ANNEX 5

REPORT OF THE WORKING GROUP ON FISH STOCK ASSESSMENT

(Hobart, Australia, 13 to 24 October 2008)

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[1] Appendices D to Q have been published only in electronic format. For these reports, please refer to www.ccamlr.org/pu/e/e_pubs/fr/drt.htm.

REPORT OF THE WORKING GROUP ON FISH STOCK ASSESSMENT

(Hobart, Australia, 13 to 24 October 2008)

OPENING OF THE MEETING

1.1 The meeting of WG-FSA was held in Hobart, Australia, from 13 to 24 October 2008. The Convener, Dr C. Jones (USA), opened the meeting and welcomed participants.

1.2 The Working Group welcomed Dr X. Zhao as the People's Republic of China's first participant in the work of WG-FSA.

1.3 The Working Group joined the Scientific Committee in urging Members to participate fully in its future work, and to send a greater number of experts to the meetings of working groups. The work of the Scientific Committee, including WG-FSA, is expanding and can only be achieved through greater contributions and active participation of Members (SC-CAMLR-XXVI, paragraph 14.10).

1.4 The Working Group recognised the difficulties which may arise from conducting highly technical discussions in only one working language, and emphasised the continuing need to engage all Members in its work. This matter was considered further under Future Work (paragraphs 13.1 to 13.24).

1.5 On completion of its work, the Working Group paused in memory of Dr Edith Fanta, Chair of the Scientific Committee, who passed away in May 2008. Dr Fanta was an exceptional Antarctic biologist, and a long-time participant and leader in the work of CCAMLR. She was a close friend of many in WG-FSA, and will be sorely missed by all.

ORGANISATION OF THE MEETING AND ADOPTION OF THE AGENDA

2.1 The agenda of the meeting was discussed and it was agreed to consider data requirements and research protocols using commercial fishing vessels under Item 5.1. The revised agenda was adopted (Appendix A).

2.2 The report was prepared by the participants and includes the List of Participants (Appendix B), the List of Documents considered at the meeting (Appendix C) and Fishery Reports (Appendices D to Q).

REVIEW OF AVAILABLE INFORMATION

Data requirements specified in 2007

Development of the CCAMLR database

3.1 The Data Manager, Dr D. Ramm, provided an update on recent developments in managing CCAMLR's data and associated work in support of WG-FSA and ad hoc

WG-IMAF. During the intersessional period, the Secretariat had further developed procedures, databases and data forms at the request of the Commission and the Scientific Committee and its working groups. Work relevant to WG-FSA was highlighted (WG-FSA-08/4) and included:

(i) a revision of the longline data form for fine-scale catch and effort data (C2) to allow the recording of the number of hooks that are lost attached to sections of longline during fishing, the use of vertical droplines and trotlines, and the use of cetacean exclusion devices[2] on trotlines (SC-CAMLR-XXVI, paragraph 13.12). Consequential changes were made to the CCAMLR database. The revised data form was posted on the CCAMLR website in November 2007, and was in use in 2007/08;

(ii) the development of an index of local density of licensed vessels on fishing grounds (CCAMLR-XXVI, paragraph 10.51(iii) and Annex 5, paragraph 6.21). The index (vessel presence) was developed based on the daily positions of fishing vessels reported in fine-scale data. The spatial and temporal scales of this index can be adjusted to suit the analyses (e.g. 5-day to monthly intervals, and fine-scale rectangles to SSRUs, subareas or divisions).

Data processing

3.2 The Secretariat had processed fishery and observer data from 2007/08 which had been submitted prior to the meeting, and these data were available for analyses at the meeting. In addition, the Secretariat had processed available fishery and observer data from the fishery in the South African EEZ in Subareas 58.6 and 58.7 and Area 51 (Prince Edward and Marion Islands), and fishery data from the French EEZs in Division 58.5.1 (Kerguelen Islands) and Subarea 58.6 (Crozet Island).

3.3 The Secretariat began validation of data from 2007/08 prior to the meeting, and this procedure will be completed in the forthcoming intersessional period.

3.4 Last year, WG-FSA questioned the frequent occurrence of *Dissostichus eleginoides* in catches reported by the then Uruguayan-flagged vessel *Paloma V* which fished in Divisions 58.4.1 and 58.4.3b in 2006/07. The *Paloma V* had reported the majority of its catch from those divisions as being *D. eleginoides* (80% of the catch in Division 58.4.1; 92% in Division 58.4.3b), while the landings reported in the CDS indicated that the catch consisted mostly of *D. mawsoni*. It was also noted that the data submitted by the scientific observer contained observations on both species.

3.5 In 2008 the Secretariat contacted the Uruguayan authorities to seek clarification and advice on the fine-scale data submitted by the *Paloma V* when the vessel fished in Divisions 58.4.1 and 58.4.3b in 2006/07, and to confirm the identity of toothfish species reported in the data. Uruguay confirmed that the catches of *D. eleginoides* reported in the fishery and observer data were correct, and that a discrepancy had occurred in the CDS data; this discrepancy was addressed. The Working Group requested that the Scientific Committee consider this issue further.

[2] The Working Group requested that the Scientific Committee determine a suitable terminology for this device.

Fishery Plans

3.6 The Secretariat has maintained the database which holds information on Fishery Plans and has added the data from 2007/08 to the time series.

Fisheries information

Catch, effort, length and age data reported to CCAMLR

3.7 Under the conservation measures in force in 2007/08, fishing took place in 12 fisheries targeting icefish (*Champsocephalus gunnari*), toothfish (*D. eleginoides* and/or *D. mawsoni*) and krill (*Euphausia superba*) (CCAMLR-XXVII/BG/15). Activities in exploratory fisheries were summarised in WG-FSA-08/4 in Table 2.

3.8 Three other fisheries targeting toothfish were conducted in the Convention Area in 2007/08:

- fishery for *D. eleginoides* in the French EEZ in Division 58.5.1
- fishery for *D. eleginoides* in the French EEZ in Subarea 58.6
- fishery for *D. eleginoides* in the South African EEZ in Subareas 58.6 and 58.7, and Area 51 outside the Convention Area.

3.9 Catches of target species by region and gear reported from fisheries conducted in the CAMLR Convention Area in 2007/08 are summarised in Table 1.

3.10 The Working Group noted the Secretariat's work in monitoring fisheries in 2007/08 (CCAMLR-XXVII/BG/15). This had resulted in the closure of four fishing areas and two fisheries. All the closures were triggered when the catches of *Dissostichus* spp. approached their respective catch limits, and no catch limit was exceeded.

3.11 Fishery and scientific observer information, including tables and figures, in WG-FSA's Fishery Reports was updated by the Secretariat, where possible, immediately prior to the 2008 meeting (WG-FSA-08/4, Table 3). Developments during the intersessional period included the implementation of the length–mass parameters used in the assessments (WG-FSA-08/4, Table 4), development of an R script to plot the catch-weighted length frequencies, and plotting of the catch-weighted length frequencies for *D. eleginoides* in Subarea 48.3 in two time series (1984/85 to 1996/97, and 1997/98 to present). Fishery Reports are discussed under Item 5.

Estimates of catch and effort from IUU fishing

3.12 WG-FSA reviewed estimates of IUU catches in the Convention Area prepared by the Secretariat based on information submitted by 8 October 2008 (Table 2 and WG-FSA-08/10 Rev. 2). As in previous years, the agreed deterministic method used by the Secretariat to estimate IUU fishing effort was based on information on the number of vessels sighted. Additional information on fishing trips and catch rates was derived from CCAMLR data on licensed vessels. The available catch history of *Dissostichus* spp. taken by IUU fishing in the

Convention Area derived from longlining and gillnetting activities was summarised in Table 3 and Figure 1. The Working Group endorsed these estimates for use in stock assessment and by ad hoc WG-IMAF (see Items 5, 7 and 8).

3.13 WG-FSA noted that it was likely that the majority of IUU vessels sighted were gillnet vessels and that there is currently no information on the likely catch rates of these vessels (see also paragraph 8.4). The Working Group therefore cautioned that the application of longline catch rates to the method used for estimating IUU removals may have resulted in a conservative estimate of IUU catches. Further, gillnets are less selective than longlines and may result in greater catches of by-catch and occurrences of incidental mortality. This matter was referred to ad hoc WG-IMAF and SCIC for further consideration.

3.14 WG-FSA agreed that the number of vessels sighted was fewer than in previous years and noted that this may be as a result of several factors, including those potentially related to economic factors, as well as the effect of CCAMLR measures to deter IUU fishing.

3.15 WG-FSA also considered the case of a vessel which had engaged in licensed fishing operations in the Convention Area in 2007/08, but which was subsequently reported to have engaged in transhipment operations with a number of IUU fishing vessels. WG-FSA considered that this may have an impact on assessments to be undertaken as existing datasets may have been compromised. However, WG-FSA agreed that it was not in a position to determine if the vessel had engaged in IUU fishing activity until the matter had been discussed by SCIC. The Working Group therefore decided to identify the datasets which might be affected and conduct parallel assessments, including and excluding data in respect of the vessel concerned.

3.16 Although there was no significant uncertainty attached to IUU fishing events reported in 2007/08, the Secretariat applied the JAG matrix to the estimate derived from the agreed methodology for the consideration of WG-FSA. All sightings in 2007/08 were of clearly identified IUU fishing vessels and all received a slightly reduced ranking based on the assumption that all were gillnetters. Three of the sightings received a further reduced weighting factor on the basis that they were not sighted fishing at the time. Another two sightings received a further reduced weighting factor on the basis that they were sighted by legal vessels rather than a surveillance platform. The application of the matrix reduced the overall estimate of IUU catches by 81 tonnes (approximately 7%) to 1 088 tonnes (WG-FSA-08/10 Rev. 2, Table 2). The evaluation of the threats arising from IUU fishing activities was discussed under Item 8.

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

3.17 Catches of *Dissostichus* spp. in CCAMLR waters which were reported to the Secretariat in STATLANT data and the catch and effort reporting system, and catches outside the Convention Area reported in the CDS in 2006/07 and 2007/08 are summarised in Table 4. The total CDS-reported catch of *Dissostichus* spp. for 2007/08 to October 2008 was 10 291 tonnes.

3.18 WG-FSA noted that most of the catch of *Dissostichus* spp. taken outside the Convention Area was from Areas 41 and 87. The Working Group also noted that the CDS records only processed weights and that the figures provided by the Secretariat were converted to estimated green weight using a standard set of conversion factors.

Scientific observer information

3.19 Scientific observers appointed under the CCAMLR Scheme of International Scientific Observation were deployed on all vessels targeting finfish in the Convention Area, and some vessels targeting krill in 2007/08. Scientific observers have participated in 60 cruises so far in 2007/08: 52 cruises on vessels targeting *Dissostichus* spp. or *C. gunnari* (40 cruises on longliners, 9 cruises on trawlers and 3 cruises on a pot vessel) and 8 cruises on vessels fishing for *E. superba* (see WG-FSA-08/5 Rev. 1 to 08/8 and SC-CAMLR-XXVII/BG/2). Scientific observations were discussed under Items 7 and 11.

Inputs for stock assessment

Catch-at-length/age from fisheries

3.20 The exploratory fishery for *D. mawsoni* has been operating for 11 years in Subarea 88.1 and for six years in Subarea 88.2. Summaries of the large amount of data collected on toothfish and the associated by-catch by all vessels participating in the fishery were presented (WG-FSA-08/22). All SSRUs in the two subareas except for 881D and 882C have now been fished. The catch in the 2007/08 season was the fourth-highest on record with a total of 2 666 tonnes out of a catch limit of 3 207 tonnes. The length-frequency data from the Ross Sea fishery have been very consistent over the past three to four seasons. There is no evidence of any truncation of the overall length-frequency distribution and no evidence for a reduction in fish length in any SSRU over time. Although moderate numbers of small fish are caught in some years, these year classes are not seen in large numbers in later years in the fishery. So at this stage there is no evidence for strong variation in year-class strength in the fishery.

3.21 The Working Group noted that a lower number of sets occurred in the 2007/08 season than had occurred in the previous five years. This was attributed to the severe constraint imposed by the occurrence of very heavy ice in the Ross Sea during this season.

3.22 Although it was noted that the length-frequency distributions were stable, it was not clear if the median was the best measure to be used to pick up changes in size distribution over time. It was agreed that further work investigating this issue was warranted.

3.23 The Working Group also discussed whether heavy ice coverage impacted the distribution of the fish or simply the distribution of fishing effort. It was agreed that this issue should be further investigated.

Research surveys

3.24 In April 2008 the UK conducted a bottom trawl survey of Subarea 48.3 on the FV *Sil*, with 70 bottom trawls undertaken giving good geographic coverage (WG-FSA-08/28). The biomass of *C. gunnari* was estimated by using 10 strata and the updated sea-floor areas and adjusting this for the low headline height of the UK trawl (see SC-CAMLR-XXII, Annex 5). Catch-weighted length frequencies indicated that the icefish population was dominated by 2+ and 3+ fish, with difference in the size between Shag Rocks and South Georgia and with few small fish in the NW South Georgia area. The *D. eleginoides* population was dominated by the same cohort that has been detected by surveys since 2003, with no evidence of new recruitment since. Biomass estimates and length frequencies are reported for other non-target species. Conducting the survey in April, as opposed to previous efforts being conducted in September and January, was successful. The icefish appeared to be dispersed which is amenable to a random trawl survey.

3.25 The Working Group noted the impact on biomass calculations of varying headline height. It was noted that, as bottom topography becomes rougher and towing line length is decreased, the spread of the trawl doors decreases which increases headline height. This changes the proportion of the fish populations that are susceptible to the gear. At present a constant adjustment factor (1.241) is used (SC-CAMLR-XXI, Annex 5).

3.26 The Working Group agreed that the adjustment factor presently used is subjective and for icefish, in particular, the proportion not available to the gear is likely to vary by year and even month. It was agreed that further investigation using acoustic methods should be undertaken.

3.27 The Working Group noted that coverage of areas around South Georgia was much better than during last year. It was recognised that sampling around the southwest and southeast is difficult, so data from other areas are used to extrapolate to these areas (Boxes 18, 19 and 23 not sampled). It was suggested that acoustic data from previous years (e.g. historical Soviet/Russian and UK survey data) may be of use to help interpret icefish biomass in these areas. It was noted that, although there have been limited historical catches in these areas, there have not been catches in the last couple of years.

3.28 New Zealand completed a survey using the NIWA research vessel *Tangaroa* in the Ross Sea in February and March 2008 as part of the IPY (WG-FSA-08/31). The main aim of the survey was to carry out a CAML in this region. The shelf and slope were stratified by depth and at least three random trawls completed in each stratum. Survey effort was severely constrained by the occurrence of heavy ice during the survey period. Catch rates by station are presented for the eight most abundant species, along with catch-weighted length frequencies and biomass estimates of those species.

3.29 The Working Group recognised that the Ross Sea is a very large area to be surveyed and that surveys with such small numbers of trawls in each stratum will yield biomass estimates with large uncertainties. However, the Working Group recognised that this survey was a very valuable contribution because it was the first such effort completed using large commercial-sized nets.

3.30 Australia completed a randomised stratified survey of *C. gunnari* in Division 58.5.2 in the vicinity of Heard Island in July 2008 to provide information for an assessment of short-

term annual yield in the 2009 season (WG-FSA-08/56). The Working Group noted that the survey was a significant contribution to a long-term series of surveys in this division. A preliminary assessment of yield for the area of Division 58.5.2 to the west of 79°20'E using standard CCAMLR methods is provided (WG-FSA-08/56). The strong year class detected in last year's survey is now fully recruited as the 2+ cohort and dominates the population.

3.31 The Working Group noted that specific locations of sampling stations were not included in the paper; however, they are available to the Working Group from the CCAMLR database as needed to complete stock assessments. The Working Group recalled that a pro forma outlining the data to be included when presenting the results of a trawl survey had been presented to the Working Group (WG-FSA-SAM-06/15), but that there had not been agreement on this (WG-FSA-06/6). The Working Group agreed that, as a minimum, a description of how the survey data are collected and summaries of the data relevant to assessments be provided. In this way, a record can be maintained explaining how data present in the CCAMLR database are obtained.

3.32 In May 2008 Australia completed a randomised longline survey, consisting of 15 standardised sets over two strata covering areas of commercial fishing activity, using the Australian-flagged longliner FV *Janas* on BANZARE Bank within Division 58.4.3b (WG-FSA-08/57). Catch rates were very low, ranging between 0 and 135 kg/thousand hooks. This is consistent with toothfish being at low densities across the majority of the surveyed area. Catches of toothfish consisted of both species. Data on size distributions and size-at-maturity indicate that the *D. mawsoni* population is almost entirely large mature fish with a bias towards males.

3.33 The Working Group noted that the two species of toothfish were found in separate locations and noted that water masses may be an important variable determining their distribution. The Working Group noted that the measurement of water temperature at the depth at which the different species are caught would greatly assist in understanding the factors influencing their relative distribution

3.34 Japan conducted a research survey for toothfish in SSRUs A, B, C, and D in Division 58.4.4 (Ob and Lena Banks) from July to September 2008 on board the *Shinsei Maru No. 3*. Trotlines were used during fishing operations. Because the survey was not completed until 27 September 2008, Japan could not provide a formal report of the survey results in time for the Working Group meeting. However, it did provide a preliminary short report and verbal information to the Working Group.

3.35 Information provided by Japan indicated that the main objective of the research was to collect various biological data on toothfish in Division 58.4.4 needed for assessing the status of these stocks. No information related to recent stock size exists in this division because of the prohibition of direct fishing since 2002. The vessel had one CCAMLR international and one domestic observer on board.

3.36 To ensure coverage of all SSRUs and to get more information on higher-density areas for toothfish, the survey was conducted in two phases. In phase 1, each SSRU B, C and D was partitioned into four survey areas and five hauls were set in each survey area. In SSRU A five sets were conducted. During phase 2, the research was conducted in the same way as phase 1 except no attempt was made to space the sets 5 n miles apart as was the case in phase 1. Tagging of fish was conducted at the rate of 3 fish per tonne. DNA and otolith

samples were collected from toothfish from each SSRU. During phase 1 operations, 65 hauls were set and in phase 2, 53 hauls were set. A total of 76.9 tonnes of toothfish was taken during both phases.

3.37 The Working Group appreciated the provision of information by Japan despite the short preparation time available.

3.38 The Working Group noted that the research effort had been conducted using trotlines designed by Japan. It also noted that their design was most likely different than trotlines used by Russia and others and very different from longlines used in other toothfish fisheries. It agreed that it would be difficult to interpret CPUE data taken from the Japanese trotlines compared to other longline methodologies used to fish for toothfish. Further work was suggested, such as examining data from other subareas/divisions where the trotlines might have been used simultaneous with other longline gear. In addition, CPUE of line set might be investigated to compare the various methods. Until a better understanding of CPUE from trotlines is acquired, it will be very difficult to interpret status of these stocks using these data.

3.39 The Working Group requested Japan to provide all details of the trotlines in its research report so that differences between its method and other methods could be better understood. The Working Group also noted that the by-catch rate of macrourids was about 5% of the catch of toothfish.

3.40 Dr D. Agnew (UK) indicated that the relatively abundant small fish encountered in the Japanese survey may suggest relatively good recruitment in the area.

3.41 Dr T. Ichii (Japan) noted that although the fishing efficiency using trotline gear is different from that of other gear, the CPUE in phase 1 calculated during the Japanese survey was twice as high (60 kg/thousand hooks in 2008 versus 33 kg/thousand hooks in 2001) as that observed when the catch limit was established in 2001.

3.42 Dr Ichii indicated that a single survey was not sufficient to provide data to determine status of fish stocks in Division 58.4.4 and that a minimum of three years would be needed to detect trends in stock status.

3.43 Some members questioned whether more data should be collected at this time given the uncertainty of how to interpret present CPUE data. In addition, there was concern that subsequent annual surveys may impede the ability of the stocks in the closed area to recover. It was suggested that before further data collection was to be made, an experimental design be presented showing how data collection and data analyses would be used to assess the stocks and how the stocks would recover so that a commercial fishery might be executed. This would entail being able to determine standardised CPUE data which can be compared to toothfish data in other subareas/divisions in the Convention Area and also to the historic CPUE in that subarea.

3.44 In the interim, it was suggested that periodic surveys over a long time period might provide relative abundance, cohort strength and tagging data. This would alleviate risk associated with annual takes at the level of exploratory fisheries.

CPUE analyses

3.45 The Working Group recalled that at last year's meetings the Scientific Committee and Commission had agreed that, where appropriate, biennial assessments should be completed. Therefore, the Working Group recognised that this year no assessments would be performed for some toothfish fisheries (Subareas 48.3, 88.1 and 88.2 and Division 58.5.2). However, it was agreed that Fishery Reports should be updated as appropriate as these represent valuable tools in the assessment work. These would include results of CPUE analyses which were available.

Tagging studies

3.46 WG-FSA-08/46 reported on the continuation of the tag-recapture experiment in Subarea 48.4 in 2007/08, and summarised numbers of toothfish and skate tag-recaptures, movement and mixing of tagged fish, catch and by-catch rates in 2007/08. The Working Group noted that this paper included a proposal to continue the tag-recapture experiment, and this was discussed further under Item 5.3.

3.47 The Working Group noted that both species of toothfish were encountered in Subarea 48.4, however, previous hypotheses suggested that *D. mawsoni* would be encountered much further south. The Working Group noted that the oceanography in this area may cause conditions similar to those typical of higher latitudes.

3.48 WG-FSA-08/15 described the Secretariat's progress toward administering toothfish tagging programs for all new and exploratory fisheries from the 2007/08 season. The Working Group noted that there were still difficulties in matching recaptured fish with release records, however, observers submitting photographs of tag-recaptures to the Secretariat had assisted with this issue.

3.49 The Working Group considered that requiring photographs, entering of recapture details in logbooks and returning the tags to the Secretariat involved some redundancy but allowed for improved validation. For example, the Working Group recognised that digital images could be manipulated, therefore photographic evidence may not alone be evidence of a tag-return. The Working Group agreed that the Secretariat should ensure that Members return physical tags, as well as check for correct transcription of returned tags, including all alphanumeric characters. The Working Group was optimistic that the centralisation of the tagging program in new and exploratory fisheries would go some way to addressing these issues into the future.

3.50 In response to the request from the Scientific Committee (SC-CAMLR-XXVI, paragraph 12.9) to present an analysis of the tag-recapture rates on individual vessels, Dr K. Reid (CCAMLR Science Officer) provided a description of the problems encountered in analysing the data held in the CCAMLR database. This included an example of the discrepancies between the numbers of tags reported recaptured in the C2 and observer data for individual vessels, as well as the presence of a large number of duplicate tag numbers (reported from multiple fisheries, in multiple years, and by multiple Flag States) in the

database. Dr Reid indicated that the incomplete reporting of tag numbers also meant that a large number (>30%) of tag-recoveries could not be attributed to a specific release event with 100% accuracy.

3.51 The Working Group agreed that there are two types of error to be considered – accidents and non-compliance – and it would be useful to separate detection and remediation methodologies for each type of error. Mr J. Fenaughty (New Zealand) observed that errors between the C2 and observer data are possible because observers work shifts whereas vessels operate 24 hours per day, hence tags detected when the observer is not present may result in a discrepancy.

3.52 The Working Group recalled that data-checking performed by analysts working on the Ross Sea assessment was able to achieve satisfactory matches for all but 10–20 tags, so discrepancy rates of up to 30% were of concern since any tag-recaptures that were unable to be included in tag-based assessments had the potential to create an upward bias on biomass estimates. The Working Group noted that the procedure for inferring a satisfactory match between a tag-recapture and release record should be documented, and be algorithmic to minimise any subjectivity. Further, alterations made by the Secretariat to data after it is submitted should be flagged in the database with the reason why a correction was made (paragraph 11.7).

3.53 The Working Group noted that there is a clear incentive for a vessel to report releases rather than recoveries because they must obtain particular rates of release to comply with conservation measures. However, there is currently no such formal assessment of recapture rates, and it may be possible to manipulate recapture rates by reporting recaptures with incomplete data so as to make matching to a release record difficult or impossible. This may allow a non-compliant vessel to appear broadly consistent with other vessels, without these tag-recaptures being able to be incorporated into stock assessments.

3.54 The Working Group endorsed Fishery Reports summarising all tag-returns, as well as the rates at which they could be matched to a release record. The Working Group also noted the discussions by WG-SAM on relating data quality and tag-recapture rates in the Ross Sea, and requested the Scientific Committee to consider how to achieve full compliance with requirements of the tagging program.

3.55 The Working Group agreed that the Secretariat will undertake to identify the tagging details for all tags recovered, including:

(i) direct comparison of reported recapture details with data available in the tagging database;

(ii) use of digital photographs and actual tags to verify tag identities;

(iii) correspondence with Members to clarify remaining uncertainty.

3.56 The Working Group agreed that in order to facilitate the work of the Secretariat in undertaking steps (i) to (iii), Members who have historically conducted tagging programs in, or adjacent to, the Convention Area are requested to submit inventories of tags released and recaptured.

3.57 The Working Group agreed that the Secretariat should be responsible only for determining exact matches between recaptures and releases. Any inferred matches conducted

by Members in the process of further data-checking for assessments should not be used to alter the data held by the Secretariat, however, the procedure should be clearly described such that the checked dataset can be readily recreated by the Secretariat during assessment validation.

3.58 The Working Group recommended that to avoid bias, all unmatched tag-recaptures should be summarised in the Fishery Reports, and incorporated into assessments, and suggested that a way of incorporating them may be to pro-rate the numbers of scanned fish by the ratio of matched recaptures to total recaptures. The Working Group requested WG-SAM consider further ways of incorporating unmatched tag-recaptures into the assessment.

3.59 The Working Group congratulated the Secretariat for its work on the new and exploratory tagging program, and encouraged all Members to consider using the tagging equipment provided by the Secretariat. Dr A. Constable (Australia) noted that, as the CCAMLR tags were produced by the same manufacturer (Hallprint) and of the same type to those used for the last 11 years in the Division 58.5.2 toothfish fishery, Australia would exhaust its current stores of tags before commencing deployment of the new CCAMLR tags.

3.60 The Working Group noted that the Secretariat had purchased tags suitable for tagging skates, with a contrasting colouration and the prefix 's', and recommended that Members purchase these tags to participate in skate tagging during the Year-of-the-Skate.

3.61 WG-FSA-08/16 described tagging by the vessel *Banzare* in Divisions 58.4.1. Due to a lack of fish suitable for tagging in Division 58.4.1, the vessel did not achieve the required tagging rate of three fish per tonne. The vessel then proceeded to fish in Divisions 58.4.3a and 58.4.3b and tag above the required rate.

3.62 The Working Group noted that this issue was more appropriately considered by SCIC. However, the Working Group noted that increased tagging outside Division 58.4.1 did not meet the objectives of the tagging program, and were concerned that such a situation may indicate that sufficient tags were not released throughout the fishing operation, as has been recommended. Furthermore, many vessels still managed to tag fish at the required rate in the Ross Sea, despite poor sea-ice conditions in 2007/08.

3.63 The Working Group also noted that the Secretariat currently monitors the tagging rate based on 5-day reports, so vessels have information they can use to ensure they meet the tagging rates required by conservation measures.

Biological parameters

3.64 WG-FSA-08/17 examined ageing protocols and growth characteristics of *D. mawsoni* based on ages derived from radio-isotope analysis and estimates from otolith growth zone counts. The study broadly confirms the current hypotheses regarding the rates of growth and maximum ages of *D. mawsoni*. Additional discussion of these findings is taken up in paragraph 9.7.

3.65 The Working Group noted differences in the parameters estimated for the von Bertalanffy growth curve, and the fact that the L_∞ estimated was much lower than the maximum size reported for *D. mawsoni*. However, the Working Group noted that caution

was required when interpreting L_∞ as the maximum achievable size for the species, since this could be the result of the relative scarcity of large old individuals in age-at-length datasets analysed to date.

3.66 The Working Group considered the hypothesis presented in WG-FSA-08/17 that the lower L_∞ in this study, compared with an earlier study of Horn (2002), provided evidence of truncation in length and age due to fishing. However, the Working Group noted that estimates of k and L_∞ are almost always highly correlated, and hence under-ageing of large fish is likely to be contributing to this effect.

3.67 The Working Group further noted that size-at-age was more variable in this study compared to that of Horn (2002). The Working Group also noted that one l50 cm fish in the dataset aged to be 7 years old was considered to have an unfeasibly rapid growth rate. The Working Group concluded these issues could be due to several factors, including inter-laboratory differences in otolith preparation methodology and interpretation of increments.

3.68 Dr D. Welsford (Australia) stressed that while experienced otolith readers may be internally consistent in their age determinations, this does not necessarily indicate that estimated ages are correct. He emphasised that for an ageing method to be considered valid, a combination of evidence is required, including:

(i) the age at which the first ring is visible
(ii) evidence that rings consistently track a time scale
(iii) rings that are clear enough to be read consistently.

3.69 The Working Group agreed that the radiometric ages presented in WG-FSA-08/17 in part addressed point (ii), albeit with broad confidence intervals. The Working Group noted other studies presented in recent years using otoliths from toothfish with strontium and tetracycline tags provided confidence in current ageing protocols.

3.70 The Working Group agreed that construction of a reference collection, and comparisons between laboratories routinely ageing *D. mawsoni*, was required to address point (iii), and encouraged the authors of WG-FSA-08/17 to pursue this with Mr Horn in New Zealand.

3.71 The Working Group also agreed that studies on small fish were needed, since datasets with clear cohort progression should enable the validation of the position and appearance of the first clear annual increment in otoliths, noting that previous work had shown that the increments laid down in the first five or so years were the hardest to discriminate in toothfish, and that this difficulty affects the accurate allocation of both young and old fish to year classes.

3.72 An analysis of *D. mawsoni* GSI indices in the Ross Sea region was provided in WG-FSA-08/48. Analysis by GLM showed differences due to latitude, fish length and month. Histological analyses also indicated that GSI may be a better proxy for maturity than observer staging data, and the authors were able to determine with good reliability whether a fish had spawned in the previous season, based on the presence of post-spawning structures. However, they are currently unable to distinguish histologically between immature and resting females that have not spawned in the previous season.

3.73 The Working Group expressed concern that macroscopic gonad staging was apparently not effective for determining maturity. The Working Group requested that the histological data detailed in WG-FSA-08/48 be used to develop refined macroscopic characters for staging *D. mawsoni* in the Ross Sea.

3.74 There is still uncertainty as to the proportion of the population existing in different areas. Dr K.-H. Kock (Germany) noted that a median size-at-maturity of 135 cm corresponded to a fish age of 18+ and is larger and older than currently used in the assessment.

