toothfish (*Dissostichus mawsoni*) in the Ross Sea for the years 1997–98 to 2010–13 S. Mormede, A. Dunn and S.M. Hanchet (New Zealand)
WG-FSA-13/52	Assessment models for Antarctic toothfish (*Dissostichus mawsoni*) in Subarea 88.2 SSRUs 88.2C–H for the years 2002–03 to 2012–13 S. Mormede, A. Dunn and S.M. Hanchet (New Zealand)
WG-FSA-13/53	A spatially explicit population dynamics operating model for Antarctic toothfish in the habitable depths of the Ross Sea region S. Mormede, A. Dunn, S. Parker and S. Hanchet (New Zealand)
WG-FSA-13/54	Further review of CCAMLR tagging programmes S. Parker and J. Fenaughty (New Zealand)
WG-FSA-13/55	Priority research surveys to address uncertainties in the assessment of toothfish in Subareas 88.1 and 88.2 S. Hanchet, B. Sharp and S. Parker (New Zealand)
WG-FSA-13/56	Steps carried out to check the data inputs to the stock assessment of the Ross Sea region of Antarctica S. Mormede (New Zealand) and S. Thanassekos (CCAMLR Secretariat)
WG-FSA-13/57 Rev. 1	Comparison of catches for toothfish in 58.4.1, 58.4.2, and 48.6 from vessels with anomalous CPUE A. Dunn, B.R. Sharp (New Zealand), C. Darby (United Kingdom) and O.R. Godø (Norway)
WG-FSA-13/58	Report of vulnerable marine ecosystems in South Georgia Islands (CCAMLR Subarea 48.3) through research dredge sampling E. Gaitán, L. Schejter, D. Giberto, M. Escolar and C. Bremec (Argentina)
WG-FSA-13/59	Study on reproductive biology of *Champsocephalus gunnari*, *Chaenocephalus aceratus* and *Pseudochaenichthys georgianus* from South Georgias and Shag Rocks, Dr Eduardo Holmberg survey – May 2013 M.I. Militelli, G.J. Macchi and K.A. Rodrigues (Argentina)
WG-FSA-13/60	Diet components and trophic interactions in five demersal fish in CCAMLR Subarea 48.3 N.R. Marí and G.H. Troccoli (Argentina)

WG-FSA-13/61   Cruise report EH-2013/02
                       G. Álvarez Colombo, J. Bastida, F. Castro, Á. Cubiella,
                       E. Gaitán, E. Marschoff, P. Martinez, L. Padovani,
                       D. Palmerola, R. Reta, R. Silva, S. Vivequin, O. Wöhler
                       and A. Zavatteri (Argentina)

WG-FSA-13/62   Report on Argentine CCAMLR Subarea 48.3 survey: fish
                       A. Zavatteri and A. Giussi (Argentina)

WG-FSA-13/63   Re-analysis of CPUE in both species of toothfish in 48.6
                       area
                       R. Wiff, J.C. Quiroz (Chile) and R. Scott (United
                       Kingdom)

WG-FSA-13/64   Population assessment of Antarctic toothfish in
                       Subarea 48.4 using tag-recapture method
                       V. Laptikhovsky (United Kingdom)

WG-FSA-13/65   Comparison of *Champsocephalus gunnari* catches in
                       Subarea 48.3 from1994–97 and 2013 cruises
                       E. Marschoff and P. Martínez (Argentina)

WG-FSA-13/66   Vacant

WG-FSA-13/67   Has climate change promoted genetic fragmentation in the
                       ice-dependent fish *Pleuragramma antarcticum*?
                       C. Agostini, T. Patarnello (Italy), J. Ashford, J. Torres
                       (USA) and L. Zane (Italy)

WG-FSA-13/68 Rev. 1   Summary of scientific observer data collected in the
                       CAMLR Convention Area during 2013
                       Secretariat

Other documents

WG-FSA-13/P01   Age validation of juvenile *Notothenia rossii* at Potter Cove,
                       South Shetland Islands, using mark-recapture data
                       E. Moreira, E. Barrera-Oro and M. La Mesa
                       (*Polar Biol.*, 2013, doi 10.1007/s00300-013-1392-7)

WG-FSA-13/P02   How precautionary is the policy governing the Ross Sea
                       Antarctic toothfish (*Dissostichus mawsoni*) fishery?
                       P.A. Abrams
                       (*Ant. Sci*, accepted)

WG-FSA-13/P03   Influence of data quality and quantity from a multiyear
                       tagging program on an integrated fish stock assessment
                       P. Ziegler
                       (*Can. J. Fish. Aquat. Sci.*, 70 (2013): 1031–1045)