3.75 The Working Group noted that, for the purposes of stock assessment, knowing that a fish spawned in the previous year is good evidence of maturity, and so the histology work provided in WG-FSA-08/48 represented a significant improvement in estimating size at maturity for *D. mawsoni* in the Ross Sea. Predicting which fish will spawn next year is less reliable since eggs can be developed, then reabsorbed, depending on exposure to environmental conditions. Data arising from the present study could usefully be applied in the Ross Sea assessment for next year since it represented a good sample size for this species and should improve previous estimates. The Working Group noted that it would be useful to look at the sensitivity of assessments to changes in parameters for length at maturity, and New Zealand had proposed further research to establish the growth of oocytes to further refine understanding of reproduction in the Ross Sea (paragraphs 5.108 to 5.115).

3.76 Dr Constable suggested that it was important to consider the rationale for additional studies as proposed by New Zealand. He suggested they might be useful for developing an advance warning system for recruitment, based on spawning output. However, with respect to current assessment methods, this is less important since recruitment is estimated from the age structure of the catch. He also indicated that it is the maturity ogive that would be most useful in determining the spawning biomass and what the escapement of fish is likely to be from the fishery to the spawning stock.

3.77 WG-FSA-08/12 summarised the maturity level of gonads and feeding behaviour (as inferred from stomach contents) of toothfish from a single observer cruise on board a Spanish longliner in the Ross Sea from November 2007 to March 2008. The Working Group noted that the study confirmed that toothfish are a generalist predator, and further noted the presence of a single toothfish with both male and female gonad lobes. Gonad-staging data and length-frequency distributions were also presented in the paper. The Working Group suggested these data might be usefully combined by the authors to provide information on size at maturity.

3.78 WG-FSA-08/28 summarised diet patterns in *C. gunnari* in Subarea 48.3 and hypothesised that the predominance of amphipods in the diet of younger age classes may buffer the younger fish in the stock against interannual variability in krill abundance. The Working Group noted that older age classes have been shown to have a more demersal habit, eating predominantly fish and mysids.

3.79 The Working Group noted that it may be possible to use dietary information to tune the natural mortality parameter in icefish assessments, and encouraged the development of models that may assist in understanding the impacts of top-down and bottom-up ecosystem effects, as well as fishery impacts on icefish.

3.80 WG-FSA-08/23 was originally listed under this agenda item, however, the Working Group referred it to be addressed under Agenda Item 6.

Depredation

3.81 WG-FSA-08/44 detailed a study of catch and by-catch rates of trotlines with the Chilean cetacean excluders[3], compared with Spanish longlines, in Subarea 48.3. The Working Group noted that this was the first study from within the CAMLR Convention Area with an experimental design to investigate the effectiveness of the 'cachalotera' system[3] for minimising cetacean predation and the effects on catch rates of by-catch and toothfish.

3.82 Differences between gear types provided difficulties for comparing catch rates, however, the Working Group noted that, in the presence of cetaceans, there was some evidence for the effectiveness of cachaloteras on trotlines compared to the Spanish system. Grenadier by-catch, and to some extent skate by-catch, was generally lower on trotlines compared with the Spanish system, however, skates and toothfish were often in poor condition making them unsuitable for tagging and unlikely to survive if released. Dr Welsford noted that anecdotal evidence had been presented at ad hoc TASO that suggested the cachaloteras may rub tags off toothfish as the line is retrieved.

3.83 Dr V. Bizikov (Russia) noted that it had been reported previously to WG-FSA that trotlines can catch less by-catch than the autoline system. The Working Group emphasised that paired experimental fishing trials would be necessary to understand the effects of the configuration of trotlines on catch rates, and that ad hoc TASO had noted that the range of trotline configurations used in the Convention Area was still not well understood.

PREPARATION FOR ASSESSMENTS AND ASSESSMENT TIMETABLE

WG-SAM report

4.1 The sections of the WG-SAM report relevant to the WG-FSA-08 agenda were detailed to the Working Group by the Convener of WG-SAM-08. The concept of version control raised at the WG-SAM meeting was suggested as an issue to be taken up in discussion by the Working Group (Annex 7, paragraphs 7.1 to 7.4).

Review of preliminary stock assessment papers

4.2 WG-FSA-08/28 detailed the preliminary assessment of *C. gunnari* in Subarea 48.3. Seabed areas were obtained from the recently updated South Georgia bathymetry dataset, based primarily on swath bathymetry. With respect to the issue of how the new seabed areas compare to the old estimates, the Working Group noted that although the seabed area has increased, the depth ranges included in the strata were reduced so that the general effect of the change is likely to be neutral. It was noted that some hauls were taken after dark and that the

[3] The Working Group requested that the Scientific Committee determine a suitable terminology for these devices.

inclusion of these data in the analysis might bias the survey biomass results downwards. However, the increased accuracy of having these extra hauls might increase the lower 95% confidence interval which might actually increase the biomass estimate used to calculate a catch limit. The Working Group noted that the effect of including these hauls would not significantly impact the assessment results and that it would be preferable to keep these data in the analysis.

4.3 Given the low sampling frequency in the areas traditionally not fished, the Working Group noted that extrapolating survey results into these regions might inflate the population estimate from the survey. It was noted that the areas with a greater number of samples were not used to infer the density in the low sampling regions. The potential correlation between number of hauls and biomass was raised and the Working Group noted that, while there is a relationship between the lower confidence intervals and the number of hauls, any correlations between the number of hauls and mean biomass seen in the limited sample size are likely to be spurious.

4.4 The Working Group noted slight differences between the length–weight relationship tabled in the previous fishery report and the ones used in the analyses. It was also noted that the coefficients used in the analysis were estimated from the survey data and that differences were very slight and unlikely to have any significant impact.

4.5 The Working Group recalled that there are relationships between krill density and icefish spatial location, and that this could help provide an indication of density in the areas not covered in the survey (WAMI, 2001; see SC-CAMLR-XX, Annex 5, Appendix D). The Working Group noted the existence of information on krill density and that it does tie to a degree with observed icefish locations in the northern areas. The Working Group noted that there was evidence of krill in the regions not covered in the survey.

4.6 The Working Group noted that there was an observable pattern in the distribution of age classes around the survey area and considered whether older fish gathered in regions of higher myctophid density. It noted that there was evidence that this is the case.

4.7 The use of a pelagic trawl gear was suggested to try and detect the presence or otherwise of icefish in the southern South Georgia shelf area. The Working Group agreed that this would be useful. However, a change in gear type used for surveys would not be desirable given the length of the time series with the present gear type. It was also suggested that perhaps a purely icefish-targeted survey might be desirable to improve the estimate of icefish abundance, as opposed to the current multi-species type survey design.

4.8 The Working Group considered whether there were any data from the current survey on the spawning condition of icefish. It was noted that shallow areas are often used for spawning and that the survey may miss spawning animals in these cases.

4.9 WG-FSA-08/56 detailed the preliminary assessment of *C. gunnari* in Division 58.5.2. Given the observed large decline in the numbers of the current dominant cohort over recent years, the Working Group considered whether this could be used to estimate natural mortality. It was noted that there are likely changes in natural mortality over time, and that the resultant estimates are very uncertain but that, in principle, this can be done. Given the lesser dependence on krill of icefish in Division 58.5.2, the Working Group considered whether there was more stability in the icefish natural mortality. It was noted that there are a number

of drivers of potential changes in icefish natural mortality (predation and food availability), and there are current trends in predator populations in the region making it difficult to infer stability in natural mortality.

4.10 Given the likely impact of the condition of icefish in Subarea 48.3 on natural mortality, the Working Group considered whether there were data available on the condition of icefish in Division 58.5.2. It noted that observed density-dependent growth changes in Subarea 48.3 made that possibility quite probable but that such detailed data for Division 58.5.2 was not currently available.

4.11 A brief detailing of the pertinent issues and requests from WG-SAM with respect to the assessment model detailed in WG-SAM-08/8 was given to the Working Group. WG-FSA encouraged the authors to undertake the suggested work and to submit the work to WG-SAM in the future.

4.12 WG-FSA-08/43 detailed a revised assessment of toothfish stocks in Divisions 58.4.1 and 58.4.2. Given the apparent uncertainty in CPUE estimates for Divisions 58.4.1 and 58.4.2, the Working Group considered how consistent the CPUE used in the comparative CPUE abundance estimates was with respect to that seen in the Ross Sea. The differences sometimes seen when using vessels that fished in both the Ross Sea and continental areas, and those that fished only in Divisions 58.4.1 and 58.4.2, made it clear that the result of the comparative method in this case should not be treated as anything more than an approximate estimate of abundance. The high error in the standardised CPUE was not included in the biomass estimate confidence intervals, only the Ross Sea biomass uncertainty, and a method of inclusion was suggested which may prove useful in further analyses.

4.13 The Working Group noted that the disparate information in the CPUE analyses (lower biomass levels) and the tag data (higher biomass) levels was similar to that seen in the BANZARE Bank work undertaken the previous year. Depletion estimates directly contradicted the estimates of biomass coming from a simple analysis of the tag-returns. The Working Group agreed that the analyses indicated that the data in these divisions were of poor quality. It was noted that the information may still be useful for the purposes of providing management advice. The Working Group suggested that using the maximum biomass estimates may be more informative, as even under these assumptions the general conclusions of WG-FSA-08/43, with respect to biomass levels and the apparent lack of tag-returns, did not change. The Working Group noted that the currently closed SSRUs may be opened for future fishing on the condition that (i) the issues surrounding the lack of tag-returns could be answered and resolved, and (ii) there was a satisfactory expectation of the Scientific Committee that if (i) was achieved, then a revised tagging program would provide information usable in any future assessments of these stocks. The Working Group thanked the authors of WG-FSA-08/43 for pursuing this work.

4.14 The Working Group noted that the two-stock 'east and west' hypothesis could also be simply a differential immature/mature distribution of animals of one stock, as is seen in the Ross Sea. It was agreed that even though the (very low) number of tag-returns might support a two-stock hypothesis, the sample size is currently so low that both hypotheses are equally plausible.

4.15 A proposal for an extension to the mark–recapture experiment in Subarea 48.4 (WG-FSA-08/46) was presented, with respect to assessment-related issues, to the Working

Group. The Working Group considered the risk of removing 75 tonnes catch for one year in order to obtain a more precise estimate of the stock abundance. The Working Group considered whether the tagging rate in this area could simply be adjusted upwards. The Working Group recognised that the required tagging rate in this area was already high (five fish per tonne of green weight caught).

4.16 WG-FSA-08/32 detailed indicative estimates of biomass and yield for *Macrourus whitsoni* on the continental slope of the Ross Sea. The Working Group agreed that this kind of approach, where feasible, was a step forward in terms of assessing the sensibility of the current by-catch conservation measures for this species in this region. As to the sampling coverage (in terms of the depth spread of the species), the Working Group noted that these fish are bottom feeding and that a photographic survey might be useful in further understanding the spatial distribution of *M. whitsoni*.

4.17 The Working Group suggested that, given the low level of evidence for a direct proportionality, the catch limit for macrourids could be de-coupled from the catch limit of the target species. It noted that previous work had looked to assess the impact of such catch levels on the non-target species and that this was a sensible approach. The catch limit can be reassessed as new information becomes available and/or if this limit is repeatedly reached. The Working Group thanked the authors of WG-FSA-08/32 for pursuing this work.

4.18 WG-FSA considered a methodology for assessing data quality (WG-SAM-08/13) which was presented at WG-SAM-08. The paper outlined methods that could be used by SCIC with respect to the identification of vessels which did not comply with the CCAMLR data reporting requirements. The Working Group recommended that the authors of WG-SAM-08/13 continue to develop a series of data quality metrics in conjunction with the Secretariat during the intersessional period, and report progress to WG-SAM. The Working Group noted a standardised approach, whereby the Secretariat reported to the Working Group on the results of an agreed set of data tests, would be worthwhile.

Assessments to be carried out and assessment timetable

4.19 The Working Group considered the preliminary assessments for the fisheries for *C. gunnari* in Subarea 48.3 (WG-FSA-08/28) and Division 58.5.2 (WG-FSA-08/56). It was agreed that these assessments would be reviewed during the meeting, and the information used to develop the management advice for these fisheries.

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

ASSESSMENT AND MANAGEMENT ADVICE

New and exploratory fisheries in 2007/08 and notifications for 2008/09

5.1 In 2007 the Commission agreed to seven exploratory longline fisheries for *Dissostichus* spp. in the 2007/08 season (Conservation Measures 41-04, 41-05, 41-06, 41-07,

41-09, 41-10 and 41-11), and no new fisheries had been notified for 2007/08. Activities in the exploratory fisheries are outlined below and summarised in Tables 5 and 6.

5.2 Notifications for new and exploratory fisheries in 2008/09 are summarised in Table 7. Twelve Members submitted paid notifications for exploratory longline fisheries for *Dissostichus* spp. in Subareas 48.6, 88.1 and 88.2 and Divisions 58.4.1, 58.4.2, 58.4.3a and 58.4.3b, for an exploratory trawl fishery for *E. superba* in Subarea 48.6, and for new pot fisheries for crab in Subareas 48.2 and 48.4.

5.3 In addition, one Member notified its intention to fish for crabs in Subarea 48.3 in 2008/09 in accordance with Conservation Measure 52-01 (see paragraph 5.173).

5.4 The Working Group agreed that it would not attempt to determine whether the notifications for exploratory fisheries satisfied the requirements of the notification procedure (Conservation Measure 21-02); this, it believed, should be done by SCIC.

5.5 Unstandardised CPUE data for *Dissostichus* spp. caught in exploratory longline fisheries between 1996/97 and 2007/08 are summarised in Table 8.

5.6 Under Conservation Measure 41-01, each longline vessel fishing in exploratory fisheries for *Dissostichus* spp. in 2007/08 was required to tag and release *Dissostichus* spp. at the rate of one toothfish per tonne of green-weight catch throughout the season in Subareas 48.6, 88.1 and 88.2 and three fish per tonne in Divisions 58.4.1, 58.4.2, 58.4.3a and 58.4.3b (Table 9). In 2007/08, 5 228 *Dissostichus* spp. were reported to have been tagged and released in the exploratory longline fisheries (Table 10), and 261 tags were recovered (Table 11).

Notification for new fisheries for crabs in Subareas 48.2 and 48.4

5.7 One Member (Russia) and one vessel notified their intention to conduct new pot fisheries for crabs in Subareas 48.2 and 48.4 in the 2008/09 season.

5.8 The Working Group recalled that the crab fishery had been carried out in Subarea 48.3 in 1992, 1995, 1996 and 2002, targeting mainly *Paralomis spinosissima* and *P. formosa*. Annual catches have been around 250 to 300 tonnes, with one vessel participating each year. The fishery was conducted using strings of standard crab pots with 60 to 169 pots in each string (mean number 120 pots per string). Pot soak time ranged from 14 to 74 hours, averaging 30 hours. By-catch of finfish never exceeded 9% (mean by-catch was 1.4%). The main by-catch species was *Dissostichus* spp.

5.9 The Working Group noted that no crab fishery has ever been attempted in Subareas 48.2 and 48.4. Noting the issues to be considered in addition to the requirements for the crab fishery discussed below, the Working Group considered that the existing Conservation Measures 52-01 and 52-02 for the crab fishery in Subarea 48.3 could be used as a template to develop an experimental harvest regime for crabs in Subareas 48.2 and 48.4 should they proceed. All aspects of Conservation Measures 52-01 and 52-02 should be applied to conservation measures developed for Subareas 48.2 and 48.4 with the exception of modifications suggested below:

(i) two scientific observers should be present, including at least one international scientific observer;

(ii) the season 2008/09 should be defined as the period from 1 December 2008 to 30 November 2009, or until the catch limit is reached, whichever is sooner.

5.10 The Working Group had no information on which to calculate the sustainable yield for crab fisheries in Subareas 48.2 and 48.4. In the absence of scientific data, the Working Group carried out some comparative calculations based on available information about potential habitat and crab densities, noting that catches for new and exploratory fisheries are only to be as great as that needed to acquire information that would lead to assessments of stock status.

5.11 The following paragraphs outline the special considerations for the proposed crab fishery in each subarea.

Subarea 48.2

5.12 The Working Group noted that there is no information on which to determine a catch limit for crabs in Subarea 48.2 as there is no information on the types of species or abundances that might form the basis of a sustainable fishery. The Working Group considered that an approach consistent with assigning catch limits in exploratory toothfish fisheries would be appropriate, i.e. the catch should be at a nominally low level to provide for doing research on stock distribution and abundance and for helping determine strategies that will lead to an assessment of stock status and sustainable harvest strategies. It agreed that, should the crab fishery proceed in this subarea in the 2008/09 season, the experimental regime adopted for Subarea 48.3 would be appropriate with a catch limit in the order of 250 tonnes.

5.13 Consistent with the experimental harvest regime for crabs in Subarea 48.3, the regime for this subarea would mean that, at the start of fishing operation in Subarea 48.2, every vessel shall expend 200 000 pot hours of effort within a total area defined by 12 blocks of 0.5° latitude by 1.0° longitude (Figure 2). The vessel shall not expend more than 30 000 pot hours in any single block of 0.5° latitude by 1.0° longitude. For each string, pot hours shall be calculated by taking the total number of pots on the string and multiplying that number by the soak time (in hours) for that string. Soak time shall be defined for each string as the time between start of setting and start of hauling.

5.14 The vessel shall not fish outside the area delineated by the 0.5° latitude by 1.0° longitude blocks or continue to fish once the experimental regime had been completed prior to the results of the survey being analysed by WG-FSA.

5.15 The Working Group noted that by-catch of finfish may be problematic in this fishery because of the closure of Subarea 48.2 to the capture of finfish during commercial operations until such time as a survey of finfish had been undertaken and the results analysed by WG-FSA. However, this was not considered to be a problem if the fishery only undertook the experimental regime with no further fishing until the methods for managing by-catch could be assessed by WG-FSA.

5.16 All by-catch of finfish during the experimental fishing regime shall be recorded for length, identified to species and then released to the sea with the least possible handling.

Before the release, all specimens of *Dissostichus* spp. shall be measured and tagged. Full biological data should be taken from dead finfish by-catch and they should be returned to the sea.

Subarea 48.4

5.17 The Working Group recommended that every vessel participating in the crab fishery in Subarea 48.4 in the 2008/09 season should conduct fishing operations in accordance with an experimental harvest regime. This regime would mean that at the start of fishing in Subarea 48.4, every vessel should expend approximately 30 000 pot hours of effort distributed amongst the seven island groups (Figure 3) with no more than 4 500 pot hours in any single island group. For each string, pot hours should be calculated by taking the total number of pots on the string and multiplying that number by the soak time (in hours) for that string. Soak time should be defined for each string as the time between start of setting and start of hauling.

5.18 The vessel shall not fish outside the area of the seven island groups mentioned above (Figure 3) prior to the results of the fishery being analysed by WG-FSA.

5.19 The area of seabed shallower than 500 m in Subarea 48.4 is 2 107 km^2, compared to 42 400 km^2 in Subarea 48.3. On a strictly pro-rata basis this would suggest a catch limit of 79.5 tonnes in Subarea 48.4. However, information from the longline fishery in Subarea 48.4 (WG-FSA-08/46) suggested that in the north of the subarea (north of 57°30'S) the crab catches are likely to be present at lower densities in the south than the north, and that therefore the potential habitat in the north of the subarea should be halved. Additionally, available data on crab by-catch in the longline fishery show that CPUE for crabs in the north is roughly one-third of the CPUE from longline fisheries around South Georgia. Given these considerations, and the fact that there is no information on crabs in Subarea 48.4 south of 57°30'S, the Working Group agreed that should the crab fishery proceed in this subarea, the experimental regime would be appropriate with a precautionary catch limit of 10 tonnes (Table 12).

5.20 All by-catch of finfish during the experimental fishing regime shall be recorded for length, identified to species and then released to the sea with the least possible handling. Before the release, all specimens of *Dissostichus* spp. shall be measured and tagged. Full biological data should be taken from dead finfish by-catch and they should be returned to the sea.

Progress towards assessments of exploratory fisheries

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

Divisions 58.4.1 and 58.4.2

5.21 WG-FSA-08/63 examined expected tag-recapture rates in new and exploratory *Dissostichus* spp. fisheries in the southern Indian Ocean sector. In particular, the paper considered the potential for tagging programs in new and exploratory fisheries to yield

sufficient data to be of use in determining catch limits in the early stages of fishery development. Scenarios were developed using a range of tag-release rates, tag-detection rates, natural mortality, fish movement out of the fishery, and IUU removals in order to estimate the expected numbers of tag-returns. Even under 'worst-case' assumptions (e.g. lower detection rates, higher tag mortality, high levels of emigration and high IUU) tag-recaptures were still expected to be considerably higher than currently observed in Divisions 58.4.1 and 58.4.2. The paper concluded that if current tag-recapture rates continue, then tag-based assessments of stock status in Divisions 58.4.1 and 58.4.2 are likely to remain uncertain in the short to medium term, and fishing should remain focused in areas where tag-releases have been concentrated until these uncertainties can be addressed.

5.22 Progress on assessing the exploratory fishery in Divisions 58.4.1 and 58.4.2 was presented in WG-SAM-08/4 and a summary was provided in Annex 7, paragraphs 3.1 to 3.5. WG-SAM recommended that WG-FSA use the methods described in this paper to provide management advice for the *Dissostichus* spp. fishery in this division, once a number of modifications had been made (Annex 7, paragraph 4.3). WG-SAM also recommended that tagging be continued at the current rate in these divisions.

5.23 An updated assessment of the exploratory fisheries in Divisions 58.4.1 and 58.4.2, including the minor modifications requested by WG-SAM, was provided in WG-FSA-08/43 (paragraphs 4.12 and 4.13). The authors compared estimates of abundance for these areas using four methods: comparative CPUE trends, local depletions, a constant recruitment model and mark–recapture data. Recapture rates were so low that a reliable stock assessment based on these data was not possible, and instead they presented estimates of the number of expected tag-returns given the estimated biomass. Estimates of biomass by SSRU were moderately consistent between CPUE comparisons and local depletion methods. However, the predicted estimates of tag-recaptures were much higher than those observed. The paper provided tentative estimates of precautionary yield from Divisions 58.4.1 and 58.4.2, noting that these are substantially lower than the existing catch limits.

5.24 The Working Group noted that the full uncertainty in the longline CPUE in the two areas had not been incorporated into the assessment (paragraphs 4.12 to 4.14). For the purposes of providing advice on potential catch limits for the open SSRUs in Divisions 58.4.1 and 58.4.2, a further analysis was carried out which incorporated the uncertainty in CPUE into the biomass estimates for the SSRUs obtained using the comparative CPUE method detailed in WG-FSA-08/43. SSRU-specific yield calculations were calculated assuming an exploitation rate of 0.05 (which appears to be a sustainable exploitation rate for the assessed *Dissostichus* spp.) multiplied by the biomass estimate. Estimates of yield were also made for SSRUs 5841C, 5842A and 5842E based on depletion-derived biomass estimates. These are the only SSRUs for which depletion estimates were available over several years, from which the most recent best-fit depletion was selected. Yields were calculated separately for the median, 25 percentile and 75 percentile biomass values for each SSRU. The results of the analysis are presented in Table 13.

5.25 The Working Group also noted that the estimates of yield were based on 2006/07 season data and did not include legal and IUU catches from the 2007/08 season.

5.26 Dr L. Pshenichnov (Ukraine) noted that the estimation of fished areas of Divisions 58.4.1 and 58.4.2 has not been corrected for the closed SSRUs of Divisions 58.4.1 and 58.4.2. He noted that the assumption that CPUE is proportional to toothfish density is not

correct for a longline fishery, and that this leads to an increase in the uncertainty of the analysis. He further noted that the biomass of toothfish was estimated by means of an unknown constant (the catchability) (WG-FSA-08/43). Catchability of longline as a whole, and longlining of toothfish in particular, is unknown and should not be used for biomass estimation. He also considered that catches of immature (1–4 years old) fish in Division 58.4.2 (WG-FSA-08/23) using bottom trawls are similar to those found in other subareas which suggests that recruitment and biomass of fish in this division is also similar to those subareas. This is inconsistent with the summary of WG-FSA-08/43.

5.27 Dr Constable noted that Dr Pshenichnov was correct in stating that the estimates of biomass related only to the open SSRUs. He also noted that juveniles were caught in a fishery rather than a random trawl survey and therefore the distribution of juvenile fish is not known. Dr Agnew noted that CPUE does reflect local density to some extent, as shown by depletion work. He disagreed that CPUE is not proportional to abundance, particularly at catches which are way lower than saturation levels. The Working Group noted that a key issue was in understanding the catchability of new fishing techniques, not of known gear types.

5.28 The Working Group also reflected on the expected IUU removals for that area, calculated at an order of magnitude higher than expected yields. It commented these calculations might require careful review, in particular the CPUE assumptions.

5.29 The Working Group considered that although the estimates of yield from the analysis were uncertain, the results suggested that the size of the *Dissostichus* spp. population in these two divisions was likely to be small and that the current catch limits were unlikely to be sustainable. The Working Group therefore recommended that the catch limits be reduced in each of the open SSRUs in Divisions 58.4.1 and 58.4.2 to the estimates of yield based on the median biomass estimates provided in Table 13. The Working Group also recalled the work of WG-SAM which considered that catches of 10 tonnes were unable to provide useful information to enable the assessment of a stock except in circumstances of well-designed research programs testing clear hypotheses (Annex 7, paragraph 4.6). Therefore, the Working Group further recommended that SSRUs with a yield of less than 20 tonnes be closed to fishing.

Dissostichus spp. Division 58.4.1

5.30 Four Members (Republic of Korea, Namibia, Spain and Uruguay) and six vessels fished in the exploratory fishery in Division 58.4.1 in 2007/08. The precautionary catch limit for toothfish was 600 tonnes, of which no more than 200 tonnes could be taken in SSRUs C, E and G. The five other SSRUs (A, B, D, F and H) were closed to fishing, and research fishing was permitted with a limit of 10 tonnes of *Dissostichus* spp. and one vessel per SSRU. Fishing was prohibited in depths less than 550 m in order to protect benthic communities. Information on this fishery is summarised in Appendix D.

5.31 The total catch of *Dissostichus* spp. (mostly *D. mawsoni*) reported so far in 2007/08 was 413 tonnes. SSRU G was closed on 30 January 2008 when the catch approached the *Dissostichus* spp. limit of 200 tonnes in that SSRU (final reported catch in that SSRU was 197 tonnes). Research fishing was conducted by Spain in SSRUs D (reported catch:

10 tonnes), F (reported catch: 3 tonnes) and H (reported catch: 10 tonnes). Although the closure date of the fishery is currently under review, the fishery is expected to close on 30 November 2008. Information on IUU activities indicated that 94 tonnes of toothfish were taken in 2007/08.

5.32 A total of 1 134 toothfish were tagged and released in the 2007/08 season, and six tagged toothfish were recaptured during that season (Tables 9 and 11).

5.33 Six Members (Japan, Republic of Korea, New Zealand, South Africa, Spain and Uruguay) and a total of 13 vessels notified their intention to fish for toothfish in Division 58.4.1 in 2008/09 (Table 7a).

5.34 The Working Group considered the preliminary assessment of *Dissostichus* spp. discussed in paragraphs 5.21 to 5.29. It recommended that the catch limits be reduced in each of the open SSRUs in Division 58.4.1 to the estimates of yield based on the median biomass estimates provided in Table 13. The Working Group further recommended that SSRUs with a yield of less than 20 tonnes be closed to fishing (paragraph 5.29).

Dissostichus spp. Division 58.4.2

5.35 Two Members (Republic of Korea and Namibia) and three vessels fished in the exploratory fishery in Division 58.4.2 in 2007/08 and the reported catch was 124 tonnes. The fishery remains open until 30 November 2008. The precautionary catch limit for toothfish was 780 tonnes, of which no more than 260 tonnes could be taken in SSRUs A, C and E. Two other SSRUs (B and D) were closed to fishing. Fishing was prohibited in depths less than 550 m in order to protect benthic communities. Information on this fishery is summarised in Appendix E.

5.36 The fishery targeted *D. mawsoni* and operated in SSRUs A, C and E in 2007/08. There was no evidence of IUU fishing in 2007/08.

5.37 A total of 673 toothfish were tagged and released in 2007/08 and there have been no recaptures of tagged toothfish (Tables 10 and 11).

5.38 Six Members (Australia, Japan, Republic of Korea, New Zealand, Spain and Uruguay) and a total of nine vessels notified their intention to fish for toothfish in Division 58.4.2 in 2008/09.

5.39 The Working Group considered the preliminary assessment of *Dissostichus* spp. discussed in paragraphs 5.21 to 5.24. It recommended that the catch limits be reduced in each of the open SSRUs in Division 58.4.2 to the estimates of yield based on the median biomass estimates provided in Table 13. The Working Group further recommended that SSRUs with a yield of less than 20 tonnes be closed to fishing (paragraph 5.29).

Dissostichus spp. Division 58.4.3a

5.40 One Member (Uruguay) and one vessel fished in the exploratory fishery in Division 58.4.3a in 2007/08. The precautionary catch limit for toothfish was 250 tonnes and the reported catch was 9 tonnes. The fishery was closed on 31 August 2008. Information on this fishery is summarised in Appendix F.

5.41 There was no evidence of IUU fishing in 2007/08.

5.42 A total of 41 toothfish was tagged and released in 2007/08 and two tagged toothfish were recaptured during that season.

5.43 One Member (Japan) and one vessel notified their intention to fish for toothfish in Division 58.4.3a in 2008/09.

5.44 Progress on assessing the exploratory fishery in Division 58.4.3a was presented in WG-SAM-08/5 and a summary was provided in Annex 7, paragraphs 3.6 to 3.8. WG-SAM recommended that WG-FSA use the methods described in this paper to provide management advice for the *Dissostichus* spp. fishery in this division (Annex 7, paragraph 4.4).

5.45 The Working Group considered that there was less uncertainty about using the tagging information in Division 58.4.3a compared with Divisions 58.4.1 and 58.4.2. The reason for this was that, given the number of releases and catch levels (both legal and IUU), if the observed number of tags was an underestimate (e.g. there should have been 10 recaptures rather than the five observed) then there would be a very large chance that the population in the division over the period of the tag experiment would have to have been effectively removed by fishing. The Working Group agreed that this is not the case and this provided some confidence in using the tagging data to estimate population size in this division.

5.46 The preliminary stock assessment detailed in WG-SAM-08/5 employed a biomass dynamic surplus production model to assess the status of the stock, using the release (199) and recapture data (5) for 2005 and 2006 respectively, as well as legal and illegal catches for this division. Resultant stock size estimates were then used to estimate long-term yields (using the CCAMLR decision rules) under four different assumptions about the additional uncertainty in future stock dynamics, beyond that already accounted for in the stock assessment. This gave a range of potential long-term yields: 113, 105, 103 and 86 tonnes, which encompassed a wide-range of future stock dynamic uncertainty assumptions (two recapture probability models (binomial and normal) and three different values for future process error).

5.47 The catch limit for Division 58.4.3a for the 2007/08 fishing year was 250 tonnes. The Working Group agreed that the assessment suggested that this level of catch was not sustainable and that the catch limit for this division be reduced to a level in the range of 86 to 113 tonnes.

Dissostichus spp. Division 58.4.3b

5.48 Three Members (Japan, Namibia and Uruguay) and three vessels fished in the exploratory fishery in Division 58.4.3b in 2007/08, and Australia (one vessel) conducted a

scientific research survey. In November 2007, the division was divided into two SSRUs: A north of 60°S; and B south of 60°S. The precautionary catch limit for *Dissostichus* spp. in the fishery was 150 tonnes in SSRU A and SSRU B was closed to fishing. In addition, fishing was not permitted from 16 March 2008 until the end of the notified research survey or 1 June 2008, whichever was sooner. An additional catch limit of 50 tonnes was provided for the research survey in SSRUs A and B. Information on this fishery is summarised in Appendix G.

5.49 The fishery operated in SSRU A and reported a total catch of 139 tonnes of *Dissostichus* spp. (93% of the precautionary catch limit for the fishery); the fishery was closed on 20 February 2008, prior to the start of the notified research survey. The research survey was conducted in May 2008 and a total of 2 tonnes of *Dissostichus* spp. was reported from SSRUs A and B (see also WG-FSA-08/57).

5.50 Information on IUU activities indicated that 246 tonnes of toothfish were taken in 2007/08.

5.51 A total of 417 toothfish was tagged and released in 2007/08, and one tagged toothfish was recaptured during that season.

5.52 Three Members (Japan, Spain and Uruguay) and three vessels notified their intention to fish for toothfish in Division 58.4.3b in 2008/09.

5.53 In 2007, an analysis of longline CPUE was carried out in Division 58.4.3b using a Leslie depletion analysis (SC-CAMLR-XXVI, Annex 5, paragraph 5.7). A random longline survey was carried out in this division by Australia in May 2008 (paragraph 3.32). WG-FSA-08/57 concluded that catch rates of *Dissostichus* spp. were very low, consistent with toothfish being depleted to low densities across the surveyed area. It also noted that only very large *Dissostichus* spp. were present in the area and the only tag-recapture reported for this division in 2007/08 occurred during the survey.

5.54 Dr Ichii questioned whether the sample size of 15 random stations was sufficient to elucidate the stock status of the area. For example, there are strata of both higher and lower density in the area and he expressed concern that the sample size was not large enough to cover both types of strata. For example, one of the important preferred fishing grounds used by a Japanese vessel (58°S 76–78°E) was not covered. He also noted that the CV from the survey was very large. He further considered that it was important to compare commercial CPUE data from the 2007/08 fishing season with that of previous years, and questioned why the commercial CPUE data had not been analysed this year.

5.55 In response, the authors of WG-FSA-08/57 noted that the survey was conducted following a randomised design, and at a scale that was agreed by the Scientific Committee, which was considered appropriate given the concern about the status of the stock (SC-CAMLR-XXVI, paragraphs 4.146 to 4.148 and 9.10). The randomised design gives a more accurate indication of average catch rates across the survey area, which was one of the main objectives of the survey. The precision of the average catch rate was not reported in WG-FSA-08/57 but was further calculated during the Working Group meeting using the methods described in Candy (2004) which gave an approximate 95% confidence bound for *D. mawsoni* of between 17 and 60 kg/thousand hooks. This indicates that catch rates can be considered small relative to other areas such as Subarea 88.1.

5.56 The authors of WG-FSA-08/57 further explained that as the survey strata and sampling stations were allocated to depths where commercial fishing occurs, and broadly covering two of the three main areas were the commercial fishery has concentrated in the past (WG-FSA-07/44), there is no clear reason how the low catch could be an artefact of either the survey design or the level of fishing effort. Furthermore, the gear and crew of the FV *Janas* has a proven track record for catching at rates comparable to other autoliner vessels in the toothfish fisheries in both Division 58.5.2 and Subarea 88.1, and that this data could be used to standardise the catch rates in the survey.

5.57 The Working Group agreed research has shown the following:

(i) Based on fishing information until last year, the fisheries across BANZARE Bank show that the preferred fishing grounds were depleted in the Southern Area (adopted by WG-FSA-07, resulted in the closure of the Southern Area).

(ii) Based on the survey and fisheries across BANZARE Bank, there are very few fish apart from in the preferred fishing grounds.

(iii) The fish found in the preferred fishing grounds are large and likely spawning, there are no small fish and fish are male dominated (79%).

(iv) In the survey, the fish are large and mostly male.

(v) Spawning fish in East Antarctica have only been found on BANZARE Bank (WG-FSA-07/44 and paragraph 3.32).

5.58 The Working Group noted that only two of the three preferred fishing grounds in the area were covered by the random survey. However, the random nature of the survey implies the area was adequately covered. Japan noted it would have liked to see the third preferred fishing grounds surveyed and a larger number of stations sampled to provide a more robust estimate of biomass. The Working Group recommended that WG-SAM should look at how to design longline surveys and in particular with regards to how to deal with preferred fishing grounds, and how to reconcile datasets from different types of fishing gear. It also referred to paragraphs 5.75 to 5.78 which deal with the design of survey research.

5.59 The Working Group was unable to provide management advice on catch limits in this division.

Dissostichus spp. Subarea 48.6

5.60 Four Members notified their intention to fish in the exploratory fishery in Subarea 48.6 in 2007/08; however, to date, none fished and the fishery remains open until 30 November 2008. The precautionary catch limit for *Dissostichus* spp. was 400 tonnes and information on this fishery is summarised in Appendix H.

5.61 The fishery has operated predominantly in SSRU A and the main species caught is *D. eleginoides* over the course of the fishery. SSRU A was divided into A and G in November 2007 (see Conservation Measures 41-01).

5.62 There was no evidence of IUU fishing in 2007/08.

5.63 A total of 366 toothfish have been tagged and released since 2003/04, and a total of five tagged toothfish have been recaptured (Tables 10 and 11).

5.64 Two Members (Japan and Republic of Korea) and a total of three vessels notified their intention to fish for toothfish in Subarea 48.6 in 2008/09 (Table 7a). Dr Ichii noted that Japanese-flagged vessels would begin fishing in this subarea in late October 2008.

5.65 The Working Group noted that there are still very few tag-recaptures from Subarea 48.6, and that no progress could be made on assessments of *D. eleginoides* in this subarea. The Working Group recommended the tagging rate be increased to three toothfish per tonne, in line with other new and exploratory areas with low information.

Dissostichus spp. Subareas 88.1 and 88.2

5.66 In 2007/08, eight Members (Argentina, Republic of Korea, New Zealand, Russia, South Africa, Spain, UK and Uruguay) and 15 vessels fished in the exploratory fishery in Subarea 88.1. Fishing was restricted due to sea-ice and vessels fished between December 2007 and early March 2008; no research fishing was conducted. The fishery was closed on 31 August 2008 and the total reported catch of *Dissostichus* spp. was 2 259 tonnes (84% of the catch limit) (CCAMLR-XXVII/BG/15, Table 2). During the course of fishing, SSRUs B, C and G were closed on 19 December 2007, triggered by the catch of *Dissostichus* spp. (total catch 259 tonnes; 83% of the catch limit). The IUU catch for the 2007/08 season was estimated to be 187 tonnes. Information on this fishery and management advice is summarised below (paragraphs 5.88 to 5.107).

5.67 Nine Members (Argentina, Chile, Republic of Korea, New Zealand, Russia, South Africa, Spain, UK and Uruguay) and a total of 21 vessels notified their intention to fish for *Dissostichus* spp. in Subarea 88.1 in 2008/09.

5.68 Four Members (New Zealand, Russia, UK and Uruguay) and four vessels fished in the exploratory fishery in Subarea 88.2. Fishing was restricted due to sea-ice and vessels fished in February and March 2008; no research fishing was conducted. The fishery closed on 31 August 2008 and the total reported catch of *Dissostichus* spp. was 416 tonnes (73% of the limit) (CCAMLR-XXVII/BG/15). SSRU E was closed on 1 February 2008, triggered by the catch of *Dissostichus* spp. (total catch 333 tonnes; 98% of the catch limit). There was no evidence of IUU fishing in 2007/08. Information on this fishery and management advice is summarised below (paragraphs 5.88 to 5.107).

5.69 Nine Members (Argentina, Chile, Republic of Korea, New Zealand, Russia, South Africa, Spain, UK and Uruguay) and a total of 19 vessels notified their intention to fish for *Dissostichus* spp. in Subarea 88.2 in 2008/09.

5.70 The Fishery Report for *Dissostichus* spp. in Subareas 88.1 and 88.2 is contained in Appendix I. By-catch limits of *M. whitsoni* were decoupled from the catch limits of target species based on estimates of biomass for Subarea 88.1 (section 4.2). Current move-on rules were retained.

5.71 In accordance with the advice of the Scientific Committee in 2007, the assessment for Subareas 88.1 and 88.2 was not updated. The Working Group agreed that the management advice on catch limits for Subareas 88.1 and 88.2 could be carried forward from last year (see also paragraphs 5.88 to 5.97).

5.72 The Working Group noted that the move to a biennial assessment of *D. mawsoni* had allowed resources to be directed to other important tasks related to evaluating the toothfish assessment. For example, the development, over the last year, of a spatial population model which could be used to carry out MSE work on aspects such as movement and tagging in the toothfish fisheries, and the review of aspects of the management of the fishery. Biennial assessments are considered further in paragraphs 12.6 and 12.7. The Working Group also agreed that a specific data collection plan could be developed for the fishery.

5.73 The Working Group recommended an additional SSRU in the region to the west of 170°E in the western Ross Sea including Terra Nova Bay and McMurdo Sound (i.e. SSRU 881J west) be created. It further recommended that this SSRU should be closed to fishing because of its importance as a corridor for sub-adult toothfish moving between the shelf and the northern area to spawn.

5.74 The Working Group also recommended that the catch limits for SSRUs 881J (east of 170°E) and 881L be combined. It noted that combined catch limits for these SSRUs would need to be revised based on the reduced seabed areas and CPUE estimates for this region, and that this could be calculated during the week of the 2008 meeting of the Scientific Committee if this recommendation was endorsed.

Development of methods to assess exploratory fisheries in the future

Data requirements for assessing exploratory fisheries

5.75 The Working Group considered that the key requirements for assessing a fish stock are knowledge of stock structure, productivity (natural mortality, age, growth, size at maturity), and abundance. The Working Group then reviewed the data that are required from the fishery to be able to carry out an assessment. This included catch, effort, sex/length (and age) distribution, tags, CPUE and other biological data. It considered that there are a number of issues associated with these data including:

- data quality control and/or weighting of input data;
- representativeness of the data;
- biases associated with data;
- general uncertainty;
- constant q in extrapolation of CPUE (the fishery is not uniform, but has high spots and low spots);
- variable units of effort (e.g. number of hooks in trotlines);
- priorities in data collection.

5.76 The Working Group focussed its discussion on estimates of abundance, which is seen as the main issue for exploratory fisheries – particularly those in the Indian Ocean sector (Divisions 58.4.1, 58.4.2 and 58.4.3b) as well as Subarea 48.6. The generally very low recapture rate of tags from these areas has been discussed above. In contrast, the Working Group noted that tag experiments in other areas, such as Subareas 88.1, 88.2, 48.3 and 48.4, have proved more successful and have enabled stock assessments. However, the Working Group noted that even in Subarea 88.1, the very low tag-recapture rates from the tag-releases of some vessels still needed to be addressed (e.g. SC-CAMLR-XXVI, Annex 5; WG-SAM-08/7). The Working Group then reviewed reasons why some of the tagging programs had been more successful than others.

5.77 The Working Group considered the following issues were important in tagging programs: spatial distribution of tags and subsequent fishing effort, number of tags released, shedding rates, mortality of tagged fish, detection rates, consistent fishing vessels and non-compliance with the tagging program.

5.78 The Working Group considered that one of the most important aspects of a tagging program was the spatial distribution of tags and fishing effort. It was recognised that toothfish tend to move only short distances over the first 1–2 years, and that it may take several (five or more) years for toothfish to mix through the population. Therefore, for a tagging program to be effective in the short term, it was necessary for tagging and subsequent fishing effort to be carried out over the same areas. Plots of tag-releases and fishing effort from the tag experiments in Subareas 48.3, 48.4, 88.1 and 88.2 generally show good overlap between tag-releases and subsequent fishing effort (e.g. SC-CAMLR-XXVI; WG-FSA-08/46). It was noted that spatial population models could potentially address some of the tag spatial mixing issues, but that they required considerably more data than were currently available in the southern Indian Ocean sector fisheries. It was also noted that vessels in Subarea 88.1 often tended to catch their own tags as they had their own fishing locations, and that this may lead to higher recapture rates in that area.

5.79 To determine whether the spatial mismatch between tags and subsequent fishing effort was a possible reason for the lack of tag-recaptures in Divisions 58.4.1, 58.4.2, 58.4.3a and 58.4.3b, the Working Group reviewed the annual distribution of tags and subsequent fishing effort in these areas. The results suggested reasonably good overlap of where the tags were released and where the effort was subsequently carried out, and so spatial overlap was not a problem.

5.80 The Working Group also agreed that the tagging rate had to be sufficiently high to ensure reasonable recoveries of tags to achieve a precise estimate of abundance. An approach for estimating the number of tags required to give a predicted abundance CV was summarised in Annex 7, paragraphs 3.9 and 3.10. Approximate initial estimates of stock size (and hence required number of tag-releases) could be estimated by comparing relative CPUE in the fishery with that derived from the same vessels fishing in Subareas 88.1 and 88.2, from which the tagging rate and catch limit can be adjusted. It was noted that strong heterogeneity in fish abundance within an area is likely to be an issue.

5.81 Tagging rate per vessel was plotted against time to check whether tagging was carried out at the same rate as fishing in accordance with Conservation Measure 42-01. The results were very variable, with some vessels tagging at the correct rate throughout fishing, whilst other vessels initially released very few tags and the tagging rates sharply increased in the

middle or at the end of the fishing period (Figure 4). The Working Group was concerned that relatively high tagging rates over very short periods of time could be detrimental to the condition of the fish on release, and was not consistent with the required spreading of tagged fish throughout the area. The Working Group recommended this issue be referred to SCIC and noted attention might need to be drawn to the conservation measure and changes made last year to address this issue.

5.82 The Working Group agreed that in the absence of reliable tagging data, an alternative approach is required for developing stock assessments in the short term. The only other data currently available for developing stock assessments in these areas is CPUE. The Working Group noted CPUE had been used in both depletion studies and by comparison of CPUE between areas in Divisions 58.4.1 and 58.4.2 (paragraphs 5.22 to 5.24). However, there is concern that the CPUE estimates used for such analyses are not directly comparable. This is particularly the case when different vessels are fishing in different locations in different years. The Working Group noted that the fishing design used in Subareas 48.3 and 48.4 for spreading tags and fishing effort across the area would also provide unbiased estimates across the area.

5.83 The Working Group recalled that there is a requirement for vessels fishing in exploratory fisheries to carry out up to 20 research sets, which must have a minimum distance of 5 n miles. However, some of the lines being fished are up to 40 km long which makes the 5 n mile minimum distance ineffective as an effort-spreading mechanism. The Working Group considered that an alternative might be to have a more structured research fishing plan, fishing in a more systematic pattern with shorter lines analogous to the experimental design used for the crab fishery in Subarea 48.3. When first entering the fishery, fishers must carry out experimental research fishing within a number of squares before the commercial phase of the fishing can proceed (Conservation Measure 52-02).

Research designs in exploratory toothfish fisheries

5.84 Issues when considering research designs in exploratory fisheries were considered by WG-SAM (Annex 7, paragraphs 4.1 to 4.9). It recommended WG-FSA consider defining specific research plans, including set positions, and consistent gear configurations. It also noted that in regard to the use of the 10 tonne research exemption, a vessel's operational characteristics should be well known, it should set many short lines, and the positions of the line should be determined prior to the research starting.

5.85 In addition to the discussion outlined above, the Working Group examined the question of how to use research results from these surveys in assessments. Longline research has been very difficult to use because of the non-reproducibility, non-overlap of vessels etc. Standards must be set on how to carry out research, design work and trials have to be carried out prior to further work being done. One main issue is the catchability coefficient (q) between vessels, and how it can be determined. This is a particular issue when comparing between different gear methods (e.g. Spanish line, autoline, trotline) (WG-FSA-08/44), as well as within the trotline method which is also very variable between vessels.

5.86 An additional approach is to use data from other areas to extrapolate between areas. This would give an understanding of how variable CPUE might be between years or vessels.

CPUE always needs to be standardised. A more prescriptive and standardised pattern of fishing might be helpful in obtaining representative data, and could include grid fishing with a prescriptive number of hooks etc.

5.87 The Working Group recommended that vessels entering a new SSRU in Subareas 48.6 and 58.4 should be required to carry out 10 research sets with a maximum hook number of 5 000 (as part of Conservation Measure 41-01) on a stratified random basis through prescribed areas within that SSRU before carrying out their commercial fishing. Sets would be carried out on, or close to, supplied positions within strata based on fishable area where that information is available. Alternate positions could be supplied to replace any positions that were unfishable for any reason. It considered that the prescribed areas could be identified and random positions generated during the week of the 2008 meeting of the Scientific Committee if it agreed to this recommendation. It also considered that, if carried out annually by the same vessels, the research sets could be used to develop a time series of relative abundance indices.

Review of the management of *Dissostichus* spp. in Subareas 88.1 and 88.2

5.88 WG-FSA-08/50 focused on the management of the Ross Sea toothfish fishery and summarised the management and conduct of the fishery up to the 2004/05 fishing year (prior to the start of the three-year experiment). This included the reasons why the three-year experiment was initiated and the key objectives of the experiment. The operational changes which formed the framework of the three-year experiment, and the success and/or any problems associated with each of those changes, were reviewed. Key operational and research objectives for the fishery in relation to Article II of the Convention were identified, including uncertainties in our current knowledge which need to be addressed to fulfil the requirements of Article II. These include, for example, uncertainty in the biological parameters and stock assessment of *D. mawsoni*, uncertainty in its ecological relationships with predators and prey, and uncertainty over other ecosystem effects of fishing.

5.89 The paper concluded that the three-year experiment has been very successful, because it has led to an improved stock assessment of *D. mawsoni* and allowed development of techniques for monitoring by-catch species and other potential ecosystem effects of the fishery. The additional move to a biennial assessment of toothfish in 2006/07 has also allowed resources to be redirected into the development of a spatial population model and other research, which will be important for future MSE of the toothfish fishery. WG-FSA-08/50 strongly encouraged the adoption of an operational framework for the medium term (next 3–5 years) which would allow good quality data to be gathered on a stable and consistent basis.

5.90 The paper recommended the following minor changes to the operational framework to meet the science and management objectives of the fishery:

(i) Retain existing network of open and closed SSRUs in Subareas 88.1 and 88.2, and, in addition, consider creating an additional SSRU in the region to the west of 170°E in the western Ross Sea including Terra Nova Bay and McMurdo Sound (i.e. SSRU 881J west).

(ii) Retain the current amalgamation of SSRU catch limits and, in addition, consider amalgamation of catch limits for SSRUs 881J (east of 170°E) and 881L.

(iii) Readjust proportional catch limits in these revised SSRUs based on revised seabed areas and new CPUE.

(iv) Modify research exemption for closed SSRUs (Conservation Measure 24-01). Instead of 10 tonnes for each SSRU for each year, focus on research experiments lasting 2–3 years in a specific SSRU with 60 tonnes per year[4]. Retain tagging at a minimum of three tags per tonne for each year of the experiment. Ensure an appropriate gap (e.g. 5–10 years) between such experiments in the same SSRU to minimise the impact.

(v) Allow retention of catch limits for toothfish and by-catch species for 'out of season' experiments in open SSRUs.

(vi) Continue with biennial assessments of *D. mawsoni* in the two subareas.

(vii) Develop specific data collection plan and research plan for the Subarea 88.1 and 88.2 fisheries.

5.91 The Working Group thanked New Zealand for carrying out this work, and noted that considerable progress had been made on the stock assessment for *D. mawsoni* in Subareas 88.1 and 88.2.

5.92 Some members expressed concern at the level of research fishing that could be carried out in some of the closed SSRUs as a result of recommendation (iv). They were also concerned that this could unduly impact on the assessment if effort were spread too widely. However, it was pointed out that this level of catch (and associated effort) is already available to be fished in the closed SSRUs under the research exemption. The Working Group agreed that it was important that any changes to the operational framework should not impact unduly on the current stock assessment.

5.93 There was disagreement amongst members in the Working Group over the network of open and closed SSRUs.

5.94 Some members considered that the network of open and closed SSRUs should be retained because they considered that progress in the stock assessment had been assisted by the concentration of effort within the open SSRUs. They agreed that recommendations (i), (ii) and (iii) should be implemented. They considered that recommendation (iv) should be modified slightly so that the tonnage available under a research exemption would need to be evaluated on a case-by-case basis, would be subject to review by WG-FSA (in accordance with the survey standards developed in paragraphs 5.84 to 5.87) and be for no more than a maximum of 60 tonnes. They noted that this increased catch should only be available for a period of up to two years after which that SSRU would remain closed for an appropriate time period (e.g. 5–10 years). They also noted that this would replace the 10 tonne research exemption which is currently in place in each closed SSRU.

[4] Note 60 tonnes is the sum of the 10 tonne research exemptions from the six closed SSRUs in Subareas 88.1 and 88.2.

5.95 Dr Pshenichnov considered that the three-year experiment had been unsuccessful because it had not led to an improved stock assessment of *D. mawsoni* in these subareas. In particular, the experiment had led to a lack of data from closed SSRUs, the inability to recapture tagged fish which had moved to closed SSRUs, and the inability to tag fish in closed SSRUs. He noted that there were no data on the distribution and size composition of toothfish and on the rate of by-catch (catch composition) in those SSRUs. He considered that the absence of these data meant that the data for use in the stock assessment was incomplete, and that he had drawn this fact to the attention of the Scientific Committee and Commission each year.

5.96 Dr K. Shust (Russia) also expressed doubts over the success of the three-year experiment on toothfish tagging in the Ross Sea. Several sources of substantial uncertainty of stock assessments of toothfish in the Ross Sea based on the tag-returns were pointed out (WG-SAM-08/8). The first source is the absence of data from the closed SSRUs. Another source comes from taking into account tag-returns from the New Zealand fishery only, which operates from year to year within restricted areas of the Ross Sea and adjacent waters. Together, these sources may result in considerable underestimation of toothfish biomass and catch limit in the Ross Sea. Taking into account the reasons mentioned above, continuation of the toothfish tagging program should not be further confined to open SSRUs. The uncertainties related to the current tagging schedule may be amplified even further under three- or five-year experiments of toothfish fishery management. Taking all this into account, Dr Shust suggested that the Scientific Committee consider the possibility of opening all closed SSRUs in order to distribute the fishing effort across the entire area of the fishery.

5.97 The Working Group recommended that the relative merits of the different views on harvest strategies and research programs for toothfish in the Ross Sea (paragraphs 5.89 and 5.94 to 5.96) be evaluated using simulations (see Annex 7, paragraphs 5.1 to 5.6). It recommended that such work be submitted to WG-SAM for review of the simulation and assessment methodologies before submitting the outcomes to WG-FSA for consideration.

Management advice

5.98 The Working Group considered that although the estimates of yield from the analysis were uncertain, the results suggested that the size of the *Dissostichus* spp. population in Divisions 58.4.1 and 58.4.2 was likely to be small and that the current catch limits were unlikely to be sustainable. The Working Group therefore recommended that the catch limits be reduced in each of the open SSRUs in these two divisions to the estimates of yield based on the median biomass estimates provided in Table 13 (paragraph 5.29).

5.99 The catch limit for Division 58.4.3a for the 2007/08 fishing year was 250 tonnes. The Working Group agreed that the assessment suggested that this level of catch was not sustainable and that the catch limit for this division be reduced to a level in the range of 86 to 113 tonnes (paragraph 5.47). The Working Group was unable to provide management advice on catch limits in Division 58.4.3b (paragraph 5.59).

5.100 The Working Group agreed that measures in the research and data collection plans, including the requirement to tag toothfish at the rate of three toothfish per tonne, be retained

for the exploratory fisheries in Subarea 58.4 (paragraph 5.22). It further noted that if there are improvements in the release and recapture of tags in these subareas, then these data could form the basis of an assessment in the short to medium term.

5.101 The Working Group recommended that vessels entering a new SSRU in Subareas 48.6 and 58.4 should be required to carry out 10 research sets with a maximum hook number of 5 000 (as part of Conservation Measure 41-01) on a stratified random basis through prescribed areas within that SSRU before carrying out their commercial fishing. Sets would be carried out on, or close to, supplied positions within strata based on fishable area where that information is available. Alternate positions could be supplied to replace any positions that were unfishable for any reason. It considered that the prescribed areas could be identified and random positions generated during the week of the 2008 meeting of the Scientific Committee if it agreed to this recommendation (paragraph 5.87).

5.102 The Working Group was unable to provide further management advice regarding catch limits in Subarea 48.6. It noted that there are still very few tag-recaptures from Subarea 48.6. The Working Group recommended that the tagging rate be increased to three toothfish per tonne, in line with other new and exploratory areas with low information (paragraph 5.65).

5.103 The Working Group agreed that the management advice on catch limits for *Dissostichus* spp. in Subareas 88.1 and 88.2 could be carried forward from last year. However, it noted that it would be expected that the assessment be updated next year.

5.104 The Working Group recommended new catch limits for *Macrourus* spp. in Subarea 88.1 based on the advice given in paragraphs 6.16 to 6.22.

5.105 The Working Group considered the New Zealand proposal on the future management of the *Dissostichus* spp. fishery in Subareas 88.1 and 88.2 but was unable to provide consensus advice on the issue of maintaining the network of open and closed SSRUs in these subareas.

5.106 However, the Working Group recommended an additional SSRU in the region to the west of 170°E in the western Ross Sea, including Terra Nova Bay and McMurdo Sound (i.e. SSRU 881J west) be created, and that this SSRU should be closed to fishing (paragraph 5.73).

5.107 The Working Group also recommended that the catch limits for SSRUs 881J (east of 170°E) and 881L be combined, and noted that the combined catch limits be revised based on the reduced seabed areas and CPUE estimates for this region (paragraph 5.74).

Notifications to conduct research surveys using commercial vessels under Conservation Measure 24-01

Proposal by New Zealand to conduct winter research in Subarea 88.1

5.108 WG-FSA-08/62 presented an application by New Zealand to undertake scientific research during the austral winter in CCAMLR SSRUs 881B, C and G in 2008/09, as the first in a possible three-year time series. The proposal is for a targeted longline survey designed to cover critical gaps in the knowledge of the life cycle of *D. mawsoni* in the Ross Sea by

collecting biological samples from a broad spread of locations across the northern Ross Sea (where toothfish are expected to spawn) during the austral winter. The survey is designed to collect information that should assist in the understanding of the early life history and reproduction of *D. mawsoni* in the Ross Sea region, and addresses key questions identified at the 2007 CCAMLR meeting (SC-CAMLR-XXVI, paragraph 4.48; SC-CAMLR-XXVI, Annex 5, paragraphs 3.64 to 3.67). In addition, tag data collected is likely to provide additional information on the timing of the spawning movements of mature *D. mawsoni* and residence times in the northern area.

5.109 The survey proposes to collect data to allow the testing of three scientific hypotheses and has six additional scientific objectives. The results of the research will contribute to an improved understanding of the Ross Sea *D. mawsoni* stock structure, and, in the longer term, lead to improved estimates of length/age of maturity and proportion of mature fish that spawn. Data collected during the survey will provide information that is likely to directly influence future assessments of *D. mawsoni*. The proposed research is in accordance with existing conservation measures, proposes a tagging rate of at least three toothfish per tonne (usually one fish per tonne in this region), and proposes to have two scientists on board (including the option for an international scientist) in addition to the two scientific observers.

5.110 The paper requested that a catch of 150 tonnes, equating to approximately 4 600 fish, be allocated from the northern area (SSRUs 881B, C, G) catch limit of 313 tonnes to allow this research to be conducted. This figure is based on an estimation of the numbers of fish required to investigate the spawning characteristics and maturity cycle, for the investigation of within-season movement, and takes into account the logistical constraints for carrying out the proposed research in this area and at this time of year.

5.111 The Working Group agreed that the immediate results of the research were unlikely to have a direct impact on the assessment in the coming year. However, most members of the Working Group agreed that the survey would provide important information on the reproductive biology and early life history of *D. mawsoni*. They noted that the results from the survey by themselves would not provide estimates of length-at-maturity or proportion of mature fish spawning because the survey will only show what proportion are spawning in the ice-free area. However, they agreed that the maturity status, histological characteristics, and GSI data would all help to further define the developmental cycle of *D. mawsoni*, which was necessary before the length-at-maturity and proportion spawning could be resolved (paragraphs 3.72 to 3.76).

5.112 The Working Group also expressed concern over the size of the proposed catch. Dr S. Mormede (New Zealand) noted that part of the reason for the large tonnage being proposed was the large average weight of toothfish in that area (32 kg) rather than a large number of toothfish proposed to be caught. The numbers required to be scanned for tags and sampled reproductively had been calculated using a power analysis. She noted that it had been estimated that about 3 000 toothfish would need to be scanned in SSRU 881C alone during the survey in order to recover nine tags, with further scanning required in SSRU 881B. Similarly, Dr S. Parker (New Zealand) noted that these numbers of fish were required to be sampled for maturity status so that the lower tail of the length distribution could be adequately sampled. The Working Group noted that a total of 500 fish ovaries and testes would actually be retained and later examined for histological analysis.

5.113 Dr Constable questioned how the survey would help CCAMLR. He considered that the impact of collecting the proposed data on the assessment should first be evaluated through simulations. He noted that this would address some members' concerns regarding the proposed size of the catch. He also questioned the impact on the assessment if these fish were removed during the winter instead of during the traditional summer fishery.

5.114 The Working Group noted that there was no process to determine how a catch may be set aside for this type of research fishing:

(i) Dr Ramm noted the importance of the catch limit in this area for vessels first entering the Ross Sea fishery in December each year, and that in most years all the catch limit in this region was taken.

(ii) One approach would be to subtract the catch from the catch limit at the start of the following season but the Working Group requested the assessment subgroup to look at the impact this would have on the assessment and catch allowance. Dr S. Hanchet (New Zealand) reported that Mr A. Dunn (New Zealand), who carries out the Ross Sea stock assessment, indicated that removal of the catch six months earlier than in the model would have very little impact on the assessment (estimated to be up to a couple of tonnes to the yield on the 35-year projection).

(iii) Another approach suggested by the Working Group was to tender the research out so that other Members had the opportunity to bid for the research (paragraphs 5.75 to 5.83).

5.115 Dr R. Holt (USA) noted that because it is a multi-year proposal, the removal of catch from the northern SSRUs at this time of the year may have more of an impact on the assessment. Dr Agnew noted that the Ross Sea toothfish fishery is still in the fishing-down phase, so the impact of the removal of a small additional catch at this time would be less critical.

Proposal by Japan to conduct a research survey in Division 58.4.4

5.116 Japan submitted a notification to conduct scientific research in 2008/09 (WG-FSA-08/39). The notification is to continue research on the distribution and population structure of toothfish in Divisions 58.4.4a and 58.4.4b started in 2007/08. The survey vessel will again use trotlines and has requested a catch limit of 120 tonnes of toothfish. The notification falls under paragraph 3 of Conservation Measure 24-01. The main objective outlined in the notification is to collect various biological and physical oceanographic data on toothfish required for assessing the status of the stocks. This information is important because it has been five years since the area has been open to fishing. In addition, tagging activities at the rate of three toothfish per tonne will be conducted to contribute to future investigations on the distribution and population structure of toothfish in these areas. A two-phase research plan is outlined.

5.117 Dr Ichii noted that research last year suggested that length composition data showed juvenile and adult toothfish in abundance, and that CPUE was twice as high as that used to initially set the catch limit of 103 tonnes. He noted that fishing efficiency of trotlines is expected to be a little higher than that of other longline systems. However, if trotlines were

twice as efficient as other longlines, then all vessels would be using trotlines. The research indicated that the stock status might not be in poor condition, and that further research is required for a robust assessment. Dr Ichii also noted that data from a single-year survey are not enough to provide a reliable assessment of fish stocks and that at least three years of survey data are indispensable to provide better temporal coverage. It is proposed that coverage be extended to include depths shallower than <500 m in Ob and Lena Banks to assess more recent recruitment. Regarding the total catch, in order to obtain an appropriate sample size, and considering the economical feasibility, Japan proposed setting a catch limit of 30 tonnes for each SSRU, thus the total catch limit would be 120 tonnes. He further noted that regulated fishing in this division will also monitor and deter IUU vessels.

5.118 Dr Kock asked whether data on the recruitment and recruitment variability of *D. eleginoides* could be obtained from data collected by Ukraine during its trawl fishery in this area. Dr Pshenichnov replied that these data are available on paper but not electronically.

5.119 The Working Group agreed that the research might lead to population estimates if a robust research procedure is in place. It noted that the fishery was closed in 2002 because it was thought that the population had become depleted after high levels of IUU fishing (SC-CAMLR-XXI, paragraph 4.106). Dr Agnew questioned if it would be possible to not only estimate current population size, but also to estimate the level of depletion of the population with regards to initial biomass. He suggested that one approach could be to carry out simulation studies including the tag-recaptures and size-composition data. The Working Group agreed that thought should be given within the next year to methods to be used to understand population depletion in addition to its current size, and potential recovery.

5.120 The Working Group noted that before advice is given to the Scientific Committee, it needed to be confident that the research is not going to impede the recovery of the stock. It needed to see how the data are going to be used, standardised, and how stock status and trajectory can be determined using these data. Importantly, an understanding of how to appropriately use CPUE from trotlines is needed. It was also considered that if the same gear was used as had been used previously in the fishery, then an answer would be much faster to obtain. In this regard, it also noted that the catch limit when the fishery was closed was 103 tonnes, and that a catch proposal of 120 tonnes seemed excessive.

5.121 Dr Ichii thanked the Working Group for its useful comments. He stressed, however, that length-composition data and CPUE indicate the stock status might not be in poor condition, and that further research is required for a robust assessment.

General principles for CCAMLR-sponsored research

5.122 The Working Group considered the general principles and requirements to be met for CCAMLR-sponsored research. It noted that such research:

(i) would be designed to support the Commission in its work to achieve the objectives in Article II;

(ii) needs to be consistent with the precautionary approach of CCAMLR;

(iii) should not undermine initiatives taken in other parts of CCAMLR or in other parts of the Antarctic Treaty System, such as species protection, closed areas and/or ASPAs and ASMAs;

(iv) under such direct sponsorship, could involve, *inter alia*:

(a) special catch allocations from a catch limit to undertake research;

(b) research exemptions to existing conservation measures provided for in Conservation Measure 24-01;

(c) coordination of data acquisition and field programs through the CCAMLR Secretariat;

(d) special requirements to be undertaken by all Members during fishing operations.

5.123 The Working Group noted from the previous experience for designing the CCAMLR-2000 Survey and other work done under the auspices of CCAMLR, that the following steps would be involved in developing and utilising CCAMLR-sponsored research:

(i) Preparation:

(a) Demonstrate need of the research –

It was noted that 'need' can be determined from the consequences that the research will have for the Commission in achieving the objectives in Article II, e.g. is a catch limit too high (conservation objectives may not be met) or too low (conservation may not be an issue and more catch is possible) and not likely to be corrected using the existing process, and would the advice to the Commission be improved by the research? Analyses could be used to help demonstrate need, including management strategy evaluation, power analyses, and/or draft assessments using plausible datasets that may be obtained from research.

(b) Develop a research design to address the need –

It will be important to identify the data needed to be collected to resolve the issue, including the spatial and temporal sampling required, and the number of samples needed to achieve the accuracy and precision of the estimate required.

(c) Evaluate whether there may be short- or long-term effects of the research plan on current advice to the Commission –

It was noted that while the research is being undertaken, the quality of the current advice may be altered. The degree to which that would impact on the Commission achieving its objectives will need to be considered.

(d) Identify the necessary standards to be met during data collection –

Such standards will need to include specifying the data quality requirements (e.g. tagging), vessel and observer capability and standards, survey design and implementation.

(e) Determine any specific requirements to be met for implementing the research program –

Such requirements will include consideration of prospective participants (Members, fishing vessels, research vessels), how the participation will be managed, establishing a capability to meet standards, determining the contribution required from CCAMLR (catch allocation, requirements in conservation measures, research exemptions, Member contributions) and requirements of observers and vessels.

(ii) Implementation.

(iii) Analysis of results.

(iv) Provision of advice to the Commission.

5.124 The Working Group agreed that these would be useful and requested the Scientific Committee consider whether these guidelines could be used for establishing CCAMLR-sponsored research programs.

Dissostichus eleginoides South Georgia (Subarea 48.3)

5.125 The Fishery Report for *D. eleginoides* in Subarea 48.3 is contained in Appendix J.

5.126 Following the advice of the Scientific Committee, the assessment was not updated in 2008.

Management advice

5.127 The Working Group recalled that the Commission had agreed that the catch limit for toothfish in Subarea 48.3 (SGSR stock) should be 3 920 tonnes in each season for the 2007/08 and 2008/09 fishing seasons (CCAMLR-XXVI, paragraph 13.54). No assessment was conducted this year and there is no change to the catch limit agreed for the 2008/09 season.

Dissostichus eleginoides Kerguelen Islands (Division 58.5.1)

5.128 The Fishery Report for *D. eleginoides* in Division 58.5.1 is contained in Appendix K.

5.129 The catch of *D. eleginoides* reported for this division to 31 August 2008 was 2 853 tonnes. Only longlining is currently permitted in the fishery. The estimated IUU catch for the 2007/08 season was zero inside the French EEZ. Some IUU fishing may occur outside the EEZ as reported in WG-FSA-08/10 Rev. 2.

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

Management advice

5.131 The Working Group encouraged the estimation of biological parameters for Kerguelenand the development of a stock assessment for this area. It also encouraged cooperative work in the intersessional period between France and Australia on analysis of catch and effort data and other data that could be used to progress understanding of fish stocks and fishery dynamics for Divisions 58.5.1 and 58.5.2 and Subarea 58.6. The Working Group encouraged France to continue its tagging program in Division 58.5.1.

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

5.133 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 Conservation Measure 32-13, remain in force.

5.134 The Working Group noted that France had made significant progress in mitigating by-catch, including area/season closures (SC-CAMLR-XXVI, Annex 6, paragraph II.23). It noted that the CPUE analysis would probably be robust to these changes so long as detailed haul-by-haul data continued to be available.

Dissostichus eleginoides Heard Island (Division 58.5.2)

5.135 The Fishery Report for *D. eleginoides* in Division 58.5.2 is contained in Appendix L.

5.136 Following the recommendation by the Scientific Committee, the toothfish assessment for *D. eleginoides* in Division 58.5.2 was not updated. The Working Group noted that the *D. eleginoides* stock assessment in this division will be updated in 2009.

Management advice

5.137 The Working Group recommended that the catch limit for *D. eleginoides* in Division 58.5.2 west of 79°20'E should be 2 500 tonnes for the 2008/09 fishing season.

Dissostichus eleginoides Crozet Islands (Subarea 58.6)

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

5.139 The catch of *D. eleginoides* reported for this subarea to October 2008 was 684 tonnes. Only longlining is currently permitted in the fishery. The estimated IUU catch for the 2007/08 season was zero inside Subarea 58.6 as reported in WG-FSA-08/10 Rev. 2.

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

Management advice

5.141 The Working Group encouraged the estimation of biological parameters for Crozet, and the development of a stock assessment for this area. The Working Group encouraged France to continue its tagging program in Subarea 58.6.

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

5.143 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 Conservation Measure 32-13, remain in force.

5.144 The Working Group noted that France had made significant progress in mitigating by-catch, including area/season closures (SC-CAMLR-XXVI, Annex 6, paragraph II.23). It noted that the CPUE analysis would probably be robust to these changes so long as detailed haul-by-haul data continued to be available.

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

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

5.146 The catch limit of *D. eleginoides* in the South African EEZ for the 2007/08 season was 450 tonnes for the period from 1 December 2007 to 30 November 2008. The catch reported for Subareas 58.6 and 58.7 as of 5 October 2008 was 61 tonnes, all of which was taken by longlines. The IUU catch for the 2007/08 season was assumed to be equal to the IUU catch in 2004/05 at 156 tonnes.

5.147 The CPUE series was not updated by the Working Group in 2008.

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

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

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

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

Champsocephalus gunnari South Georgia (Subarea 48.3)

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

5.151 In the 2007/08 fishing season the catch limit set for *C. gunnari* in Subarea 48.3 was 2 462 tonnes. During the 2007/08 season the fishery caught 1 326 tonnes by the end of October 2008. The fishery remains open until 14 November 2008 and it is anticipated that the full catch will be taken.

5.152 In April 2008 the UK undertook a random stratified bottom trawl survey of the South Georgia and Shag Rocks shelves (WG-FSA-08/28). The survey employed the same trawl gear and survey design as previous UK surveys in Subarea 48.3.

5.153 The Working Group agreed that a short-term assessment should be implemented in the GYM, using the one-sided bootstrap lower 95% confidence bound of total biomass from the 2008 survey.

5.154 All input parameters for the assessment remained unchanged from 2007.

Management advice

5.155 The Working Group recommended that the catch limit for *C. gunnari* should be set at 3 834 tonnes in 2008/09 and 2 631 tonnes in 2009/10 based on the outcome of the short-term assessment.

Champsocephalus gunnari Heard Island (Division 58.5.2)

5.156 The Fishery Report for *C. gunnari* in Division 58.5.2 is contained in Appendix P.

5.157 The catch limit of *C. gunnari* in Division 58.5.2 for the 2007/08 season was 220 tonnes for the period from 1 December 2007 to 30 November 2008. The catch reported for this division as of 5 October 2008 was 199 tonnes.

5.158 A large 2+ year class, probably the result of spawning by the 4+ year class dominant in 2006, was observed to dominate the population in the survey undertaken in June 2008.

5.159 The short-term assessment was implemented in the GYM, using the one-sided bootstrap lower 95% confidence bound of total biomass from the 2008 survey. All other parameters were the same as in previous years.

Management advice

5.160 The Working Group recommended that the catch limit for *C. gunnari* in 2008/09 be no more than 102 tonnes.

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

Assessment and management advice for other fisheries

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

5.162 CCAMLR closed commercial finfishing in the Antarctic Peninsula (Subarea 48.1) and the South Orkney Islands (Subarea 48.2) after the 1989/90 season. Both subareas should only be reopened to commercial exploitation if scientific surveys had demonstrated that the condition of fish stocks had improved to the extent which would allow commercial harvesting.

5.163 The last three estimates of fish biomass in Subareas 48.1 and 48.2 were obtained in February–March 2006 (Antarctic Peninsula) (Jones and Kock, 2006), December 2006–January 2007 (Elephant Island and the lower South Shetland Islands) (Kock et al., 2007) and in February–March 1999 around the South Orkney Islands (Jones et al., 2000). Results from these surveys do not indicate that fish biomass had increased to the extent that a reopening of the fishery should be considered.

5.164 A new trawl survey will be undertaken in Subarea 48.2 by the US AMLR Program with international participation in February–March 2009.

Management advice

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

South Sandwich Islands (Subarea 48.4)

5.166 The Working Group considered the results of the three-year mark–recapture experiment conducted in the Northern Area of Subarea 48.4 (Conservation Measure 41-03). Between 2005/06 and 2007/08, a total of 929 *D. eleginoides* were tagged and released in Subarea 48.4 and 25 tagged fish were recaptured, including 23 fish in 2007/08 (Appendix Q). The experiment has allowed a preliminary assessment of *D. eleginoides* in the Northern Area, and the vulnerable biomass was estimated to be between 1 000 to 2 000 tonnes (WG-FSA-08/46).

5.167 The Working Group also considered the UK's proposal to continue the mark–recapture experiment in Subarea 48.4 in 2008/09 so as to allow for a full assessment of *D. eleginoides* in the Northern Area in 2009. Additionally, the UK proposed to commence a mark–recapture experiment in the Southern Area of Subarea 48.4 (Figure 5), with the aim of collecting data required for the assessments of the population structure, size, movement and growth of both *D. eleginoides* and *D. mawsoni* in the Southern Area of Subarea 48.4.

5.168 The main elements of the proposal, which is described in WG-FSA-08/48, include:

Northern Area –

(i) a catch limit of 75 tonnes for *D. eleginoides*;

(ii) the continued prohibition of the taking of *D. mawsoni* other than for scientific research purposes;

(iii) the introduction of catch limits for by-catch species, with a limit for macrourids of 12 tonnes (16% of the catch limit for *D. eleginoides*) and a limit for rajids of 4 tonnes (5% of the catch limit for *D. eleginoides*).

Southern Area –

(i) a catch limit of 75 tonnes for *Dissostichus* spp. (*D. eleginoides* and *D. mawsoni* combined) in the Southern Area;

(ii) the introduction of a move-on rule for by-catch species, with a macrourid trigger set at 16% of the catch of *Dissostichus* spp., and a trigger for rajids set at 5% of the catch of *Dissostichus* spp.

5.169 The Working Group congratulated the UK on this initiative, noting that the three-year mark–recapture experiment and new proposal for 2008/09 provides a staged approach to the

assessment of *Dissostichus* spp. in Subarea 48.4. This approach illustrates how new data may be added to existing information to develop assessments in areas where the status of stocks was previously unknown.

5.170 The Working Group noted that last year one *D. eleginoides* which had been tagged in Subarea 48.4 was recaptured in the eastern sector of Subarea 48.3. No fish have yet been detected moving from Subarea 48.3 to 48.4. Dr Agnew advised that the tagging data and genetic samples collected in Subareas 48.3 and 48.4 will be analysed by the UK to determine the relationship between these populations.

Management advice

5.171 The Working Group endorsed the proposed extension to the mark–recapture experiment (paragraph 5.168) and the catch limit of 75 tonnes in the Northern Area and 75 tonnes in the Southern Area. The Working Group agreed that the research undertaken in Subarea 48.4 had been conducted in a manner that allowed the controlled development of a robust assessment of the stock. It also noted that the UK had provided detailed proposals and annual reports throughout the duration of the experiment. Although the catch limit for *D. eleginoides* proposed for 2008/09 in the Northern Area is 50% higher than the estimated sustainable yield (50 tonnes) (see WG-FSA-08/46), this would provide improved precision for a CASAL-type assessment of the subarea when combined with the data from the previous three years of the experiment, and would be consistent with the overall objectives of the research.

5.172 In addition, ad hoc WG-IMAF recommended amending Conservation Measure 24-02 in order to align the mitigation requirements for Subarea 48.4 with the IMAF risk assessment, such that daytime setting would be permitted if bottle tests are undertaken, and the fishing season be extended to run from 1 December to 30 November (Annex 6, paragraph 9.10).

Crabs (*Paralomis* spp.) (Subarea 48.3)

5.173 Crabs were not exploited in the 2007/08 season. Russia notified the Commission of its intention to fish for crabs in this subarea during the 2008/09 season. It indicated its intention to conduct fishing operations in accordance with conditions specified under Conservation Measures 52-01 and 52-02.

Management advice

5.174 The Working Group recommended that the existing Conservation Measures 52-01 and 52-02 on crabs remain in force.

Squid (*Martialia hyadesi*) (Subarea 48.3)

5.175 Squid were not exploited in the 2007/08 season. No proposal for the harvest of squid has been received by CCAMLR for the 2008/09 season.

Management advice

5.176 The exploratory fishery on squid was subject to Conservation Measure 61-01. No new information on the species was available. The Working Group recommended that the conservation measure remain in force.

FISH AND INVERTEBRATE BY-CATCH

6.1 The Working Group agreed that discussions on this agenda item would be restricted to issues related to fish by-catch and identification guides.

6.2 The Working Group identified the following areas of particular interest for the 2008 meeting:

(i) review of by-catch in longline and trawl fisheries in the CAMLR Convention Area;

(ii) the efficacy of the changes to Conservation Measure 33-03 (the move-on rule for macrourid by-catch in new and exploratory fisheries);

(iii) implementation of the Year-of-the-Skate in the forthcoming season;

(iv) macrourid by-catch limits for Subarea 88.1;

(v) by-catch mitigation;

(vi) benthic by-catch guides.

Estimation of by-catch in longline fisheries

6.3 Fine-scale data (C2) estimates of total removals of by-catch species reported from longline fisheries within the CAMLR Convention Area during the 2007/08 season are shown in Table 14. By-catch limits were not reached for any species, although limits were approached for some species. The numbers and fate of *Dissostichus* spp., macrourids, rajids and 'other species' reported in 2007/08 in fine-scale data are detailed in Table 15.

Rajids

6.4 Reported retained rajid by-catch (as a percentage of *Dissostichus* spp. catch) in longline fisheries within the Convention Area in 2007/08 was low (<4% *Dissostichus* spp.), except in those areas where almost all rajids are retained and processed (French EEZs: Division 58.5.1 and Subarea 58.6). The Working Group noted that only 4 tonnes of *Dissostichus* spp. were caught in Division 58.4.3a, with a rajid by-catch of 2 tonnes.

6.5 With the exception of the French EEZs and Subarea 58.4, a large proportion of the skates were cut off lines in most regions.

6.6 The total catch of skates was estimated by summing the numbers caught and released (Table 15) and multiplying by the mean weight of skates caught in each subarea derived from corresponding C2 data (Table 16). The Working Group noted that many skates survive being cut off lines and that the estimates in Table 16 represent a 'worst-case scenario' in which released skate suffered 100% mortality.

6.7 Estimates of total catches of rajids in each area (Table 16) were all below the corresponding area catch limits. Estimates of total catch were 83% of the catch limit in Subarea 48.3, 35% in Division 58.5.2 and 53% in Subarea 88.1.

Macrourids

6.8 By-catch rates for macrourids (as a percentage of *Dissostichus* spp. catch) for the 2007/08 fishing season ranged from 1.1 to 15.9%. By-catch limits were not reached in any subarea. The highest catch rates (as a percentage of *Dissostichus* spp.) were in the French EEZs (Division 58.5.1 and Subarea 58.6) and in Subarea 48.4.

6.9 In comparison with the 2006/07 season, the by-catch of macrourids was similar across most areas, with a reduction (as a percentage of *Dissostichus* spp.) in Subareas 48.4 and 58.6.

6.10 The Working Group investigated the effect of the change to the macrourid move-on rule (Conservation Measure 33-03) agreed at last year's meeting (SC-CAMLR-XXVI, paragraph 4.188). The move-on rule was triggered if the catch of *Macrourus* spp. taken by a single vessel in any two 10-day periods in a single SSRU exceeded 1 500 kg and 16% of the *Dissostichus* spp. catch. The new move-one rule was triggered on one occasion (in Subarea 88.1), with 10 instances of the criteria being met in a single 10-day period. Under the previous version of Conservation Measure 33-03, the move-on rule (triggered solely by the *Macrourus* spp. catch exceeding 16% of *Dissostichus* spp.) would have been triggered three times (twice in Subarea 88.1 and once in Subarea 88.2) with 19 instances of the trigger being met in one 10-day period.

6.11 The Working Group noted that the by-catch of *Macrourus* spp. in new and exploratory fisheries had not increased in 2007/08 and recommended that the modified move-on rule be retained.

Other species

6.12 By-catch of other species were generally low (<2% *Dissostichus* spp.). The 36 tonnes attributed to other species in Subarea 48.3 was largely *Antimora rostrata*. The 20 tonnes attributed to other species in Subarea 88.1 was mostly *Muraenolepis* spp.

Estimation of by-catch in trawl fisheries

6.13 By-catch in trawl fisheries for icefish (Subarea 48.3 and Division 58.5.2) and toothfish (Division 58.5.2) derived from fine-scale (C2) data are detailed in Table 17.

6.14 The by-catch in the trawl fishery for *C. gunnari* in Subarea 48.3 was negligible (<0.5% of target species) and similar to 2006/07. The Working Group noted that the fishery is still open and additional low levels of by-catch are likely. In the Division 58.5.2 *C. gunnari* trawl fishery, the by-catch was 9% of the target species, with the main species being *Channichthys rhinoceratus*. In the Division 58.5.2 *D. eleginoides* trawl fishery, the by-catch was 2% of the target species, with macrourids and *A. rostrata* the main by-catch species.

6.15 The Working Group noted the brief information given in WG-FSA-08/23 about the by-catch of juvenile *D. mawsoni* in krill trawls in Division 58.4.2 in 1987 and 1989. The Working Group agreed that information collected in that fishery between 1975 and 1990 would be valuable to the work of CCAMLR. Dr Pshenichnov reported that a large amount of information was available in paper records, but funding was needed to digitise the data.

Precautionary catch limits for *M. whitsoni* in Subarea 88.1

6.16 WG-FSA-08/32 presented estimates of biomass and yield for grenadiers for the Ross Sea fishery (Subarea 88.1 and SSRUs 882A–B). The Working Group welcomed the concept of decoupling by-catch limits from those of target species and agreed to use estimates of biomass for Subarea 88.1, noting that SSRUs 882A–B are currently closed.

6.17 The Working Group noted that the CV of the biomass estimate was 0.3, and agreed that it was appropriate to use the γ value calculated assuming a CV of 0.5 for the estimate of B_0.

6.18 The Working Group agreed to use the constant density assumption when extrapolating the biomass estimate across the slope region, noting that this would provide a more precautionary estimate of yield than one based on extrapolations using longline CPUE data. The resulting biomass estimate for SSRUs 881H, I and L was 21 401 tonnes which gave a yield estimate of 388 tonnes.

6.19 The Working Group noted that the estimated biomass in the paper covered depths from 600 to 2 000 m which included all of SSRUs 881H, I and K, but also extended into small parts of the shelf SSRUs 881J and L. The Working Group therefore agreed that the estimate of grenadier yield of 388 tonnes needed to be apportioned across these five SSRUs.

6.20 Historic catches in SSRUs 881J and 881L have tended to be small (WG-FSA-08/22), and so the proposed catch limits were set slightly higher than the maximum catches in these SSRUs. The remaining yield was placed into the slope SSRUs 881H, I and K.

6.21 No new data were available on grenadier biomass in SSRUs 881B, C and G. The Working Group agreed to reduce the existing catch limit of 50 to 40 tonnes for this region. The biomass estimate for SSRUs 882A–B was 5 491 tonnes which gave an equivalent yield estimate of 100 tonnes.

6.22 The Working Group recommended that the existing move-on rules be retained, but agreed to review macrourid by-catch limits and catches on an annual basis.

Skate biology

6.23 WG-FSA-08/20 presented updated biological parameters for the starry skate (*Amblyraja georgiana*) and proposed minor updates to the observer maturity guide. WG-FSA-08/21 presented revised age and growth estimates for starry skates, with slower early growth and greater longevity (28–37 years compared with 6–11 years). The Working Group noted that the new data was consistent with other studies of cold-water skates. It also noted the lack of validation and recommended validation work be undertaken. The Working Group noted that it would be useful to utilise common methodology and reading methods for skates throughout the CAMLR Convention Area and recommended that the CCAMLR Otolith Network (CON) be tasked with coordinating this.

Macrourid mitigation measures

6.24 WG-FSA-08/52 presented preliminary trials on the use of artificial bait to reduce macrourid by-catch in the longline toothfish fishery. Results show there might be a slight improvement in by-catch in some areas, and further trials are to be carried out. The Working Group noted that there might not be any biological reason why artificial bait is less attractive to macrourids. The Working Group considered the potential environmental impact of introducing artificial bait to the CCAMLR region, but recognised the bait is a macerated form of the usual bait (mackerel).

Year-of-the-Skate

6.25 The Working Group noted the Scientific Committee's endorsement of the Year-of-the-Skate in the 2008/09 season (SC-CAMLR-XXVI, paragraphs 4.181 to 4.184). The Year-of-the-Skate will apply to all *Dissostichus* spp. fisheries in the Convention Area, with a tagging program focused on new and exploratory fisheries. The Working Group also noted the Scientific Committee's recommendation that, during the Year-of-the-Skate, all skates be brought on board prior to release (see paragraphs 6.28 to 6.31).

Skate identification

6.26 The Working Group noted that skate identification remains an issue, particularly with regard to rare species and in specific areas. For instance, WG-FSA-08/13 reported two putative new species of *Bathyraja* spp. from the Crozet Archipelago. The Working Group welcomed the new identification sheets developed for Division 58.5.2 (WG-FSA-08/55).

6.27 The Working Group noted the value of obtaining tissue samples for genetics and voucher specimens of skates from a range of species in different areas.

Skate capture and handling

6.28 WG-FSA-08/30 reviewed the methods of handling skates on a New Zealand autoliner and demonstrated that bringing skates on board was potentially quicker than cutting them off in the water, with less incidence of injury to the skate. This procedure also provided better tag detection and species identification, and allowed assessment of the condition of the skate. The Working Group noted that such results would be dependent on the vessel and crew and the specific procedures used for skate release.

6.29 The Working Group noted that there is no clear scientific evidence that bringing skates on board (or alongside) the vessel improved survival, but noted that bringing skates on board would enable a better assessment of the condition of the skate and permitted improved scanning for tagged fish. The Working Group therefore recommended that, during the Year-of-the-Skate, all skates caught be brought on board or alongside the hauler to be scanned for tags and for their condition to be assessed.

6.30 The Working Group further recommended that, during the Year-of-the-Skate, all vessels assess the state of all captured skates, scan for tags and retain all skates in condition 1 (dead) or 2 (with life-threatening injuries). For skates in condition 3 (alive, with injuries serious enough to possibly reduce survival) or 4 (alive and in good condition), the skate should be released by cutting the snood as close to the hook as possible or cutting the snood and removing the hook from the skate, providing this does not further damage the skate.

6.31 The Working Group recommended that the efficacy of this approach be reviewed during its meeting in 2009.

6.32 The Working Group recommended that, during observation periods, the observer be tasked with assessing the condition of all skates to investigate the likelihood of survival and to scan for tags. These survival data would then be scaled to the total catch to get an estimate of skate removals, whilst tag-detection rates during the observation periods could be compared to those outside the observation period.

Changes to logbooks

6.33 WG-FSA-08/49 presented the New Zealand skate-tagging experiments in 2007/08 and proposed updates to the protocol and logbook for the Year-of-the-Skate. The Working Group recommended a simplification of the forms to reduce the risk of double-reporting of skates.

6.34 The Working Group recommended that the observer logbook be updated to improve ease of recording, capture information required for the Year-of-the-Skate, and make the logbook flexible to accommodate specific by-catch sampling. The Working Group recommended amendments to the form L5 to capture likelihood of survivorship of skates and the removal of form L11 (where that information was previously recorded). It also recommended small changes to form L6 to permit the recording of the biological, tagging or recapture details of any species.

Skate tagging protocols

6.35 The Working Group noted that a primary goal of the Year-of-the-Skate was the establishment of a skate tagging program in new and exploratory fisheries and noted that skate tagging programs are already operational in Subarea 48.3 and Division 58.5.2.

6.36 The Working Group considered the tagging rates necessary to achieve an estimate of biomass. The Working Group employed the methodology detailed in WG-SAM-08/6 to estimate tagging levels required to give a pre-defined abundance estimate precision in the following year, for a given level of catch and with an approximate estimate of the underlying biomass.

6.37 In the Ross Sea, a very preliminary stock assessment suggested the biomass of skates to be about 6 000 tonnes (SC-CAMLR-XXVI, Annex 7), with around 7 500 skates scanned in an estimated catch of 70 tonnes in 2007/08 (Table 16). Estimates of survivorship (given mean depth at which the fish are taken) and of tag shedding were used to define a tag-associated mortality of 0.41 (a survivorship of 66%). Natural morality was assumed to be 0.15. Using the number of skates tagged per skate caught to define tagging intensity (based on the catch and stock size in 2008), the Working Group investigated three candidate CVs of 0.2, 0.3 and 0.5 (representing accurate to moderately accurate to poor estimates). The model predicts that tagging around 1 in 2, 1 in 5 and 1 in 20 skates would achieve CVs of 0.2, 0.3 and 0.5 respectively.

6.38 The Working Group therefore recommended a tagging rate of 1 in every 5 skates caught in new and exploratory fisheries during 2008/09 up to a maximum of 500 skates per vessel. The tagging program will be coordinated by the Secretariat, which will be the repository for skate tagging kits.

6.39 The Working Group noted that there would be a change in tag type in Subareas 88.1 and 88.2 in 2008/09 (WG-FSA-08/30) and that there is potential to confound population assessments due to differing tag-loss rates through time or differences in tag loss between tag types. The Working Group recommended that in new and exploratory fisheries, skates be double-tagged, with one CCAMLR tag (issued by the Secretariat) in each wing. The Working Group further recommended that, where possible, tagging experiments be undertaken to compare different tag types and estimate tag-shedding rates.

6.40 The Working Group recommended that all skates be measured prior to release. Such information is valuable in reducing the uncertainty about skate growth rates.

Skate biological information

6.41 The Working Group noted the requirement to undertake additional biological sampling on skates during 2008/09, but recognised that observers already have a full workload. The Working Group considered the impact on assessments of reducing the number of *Dissostichus* spp. sampled per line, to permit more skates to be analysed per line.

6.42 Applying simple sampling theory (using the basic square root proportionality relationship between precision and sample size), the Working Group estimated that a reduction in sample size from 35 to 20 *Dissostichus* spp. would result in a reduction in precision of 25% around mean values. The Working Group noted that skates were not caught on all lines, so the actual loss of precision would be less than 25%.

6.43 The Working Group noted that the number of biological samples carried out is proposed to change from 35 per line to one per 150 hooks, and endorsed this recommendation (paragraph 11.4(ii)(e)). Therefore, the Working Group proposed that, when skates are caught on a line, they are randomly sampled at a rate of 3 skates/thousand hooks, with the *Dissostichus* spp. sampling reduced to 4 toothfish/species/thousand hooks. If sufficient numbers of skates are not caught to meet this protocol, it is proposed that the total number of biological samples per line should remain constant with the additional sampling carried out on *Dissostichus* spp. The Working Group recommended that this increased recording of biological information for skates initially be limited to the Year-of-the-Skate, but be reviewed at next year's meeting of WG-FSA.

6.44 The Working Group noted that the only biological information requiring sacrifice of the animal is female maturity stage. Therefore, the Working Group recommended that skates should not be sacrificed for biological sampling, and that female maturity stage only be recorded if the skate is dead or has sustained life-threatening injuries (conditions 1 and 2). All live skates which are part of the biological sampling, which have not sustained life-threatening injuries, should be handled with care and released after biological information has been recorded, if they are still suitable for release (i.e. still in condition 3 or 4).

Identification guides for benthic by-catch

6.45 Following a request from the Scientific Committee (SC-CAMLR-XXVI, paragraph 4.190) for the development of area-specific guides for the identification of benthic organisms, the Working Group welcomed the development of guides to the vulnerable Ross Sea benthic fauna (WG-FSA-08/19) and to the HIMI benthic invertebrates (WG-FSA-08/59). The Working Group also noted that an invertebrate guide has been in use in Subarea 48.3 in recent seasons. The Working Group noted that the Ross Sea guide only includes taxa expected to be included in the vulnerable category, which may change when more information is available. The Working Group noted that a guide that encompassed the whole CCAMLR region would be useful, but agreed that this would be costly to achieve in the short term.

6.46 The Working Group discussed the completeness and appropriateness of current CCAMLR codes for VME-related taxa with respect to the hierarchical detail required for identification purposes. The Working Group noted that codes for some taxa do not currently

exist within CCAMLR and will need to be created. The Secretariat reported that FAO three-letter codes are associated with a full hierarchical alpha-numeric code. For taxa currently without FAO codes, the Secretariat will issue interim codes and request codes from FAO for updating at a later date. The Working Group recommended that VME-related taxa detailed in WG-FSA-08/19 currently without a code be issued with an interim code for the 2008/09 season.

6.47 Noting that the number of 3-alpha combinations is limited (17 576 combinations) the Working Group recommended that the utility of alternative hierarchical taxon identification systems, such as ITIS, be further investigated.

INCIDENTAL MORTALITY OF MAMMALS AND SEABIRDS ARISING FROM FISHING (AD HOC WG-IMAF REPORT)

7.1 The Co-conveners of ad hoc WG-IMAF presented its report (Annex 6) to WG-FSA. The Working Group discussed the following items.

Marine debris

7.2 The Working Group queried if ad hoc WG-IMAF had noted an increase in frequency of bait box packaging bands as debris and if this is becoming a greater problem in the Convention Area. The Co-conveners noted that this was the first year that ad hoc WG-IMAF has had the topic of marine debris on its agenda. It had addressed several issues relating to marine debris, but had not yet been able to undertake a comprehensive assessment of marine debris trends (Annex 6, paragraphs 12.1 to 12.14). Nevertheless, WG-IMAF noted that from the data reported to the Secretariat there had been an increase in occurrence of packaging bands in marine debris and of entangling material on Antarctic fur seals.

Estimating incidental mortality arising from IUU fishing

7.3 Noting that ad hoc WG-IMAF had not estimated incidental mortality arising from IUU fishing this year, the Working Group queried if it would be more appropriate to use more recent estimates of a fishery not using mitigation measures (e.g. the Division 58.5.1 longline fishery prior to its use of seabird mitigation measures) rather than the observed seabird by-catch rates from longline fishing operations in 1996/97 when few vessels used mitigation measures.

7.4 The ad hoc WG-IMAF Co-conveners agreed that this would be useful in considering future estimations of incidental mortality arising from IUU longline fishing. However, the key issue this year is that the vast majority of reported IUU fishing operations were of gillnet gear or vessels, reliable seabird by-catch rates and information for gillnet applications are not available (Annex 6, paragraphs 5.3 and 5.4).

Fishing methods in use in the Convention Area

7.5 The Working Group enquired if the trotline sink rates achieved to date were sufficient to avoid interactions with seabirds. The Co-conveners of ad hoc WG-IMAF noted the review of several papers last year which indicated trotlines sink relatively rapidly beyond the range of foraging seabirds, one study indicating an average of 0.8 m s^{-1} (SC-CAMLR-XXVI, Annex 6, paragraphs II.81 to II.91 and II.100).

7.6 The Co-conveners of ad hoc WG-IMAF noted that, as a result of the work of ad hoc WG-IMAF this year, SC-CAMLR-XXVII/BG/19 included suggested revisions to Conservation Measures 25-02 and 24-02 to incorporate a line-weighting standard for this newer gear application, as well as a protocol for testing the line sink rate (Annex 6, paragraphs 6.11 and 9.15).

7.7 Both WG-FSA and ad hoc WG-IMAF have identified needed information regarding the trotline longline method (Annex 6, paragraphs 6.1, 6.2 and 7.27; paragraph 11.8). Ad hoc WG-IMAF had found the paper reviewing the autoline method extremely useful (WG-FSA-08/60) and had encouraged Members to submit similar reviews on the trotline method of longlining and other fishing methods used in the Convention Area (Annex 6, paragraph 6.2). The Working Group agreed that this was particularly important work across both working groups and an area for continued cooperation.

Cross-cutting issues

7.8 WG-FSA considered the role ad hoc WG-IMAF might have, along with WG-FSA, in progressing a risk-management framework for avoiding significant adverse impacts of bottom fishing gear on VMEs (an approach that has been successfully used by ad hoc WG-IMAF to minimise the risk of fishery mortalities on seabirds).

7.9 The Co-conveners of ad hoc WG-IMAF welcomed that the risk-assessment approach was being considered to address other incidental mortality issues, such as VMEs, but noted that the current expertise within ad hoc WG-IMAF would have to be broadened to include the appropriate expertise for this topic.

7.10 The Working Group noted that one option would be to hold a VME workshop that would draw the needed and appropriate expertise from all working groups of the Scientific Committee (paragraph 10.54).

7.11 The Working Group noted the ongoing utility of coordination and cooperation between WG-FSA and ad hoc WG-IMAF and concurred with the ad hoc WG-IMAF recommendation that the current practices with respect to joint work continue.

EVALUATION OF THREATS ARISING FROM IUU ACTIVITIES

Development of approaches for estimating total removals of toothfish

8.1 The Working Group noted the Secretariat's development of the JAG matrix for estimating the uncertainty associated with IUU fishing events, and noted that this work will be reviewed by SCIC (WG-FSA-08/10 Rev. 2; see also paragraph 3.16).

8.2 The Working Group also noted that the Secretariat had developed a measure of the local density of licensed vessels (WG-FSA-08/10 Rev. 2; see also paragraph 3.12 and SC-CAMLR-XXVI, Annex 5, paragraphs 8.2 and 8.3).

Review of historical trends in IUU fishing activity

8.3 The Working Group reviewed the catch history of *Dissostichus* spp. taken by IUU fishing in the Convention Area (Table 3 and Figure 1). This time series had been updated using estimates reported in WG-FSA-08/10 Rev. 2.

8.4 The Working Group noted that the number of IUU fishing vessels observed in 2007/08 had declined (paragraph 3.14). However, the IUU fleet is increasingly dominated by gillnet vessels and there is currently no information to estimate the catch of these vessels, or the impact of gillnets on target and by-catch species, seabirds and marine mammals (Figure 6, paragraph 3.13). This matter had been referred to ad hoc WG-IMAF and SCIC.

8.5 In the absence of information on catch rates, the Working Group concluded that the increase in IUU vessels using gillnets indicates that gillnets are likely to be a more efficient method for catching target species, and noted that gillnets do not require bait and allow vessels to operate with fewer crew. Threats arising from the use of gillnets include non-selective fishing, entanglements and ghost fishing.

8.6 The Working Group agreed that further information on the IUU gillnet fleet and the operation of gillnets was urgently required. It urged Members to increase their efforts to document the IUU gillnet activities in the Convention Area and, where feasible, haul operational IUU gillnets or board IUU gillnet vessels and examine the vessels' catches and logbooks in order to gain an understanding of this IUU fishing method.

8.7 WG-FSA noted that ad hoc WG-IMAF had been unable to provide a reliable estimate of the number of seabirds killed as a result of IUU gillnet operations in 2007/08 (Annex 6, paragraphs 5.3 and 5.4).

8.8 The Working Group agreed that the reduction in the number of IUU fishing vessels sighted recently in the Convention Area was not necessarily an indication that total catches and levels of incidental mortality associated with IUU fishing activities had decreased.

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

Review of information available to the meeting

9.1 Nineteen papers contained information on the biology and ecology of target species in the fisheries (*D. mawsoni, D. eleginoides* and *C. gunnari*), by-catch species (skates), past target species (*Chaenodraco wilsoni*), and on food consumption by Antarctic fish in general. Full papers are available on request from the CCAMLR Secretariat and summaries of these documents will be available in the *CCAMLR Scientific Abstracts* and therefore are not repeated here. Ecosystem effects of fishing and interaction between predators (seals, killer whales) and *D. mawsoni* have been dealt with in Annex 4, paragraphs 6.1 to 6.23.

9.2 Following on from requests of the Scientific Committee (SC-CAMLR-XXVI, Annex 5, paragraph 9.10), some progress has been made with respect to stock structure in *D. eleginoides*, and reconstruction of the life history of *D. eleginoides*, while no further progress was noted with respect to a field guide for skates in the Southern Ocean (see below).

Dissostichus mawsoni

9.3 Results from studies on the distribution and abundance of *D. mawsoni* discussed in this section of the agenda were found to be consistent with hypotheses forming the basis of modelling work currently undertaken for the species and discussed in the remit of WG-SAM (Annex 7, paragraph 5.2).

9.4 WG-FSA-08/12 described the size characteristics of *D. mawsoni* and *D. eleginoides* caught in different areas of the Antarctic shelf, as well as characteristics of the maturity level of their gonads and nutrition (see paragraph 3.77).

9.5 The most likely areas where *D. mawsoni* spawn are the Pacific Antarctic Ridge north of the Ross Sea and the Amundsen Ridge in the Amundsen Sea. In the Cooperation Sea the most likely area of spawning is BANZARE Bank. Spawning occurs in winter and may extend into autumn or spring (WG-FSA-08/14).

9.6 The Working Group noted that results confirm the hypotheses that juvenile fish inhabit mostly the shelf, while larger fish live on the slope and pre-spawning fish are found either on their northward spawning migration or inhabit the deeper slope.

9.7 Age estimates of *D. mawsoni* indicated that they live to at least 39 years. Estimated and radiometric ages were in close agreement, confirming age estimation criteria and an annual periodicity of otolith growth zones. Von Bertalanffy growth function parameters indicate *D. mawsoni* are relatively slow growing (k = 0.111; t_0 = –0.605), especially in relation to their maximum size (L_∞ = 158.9 cm) (WG-FSA-08/17) (paragraphs 3.66 and 3.67).

9.8 The predatory nature of *D. mawsoni* from its early age onwards is underlined for various regions of the high-Antarctic in WG-FSA-08/34. Main prey items are fish and squid in larger fish, while juveniles take invertebrates to some extent. Details are provided on how the depth distribution of fish changes when fish grow larger and older.

9.9 The frequency of *D. mawsoni* females with ovaries in maturity stage IV was 1.2–10% in different regions in late summer. The individual absolute fecundity varied from 0.03 to 0.61 million eggs, and relative fecundity from 11.48 to 42.53 eggs. The diameter of the largest trophoplasmatic oocytes varied from 2.8 to 3.15 mm (WG-FSA-08/35).

9.10 The Working Group noted that previous estimates of absolute and relative fecundity have been higher. It appears as if not all mature eggs assumed to be spawned in the previous study are actually spawned. Close cooperation between New Zealand and Russia is envisaged to further elucidate the spawning of *D. mawsoni*.

9.11 WG-FSA-08/41 presented an analysis of stomachs of *D. mawsoni* caught by the longliner *Yantar* using the Spanish longline method in the Ross and Amundsen Seas during the period from 29 December 2006 to 3 March 2007. During the austral summer, *D. mawsoni* in the Ross and Amundsen Seas fed actively (index of fullness was 1.88). Among fish, *M. whitsoni* was the main food object (up to 18.2%), and among the non-fish items it was squid (8.1–27.3%).

9.12 The Working Group noted that results from this study are consistent with earlier work presented in Stevens (2004, 2006).

9.13 The Working Group also noted the results of studies reported in WG-FSA-08/48 (length-at-maturity) and WG-EMM-08/27 and 08/43 (trophic studies).

Dissostichus eleginoides

9.14 The Working Group noted the results of studies reported in WG-FSA-08/P3, 08/P4 and 08/P5 (otolith chemistry).

9.15 The Working Group noted with concern that some of the hypotheses presented in the three papers are inconsistent with current knowledge on the life cycle of *D. eleginoides*. Knowledge obtained in the course of CCAMLR-related research needs to be better incorporated in non-CCAMLR studies on this species in order to avoid two sets of research, which are not compatible, existing in parallel.

Skates

9.16 Samples of rajids taken in the commercial fishery in the Ross Sea (WG-FSA-08/20) indicated a ratio of 10.75:1 of *A. georgiana* to *B.* cf. *eatonii*, which is consistent with a previous estimate based on a large sample of tagged skates. Revised length–weight regression relationships for male and female *A. georgiana* confirmed that male and female relationships differ significantly. Better estimates of median length-at-maturity were made possible through a combination of improved observer staging of skates, and a moderate-sized sample of whole skates that was examined in the laboratory. There was no significant difference between the median length-at-maturity for male and female *A. georgiana*, which was estimated to be 67.3 cm pelvic length (=96.5 cm TL).

9.17 The Working Group noted that considerable discrepancy still exists in the understanding of how fast skates grow and how old they become. Validated ageing of skates is essential in understanding their potential to withstand even low levels of fishing. The Working Group encouraged the exchange of ageing material and information on ageing techniques in order to approach validation in ageing of skates.

Icefish

9.18 WG-FSA-08/29 investigated ontogenetic, interannual and regional variations in diet in *C. gunnari* around South Georgia in three successive summer seasons. Diet of the 2 239 fish (13–56 cm TL) investigated varied significantly between years and age classes but there was little regional difference in diet. In general, diet was dominated by krill (*E. superba*) and by the amphipod *Themisto gaudichaudii*. Smaller (younger) fish tended to prey on a higher proportion of *T. gaudichaudii* and small euphausiids such as *Thysanoessa* spp. and took smaller quantities of *E. superba*. In a season of poor krill availability, the proportion of krill in the diet, stomach fullness and fish condition were significantly lower than in the other summer seasons. The poor krill season was followed by a large reduction (>80%) in the estimated annual biomass of *C. gunnari* the following year (2005). This may have been a result of mortality of age 2+ and 3+ fish, which were more krill dependent than 1+ fish. Younger fish appear to have survived, leading to an increase in the estimated population biomass in 2006.

9.19 Age determination was conducted on *C. wilsoni* collected off the tip of the Antarctic Peninsula in 2006 and 2007 (WG-FSA-08/33). Preliminary results confirm results from earlier studies that the large majority of the fish were 2–4-year-old fish.

Antarctic fish – general

9.20 WG-FSA-08/42 presented a detailed review on the consumption of pelagic prey by Antarctic fish. The paper had initially been submitted for consideration by the Joint CCAMLR-IWC Workshop in Hobart, Australia, in August 2008. The paper had been updated since then according to comments provided at the meeting. Given that the paper has to be completed by the end of November 2008, members of WG-FSA were strongly encouraged to provide more comments on the paper before the end of CCAMLR-XXVII.

Species profiles

9.21 Species profiles have been completed for two of the species currently being fished in the CAMLR Convention Area: *D. mawsoni* (Dr Hanchet) and *C. gunnari* (Drs K.-H. Kock (Germany) and I. Everson (UK)). The profile of a third species, *D. eleginoides*, will be updated in the course of 2009 (Dr M. Collins (UK)). The Working Group recommended that these three profiles be published on the CCAMLR website in early 2010 and be updated regularly.

9.22 Species profiles of species other than the target species in the fisheries, such as *Gobionotothen gibberifrons* or *Chaenocephalus aceratus*, are currently not envisaged.

CCAMLR Otolith Network

9.23 No new information was available to the Working Group on progress in the calibration work on otolith readings following the 'Second Workshop on Estimating Age of Mackerel Icefish, *Champsocephalus gunnari'* held in Kaliningrad, Russia, in June 2006. The Working Group recommended that the calibration work be completed in 2008/09 and a report on the outcome of the otolith exchange be submitted to WG-FSA at its meeting in 2009.

CONSIDERATIONS OF ECOSYSTEM MANAGEMENT

10.1 With the exception of section 10.2, most of the Working Group's considerations of ecosystem management were discussed in greater detail in other sections of the report, and cross-references are provided where appropriate.

Ecological interactions

10.2 Ecological interactions were considered during discussion of WG-FSA-08/19 (benthos), papers discussed in section 9 of this report and Annex 4, paragraphs 6.1 to 6.23.

Bottom fishing activities and VMEs

10.3 The Working Group recalled the outcomes of its consideration of this issue last year (SC-CAMLR-XXVI, Annex 5, paragraphs 14.1 to 14.43), including:

(i) agreement on the nature of destructive fishing practices, the concept of vulnerability and what constitutes significant adverse impacts (significant harm) (SC-CAMLR-XXVI, Annex 5, paragraphs 14.4 to 14.6) and the available mechanisms within CCAMLR that could be used to avoid significant adverse impacts on VMEs (SC-CAMLR-XXVI, Annex 5, paragraph 14.7);

(ii) history of bottom fishing in the CCAMLR high-seas areas (SC-CAMLR-XXVI, Annex 5, paragraphs 14.12 to 14.20);

(iii) a proposed annual process and procedure for managing the interactions of bottom fishing with the benthic environment in order to avoid significant adverse impacts on VMEs, noting that avoidance of such impacts could be achieved using a number of mechanisms, including, *inter alia*, the development of mitigation methods, within-season avoidance (move-on) provisions or the designation of longer-term closed areas (SC-CAMLR-XXVI, Annex 5, paragraph 14.21). The procedure is described in SC-CAMLR-XXVI, Annex 5, paragraphs 14.22 to 14.39, including:

(a) recognition of the insufficiency of data and that, when evidence of VMEs is found, interim protection would be needed while sufficient data are collected to enable the Commission to judge whether continued protection of an area is needed or not;

(b) the need for research and data collection plans, fisheries operation plans, mitigation development strategies, register of vulnerable areas and conservation management plans;

(c) the inverse relationship between trigger levels and the risk of impacting areas, including examples of the use of such levels to trigger actions for research, moving on or interim protection during a season;

(d) approaches to evaluating potential benthic interactions and classification of the areas;

(e) the progression of areas in their classification, and associated data collection requirements and protection, from being 'open' to 'potentially vulnerable' to 'vulnerable';

(f) the need to match the area of the location being protected with the scale of the VME;

(g) the role of observers in acquiring data.

10.4 The Working Group noted the endorsement of its report by the Scientific Committee, which took special note of a number of issues (SC-CAMLR-XXVI, paragraphs 4.162 and 4.163). The Scientific Committee endorsed the procedure and definitions provided by WG-FSA, which is based on existing practices and procedures (SC-CAMLR-XXVI, paragraph 4.164 and Figure 1) and which clearly shows what is needed to develop scientific advice on:

(i) practical guidelines on identifying evidence of VMEs during fishing activities;

(ii) procedures that could be followed if evidence of VMEs is found;

(iii) research and data collection programs needed to:

(a) evaluate VMEs and the potential for significant adverse impacts;

(b) develop approaches to avoid and mitigate significant adverse impacts of fishing on benthic ecosystems.

10.5 The Commission endorsed this framework provided by the Scientific Committee (CCAMLR-XXVI, paragraphs 5.11 and 5.12) and the proposed further work (CCAMLR-XXVI, paragraphs 5.13 to 5.15). It tasked the Scientific Committee with developing pragmatic and flexible guidelines for:

(i) identifying VMEs;

(ii) defining actions taken by vessels which may encounter evidence of VMEs during the course of fishing.

These would be reviewed at its next meeting (CCAMLR-XXVI, paragraph 5.18).

10.6 The Working Group agreed that a suitable test of the guidelines would be whether significant adverse impacts on VMEs would be avoided while the scientific advice and management approaches were developed and refined.

10.7 The Working Group noted that Conservation Measure 22-06 requires Contracting Parties whose vessels wish to engage in any bottom fishing activities, beginning 1 December 2008, shall follow the procedures described in paragraphs 7 to 10 of the conservation measure. In addition, the Scientific Committee shall provide an assessment to the Commission, based on the best available scientific information, whether proposed bottom fishing activities would contribute to having significant adverse impacts on VMEs and what management measures could be taken to prevent such impacts. Following Conservation Measure 22-06, the Working Group identified the following tasks for providing advice to the Scientific Committee:

(i) review preliminary assessments and proposed mitigation measures expected to be submitted by Members proposing to participate in bottom fishing;

(ii) review, refine and, as needed, develop procedures and standards for assessing potential effects of proposals and possible mitigation measures;

(iii) including the use of other information and approaches available to the Working Group, provide advice on possible effects of bottom fishing activities, mitigation measures and data collection plans;

(iv) provide advice on how Members should prepare preliminary assessments and proposed mitigation measures;

(v) collate information on encounters with VMEs and advise on known and anticipated impacts of bottom fishing activities on VMEs and recommended practices when evidence of a VME is encountered in the course of bottom fishing operations.

10.8 In undertaking this task, the Working Group agreed to structure its discussion and advice around the framework endorsed by the Commission.

Encounters with VMEs, known and anticipated impacts of bottom fishing on VMEs

10.9 WG-FSA-08/53 proposed an impact assessment framework for bottom-impacting fishing methods in the CAMLR Convention Area. The paper detailed six steps in an assessment:

(i) description of the fishing gear;

(ii) description of fishing activity, and definition of spatial footprint for a standard fishing event;

(iii) description of non-standard gear deployment scenarios, and associated footprints;

(iv) vulnerability assessment for selected VME taxa;

(v) description of total historical fishing effort;

(vi) calculation of total cumulative impact.

10.10 The Working Group noted that in this impact assessment process:

(i) fishing events are considered not to overlap;

(ii) all VME taxa are assumed to be available throughout an area;

(iii) the proportion of VME taxa estimated to be affected by fishing is determined to be the proportion of the fishable area under consideration that would have been affected by the total footprint discounted by the level of escapement expected by different VME-type taxa;

(iv) consideration needs to be given as to what parts of the gear interact with benthic habitats.

10.11 WG-FSA-08/58 presented direct observations using video footage of the effects of an IWL on the seafloor during a haul. The estimated seabed area affected by the haul of the longline was estimated, based on an estimated sideways sweep of the line as 24 m before leaving the bottom. In his presentation, Dr Welsford noted that:

(i) the video evidence shows that benthos by-catch can be lost from the longlines before they reach the surface;

(ii) despite strong current flows, the lines for which footage was available did not move until hauling began;

(iii) although this is only one observation, footage from two other longlines showed plumes of sediment indicative of lines also moving sideways during hauling.

10.12 The Working Group noted the following points in estimating the footprint of a longline using camera gear:

(i) although the cameras are designed to be neutrally buoyant and evidence reviewed at the meeting indicated that the camera did not impact on the behaviour of the line, the potential for the camera equipment to impact on the behaviour of the line should be monitored, particularly when cameras are being used to assess the footprint of a shot;

(ii) sideways movement of lines could occur because of a vessel not hauling directly over a line or currents moving the line in opposition to the vessel;

(iii) some erect organisms that stand well above the bottom could continue to be affected by sideways moving lines even after the lines are lifted from the bottom, but such calculations should recognise that shorter organisms will be impacted over shorter widths during lifting;

(iv) the degree of sideways movement of the lines and their impacts on benthos will depend on the type of vessel, type of gear and local conditions;

(v) models of line movement, and therefore the area affected by the line, could be improved by factoring in data on location of vessels relative to the line during the haul, along with information on currents at the time of the haul.

10.13 The Working Group agreed that, as a result of this new information, the footprint of an individual autoline longline is unlikely to be as small as estimated in CCAMLR-XXVII/19. It also agreed that the magnitude of the footprint is highly uncertain, noting the observation above that a line may impact benthos up to 25 m.

10.14 The Working Group thanked Australia for developing the camera gear for deployment on longlines, indicating that this work is important for better understanding the dynamics of the fishing gear on the bottom and for estimating the effects that longlines and other gears will have on benthic organisms.

10.15 The Working Group noted that these studies focused on autoliners using IWLs. It was unclear what effects Spanish longline and trotline systems might have on benthic habitats. The Working Group noted that it had no information to consider the impacts of other gears, noting that anchors, clusters of hooks and other elements of these gear types could have impacts and that the effects of these should be evaluated. It noted that the camera gear developed by Australia could be deployed on all benthic fishing gears.

10.16 The Working Group noted that there was no empirical evidence with which to quantify the effects of fishing gear on benthic taxa or habitats in the Convention Area (see paragraph 10.54).

10.17 For the purposes of undertaking an assessment of benthic interactions of bottom fishing (SC-CAMLR-XXVI, paragraph 4.165(iii)), the Working Group reviewed and revised the analysis of the effective fishing footprint from 2007. Instead of presenting the catch in the different management areas, the accumulated effort (thousands of hooks) is summarised in Figure 7 for the period 1985–2007 and for 2008 separately. The Working Group noted that in future years it would be desirable to plot the SSRUs as well as the subarea and division boundaries.

10.18 The Working Group agreed that most attention on evaluating potential impacts of bottom fishing on VMEs needs to be given to locations with the most fishing effort relative to seabed area. It also recognised the need to distinguish between effort in shallow areas compared to deeper areas. In the absence of other information, the maps showing effort in grid cells in each subarea/division are one indicator of where most fishing effort has been deployed. This can be combined with estimates of fishable seabed area to estimate the

proportion of fishable area possibly impacted by fishing gear. Table 18 shows the results of such an analysis for SSRUs in Divisions 58.4.1 and 58.4.3b. Fishable seabed areas, total accumulated effort (summed length of lines deployed over the course of the fishery) and the proportion of total effort in each depth stratum were estimated using data from the CCAMLR database according to the depth ranges used in the *CCAMLR Statistical Bulletin*. The potential proportions of seabed areas that may have been affected by longlines were calculated using a low and high value for the estimated width of the area affected by an individual longline – 1 m (consistent with CCAMLR-XXVII/19) and 25 m (consistent with WG-FSA-08/58). Table 18 also shows the same calculations for Subarea 88.1 but only for the depth range 600–1 800 m. The breakdown of seabed area by depth is not available at present. The seabed areas used in the Subarea 88.1 analysis were those provided to New Zealand in 2003 (SC-CAMLR-XXII, Annex 5, Table 5.3). The summary effort data without the seabed calculations for Subarea 88.1 and the other SSRUs in the exploratory toothfish fisheries are also given.

10.19 The Working Group agreed that this approach is a useful foundation for providing advice on the current scales of possible interactions of fishing gears with VMEs in exploratory longline fisheries, noting that some SSRUs in the seamount/ridge areas to the north of Subarea 88.1 may have had larger proportions than other SSRUs of seabed potentially affected by bottom fishing activities.

10.20 The Working Group recommended that updated seabed area information be obtained for the three depth strata from reliable sources for all SSRUs.

10.21 The Working Group noted that these data could be used to assess, as per Conservation Measure 22-06, the possible contributions of proposed fishing activities to impacts in different areas. However, there is insufficient information on the areas proposed to be fished in the coming exploratory fisheries to provide advice on what those contributions to impacts on VMEs might be.

10.22 The Working Group also noted that:

(i) such analyses will need to take account of the potential for lines to be overlapping, such as would be the case in repeat sets, and that, in these cases, consideration will need to be given as to whether the full impact of fishing occurs during the first interaction, with repeat sets having subsequent negligible effects (but see the conclusions in CCAMLR-XXVII/19);

(ii) the degree of impact within the footprint is difficult to ascertain because of the absence of empirical data on the effects of the different types of longlines on benthic habitats and VME-taxa. The Working Group agreed that future work to obtain empirical data was needed to reduce this uncertainty on the degree of impact of an individual line. Also, refinement is needed of the methodologies and calculations for determining the footprint (area) affected by the different types of longlines (WG-FSA-08/58) and for estimating the possible impacts on VME-taxa within the footprint as described in WG-FSA-08/53. These would be useful topics for discussion in the workshop noted in paragraph 10.54.

(iii) observed by-catch from longlines may not be a good indicator of interactions of longlines with VMEs because taxa affected by the longlines may not be

observed as by-catch when landed (paragraph 10.11). As a result, no by-catch may not mean that there has been no interaction with a VME. However, presence of VME taxa in by-catch may be indicative of the presence of a VME. Although catch rates of VME taxa cannot be used at present, it may be possible to use such rates to estimate the scale of impacts on VMEs in the future if the catchability of individual VME taxa can be determined.

10.23 The Working Group concluded this discussion noting that reducing the uncertainty in evaluations of accumulated impacts and the potential for proposed fishing activities to contribute to future impacts will be dependent on improving methods for assessing footprints coupled with the developing assessments of risk in different areas as outlined below.

Approaches to avoid and mitigate significant adverse impacts on VMEs

Preliminary assessments and proposed mitigation measures by Members

10.24 Table 19 summarises the relationship between new and exploratory fishing proposals and the submissions on preliminary assessments and proposed mitigation measures by Members. A summary of the available submissions is provided in CCAMLR-XXVII/26. The Working Group noted that only 5 out of 12 proposals contained preliminary assessments. As a consequence, the Working Group was unable to review and advise on the potential impacts of all new and exploratory fishery proposals.

10.25 The Working Group noted the large variation in substance of the preliminary assessments and agreed that a common approach is needed for providing these assessments, similar to the requirements for notifying exploratory fisheries. It agreed that the proposed pro forma given in Table 20 would provide a suitable standard for Members submitting preliminary assessments of the potential for their proposed bottom fishing activities to have significant adverse impacts on VMEs. The pro forma is designed to be consistent with the requirements for proposals on exploratory fisheries and is based on the requirements set out in paragraphs 7(i) and 7(ii) in Conservation Measure 22-06. The Working Group agreed that some consistency is needed in the provision of information on the following:

(i) Scope of the proposed operations –

  (a) fishing method(s) to be used
  (b) statistical area in which fishing will occur
  (c) likely period of operations.

(ii) Proposed fishing activity –

  (a) detailed description of gear;

  (b) scale of proposed activity, including estimates of total numbers of hooks and/or lines to be deployed;

  (c) spatial distribution of activity.

(iii) Mitigation measures to be used.

(iv) Assessment of known/anticipated impacts on VMEs –

(a) estimated spatial effort footprint;

(b) summary of potential VMEs present within areas of activity;

(c) likelihood of impacts;

(d) likely magnitude/severity of the interaction of the proposed fishing gear with VMEs;

(e) likely physical and biological/ecological consequences of impact.

(v) Estimated cumulative footprint.

(vi) Research activities related to provision of new information on VMEs –

(a) previous research, including the collection of direct and indirect evidence of VMEs;

(b) proposed research activities during the proposed fishing operations;

(c) proposed follow-on research.

10.26 The Working Group agreed that the requirements for preliminary assessments by Members will change as information on bottom fisheries improves. It is expected that points (i)–(iii) above are likely to be the most important information to be provided with proposals in future years, but at present details are also needed on points (iv)–(vi).

10.27 The summary of benthic by-catch in CCAMLR-XXVII/26 assembled by the Secretariat from the CCAMLR database was reviewed by the Working Group. The Working Group thanked the Secretariat for its work and agreed with the conclusion of the paper that the level of taxonomic detail in the CCAMLR database was insufficient for conducting quantitative analyses of interactions of the fisheries with benthic taxa and the potential effects on VMEs. Also, the variable quality in the identification of benthos would also impede the use of these data. This is discussed further in paragraphs 6.45 to 6.47.

10.28 The Working Group agreed that there are few empirical data to determine what the effects of the proposed activities might be on VMEs in the Convention Area and whether there would be overlap between the proposed fishing activities and VMEs.

Advice on possible effects of bottom fishing activities, mitigation measures and data collection plans

10.29 WG-FSA-08/64 provided a risk-management framework to evaluate the risk of proposed fishing operations contributing to significant adverse impacts on VMEs and for providing advice on management and mitigation measures that might be necessary, particularly for high-risk areas. The framework enables the assessments of risk for specific areas to be updated with new information and knowledge as it arises.

10.30 The Working Group agreed that a risk-assessment approach similar to that used by ad hoc WG-IMAF would be valuable and that the method in WG-FSA-08/64 could be developed further in this regard. It noted that the risk of significant adverse impacts should be evaluated at spatial scales commensurate with the scale of VMEs, i.e. much smaller spatial resolution than that considered by WG-IMAF. The important elements of a risk assessment would include, *inter alia*, the following concepts:

(i) Not all areas are equal with regard to probability of encounters with, or impacts on, a VME but information needed to assess such probabilities is very limited.

(ii) Models of likely habitat can be developed based on geomorphological, oceanographic and other environmental data and relating these to observations of where different VME taxa might be found. Observations can include direct observations (using videos, benthic sampling equipment) or indirect observations such as by-catch from fisheries.

(iii) An appropriate scale for characterising risk would be 0.5° latitude and 1.0° longitude, consistent with CCAMLR fine-scale areas.

(iv) Different areas will have different risks, e.g. higher-risk areas might be seamounts, heads of canyons and depths shallower than 550 m.

(v) There will be different requirements for data collection, research and mitigation for different levels of risk and different gear types.

(vi) The assignment of risk would need to be reviewed as new information becomes available.

10.31 The Working Group was unable to develop a risk assessment map for use in providing advice at this meeting on the possible effects of proposed fishing activities but recommended that the approach be developed further for the next meeting of WG-FSA, based on the considerations in paragraphs 10.29 and 10.30 and in the following section on VMEs.

10.32 The proposals summarised in CCAMLR-XXVII/26 for VME mitigation measures and activities related to VME interactions during fishing operations are summarised in Table 21. These could be naturally divided into three main classes of actions – activities by observers, responses of vessels and reporting requirements.

10.33 The Working Group agreed that observations of benthic by-catch will be important in the coming year. It would be useful for observers to provide information on the following:

(i) the locations and types of taxa being landed, where identification should be at least to the level of morphotypes provided in the poster developed by New Zealand (paragraph 6.45);

(ii) the numbers and, where possible, total mass of each taxon being landed;

(iii) information on the likely geographic origin of the taxa – noting that observations by hook or by magazine could be related to the geographic position of the line on the substratum, although this may require an observer to be provided with a hand-held GPS to note the position of the vessel when a taxon is landed;

(iv) in the future, an increase in the level of detail may be triggered by catches of specific types of taxa but it was recognised that, for the near future, records should be maintained of all landed taxa and that information by observers should be as complete as possible for the periods of observation.

10.34 The Working Group also noted that it would be desirable for observers to obtain information on the operations of the gear and for developing monitoring protocols. However, given the high workload of observers, these were considered to be lower priorities for the coming year.

10.35 The Working Group noted that the level of taxonomic detail requested to be recorded by observers in the coming season was unlikely to identify endemic species. It recommended that this issue be considered further at the workshop proposed in paragraph 10.54. It also requested this be considered by ad hoc TASO to see if practical methods could be adopted for obtaining finer taxonomic resolution in benthos by-catch data.

10.36 Proposed responses of vessels varied between submissions and were also dependent on the level of evidence required before triggering action. Actions proposed were:

(i) only undertaking research when VMEs became evident in landed by-catch
(ii) moving on when any evidence of VMEs was found
(iii) a mixture of the two based on a two-tiered trigger system.

The Working Group agreed that a common strategy was needed that would have specific variations depending on the type of gear being used. However, there was insufficient information to determine an agreed strategy, including the type and level of by-catch that would be required to trigger action and the precise nature of the action that should be taken. It was proposed that such issues would need to be resolved at a VME workshop (paragraph 10.54).

10.37 The Working Group noted the general expectation of Members to report encounters of fishing vessels with VMEs. However, there was variation amongst the submissions on what evidence was required before such an encounter would be reported. Nevertheless, observer data should be reported, along with the data necessary for the preliminary assessments by Members to be submitted in accordance with Conservation Measure 22-06 (Table 20).

10.38 A difficulty in the discussion was resolving the tension between protecting VMEs from significant adverse impacts and obtaining the information on whether those impacts are arising or have arisen. Under such circumstances, a strategy for avoiding significant adverse impacts on VMEs, such as through identifying areas that need to be avoided, will need to be developed taking account of the following issues:

(i) the degree to which by-catch on longlines is likely to be representative of the benthos affected by the longlines is not known but a positive record of VME taxa in the by-catch can be indicative of a VME (paragraph 10.22(iii));

(ii) undertaking research fishing in an area following a large catch of benthos in order to better document the VME is dependent on the spatial effects of the research lines being less than the spatial extent of the VME and that the latter will be appropriately circumscribed by the fishing research activity;

(iii) moving the fishing vessel out of the area following a large catch of benthos may over-interpret the by-catch as being representative of a VME and falsely assume that continued fishing in the area will impact the VME;

(iv) the requirement to use longlines to circumscribe VMEs may be ameliorated by using alternative methods for observing VMEs (see paragraph 10.44).

10.39 It was noted that continuing to fish in areas for which by-catch evidence indicates a possibility of interactions with a VME is contradictory to trying to protect VMEs from significant adverse impacts. Also, continuing such fishing in an area where evidence of a VME has been found may be contrary to Conservation Measure 22-06, paragraph 8.

10.40 The Working Group recognised this conundrum. It also noted that it could not calculate the level of evidence of VMEs to trigger actions for the different vessels at this meeting. The Working Group agreed that full compliance in providing data on benthos by-catch will be important in order to determine vessel-specific recommendations on trigger levels. An alternative strategy to vessel-specific trigger levels would be to identify areas that need to be avoided by all vessels.

10.41 The Working Group noted that data were available in CCAMLR-XXVII/26 to review locations of catches of VME taxa. However, it had insufficient time to make recommendations on areas that may need to be closed to the fleet for the coming season according to Conservation Measure 22-06. The Working Group noted that time should be made available next year to undertake such assessments and encouraged an improvement of data quality and quantity to support this.

10.42 The Working Group agreed that whatever strategy is adopted for the coming year, it will be important to collect as much benthos by-catch data as possible for analysis next year. It also agreed that experience of ad hoc WG-IMAF showed the following to be important in combating the incidental mortality of seabirds in fisheries and will be relevant to avoiding significant adverse impacts on VMEs:

(i) education of the crews of vessels participating in exploratory bottom fisheries will help increase awareness of the value of VMEs, in terms of their marine biodiversity and as habitat to fish assemblages, and the importance of developing mitigation measures to avoid impacts on them;

(ii) continued development of methods to reduce the frequency of gear loss that could impact on VMEs.

10.43 The Working Group noted that it would be useful to undertake simulations of different management approaches to evaluate which avoidance/research approaches may be most useful in avoiding significant adverse impacts on VMEs when there is no information on which to judge a suitable approach.

VMEs and significant adverse impacts

10.44 The Working Group noted that knowledge of VMEs and the types of impacts of bottom fishing activities will be enhanced by observations from a variety of methods,

including acoustics, video, benthic sleds, benthic grabs and by-catch in fishing gear. These methods could be used in both fishery and fishery-independent (research) operations. Other fishery-independent data could be obtained from dedicated scientific activities using CTDs, multi-beam sonar and satellites.

10.45 The Working Group noted a number of sources of existing information on the distribution and abundance of benthic fauna and habitats in the CAMLR Convention Area, including:

(i) the benthic bioregionalisation adopted by SC-CAMLR in 2007 (SC-CAMLR-XXVI, paragraphs 3.80 to 3.84), including a map of geomorphological features in the Ross Sea, eastern Antarctica and the greater Kerguelen Plateau, which shows, in particular, seamounts, canyons and variation in shelf areas;

(ii) data and information in the SCARMarBIN database (www.scarmarbin.be);

(iii) data and analyses for specific regions of the Southern Ocean, including:

  (a) habitat maps near the Mertz Glacier (Beaman and Harris, 2005);

  (b) types and general distribution of habitats in the southwestern Ross Sea (Barry et al., 2003);

  (c) maps of habitat features in the Antarctic Peninsula (Lockhart and Jones, 2008);

(iv) analyses of longline benthos by-catch data in the Ross Sea (CCAMLR-XXVII/26).

10.46 The Working Group noted that knowledge to date on the distribution of benthic fauna in the Southern Ocean indicates that there may be a large degree of endemism, i.e. locally restricted distributions of some taxa. This may be because of the particular life histories and dispersal of Antarctic benthic fauna, e.g. brooding versus broadcast spawners. The report on the CCAMLR bioregionalisation (SC-CAMLR-XXVI, Annex 9; SC-CAMLR-XXVI, paragraphs 3.71 to 3.89; SC-CAMLR-XXVI/11) indicated that most species were restricted to one box, indicating endemism at this scale (SC-CAMLR-XXVI, Annex 9, paragraphs 129 and 130).

10.47 The Working Group noted that a conclusion of endemism may not be easily drawn from only a few samples. However, such 'false positives' would result in protection of those VMEs until such time as further information became available when, if endemism was found not to be the case, the protection could be removed. If no protection was given and endemism was the true case, then there could be significant adverse impacts. In the case of seamounts, there is an increasing body of evidence that fauna can be endemic to individual or locally grouped sea mounts (Rogers, 2004).

10.48 The Working Group also recognised that experts other than those usually involved in CCAMLR may have data and knowledge suitable for consideration of VMEs and their vulnerability. It noted that the coordinated efforts in the CAML (www.caml.aq) and the IPY in sampling benthic habitats throughout Antarctica would provide useful data for these

analyses, such as that presented to the WG-FSA this year (SC-CAMLR-XXVII/13; WG-FSA-08/31). It encouraged the involvement of SCAR in providing data and advice on these issues.

10.49 The Working Group agreed that the development of a risk-assessment map required the development of a model of habitat types associated with features identifiable in datasets that give synoptic coverage of the CAMLR Convention Area, including bathymetry, geomorphology, oceanography and satellite data sources. Although there will be uncertainty in the application of such a model, it is unlikely that a detailed map of the distribution of VMEs throughout the CAMLR Convention Area from direct observations will ever be available. An example of such a model for an area of Division 58.4.1 is available in Beaman and Harris (2005). This approach uses empirical observations of the relationship between biota and physical attributes and then interpolating that relationship across the synoptic map of the physical environment. Such a process could be undertaken using research programs in other areas. Alternatively, theoretical models of those relationships could be developed from available data and, until such time as sampling is undertaken in an area, these models could be extrapolated to areas for which some physical synoptic data is available.

10.50 The Working Group agreed that direct evidence of VMEs, if available, should be included in the development of risk-assessment maps and in identifying VMEs that need to be avoided. It was agreed that camera evidence is the most compelling for identifying VMEs but that evidence gathered by research sampling devices such as beam trawls, sleds and grabs would be very strong indications of the presence of VME taxa.

10.51 As described above (paragraph 10.22(iii)), fishing gears are likely to be poor sampling devices of VME taxa. The Working Group agreed that the presence of VME taxa, or indicators of VMEs in samples from any of these methods, would be evidence that VMEs could be present. However, it also agreed that the converse of no VME taxa or indicators of VMEs in the samples did not necessarily represent an absence of VMEs. The degree to which this could be concluded would be dependent on the selectivity and sampling efficiencies of the gears.

10.52 The Working Group noted the lack of empirical evidence of the vulnerability of benthic taxa to the different bottom fishing gears used in exploratory fisheries. Consequently, it agreed that, in the first instance, the risk-assessment map will need to rely on expert opinion on vulnerability and possible impacts of fishing gears on different habitat types and VMEs (WG-FSA-08/53, 08/64).

10.53 The Working Group noted that there were only a few experts on benthic ecology available to the meetings and it would be useful to have a broad expert review of the issues surrounding the ecology and vulnerability of VMEs in the Southern Ocean. It also noted the discussion on this topic by WG-EMM (Annex 4, paragraphs 3.27 to 3.33).

10.54 The Working Group endorsed the view of WG-EMM that it would be useful to hold an expert workshop to consider the issues identified in Annex 4, paragraph 3.31. In addition, it requested that the following questions be incorporated into the discussion, noting the development of definitions and concepts in its report from last year (SC-CAMLR-XXVI, Annex 5, paragraphs 14.4 to 14.6):

(i) In the absence of direct observations of VMEs, how might maps be developed indicating where these VMEs are likely to be?

(ii) What are the likely life-history attributes of indicative VME taxa in those VMEs and, as a result, the likely resilience and resistance of those VMEs to bottom fishing impacts; what is the potential vulnerability of those VMEs to different gear types?

(iii) To what degree might benthic taxa be limited in their distribution?

(iv) What is the likely importance of VME taxa to fish assemblages and the degree to which fish diversity could be used as indicators of VMEs?

10.55 The Working Group agreed that the work on identifying VMEs and understanding the risks to VMEs of impacts by bottom fishing activities could be separated as a task from consideration of mitigation measures and data collection plans. It requested that the Scientific Committee consider whether consideration of VMEs and risk could be undertaken by WG-EMM and the consideration of mitigation measures be part of the work of WG-FSA.

Notification of VMEs

10.56 SC-CAMLR-XXVII/13 described VMEs identified by Australia during the CEAMARC-CASO voyage, part of Australia's IPY work. Eighty-nine stations were sampled using various methods, including trawl gear with associated digital video and/or stills cameras, on the continental shelf and slope off George V and Terre Adélie Lands to the west of the Mertz Glacier. Two of the stations were nominated as VMEs in the paper. Station 65 was located between 523 and 827 m at the head of a canyon system leading off the shelf and showed extensive biogenic habitat composed of hydrocorals, sponges and erect bryozoans. Station 79–81 was also located at the head of a canyon system further west at 436–844 m and showed extensive biogenic habitat composed of large sponges, hydrocorals and erect bryozoans. A video of the areas concerned was shown to the Working Group.

10.57 The Working Group agreed that these were obvious cases of VMEs, with clear evidence of well developed benthic communities.

10.58 Dr Ramm introduced the draft VME notification form developed by the Secretariat on the basis of the requirements in Conservation Measure 22-06 and tabular notification in SC-CAMLR-XXVII/13. It was designed in such a way that it could be submitted by Members as part of the 5-day reporting system during fishing operations and could be used by Members undertaking research activities.

10.59 The Working Group thanked the Secretariat for developing this form and recommended that it be used as the means of notifying the Secretariat when evidence of VMEs is encountered. It noted that the type of information that could be included in the form might vary from the data collected by observers. Nevertheless, the Working Group agreed that a Member may collect other data and knowledge not collected by the observers that could be used for notifying the occurrence of a VME.

10.60 The Working Group requested that the Scientific Committee consider the method by which these notifications would be reviewed and the process for adding a VME to the Register of VMEs. It also asked the Scientific Committee whether there was an expectation that WG-FSA be the primary working group where such reviews would be undertaken. The

Working Group noted that the requirements for protecting VMEs may change as more information becomes available, including data on the spatial extent of VMEs, and their vulnerability to fishing.

Advice to the Scientific Committee

Guidelines

10.61 The Working Group recommended the Scientific Committee consider the following in providing advice to the Commission according to its request in CCAMLR-XXVI, paragraphs 5.13 to 5.15.

10.62 The Working Group agreed that a suitable test of the guidelines would be whether significant adverse impacts on VMEs would be avoided while the scientific advice and management approaches were developed and refined.

Identifying VMEs

10.63 The Working Group drew the attention of the Scientific Committee to paragraphs 10.44 to 10.55 on its deliberations on identifying VMEs.

10.64 Knowledge exists on the distribution and abundance of benthic taxa in the Southern Ocean in sufficient form to develop maps of the distribution of some types of taxa (paragraph 10.45). It was noted that there may be a large degree of endemism, particularly on seamounts (paragraphs 10.46 and 10.47). It was also noted that there may be other sources of data on the distribution of VMEs and VME taxa, including data from recent IPY and CAML voyages (paragraph 10.48). Nevertheless, the Working Group agreed that the general distribution of VMEs in the Southern Ocean will need to be inferred using habitat models (paragraph 10.49). These could be used to develop risk-assessment maps for predicting the level of risk of impacting VMEs in different fishing locations.

10.65 The Working Group agreed (paragraph 10.50) that direct evidence of VMEs, if available, should be included in the development of risk-assessment maps and in identifying VMEs that need to be avoided. It was agreed that camera evidence is the most compelling for identifying VMEs but that evidence gathered by research sampling devices, such as beam trawls, sleds and grabs, would be very strong indications of the presence of VME taxa.

10.66 As described in paragraph 10.51, fishing gears are likely to be poor sampling devices of VME taxa. The Working Group agreed that the presence of VME taxa, or indicators of VMEs in samples from any of these methods, would be evidence that VMEs could be present. However, it also agreed that the converse of no VME taxa or indicators of VMEs in the samples did not necessarily represent an absence of VMEs. The degree to which this could be concluded would be dependent on the selectivity and sampling efficiencies of the gears.

10.67 The Working Group noted in paragraph 10.52 the lack of empirical evidence of the vulnerability of benthic taxa to the different bottom fishing gears used in exploratory

fisheries. Consequently, it agreed that, in the first instance, the risk-assessment map will need to rely on expert opinion on vulnerability and possible impacts of fishing gears on different habitat types and VMEs.

10.68 The Working Group agreed in paragraph 10.54 to endorse the view of WG-EMM that it would be useful to hold an expert workshop to consider the issues identified in Annex 4, paragraph 3.31. In addition, it requested that the following questions be incorporated into the discussion, noting the development of definitions and concepts in its report from last year (SC-CAMLR-XXVI, Annex 5, paragraphs 14.4 to 14.6):

(i) In the absence of direct observations of VMEs, how might maps be developed indicating where these VMEs are likely to be?

(ii) What are the likely life-history attributes of indicative VME taxa in those VMEs and, as a result, the likely resilience and resistance of those VMEs to bottom fishing impacts; what is the potential vulnerability of those VMEs to different gear types?

(iii) To what degree might benthic taxa be limited in their distribution?

(iv) What is the likely importance of VME taxa to fish assemblages and the degree to which fish diversity could be used as indicators of VMEs?

10.69 The Working Group agreed in paragraph 10.55 that the work on identifying VMEs and understanding the risks to VMEs of impacts by bottom fishing activities could be separated as a task from consideration of mitigation measures and data collection plans. It requested that the Scientific Committee consider whether consideration of VMEs and risk could be undertaken by WG-EMM and the consideration of mitigation measures be part of the work of WG-FSA.

Actions to be taken by fishing vessels encountering VMEs

10.70 The Working Group drew the attention of the Scientific Committee to its deliberations in paragraphs 10.29 to 10.43 on defining actions taken by vessels which may encounter evidence of VMEs during the course of fishing. The outcomes are described further in sections relevant to the implementation of Conservation Measure 22-06 below.

Advice on tasks in Conservation Measure 22-06

10.71 The following advice is provided to the Scientific Committee on tasks identified in Conservation Measure 22-06.

Advice on submissions by Members of preliminary assessments and proposed mitigation measures

10.72 In accordance with the requests of Conservation Measure 22-06, paragraph 7, the Working Group reviewed in paragraphs 10.24 to 10.28 the preliminary assessments and proposed mitigation measures submitted by Members proposing to participate in bottom fishing. The Working Group noted that only 5 out of 12 proposals contained preliminary assessments. As a consequence, the Working Group was unable to review and advise on the potential impacts of all new and exploratory fishery proposals.

10.73 The Working Group noted the large variation in substance of the preliminary assessments and agreed that a common approach is needed for providing these assessments, similar to the requirements for notifying exploratory fisheries (paragraph 10.25). The Working Group recommended that the Scientific Committee adopt the pro forma detailed in paragraph 10.25 and given in Table 20 as a suitable standard for Members submitting preliminary assessments of the potential for their proposed bottom fishing activities to have significant adverse impacts on VMEs. The pro forma is designed to be consistent with the requirements for proposals on exploratory fisheries and is based on the requirements set out in paragraphs 7(i) and 7(ii) in Conservation Measure 22-06. Further considerations are given in paragraph 10.26.

Advice on procedures and standards for assessing potential effects of proposals and possible mitigation measures

10.74 The Working Group noted that the Scientific Committee is tasked to review, refine and, as needed, develop procedures and standards for assessing potential effects of proposals and possible mitigation measures (Conservation Measure 22-06, paragraph 7(iii)). The Working Group considered three types of procedures and approaches:

(i) the magnitude of the existing footprint of bottom fisheries relevant to Conservation Measure 22-06 and the possible impacts that such a footprint may have had on VMEs (paragraphs 10.9 to 10.23);

(ii) the risk of past and future bottom fishing activities contributing to significant adverse impacts on VMEs (paragraphs 10.29 to 10.31, 10.49 and 10.50);

(iii) approaches to the development of mitigation measures for vessels (paragraphs 10.32 to 10.43).

Existing footprint of bottom fisheries

10.75 Two approaches were used in examining the existing footprint of bottom fisheries. In paragraph 10.17, the Working Group reviewed and revised the analysis of the effective fishing footprint from 2007. Instead of presenting the catch in the different management areas, the accumulated effort (thousands of hooks) is summarised in maps for each subarea

and division for the period 1985–2007 and for 2008 separately. The Working Group noted that in future years it would be desirable to plot the SSRUs as well as the subarea and division boundaries.

10.76 In paragraph 10.18, the Working Group agreed that most attention on evaluating potential impacts of bottom fishing on VMEs needs to be given to locations with the most fishing effort relative to seabed area. It also recognised the need to distinguish between effort in shallow areas compared to deeper areas. In the absence of other information, the maps showing effort in grid cells in each subarea/division are one indicator of where most fishing effort has been deployed. This can be combined with estimates of fishable seabed area to estimate the proportion of fishable area possibly impacted by fishing gear.

10.77 The potential proportions of seabed areas that may have been affected by longlines were calculated using a low and high value for the estimated width of the area affected by an individual longline – 1 m (consistent with CCAMLR-XXVII/19) and 25 m (consistent with WG-FSA-08/58). The rationale for these values is provided in paragraphs 10.9 to 10.12.

10.78 In paragraph 10.19, the Working Group agreed that this approach is a useful foundation for providing advice on the current scales of possible interactions of fishing gears with VMEs in exploratory longline fisheries.

10.79 The Working Group recommended that updated seabed area information be obtained for the three depth strata from reliable sources for all SSRUs (paragraph 10.20).

10.80 The Working Group noted in paragraph 10.21 that these data could be used to assess, as per Conservation Measure 22-06, the possible contributions of proposed fishing activities to impacts in different areas. However, there is insufficient information on the areas proposed to be fished in the coming exploratory fisheries to provide advice on what those contributions to impacts on VMEs might be.

10.81 The Working Group also drew the attention of the Scientific Committee to general points surrounding these methods noted in paragraph 10.22 that:

(i) such analyses will need to take account of the potential for lines to be overlapping, such as would be the case in repeat sets, and that, in these cases, consideration will need to be given as to whether the full impact of fishing occurs during the first interaction with repeat sets having subsequent negligible effects (but see the conclusions in CCAMLR-XXVII/19);

(ii) the degree of impact within the footprint is difficult to ascertain because of the absence of empirical data on the effects of the different types of longlines on benthic habitats and VME-taxa (paragraph 10.16). The Working Group agreed that future work to obtain empirical data was needed to reduce this uncertainty on the degree of impact of an individual line. Also, refinement is needed of the methodologies and calculations for determining the footprint (area) affected by the different types of longlines (paragraphs 10.11 to 10.14) and for estimating the possible impacts on VME-taxa within the footprint as described in paragraphs 10.9 and 10.10.

(iii) observed by-catch from longlines may not be a good indicator of interactions of longlines with VMEs (paragraph 10.11) because taxa affected by the longlines may not be observed as by-catch when landed. As a result, no by-catch may not mean that there has been no interaction with a VME. However, presence of VME taxa in by-catch may be indicative of the presence of a VME. Although catch rates of VME taxa cannot be used at present, it may be possible to use such rates to estimate the scale of impacts on VMEs in the future if the catchability of individual VME taxa can be determined.

10.82 The Working Group concluded this discussion in paragraph 10.23 noting that reducing the uncertainty in evaluations of accumulated impacts and the potential for proposed fishing activities to contribute to future impacts will be dependent on improving methods for assessing footprints coupled with the developing assessments of risk in different areas.

Risk-assessment approaches

10.83 The Working Group agreed that a risk-assessment approach similar to that used by ad hoc WG-IMAF would be valuable and that the method considered in paragraphs 10.29 and 10.30 could be developed further in this regard. It noted that the risk of significant adverse impacts should be evaluated at spatial scales commensurate with the scale of VMEs, i.e. much smaller spatial resolution than that considered by ad hoc WG-IMAF. The important elements of a risk assessment would include, *inter alia*, the following concepts:

(i) Not all areas are equal with regard to probability of encounters with, or impacts on, a VME but information needed to assess such probabilities is very limited.

(ii) Models of likely habitat can be developed based on geomorphological, oceanographic and other environmental data and relating these to observations of where different VME taxa might be found. Observations can include direct observations (using videos, benthic sampling equipment) or indirect observations such as by-catch from fisheries.

(iii) An appropriate scale for characterising risk would be 0.5° latitude and 1.0° longitude, consistent with CCAMLR fine-scale areas.

(iv) different areas will have different risks, e.g. higher-risk areas might be seamounts, heads of canyons and depths shallower than 550 m.

(v) There will be different requirements for data collection, research and mitigation for different levels of risk and different gear types.

(vi) The assignment of risk would need to be reviewed as new information becomes available.

10.84 The Working Group was unable to develop a risk-assessment map for use in providing advice at this meeting on the possible effects of proposed fishing activities, but recommended that the approach be developed further for the next meeting of WG-FSA, based on the considerations in paragraphs 10.29 and 10.30 and in the workshop recommended in paragraph 10.68.

10.85 The Working Group agreed in paragraph 10.50 that direct evidence of VMEs should be included when available in the development of risk-assessment maps and in identifying VMEs that need to be avoided.

10.86 The Working Group noted in paragraph 10.52 the lack of empirical evidence of the vulnerability of benthic taxa to the different bottom fishing gears used in exploratory fisheries. Consequently, it agreed that, in the first instance, the risk-assessment map will need to rely on expert opinion on vulnerability and possible impacts of fishing gears on different habitat types and VMEs. This would be facilitated by the workshop recommended in paragraph 10.68.

10.87 In considering approaches to the development of mitigation measures, the Working Group noted that these approaches could be naturally divided into three main classes of actions – activities by observers, responses of vessels and reporting requirements (paragraph 10.32).

10.88 The Working Group agreed that observations of benthic by-catch will be important in the coming year and recommended, in paragraph 10.33, a number of measurements to be taken. The Working Group also noted that it would be desirable for observers to obtain information on the operations of the gear and for developing monitoring protocols. However, given the high workloads of observers, these were considered to be lower priorities for the coming year (paragraph 10.34).

Mitigation measures

10.89 The Working Group drew the attention of the Scientific Committee to its consideration in paragraphs 10.36 to 10.40 of how vessels should respond to evidence of VMEs. In paragraph 10.36, the Working Group agreed that a common strategy was needed that would have specific variations depending on the type of gear being used. However, there was insufficient information to determine an agreed strategy, including the type and level of by-catch that would be required to trigger action and the precise nature of the action that should be taken. It was proposed that such issues would need to be resolved at the VME workshop recommended in paragraph 10.68.

10.90 In paragraph 10.37, the Working Group noted the general expectation of Members to report encounters of fishing vessels with VMEs. However, there was variation amongst the submissions on what evidence was required before such an encounter would be reported. Nevertheless, observer data should be reported along with the data necessary for the preliminary assessments by Members to be submitted in accordance with Conservation Measure 22-06.

10.91 A difficulty in the discussion was resolving the tension between protecting VMEs from significant adverse impacts and obtaining the information on whether those impacts are arising or have arisen. Under such circumstances, a strategy for avoiding significant adverse impacts on VMEs, such as through identifying areas that need to be avoided, will need to be developed taking account of the issues in paragraph 10.38.

10.92 The Working Group noted that fishing is prohibited in all areas shallower than 550 m in Divisions 58.4.1 and 58.4.2 (Conservation Measures 41-04 and 41-05) because of the higher risk to benthic habitats (paragraph 10.83(iv)).

10.93 It was noted in paragraph 10.39 that continuing to fish in areas for which by-catch evidence indicates a possibility of interactions with a VME is contradictory to trying to protect VMEs from significant adverse impacts. Also, continuing such fishing in an area where evidence of a VME has been found may be contrary to Conservation Measure 22-06, paragraph 8.

10.94 The Working Group recognised this conundrum in paragraph 10.40. It also noted that it could not calculate the level of evidence of VMEs to trigger actions for the different vessels at this meeting. The Working Group agreed that full compliance in providing data on benthos by-catch will be important in order to determine vessel-specific recommendations on trigger levels. An alternative strategy to vessel-specific trigger levels would be to identify areas that need to be avoided by all vessels (see paragraph 10.97).

10.95 In paragraph 10.43, the Working Group noted that it would be useful to undertake simulations of different management approaches to evaluate which avoidance/research approaches may be most useful in avoiding significant adverse impacts on VMEs when there is no information on which to judge a suitable approach.

Advice on the occurrence of VMEs

10.96 In addition to the following advice, the Working Group drew the attention of the Scientific Committee to its advice on identifying VMEs in paragraphs 10.63 to 10.69 for consideration in the requirement in Conservation Measure 22-06, paragraph 12.

10.97 The Working Group noted in paragraph 10.41 that data were available in CCAMLR-XXVII/26 to review locations of catches of VME taxa. However, it had insufficient time to make recommendations on areas that may need to be closed to the fleet for the coming season according to Conservation Measure 22-06. The Working Group noted that time should be made available next year to undertake such assessments and encouraged an improvement of data quality and quantity to support this.

10.98 The Working Group reviewed two notifications of VMEs in Division 58.4.1 (SC-CAMLR-XXVII/13) in paragraphs 10.56 and 10.57 and agreed that these were obvious cases of VMEs, with clear evidence of well developed benthic communities.

10.99 In paragraphs 10.58 and 10.59, the Working Group reviewed a draft VME notification form developed by the Secretariat on the basis of the requirements in Conservation Measure 22-06 and tabular notification in SC-CAMLR-XXVII/13. It was designed in such a way that it could be submitted by Members as part of the 5-day reporting system during fishing operations and could be used by Members undertaking research activities. The Working Group recommended that it be used as the means of notifying the Secretariat when evidence of VMEs is encountered.

10.100 In paragraph 10.60, the Working Group requested that the Scientific Committee consider the method by which these notifications would be reviewed and the process for

adding a VME to the Register of VMEs. It also asked the Scientific Committee whether there was an expectation that WG-FSA be the primary working group where such reviews would be undertaken. The Working Group noted that the requirements for protecting VMEs may change as more information becomes available, including data on the spatial extent of VMEs and their vulnerability to fishing.

Advice on known and anticipated impacts

10.101 On the basis of its discussion in paragraphs 10.9 to 10.22, the Working Group noted that no advice could be provided this year on actual or potential encounters with VMEs by exploratory longline fishing, including no advice on known and anticipated impacts, but that some depth strata in some SSRUs may have experienced higher levels of interactions with bottom fishing gear than other areas in Subarea 88.1.

10.102 In paragraph 10.28, the Working Group agreed that there are few empirical data to determine what the effects of the proposed activities might be on VMEs in the Convention Area and whether there would be overlap between the proposed fishing activities and VMEs.

10.103 The Working Group recommended that a report akin to the Fishery Reports on 'Bottom Fisheries and Vulnerable Marine Ecosystems' be developed for collating the available knowledge on VMEs, the potential for significant adverse impacts, risk assessments and potential for impacts arising from bottom fisheries. Given the large amount of work this will entail and the varying types of expertise required to undertake the different sections of such a report, the Working Group advised that it may not be appropriate for WG-FSA to be solely responsible for its development and updating. It requested the Scientific Committee to consider what might be needed in such a report to address the requirements of the Commission and how this work might be undertaken.

Advice on practices when evidence of VMEs is encountered

10.104 With respect to Conservation Measure 22-06, paragraphs 7(iii) and 9, the Working Group had no advice for the 2008/09 season on specific practices when evidence of VMEs is encountered during bottom fishing activities, but drew the attention of the Scientific Committee to the discussion in paragraphs 10.32 to 10.43.

Advice on other mitigation measures

10.105 With respect to Conservation Measure 22-06, paragraph 7(iii), the Working Group has no advice on other mitigation measures for the 2008/09 season.

Advice on research and data collection plans

10.106 With respect to research and data collection plans for bottom fisheries under Conservation Measure 22-06, the Working Group agreed that whatever strategy is adopted for

the coming year, it will be important to collect as much benthos by-catch data as possible for analysis next year (paragraph 10.42). It also agreed that experience of ad hoc WG-IMAF showed the following to be important in combating the incidental mortality of seabirds in fisheries and will be relevant to avoiding significant adverse impacts on VMEs (paragraph 10.42):

(i) education of the crews of vessels participating in exploratory bottom fisheries will help increase awareness of the value of VMEs, in terms of their marine biodiversity and as habitat to fish assemblages, and the importance of developing mitigation measures to avoid impacts on them;

(ii) continued development of methods to reduce the frequency of gear loss that could impact on VMEs.

10.107 The Working Group agreed that it would be useful for observers to provide information on the following (paragraph 10.33):

(i) the locations and types of taxa being landed, where identification should be at least to the level of morphotypes provided in the poster developed by New Zealand (paragraph 6.45);

(ii) the numbers and, where possible, total mass of each taxon being landed;

(iii) information on the likely geographic origin of the taxa – noting that observations by hook or by magazine could be related to the geographic position of the line on the substratum, although this may require an observer to be provided with a hand-held GPS to note the position of the vessel when a taxon is landed;

(iv) in the future, an increase in the level of detail may be triggered by catches of specific types of taxa but it was recognised that, for the near future, records should be maintained of all landed taxa and that information by observers should be as complete as possible for the periods of observation.

10.108 The Working Group wished to draw the attention of the Scientific Committee to paragraph 10.27 which identifies the need to improve reporting of benthic by-catch in order for such data to be useful for analyses on the interaction of bottom fishing activities with VMEs.

General

10.109 The Working Group noted that, in the absence of (i) direct observations of impacts by fishing gear, (ii) censuses of the distribution and abundance of benthic habitats, and (iii) evaluation of the ecological consequences of the effects of fishing on those habitats and critical ecological processes, a precautionary strategy will need to be adopted that will successfully avoid significant adverse impacts on VMEs in the interim of impact assessments being completed and long-term mitigation strategies being developed. The Working Group also noted that the following issues need to be considered in formulating such a strategy:

(i) Many VME taxa are expected to be sessile, slow growing and long-lived, which means that if such taxa are depleted they are unlikely to recover in two to three decades as required in Article II. Therefore, escapement of VME taxa in space is an important consideration in maintaining viable VMEs.

(ii) Precautionary strategies need to be adopted to avoid significant adverse impacts on VMEs and VME taxa that are restricted in their distribution, such as, for example, locally endemic taxa.

(iii) Consistent with the precautionary approach, controlled acquisition of data will be needed.

(iv) A single fishing event is unlikely to cause significant adverse impacts on VMEs but cumulative effects between assessments and management decisions could give rise to significant adverse impacts. Strategies are needed to limit cumulative effects between assessments as it will ultimately be a single fishing event that will cause the significant adverse impact in the course of a fishing period between assessments.

(v) Interim strategies could include:

  (a) large-scale closures of areas with a reasonable likelihood of including representative VMEs;

  (b) small-scale closures of areas on the basis of a limited by-catch of benthos during fishing operations, noting that benthos affected by longline systems may not be well represented in landed by-catch;

  (c) temporary closures of areas as in (b) while research is undertaken to establish the spatial extent of habitats and VMEs.

(vi) Without appropriate knowledge, it will be very difficult to predict when the effects of bottom fishing will have accumulated to cause significant adverse impacts on VMEs. Under such circumstances, significant adverse impacts may not be detected until after such impacts have obviously occurred.

(vii) If bottom fishing activities must overlap significantly with areas in which VMEs occur because of the distribution of fish, then the escapement of VMEs may need to be greater than expected. This is because of the need to allow for inadvertent impacts on VMEs, which could accumulate to cause significant adverse impacts.

Interactions with WG-EMM

10.110 Discussion on this matter is reported in section 9.

Development of ecosystem models

10.111 WG-EMM-08/42 reported on the further development of a mass-balanced carbon-budget trophic model of the Ross Sea as a step towards investigating ecosystem effects of the fishery for *D. mawsoni*. The Working Group noted WG-EMM's discussion of this paper in Annex 4, paragraphs 6.6 and 6.7, and underlined the importance of the paper for discussion at FEMA2 (paragraphs 13.12 to 13.17).

SCHEME OF INTERNATIONAL SCIENTIFIC OBSERVATION

11.1 In accordance with CCAMLR's Scheme of International Scientific Observation, scientific observers were deployed on all vessels in all finfish fisheries in the Convention Area.

11.2 Information collected by scientific observers was summarised in WG-FSA-08/5 Rev. 1, 08/6 Rev. 1, 08/7 Rev. 2 and 08/8.

11.3 The following cruises were conducted during the 2007/08 season:

(i) Longline: 40 cruises with scientific observers (international and national) on board all vessels. Eleven cruises were undertaken in Subarea 48.3 by 10 vessels, two cruises were undertaken in Subarea 48.4 by two vessels, nine cruises were undertaken by eight vessels in Divisions 58.4.1, 58.4.2, 58.4.3a and 58.4.3b, four cruises were conducted by two vessels in Division 58.5.2, one cruise was conducted in Subareas 58.6 and 58.7 and 13 cruises were undertaken in Subareas 88.1 and 88.2 by 13 vessels. In addition, one cruise was also conducted in Area 51 outside the Convention Area.

(ii) Trawl – finfish: five vessels conducted nine trawl cruises targeting finfish. All trawlers fishing for finfish carried scientific observers. In total, three national and six internationally designated scientific observers participated in these operations.

(iii) Trawl – krill: eight scientific observation programs were conducted by one nationally and seven internationally designated scientific observers on board krill vessels operating in the Convention Area. All of the krill trawl operations observed were in Area 48, with four cruises conducted in Subareas 48.1 and 48.2 and four cruises conducted in Subarea 48.3. A total of 3 935 trawls were conducted, with 314 trawls (8%) observed. The majority of these trawls were a result of the continuous pumping reporting method, where a single continuous haul is broken down into two-hour periods. (For an explanation of this apparently low observation rate, see Annex 6, paragraph 2.21.)

(iv) Three pot cruises targeting *D. eleginoides* were conducted during the 2007/08 season. These cruises were undertaken in Subarea 48.3, two cruises were undertaken by the Korean-flagged vessel *Jung Woo No. 2* and one by the Uruguayan vessel *Punta Ballena*. All cruises were conducted with an international scientific observer on board.

11.4 The Working Group reviewed the report of the first meeting of ad hoc TASO held in St Petersburg, Russia, on 19 and 20 July 2008 (SC-CAMLR-XXVII/BG/6), and considered the various questions referred to it by TASO.

(i) Characterisation of fishing gear:

(a) Detailed descriptions of the fishing gear per set (or haul) are essential for appropriate analysis of catch and effort data.

(b) Responsibility of reporting of these data be moved from the observer to the vessel and that appropriate changes be made to the C2 form to enable the vessels to report this information on a per set basis. However, the observer should still comment on the general characteristics of the gear used in the final report and the logbook.

(c) There is not sufficient information on the extent of variability within different gear types, especially trotlines, to reflect all parameters that may be important to standardising CPUE across different gear types. The Working Group requested that all vessels include detailed descriptions of the gear that they intend to use along with their notifications to fish. The Working Group recognised that these type of data are commercially sensitive, and that all fishery and observer data are held in confidentiality in the CCAMLR database. Access to these data is subject to the Rules for Access and Use of CCAMLR Data.

(d) As an interim measure, the Working Group recommended that the following five columns (suggested by ad hoc TASO) be added to the C2 form to capture variability in trotlines:

- the number of hooks in a cluster
- the number of clusters on a dropline
- the spacing between the droplines
- the spacing between the hook clusters
- the distance of the lowest cluster of hooks above the bottom.

(e) The Working Group endorsed the recommendation made in WG-FSA-08/60 that when a vessel sets two sections of line that are joined under water, they should be reported as two independent sets, the geographical start and finish positions of these sets being the positions of the anchors or grapnels.

(ii) Consideration of data collection requirements:

(a) As it is not always practical to count the number of individuals per species (particularly icefish) in the catch (SC-CAMLR-XXVII/BG/6, paragraph 3.18), WG-FSA recommended that form T3 be modified to enable the observer to record the total catch by weight and either the total number or the mean weight. The mean weight of fish should be obtained from a subsample of the catch.

(b) The Working Group recognised that macroscopic (field) maturity staging in *Dissostichus* spp. is still uncertain and that further work is required to improve this (paragraphs 3.72 and 3.73). It recommended that macroscopic staging still be carried out in the meantime and that GSI be measured when motion-compensated balances are available.

(c) The Working Group noted that the current sampling level for *Dissostichus* spp. in new and exploratory longline fisheries of 35 fish per set stems from a combination of a recommendation that one fish should be sampled per 150 hooks (WG-FSA-05/49) and the mean number of hooks per line in Subarea 88.1.

Where both species of *Dissostichus* spp. are sampled on a single line, this requirement potentially doubles sampling effort to 70 fish per line. The Working Group noted that in situations where both species are caught, it is uncommon for both species to be taken in equal proportions and thus it is unlikely that sampling of 70 fish would be required. Nevertheless it is important that the catch of both species is sampled in proportion to the catch. Where the catch of one of the species is a very small proportion of the catch, this may mean that individuals of the less frequent taxa are not selected for biological sampling. It is, however, important to collect information on the species which occurs in a smaller proportion of the catch.

(d) The Working Group has referred the question of the number of toothfish to be sampled for biological, age and length data to WG-SAM for re-evaluation.

(e) In the interim, the Working Group recommended a sampling rate of one *D. eleginoides* and one *D. mawsoni* per 150 hooks with a minimum of five *D. eleginoides* and five *D. mawsoni* per line. The required sample size should be determined once the line has been set and, where possible, the sample should be taken in one contiguous collection. However, see paragraph 6.43 for the recommended reduction in *Dissostichus* spp. sampling in the coming season to accommodate the additional requirements associated with the Year-of-the-Skate.

(f) It is noted that modifications to the forms in the observer logbook for the recording of skate in paragraphs 6.33 and 6.34 will simplify the observer tasks.

(g) It was agreed that data such as sea state, sea temperature and other meteorological parameters were better recorded by vessels if required (SC-CAMLR-XXVII/BG/6, paragraph 3.19). They had never been used in any analysis and should be removed from the observer logbooks.

11.5 The Working Group noted that the guides for identification of by-catch species (paragraph 6.45) are simple and easy for observers to use. It also noted that WG-FSA-08/59 is more comprehensive and was developed for both observer and scientific use, however, it has retained the facility to stop at a higher taxonomic grouping if desired.

11.6 The Working Group recommended that the requirement for vessels to report the total number of hooks lost per line should be removed from form L5. However, vessels using traditional longlines must report the number of hooks lost attached to sections of backbone on a set-by-set basis, and vessels deploying trotlines must report the number of droplines lost per set.

11.7 The Working Group recalled that the Secretariat conducts routine checks and validation of all data submitted and, where required, makes factual corrections to the data in consultation with data owners/providers. In the case of scientific observer data, the initial contact point for consultations is the technical coordinators of Designating Members. In the case of fine-scale data, the initial contact point for consultations is the data provider of the Flag States. All changes are documented in the database and the original data and amendments are archived by the Secretariat.

Advice to the Scientific Committee

11.8 The Working Group recommended that:

(i) all vessels include detailed descriptions of the gear that they intend to use along with their notifications to fish;

(ii) detailed descriptions of the fishing gear per set (or haul) be made a vessel responsibility and that the following five columns be added to the C2 form to capture variability in trotlines:

- the number of hooks in a cluster
- the number of clusters on a dropline
- the spacing between the droplines
- the spacing between the hook clusters
- the distance of the lowest cluster of hooks above the bottom;

(iii) when a vessel sets two sections of line that are joined under water, they be reported as two independent sets, the geographical start and finish positions of these sets being the positions of the anchors or grapnels;

(iv) form T3 be modified to record the total catch weight, total number caught and the mean weight of fish in the catch;

(v) photographic guides to macroscopic maturity staging of *Dissostichus* spp. be developed and that GSI be measured when motion-compensated balances are available;

(vi) a statistical analysis of the required sampling level of *Dissostichus* spp. for the collection of biological, age and length data be requested from WG-SAM;

(vii) in the interim, a sampling rate of one *D. eleginoides* and one *D. mawsoni* per 150 hooks with a minimum of five fish of each species per line be set;

(viii) data such as sea state, sea temperature and other meteorological parameters be recorded by vessels if required and no longer by observers;

(ix) the requirement for vessels to report the total number of hooks lost per line be removed from form L5. However, vessels using traditional longlines must report the number of hooks lost attached to sections of backbone on a set-by-set basis, and vessels deploying trotlines must report the number of droplines lost per set.

FUTURE ASSESSMENTS

12.1 The Working Group recalled that it had requested some refinements of the Subarea 48.3 icefish survey which would assist the assessment, in particular establishing from acoustics and pelagic trawl data the distribution of icefish to the south of South Georgia and the proportion of the population that is unlikely to be sampled by the bottom trawl used in the survey (paragraphs 3.25 and 4.7). It was further suggested that dietary information and condition might be used to tune the natural mortality parameter in icefish assessments (paragraph 3.79).

12.2 To follow 2009 as the Year-of-the-Skate, WG-FSA is considering designating 2011 as the 'Year-of-the-Grenadier'. WG-SAM was requested for advice on what assessments would be appropriate for grenadiers, and to provide advice on the research and data collection that would be required to enable WG-FSA to develop such assessments.

12.3 The mark–recapture experiments in Divisions 58.4.1 and 58.4.2 have so far failed to deliver information that will support an assessment (paragraphs 5.21 and 5.22). WG-FSA requested that WG-SAM continue to investigate alternative assessment methods such as those developed this year utilising CPUE (paragraph 5.24; WG-FSA-08/43) and, in particular, longline research surveys (WG-FSA-08/57), that may deliver robust assessments of toothfish stock status and trends in the absence of reliable tagging data.

12.4 If the Japanese research proposed in WG-FSA-08/39 is successful, an assessment of stock size in Division 58.4.4 may be possible in a few years. WG-FSA noted that it is assumed that this stock is depleted and CCAMLR's objective is to ensure its recovery. WG-SAM was requested to examine methods for determining the relative depletion and recovery status of the stock, taking into consideration that the gear being used for the experiment is not the same as gear used when the fishery was last exploited, and to advise on the data and research requirements which will enable this determination.

12.5 Given that three major longline gear types are in use in the Convention Area (Spanish, autoline and trotline), WG-SAM was asked to consider designs that would be capable of standardising gear effectively between surveys.

Frequency of assessments

12.6 The Working Group agreed that the move to a biennial assessment for three stocks (Subarea 48.3, Division 58.5.2 and the Ross Sea) had been extremely successful in releasing

time both intersessionally and at the meetings of WG-SAM and WG-FSA. This additional time had allowed the development of the first assessments for three exploratory fisheries (Divisions 58.4.1, 58.4.2 and 58.4.3a) and detailed consideration of other issues of high importance to the Commission and the Scientific Committee, such as VMEs and the Year-of-the-Skate.

12.7 The Working Group noted that for none of the stocks under biennial assessment were the Scientific Committee's three criteria for returning to annual assessments satisfied (SC-CAMLR-XXVI, paragraph 14.6). However, there had been no formal consideration of this other than by individual Members. The Working Group called for consideration to be given by WG-SAM to a formal procedure for doing this, although it acknowledged that for some stocks it may be difficult to make this decision at WG-SAM because of the timing of the fishery.

General considerations

12.8 Concern was expressed at the non-participation of many Members in the work of WG-FSA, and in particular of those whose first language is not English. Part of the problem was attributed to the difficulty of understanding what are now fairly complex stock assessment methods, although attendance by scientists with a wide range of statistical and biological expertise provides the confidence to use such methods.

12.9 Dr Holt suggested if existing members of WG-FSA were to mentor new members on a one-to-one basis, this would accelerate their integration into the group and their understanding of CCAMLR stock assessments.

FUTURE WORK

Organisation of intersessional activities of subgroups

13.1 Future work identified by the Working Group is summarised in Table 22, together with the persons or subgroups identified to take the work forward and references to sections of this report where the tasks are described. The Working Group noted that the tasks identified at the meeting or associated with established meeting procedures, do not include ongoing tasks undertaken by the Secretariat, such as data processing and validation, publications and routine preparations for meetings.

13.2 WG-FSA thanked all subgroups for their contributions and encouraged each one to continue its work in the forthcoming intersessional period, focusing, where possible, on key issues identified in Table 22. The Working Group re-emphasised that the membership to the subgroups was open to all participants (new participants are encouraged to contact the Secretariat for further information on the subgroups). The following subgroups met during the meeting:

- Subgroup on Assessments (coordinator: Dr R. Hillary (UK))
- Subgroup on Biology and Ecology (coordinator: Dr Kock)
- Subgroup on By-catch (coordinator: Dr Collins)

- Subgroup on New and Exploratory Fisheries (coordinator: Drs Hanchet and Bizikov)
- Subgroup on Observers (coordinator: Dr R. Leslie (South Africa))
- Subgroup on Tagging (coordinator: Dr Welsford)
- Subgroup on VMEs (coordinator: Dr Constable)
- Subgroup on Year-of-the-Skate (coordinators: Drs R. Mitchell (UK) and Mormede).

13.3 Dr Jones agreed to contact potential subgroup coordinators two weeks prior to the next meeting of the Working Group in order to review subgroup work plans for that meeting in light of the Working Group's priorities, meeting agenda and submitted papers.

13.4 The Working Group noted with concern that its workload, and that of other working groups, has increased in recent years, while the number of participants and Members represented had decreased over the same period. As a result, the growing workload was shared by fewer participants, and the Working Group was no longer able to address all of its tasks to the level of detail expected by the Scientific Committee.

13.5 The Working Group anticipated that it would need to consider two major topics at its 2009 meeting:

(i) revision of assessments for icefish and toothfish fisheries, including fisheries in Subareas 48.3, 88.1 and 88.2 and Division 58.5.2, and the exploratory fisheries in Subarea 58.4;

(ii) further development of approaches to avoid and mitigate significant adverse impacts of bottom fishing on VMEs.

13.6 In addition, the Working Group recognised that some recommendations from the CCAMLR Performance Review may require detailed consideration by WG-FSA in 2009.

13.7 The work on VMEs had significantly altered the workload of WG-FSA, as well as that of other working groups, and consideration of recommendations from the Performance Review also had the potential to add significantly to the Working Group's workload.

13.8 The Working Group urged the Scientific Committee to develop a medium- to long-term Science Plan in order to address the competing demands of the Commission, facilitate coordination among working groups and assign research priorities. In the absence of a Science Plan, WG-FSA would continue to address topics which it thought were of a high priority to the Scientific Committee. Such work would be limited by the time available at meetings, and by the number of participants and their areas of expertise.

13.9 The Working Group also urged its membership and that of the Scientific Committee to consider ways of augmenting participation in the work of WG-FSA and other working groups.

13.10 The Working Group recalled a proposal to conduct the Year-of-the-Grenadier in 2010 (SC-CAMLR-XXVI, Annex 5, paragraph 6.39). However, the Working Group agreed to defer this activity provisionally until 2011 as the procedures established for the Year-of-the-Skate, and the ensuing results, can then be evaluated.

13.11 Instead, the Working Group proposed that the Scientific Committee may wish to designate 2010 as the Year-of-the-VMEs in order to focus further research activities aimed at developing approaches to avoid and mitigate significant adverse impacts of bottom fishing on VMEs (section 10.2).

Second Workshop on Fisheries and Ecosystem Models in the Antarctic

13.12 The Working Group considered the set of topics for FEMA2 which had been developed by the conveners of WG-EMM and WG-FSA and discussed at WG-EMM-08 (Annex 4, paragraphs 8.1 to 8.4).

13.13 Four topics had been proposed for FEMA2:

(i) Evaluate whether the level of escapement currently espoused in existing decision rules for toothfish in the Ross Sea is sufficiently precautionary when these fish are viewed as important prey as well as predators. Such an evaluation should include a comparative analysis of the importance of toothfish as prey in different regions throughout the Southern Ocean.

(ii) Evaluate whether the existing boundaries of SSRUs in the Ross Sea could be revised on the basis of overlap between the spatial distribution of the fishery, the foraging areas of predators on toothfish, and other information such as the presence or density of VMEs. Such an evaluation should include work similar to that used for defining SSMUs in Area 48 (SC-CAMLR-XXI, Annex 4, Appendix D).

(iii) Evaluate whether the existing basis for distributing the precautionary catch limits for toothfish among SSRUs in the Ross Sea could be revised on the basis of the information considered in (ii) above.

(iv) Evaluate whether steps to implement possible revisions evaluated in (ii) and (iii) above would impact results from the ongoing tagging studies that are important components of the research plan and stock assessment process for exploratory fisheries for toothfish in the Ross Sea.

13.14 WG-FSA agreed with WG-EMM's advice that FEMA2 would need to focus on topics (i) and (ii), and that topics (iii) and (iv) would need to be addressed at a later stage (Annex 4, paragraphs 8.4 to 8.6).

13.15 Following further discussion, WG-FSA recommended that FEMA2 focus primarily on topic (i), and in particular the evaluation of the precautionary and ecosystem-based elements of the escapement levels used in managing toothfish in the Ross Sea.

13.16 The Working Group encouraged the Scientific Committee to form a small group to elaborate the terms of reference of FEMA2.

13.17 The Working Group also noted that the IWC held cetacean data and information collected by the former USSR, and that such information may be available to FEMA2.

Intersessional meetings

Meeting of WG-SAM

13.18 During the course of its meeting, the Working Group identified a number of matters which it referred to WG-SAM: paragraph 3.58 (unmatched tag-recaptures); paragraph 4.18 (data quality metrics), paragraph 5.97 (harvest strategies and research programs), paragraph 11.4(ii)(d) (sampling fish on longlines) and paragraphs 12.1 to 12.9 (future assessments).

Meeting of ad hoc TASO

13.19 During the course of its meeting, the Working Group identified a number of matters which it referred to ad hoc TASO: paragraph 10.35 (taxonomic details of observations).

Meeting of SG-ASAM

13.20 During the course of its meeting, the Working Group identified a number of matters which it referred to SG-ASAM: paragraph 3.26 and Appendix O, paragraph 7 (trawl headline height correction factor).

Notification of scientific research activities

13.21 The Working Group noted that the following Members would be conducting scientific research activities in 2009 and in accordance with Conservation Measure 24-01:

Australia:	demersal fish survey in Division 58.5.2 in May–June 2009
Japan:	research fishing in Division 58.4.4 (paragraphs 5.116 to 5.121; see also CCAMLR-XXVII/BG/15)
New Zealand:	research fishing in Subarea 88.1 (paragraphs 5.108 to 5.115; see also CCAMLR-XXVII/BG/15)
UK:	demersal fish survey in Subarea 48.3 in January–February 2009
USA:	demersal fish survey in Subarea 48.2.

13.22 Dr Constable advised that Australia would be conducting a multi-disciplinary benthic survey, primarily using camera gear, of Bruce Rise in Division 58.4.1, using various types of sampling gear, including research hookless longlines and trawls.

13.23 Dr Holt advised that the USA survey in Subarea 48.2 will also include the collection of acoustic data, net sampling for krill and video-photographic transects of benthic habitats.

13.24 The Working Group noted that Members participating in scientific research activities which fall under Conservation Measure 24-01 are required to submit the following to the Secretariat:

- a notification of research vessel activity (Conservation Measure 24-01, Annex A, Format 1 or Format 2);
- 5-day catch and effort reports during the research activity;
- annual STATLANT returns which include catches taken during the research activity;
- a summary report within 180 days of the completion of the research activity and a full report within 12 months.

OTHER BUSINESS

Letter on *D. mawsoni* in McMurdo Sound

14.1 The Working Group considered a letter, addressed to the Science Officer and the conveners of WG-EMM and WG-FSA, authored by 25 Antarctic scientists on the decline of *D. mawsoni* from McMurdo Sound (WG-EMM-08/20; see also WG-EMM-08/21), and noted the deliberations of WG-EMM on this matter (Annex 4, paragraphs 6.23 to 6.27).

14.2 The Working Group noted that WG-EMM had identified several inconsistencies in WG-EMM-08/21 and had been unable to adequately assess the conclusions of the paper. WG-EMM had requested the authors to provide further information on fishing effort and catches, biological data, including length-frequency distributions, and details of the two sampling sites (Annex 4, paragraph 6.24).

14.3 WG-FSA encouraged the scientists involved in this work to submit the data and information identified above to the CCAMLR Secretariat so that a GLM-type analysis may be used to review the conclusions reported in WG-EMM-08/21. The Working Group agreed to conduct such a review at its next meeting if the data were made available in sufficient time.

CCAMLR Science

14.4 In 2007 the Scientific Committee requested that the Editor of *CCAMLR Science*, in consultation with the Chair of the Scientific Committee and the conveners of the working groups, prepare a revision of the publication policy of *CCAMLR Science*, including consideration of the procedure for selecting papers (SC-CAMLR-XXVI, paragraphs 13.24 and 13.25). The revised policy is outlined in SC-CAMLR-XXVII/6, and Dr Reid presented the key points to the Working Group.

14.5 The Working Group supported the revised editorial process and policy.

14.6 The Working Group recognised the potentially important contribution to CCAMLR's work which is provided by scientists from outside the CCAMLR membership and that current procedures may not allow CCAMLR to gain the maximum benefit of this work.

14.7 The Working Group urged the Scientific Committee to consider allowing scientific contributions from outside the CCAMLR membership to be submitted to working groups for consideration. Further, and if so desired by the authors, such contributions could be considered for publication in *CCAMLR Science*. Such contributions also provide opportunities for the introduction of new ideas into the work of CCAMLR.

14.8 The Working Group agreed that contributions by scientists from outside the CCAMLR membership would need to be made under separate guidelines for the submission of meeting documents. Such contribution would need to be provided well in advance of meetings (e.g. two months) in order to allow sufficient time for participants to consider the findings and develop their work plans.

Joint SC-CAMLR–CEP Workshop

14.9 The Working Group discussed the proposal for a joint workshop between SC-CAMLR and the CEP ('Opportunities for collaboration and practical cooperation between the CEP and SC-CAMLR'), noting the deliberations of WG-EMM on this matter (Annex 4, paragraphs 9.1 to 9.5; WG-EMM 08/52), and the information circulated by the Secretariat (SC CIRCs 08/47 and 08/65). This workshop is currently scheduled to be held in early April 2009, immediately prior to the CEP XII meeting in Baltimore, USA.

14.10 The Working Group supported the recommendations of WG-EMM, including the suggestions for further consultation during the forthcoming meeting of the Scientific Committee.

ADOPTION OF THE REPORT

15.1 The report of the meeting was adopted.

CLOSE OF MEETING

16.1 Dr Jones thanked the subgroup coordinators, rapporteurs, other participants and Secretariat staff for their contributions and participation in the meeting, as well as in intersessional activities.

16.2 Dr Constable, on behalf of the Working Group, thanked Dr Jones for stepping up to convene the Working Group. The deliberations of WG-FSA can be intense at times, and Dr Jones led the meeting with new energy, direction and insight.

16.3 Dr Zhao expressed his thanks to the Working Group for welcoming him to the meeting and providing assistance in understanding its work.

16.4 Mr N. Smith (New Zealand), on behalf of the Working Group, noted Dr Holt's imminent retirement. The Working Group thanked Dr Holt for his outstanding leadership and contribution to the work of CCAMLR. The Working Group looked forward to Dr Holt's further involvement with its work.

16.5 The meeting was closed.

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Table 1: Total reported catches (tonnes) of target species in fisheries in the Convention Area in 2007/08. **Bold**: fishery closed. (Source: catch and effort reports to October 2008 unless otherwise indicated).

Target species	Region	Fishery	Fishing season		Conservation measure	Catch (tonnes) of target species		Reported catch (% limit)
			Start	End		Reported	Limit	
Champsocephalus gunnari	48.3	Trawl	15-Nov-07	14-Nov-08[a]	42-01 (2007)	1 326	2 462	54
	58.5.2	Trawl	01-Dec-07	30-Nov-08[a]	42-02 (2007)	199	220	90
Dissostichus eleginoides	48.3	**Longline**, pot	01-Dec-07	30-Nov-08[a]	41-02 (2007)	3 856[b]	3 920	98
	48.4	**Longline**	01-Apr-08	**14-May-08**	41-03 (2006)	98	100	98
	58.5.1 French EEZ[c]	Longline	ns	ns	ns	2 853	ns	
	58.5.2	Longline, pot, trawl	01-Dec-07	30-Nov-08[a]	41-08 (2007)	1 496	2 500	60
	58.6 French EEZ[c]	Longline	ns	ns	ns	684	ns	
	58 South African EEZ	Longline	ns	ns	ns	54	ns	
Dissostichus spp.	48.6	Longline	01-Dec-07	30-Nov-08[a]	41-04 (2007)	0	400	0
	58.4.1	Longline	01-Dec-07	30-Nov-08[a]	41-11 (2007)	413	600	69
	58.4.2	Longline	01-Dec-07	30-Nov-08[a]	41-05 (2007)	217	780	28
	58.4.3a	**Longline**	01-May-08	31-Aug-08	41-06 (2007)	9	250	4
	58.4.3b	**Longline**	01-May-08	**20-Feb-08**	41-07 (2007)	141	150[d]	94
	58.4.4	Research	20-Jun-08	27-Sep-08	24-01 (2005)	77	0[d]	-
	88.1	**Longline**	01-Dec-07	31-Aug-08	41-09 (2007)	2 259	2 700	84
	88.2	**Longline**	01-Dec-07	31-Aug-08	41-10 (2007)	416	567	73
Euphausia superba	48	Trawl	01-Dec-07	30-Nov-08	51-01 (2007)	125 063	620 000	20
	58.4.1	Trawl	01-Dec-07	30-Nov-08	51-02 (2002)	0	440 000	0
	58.4.2	Trawl	01-Dec-07	30-Nov-08	51-03 (2007)	0	452 000	0
Lithodidae	48.3	Pot	01-Dec-07	30-Nov-08	52-01 (2007)	0	1 600	0
Martialia hyadesi	48.3	Jig	01-Dec-07	30-Nov-08	61-01 (2007)	0	2 500	0

[a] Under review
[b] Does not include 2 tonnes taken during trawl survey
[c] Fine-scale data to August 2008
[d] Excluding research survey/research fishing limit (50 tonnes)
ns Not specified by CCAMLR

Table 2: Estimated effort, catch rates and total catches from IUU fishing for *Dissostichus* spp. in the Convention Area in 2007/08. The estimates are derived from information on longliners and gillnetters (source: WG-FSA-08/10 Rev. 2).

Subarea/ division	Estimated start of IUU fishing	No. of vessels sighted	Additional no. of vessels extrapolated to end of season	Estimated no. of IUU fishing vessels	Estimated no. of days fished (not extrapolated)	Estimated no. of days fished (extrapolated)	Mean catch rate (tonnes/day)	Estimated IUU catch (not extrapolated)	Estimated IUU catch extrapolated to end of season
		1	2	3	4	5	6	7	8
48.3	1991	0							
58.4.1	2005	1	0.3	1.3	55	82	1.7	94	139
58.4.2	2002	0							
58.4.3a	2003	0							
58.4.3b	2003	3	0.9	3.9	164	246	1.5	246	369
58.4.4	1996	0							
58.5.1	1996	3	0.9	3.9	164	246	3.0	489	737
58.5.2	1997	0							
58.6	1996	1	0.3	1.3	55	82	2.8	153	229
58.7	1996	0							
88.1	2002	1	0.3	1.3	55	82	3.4	187	279
88.2	2006	0							
Total		9	2.7	11.7	493	738		1169	1753

Table 3: Catch history of *Dissostichus* spp. taken by IUU fishing in the Convention Area. IUU fishing was first detected in 1988/89, and estimates are derived from longlining and gillnetting activities. Blank: no estimate; zero: no evidence of IUU fishing. (Source: WG-FSA-08/10 Rev. 2 and SC-CAMLR reports).

Season	Subarea/division													All areas
	Unknown	48.3	58.4.1	58.4.2	58.4.3a	58.4.3b	58.4.4	58.5.1	58.5.2	58.6	58.7	88.1	88.2	
1988/89		144						0		0				144
1989/90		437						0	0	0				437
1990/91		1 775						0	0	0				1 775
1991/92		3 066						0	0	0				3 066
1992/93		4 019						0	0	0				4 019
1993/94		4 780						0	0	0				4 780
1994/95		1 674						0	0	0				1 674
1995/96		0						833	3 000	7 875	4 958			16 666
1996/97		0					375	6 094	7 117	11 760	7 327	0		32 673
1997/98		146					1 298	7 156	4 150	1 758	598	0		15 106
1998/99		667					1 519	1 237	427	1 845	173	0		5 868
1999/00		1 015					1 254	2 600	1 154	1 430	191	0		7 644
2000/01		196					1 247	4 550	2 004	685	120	0		8 802
2001/02		3		295			880	6 300	3 489	720	78	92	0	11 857
2002/03		0		98			110	5 518	1 274	302	120	0	0	7 422
2003/04		0		197		246	0	536	531	380	48	240	0	2 178
2004/05	508	23		86	98	1 015	220	268	265	12	60	23	0	2 578
2005/06	336	0	597	192	0	1 903	104	144	74	55	0	0	15	3 420
2006/07		0	612	197	0	2 293	109	404	0	0	0	0	0	3 615
2007/08		0	94	0	0	246	0	489	0	153	0	187	0	1169
All seasons	844	17 945	1 303	1 065	98	5 703	7 116	36 129	23 485	26 975	13 673	542	15	134 893

Table 4: Catch (tonnes) of *Dissostichus* spp. reported from licensed fishing, and estimated from IUU fishing in the Convention Area, and reported in the CDS in areas outside the Convention Area in 2006/07 and 2007/08 (source: reported catch – past season from STATLANT data, and current season from catch and effort reports and data reported by France; IUU catch – WG-FSA-08/10 Rev. 2: CDS catch – data to October 2008).

2006/07 season

Inside	Subarea/division	Reported catch	IUU catch	Total CCAMLR	*Catch limit**
	48.1	<1**		<1	*0*
	48.3	3 539		3 539	*3 554*
	48.4	54		54	*100*
	48.6	112		112	*910*
	58.4.1	634	612	1 246	*600*
	58.4.2	124	197	321	*780*
	58.4.3	255	2 293	2 548	*550*
	58.4.4	0	109	109	*0*
	58.5.1	5 201	404	5 605	*0 outside EEZ*
	58.5.2	2 387		2 387	*2 584*
	58.6	436		436	*0 outside EEZ*
	58.7	148		148	*0 outside EEZ*
	88.1	3 091		3 091	*3 072*
	88.2	347		347	*567*
	88.3	0		0	*0*
	Total inside	16 329	3 615	19 944	

Outside	Area	CDS catch EEZ	CDS catch high seas	Total outside CCAMLR
	41	2 224	3 831	6 055
	47		593	593
	51	15	20	35
	57			0
	81	299	2	301
	87	5 440	258	5 698
	Total outside	7 978	4 704	12 682
Global total				32 626

2007/08 season

Inside	Subarea/division	Reported catch	IUU catch	Total CCAMLR	*Catch limit**
	48.3	3 856		3 856	*3 920*
	48.4	98		98	*100*
	48.6	0		0	*400*
	58.4.1	413	94	507	*600*
	58.4.2	217		217	*780*
	58.4.3	150	246	396	*450*
	58.4.4	77**		77	*0*
	58.5.1	2 853	489	3 342	*0 outside EEZ*
	58.5.2	1 496		1 496	*2 500*
	58.6	704	153	857	*0 outside EEZ*
	58.7	34		34	*0 outside EEZ*
	88.1	2 259	187	2 446	*2 700*
	88.2	416		416	*567*
	88.3	0		0	*0*
	Total inside	12 573	1 169	13 742	

(continued)

Table 4 (continued)

Outside Area	CDS catch EEZ	CDS catch high seas	Total outside CCAMLR
41	3 435	2 826	6 261
47	13	187	200
51	20	83	103
57			0
81	378		378
87	3 232	117	3 349
Total outside	7 078	3 213	10 291
Global total			24 033

* Includes catch limits for research fishing
** Research fishing/survey

Table 5: Participation in exploratory fisheries for *Dissostichus* spp. in 2007/08. Participating Members includes Members who submitted notifications but did not fish. (Source: WG-FSA-08/4)

Subarea/division	Participating Member	Number vessels fishing	*Dissostichus* spp. catch (tonnes)	
			Limit	Reported
Exploratory fisheries in Area 48 (Atlantic Ocean sector)				
48.6	Japan	-		
	Korea, Republic of	-		
	New Zealand	-		
	South Africa	-		
Total		0	400	0
Exploratory fisheries in Area 58 (Indian Ocean sector)				
58.4.1	Australia	-		
	Japan	-		
	Korea, Republic of	2		
	Namibia	2		
	New Zealand	-		
	Spain	1		
	Ukraine	-		
	Uruguay	1		
Total		6	600	413
58.4.2	Australia	-		
	Japan	-		
	Korea, Republic of	1		
	Namibia	2		
	New Zealand	-		
	South Africa	-		
	Spain	-		
	Ukraine	-		
	Uruguay	-		
Total		3	780	217
58.4.3a	Uruguay	1		
Total		1	250	9

(continued)

Table 5 (continued)

Subarea/division	Participating Member	Number vessels fishing	*Dissostichus* spp. catch (tonnes)	
			Limit	Reported
58.4.3b	Australia	1		
	Japan	1		
	Korea, Republic of	-		
	Namibia	1		
	Spain	-		
	Uruguay	1		
Total		4	150	139
			(50)*	(2)
Exploratory fisheries in Area 88 (Southwest Pacific sector)				
88.1	Argentina	1		
	Korea, Republic of	3		
	Namibia	-		
	New Zealand	4		
	Russia	1		
	South Africa	1		
	Spain	1		
	UK	3		
	Uruguay	1		
Total		14	2 700	2 259
88.2	Argentina	-		
	New Zealand	1		
	Russia	1		
	South Africa	-		
	Spain	-		
	UK	1		
	Uruguay	1		
Total		4	567	416

* Research survey

Table 6: Reported catch of *Dissostichus* spp. in exploratory fisheries. (Source: STATLANT data for past seasons, and catch and effort reports for current season.)

Season	Reported catch (tonnes) of *Dissostichus* spp. in exploratory fisheries							
	48.6	58.4.1	58.4.2	58.4.3a	58.4.3b	88.1	88.2	All exploratory fisheries
1996/97						<1	<1	<1
1997/98						42	<1	42
1998/99						297		297
1999/00						751	<1	751
2000/01			<1			660	<1	660
2001/02						1 325	41	1 366
2002/03			117			1 831	106	2 055
2003/04	7	<1	20	<1	7	2 197	375	2 605
2004/05	51	480	126	105	297	3 105	411	4 575
2005/06	163	421	164	89	361	2 969	514	4 680
2006/07	112	634	124	4	251	3 091	347	4 562
2007/08		413	217	9	141	2 259	416	3 455
Total	333	1 948	767	207	1 057	18 526	2 209	25 047

Table 7: Summary of Members and vessels notified in 2008/09 in (a) exploratory longline fisheries for *Dissostichus* spp. (with corresponding number of participating Members, number of vessels and catch limits agreed in conservation measures in force in 2007/08), (b) exploratory trawl fisheries for krill, and (c) new pot fisheries for crab. (Source: CCAMLR-XXVII/12)

Member notifications	Number of vessels notified by subarea/division						
	48.6	58.4.1	58.4.2	58.4.3a	58.4.3b	88.1	88.2
(a) Notifications for exploratory longline fisheries for *Dissostichus* spp. in 2008/09							
Argentina						2	2
Australia			1				
Chile						1	1
Japan	1	1	1	1	1		
Korea, Republic of	2	5	4			4	2
New Zealand		4	1			4	4
Russia						3	3
South Africa		1				1	1
Spain		1	1		1	1	1
UK						3	3
Uruguay		1	1		1	2	2
Number of Members	2	6	6	1	3	9	9
Number of vessels	3	13	9	1	3	21	19
Corresponding conservation measures in force in 2007/08							
Number of Members	4	8	9	1	6	9	7
Number of vessels	1*	15	15	1	1*	21	15
Target species catch limit (tonnes)	400	600	780	250	150**	2700	567

Member notifications	Number of vessels notified by subarea/division
	48.6
(b) Notifications for exploratory trawl fisheries for krill in 2008/09	
Norway	1
Total	1

Member notifications	Number of vessels notified by subarea/division	
	48.2	48.4
(c) Notifications for new pot fisheries for crab in 2008/09		
Russia	1	1
Total	1	1

* Maximum number per Member at any one time
** Excluding research fishing

Table 8: Unstandardised CPUE (kg/hook) of *Dissostichus* spp. in exploratory longline fisheries reported between 1996/97 and 2007/08. (Source: fine-scale data from commercial and fishery-based research hauls, with SSRUs as defined in Conservation Measure 41-01 (2006).)

Subarea/ division	SSRU	Season											
		1996/97	1997/98	1998/99	1999/00	2000/01	2001/02	2002/03	2003/04	2004/05	2005/06	2006/07	2007/08
48.6	A								0.04	0.07	0.11	0.15	
	D											0.05	
	E									0.08		0.13	
	G								0.02	0.07	0.16	0.07	
58.4.1	C									0.13	0.18	0.15	0.19
	D												0.09
	E									0.22	0.10	0.13	0.12
	F												0.05
	G									0.20	0.22	0.24	0.12
	H												0.15
58.4.2	A									0.08	0.08	0.13	0.20
	C							0.10		0.07	0.17		0.42
	D							0.19	0.06		0.03		
	E							0.21	0.11	0.14	0.22	0.15	0.21
58.4.3a	A									0.05	0.05	0.02	0.08
58.4.3b	A								0.04	0.07	0.11	0.13	0.15
	B								0.14	0.23	0.17	0.12	
88.1	A	0.01				0.02		0.16			0.08	0.05	
	B	0.05	0.03			0.16	0.25	0.26	0.11	0.55	0.07	0.33	0.15
	C					0.44	0.87	0.58	0.31	0.53	1.07	0.71	0.36
	E		0.07	0.06		0.03		0.05	0.08	0.28		0.02	
	F		0.00					0.03				0.16	
	G		0.06	0.02		0.13	0.12	0.16	0.12	0.15	0.63		
	H		0.17	0.26	0.38	0.41	0.72	0.45	0.21	0.73	0.60	0.38	0.40
	I		0.37	0.23	0.28	0.28	0.43	0.20	0.16	0.44	0.39	0.34	0.44
	J			0.09	0.18	0.04			0.04	0.21	0.36	0.36	0.30
	K		0.32	0.15	0.39		0.45		0.01	0.32	0.50		0.28
	L					0.12			0.10	0.14	0.16		0.17
88.2	A						0.82		0.11	0.48	0.54		
	B								0.06				
	D										0.43	0.31	0.19
	E							0.35	0.42	0.70	0.33	0.22	0.49
	F										0.26	0.02	0.39
	G										0.03		

Table 9: Number of individuals of *Dissostichus* spp. tagged and released and the tagging rate (fish per tonne of green weight caught) reported by vessels operating in 2007/08 in fisheries for *Dissostichus* spp. which have tagging requirements outlined in the conservation measures. The required tagging rate (required rate) for *Dissostichus* spp. is listed for each subarea and division, and does not include any additional requirements when conducting research fishing in closed SSRUs. Vessels which tagged more than 500 fish are indicated (see Conservation Measure 41-01, Annex C). The number of *D. eleginoides* tagged is indicated in brackets. (Source: observer data and catch and effort reports.)

Subarea or division (required rate)	Flag State	Vessel name	*Dissostichus* spp. tagged and released		
			Number of fish		Tagging rate
48.4 (5)	New Zealand	*San Aspiring*	252	(252)	5.12
	UK	*Argos Froyanes*	252	(252)	5.17
	Total		504	(504)	
48.6 (1)	No fishing				
58.4.1 (3)	Korea, Republic of	*Insung No. 1*	370	(0)	2.99
		Insung No. 2	449	(8)	2.93
	Namibia	*Antillas Reefer*	56	(0)	1.23
		Paloma V	47	(5)	3.38
	Spain	*Tronio*	202	(7)	3.03
	Uruguay	*Banzare*	10	(0)	1.03
	Total		1134	(20)	
58.4.2 (3)	Korea, Republic of	*Insung No. 1*	248	(0)	3.01
	Namibia	*Antillas Reefer*	48	(1)	5.44
		Paloma V	377	(9)	3.01
	Total		673	(10)	
58.4.3a (3)	Uruguay	*Banzare*	41	(41)	4.68
	Total		41	(41)	
58.4.3b (3)	Australia	*Janas*	15	(9)	6.45
	Japan	*Shinsei Maru No. 3*	346	(120)	3.19
	Namibia	*Antillas Reefer*	13	(1)	0.61
	Uruguay	*Banzare*	43*	(0)	4.53
	Total		417*	(130)	
88.1 (1)	Argentina	*Antartic III*	0	(0)	0
	Korea, Republic of	*Hong Jin No. 707*	255	(0)	1.20
		Insung No. 2	13	(8)	1.24
		Jung Woo No. 2	212	(11)	1.05
	New Zealand	*Avro Chieftain*	50	(0)	1.20
		Janas	179	(0)	1.03
		San Aotea II	196	(3)	1.22
		San Aspiring	370	(0)	1.08
	Russia	*Yantar*	283	(0)	1.13
	South Africa	*Ross Mar*	128	(3)	1.06
	Spain	*Tronio*	46	(38)	1.00
	UK	*Argos Froyanes*	370	(0)	1.06
		Argos Georgia	196	(14)	1.32
		Argos Helena	181	(1)	1.30
	Uruguay	*Ross Star*	95	(1)	1.56
	Total		2574	(79)	
88.2 (1)	New Zealand	*Avro Chieftain*	349	(0)	1.01
	Russia	*Yantar*	0	(0)	0
	UK	*Argos Froyanes*	38	(0)	1.09
	Uruguay	*Ross Star*	2	(0)	0.21
	Total		389	(0)	

* Includes *Dissostichus* spp. (species not identified)

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

Subarea/ division	Season								Total
	2000/01	2001/02	2002/03	2003/04	2004/05	2005/06	2006/07	2007/08	
48.6				4	62	171	129		366
58.4.1					462	469	1 507	1 134	3 572
58.4.2					342	136	248	673	1 399
58.4.3a					199	104	9	41	353
58.4.3b					231	175	289	417	1 112
88.1	326	756	1 068	1 951	3 221	2 977	3 608	2 574	16 481
88.2		12	94	433	341	444	278	389	1 991
Total	326	768	1 162	2 388	4 858	4 476	6 068	5 228	25 274

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

Subarea/ division	Season								Total
	2000/01	2001/02	2002/03	2003/04	2004/05	2005/06	2006/07	2007/08	
48.6						3	2		5
58.4.1							4	6	10
58.4.2									0
58.4.3a						6		2	8
58.4.3b					1	6	1	1*	9
88.1	1	4	13	32	59	70	206	216	601
88.2				18	17	28	33	36	132
Total	1	4	13	50	77	113	246	261	765

* Reported during longline survey in May 2008.

Table 12: Precautionary catch limits for crabs and effort limits for conducting exploratory surveys in Subareas 48.2 and 48.4.

	Subarea		
	48.3	48.2	48.4
Area of depth stratum 0–500 m (km^2)	42 400[a]	32 175[a]	2 107[a]
Provisional catch limit for crabs (tonnes)	1 600.0[b]	250	10
Time/efforts for conducting exploratory survey (pots*hours)	200 000[b]	200 000	30 000

[a] Data provided by CCAMLR Secretariat.
[b] Data from existing Conservation Measures 52-01and 52-02.

Table 13: Yield estimates (tonnes) assuming a 5% exploitation rate by SSRU using the median, 25 percentile (25%), and 75 percentile (75%) biomass levels calculated using the comparative CPUE and depletion-derived methods. Estimates are relative to the 2006/07 fishing season.

SSRU:	5841C		5841E	5841G	5842A		5842C	5842E	
Method:	CPUE	Depletion	CPUE	CPUE	CPUE	Depletion	CPUE	CPUE	Depletion
Median	98	95	43	51	24	10	9	37	42
25%	58	90	4	13	1	9	0	24	36
75%	138	100	83	88	47	12	18	50	48
Current catch limit	200		200	200	260		260	260	
2007/08 catch	177		16	197	54		37	125	
Range in historic catches	177–249		16–186	144–206	4–62		4–37	14–156	

Table 14: Catches for macrourids, rajids and other species taken as by-catch from longline fisheries in 2007/08, and reported in fine-scale data. Catches are given in tonnes and as a percentage of the catch of *Dissostichus* spp. (TOT) reported in fine-scale data. (Rajids cut from the longlines and released are not included in these estimates.) na – not applicable.

Subarea/division	Target catch (tonnes)	Macrourids			Rajids			Other species		
		Catch (tonnes)	% TOT	Catch limit	Catch (tonnes)	% TOT	Catch limit	Catch (tonnes)	% TOT	Catch limit
48.3	3807	161	4.2	196	12	0.3	196	36	0.9	-
48.4	98	16	15.9	-	4	3.6	-	0	0.5	-
48.6	0	0	0.0	64	0	0.0	100	0	0.0	140
58.4.1	410	36	8.8	96	0	0.0	50	1	0.4	60
58.4.2	217	12	5.3	124	0	0.2	50	1	0.5	60
58.4.3a	9	0	1.1	26	2	17.5	50	0	0.0	20
58.4.3b	138	7	5.0	80	1	0.4	50	1	1.1	20
58.5.1 French EEZ	2853	453	15.9	na	230	8.1	na	0	0.0	na
58.5.2	715	66	9.3	360	9	1.2	120	2	0.2	50
58.6 French EEZ	684	103	15.1	na	39	5.7	na	0	0.0	na
58 South African EEZ	54	4	7.5	na	0	0.0	na	1	1.5	na
88.1	2259	112	4.9	426	4	0.2	133	20	0.9	160
88.2	416	17	4.2	88	0	0.0	50	4	1.1	100

Table 15: Number of macrourids, rajids and other species caught or released from longline fisheries in 2007/08, and reported in fine-scale data.

Subarea/division	*Dissostichus* spp.		Macrourids		Rajids		Other species	
	Caught	Released	Caught	Released	Caught	Released	Caught	Released
48.3	574 593	4 430	109 460	310	1 598	19 558	29 550	8
48.4	5 926	496	14 946	4	724	8 276	510	133
48.6	0	0	0	0	0	0	0	0
58.4.1	12 586	688	35 425	0	11	0	2 453	2
58.4.2	6 628	633	9 648	0	74	0	1 548	0
58.4.3a	1 805	43	185	0	332	0	1	0
58.4.3b	5 184	399	10 463	0	152	155	1 839	0
58.5.1 French EEZ	608 099	1 629	285 150	0	53 151	2 461	0	0
58.5.2	138 317	802	56 090	10	1 425	5 542	14 946	0
58.6 French EEZ	123 337	462	81 065	0	10 844	9 299	0	0
58 South African EEZ	6 124	119	3 815	0	0	0	810	0
88.1	101 618	2 543	83 929	1	431	7 190	57 230	17
88.2	10 869	386	20 287	0	0	0	5581	0

Table 16: Estimated total catch of rajids (including those cut off or released) in longline fisheries in 2007/08 derived from fine-scale (C2) data.

Subarea/division	Rajids					
	Number caught	Number released	Estimated total catch (tonnes)	Mean weight (kg)	Catch limit (tonnes)	% of catch limit
48.3	1 598	19 558	162.5	7.68	196	82.9
48.4	724	8 276	43.6	4.84	-	-
48.6	0	0	0.0	-	100	0
58.4.1	11	0	0.1	8.34	50	0.2
58.4.2	74	0	0.5	6.41	50	0.9
58.4.3a	332	0	1.5	4.62	50	3.1
58.4.3b	152	155	1.0	3.41	50	2.1
58.5.1 French EEZ	53 151	2 461	240.8	4.33*	na	
58.5.2	1 425	5 542	42.3	6.07	120	35.2
58.6 French EEZ	10 844	9 299	72.5	3.60*	na	-
58 South African EEZ	0	0	0.0	-	na	-
88.1	431	7 190	70.4	9.24	133	52.9
88.2	0	0	0.0	-	50	0.0

* Derived from the total reported catch divided by numbers retained.

Table 17: Proposed catch limits of grenadiers in Subarea 88.1 assuming a CV of 0.5 for the estimate of B_0 and that the grenadier density was constant across the entire slope (WG-FSA-08/32).

Region	Current catch limit	Estimated yield	Maximum historic catch	Proposed catch limit
881B, C, G	50	-	34	40
881H, I, K	271	388	390	320
881J	79		46	50
881L	24		6	20
882A, B	0	100	8	0
Total	424	488		430

Table 18: Accumulated longline fishing effort, seabed areas and estimated proportions of effort (Prop. effort in stratum) in depth strata in SSRUs in exploratory toothfish fisheries.

(a) SSRUs for which seabed area has been estimated, the potential proportion of a depth stratum affected by the accumulated longlines to date (Prop. area effect) is estimated using two assumed widths of the area affected by a line – 1 m and 25 m. (Source: effort – C2 fine-scale data; seabed areas – Sandwell and Smith, GEBCO and GEODAS, see *Statistical Bulletin*, Vol. 20, Table 18.)

Division	SSRU	No. years of fishery	Accumulated length (km)	Depth 500–600 m				Depth 600–1 500 m				Depth 1 500–1 800 m			
				Seabed area (km^2)	Prop. effort in stratum	Prop. area effect (1m wide)	Prop. area effect (25m wide)	Seabed area (km^2)	Prop. effort in stratum	Prop. area effect (1m wide)	Prop. area effect (25m wide)	Seabed area (km^2)	Prop. effort in stratum	Prop. area effect (1m wide)	Prop. area effect (25m wide)
58.4.1	C	4	9 323	6 107	0.001	0	0	25 504	0.194	0	0.002	7 603	0.805	0.001	0.025
	D	1	173	6 076	0	0	0	35 165	1	0	0	8 640	0	0	0
	E	4	4 178	3 792	0	0	0	32 425	0.497	0	0.002	6 823	0.503	0	0.008
	F	1	93	6 390	0	0	0	31 190	0.833	0	0	3 398	0.167	0	0
	G	4	6 437	9 147	0.029	0	0.001	25 357	0.662	0	0.004	4 040	0.309	0	0.012
	H	1	108	13 673	0	0	0	15 844	0.429	0	0	2 410	0.571	0	0.001
58.4.3b	A	5	6 167	90	0	0	0	51 178	0.482	0	0.001	61 424	0.518	0	0.001
	B	4	6 707	0	0			3 598	0.011	0	0.001	15 951	0.989	0	0.01

(b) Subarea 88.1 – Accumulated longline fishing effort, seabed areas and estimated proportions of effort (Prop. effort in stratum) in SSRUs in exploratory toothfish fisheries in Subarea 88.1 for depths between 600 and 1 800 m (seabed areas in the depth ranges shown in (a) were not available). Proportion of effort in each of the depth strata in (a) are also given. na – no substratum in that range. (Source: effort – C2 fine-scale data; seabed areas – SC-CAMLR-XXII, Annex 5, paragraph 5.37 and Table 5.3.)

SSRU	No. years of fishery	Accumulated length (km)	Depth 600–1800 m			Proportion of effort in depth strata		
			Seabed area (km^2)	Prop. area effect (1m wide)	Prop. area effect (25m wide)	500–600 m	600–1 500 m	1 500–1 800 m
A	5	232	4 908	0	0.001	na	0.595	0.405
B	10	5 526	4 318	0.001	0.032	na	0.448	0.552
C	8	7 104	4 444	0.002	0.04	na	0.529	0.471
E	7	1 740	14 797	0	0.003	0.023	0.9	0.077
F	3	34	18 398	0	0	0.292	0.708	0
G	8	3 318	7 110	0	0.011	0.068	0.854	0.077
H	11	27 802	19 245	0.001	0.035	0.023	0.86	0.117
I	11	19 293	30 783	0.001	0.016	0.001	0.937	0.063
J	8	7 135	43 594	0	0.004	0.053	0.947	0
K	8	7 674	24 695	0	0.008	0.026	0.939	0.035
L	5	4 722	16 807	0	0.004	0.437	0.563	0

Table 18 (continued)

(c) Areas for which SSRU-specific seabed areas were not available. (Source: effort – C2 fine-scale data.)

Subarea/ division	SSRU	No. years of fishery	Accumulated length (km)	Proportion of effort in depth strata		
				500–600 m	600–1 500 m	1 500–1 800 m
48.6	A	4	1 825	0	0.931	0.069
	D	1	62	0	0.4	0.6
	E	2	153	0	0.431	0.569
	G	4	3 856	0.016	0.773	0.211
58.4.2	A	4	2 634	0.006	0.796	0.199
	C	4	767	0.062	0.741	0.197
	D	3	2 189	0	0.795	0.205
	E	6	4 056	0.012	0.528	0.46
58.4.3a	A	4	7 498	0	0.813	0.187
58.4.4a	A	2	1 643	0.723	0.262	0.015
58.4.4b	B	2	284	0.709	0.291	0
	C	1	195	0	0.638	0.362
	D	1	684	0	1	0
88.2	A	4	875	0	0.908	0.092
	B	1	23	0	1	0
	D	3	488	0	0.515	0.485
	E	6	7 228	0	0.786	0.214
	F	3	575	0	0.39	0.61
	G	1	35	0.25	0.75	0
88.3	B	1	60	0	0.86	0.14
	C	1	24	0	0.846	0.154
	D	1	20	0	0.762	0.238

Table 19: Summary table of notifications for bottom fisheries relevant to Conservation Measure 22-06. X – notification of a new or exploratory fishery by a Member. Notifications including preliminary assessments of potential impacts of bottom fishing activities are shown as A (subscripts: g – general assessment, a – area specific). M – proposed mitigation measures are also provided.

Fishery/Member	Subarea/division							
	48.2	48.6	58.4.1	58.4.2	58.4.3a	58.4.3b	88.1	88.2
Toothfish fisheries:								
Argentina							X	X
Australia				A_a M				
Chile							X	X
Japan		A_g	A_g	A_g	A_g	A_g		
Korea, Republic of		X	X	X			X	X
New Zealand			A_g M	A_g M			A_a M	A_a M
Russia							X	X
South Africa			X				X	X
Spain			A_a M	A_g M		A_g M	A_a M	A_g M
UK							A_a M	A_g M
Uruguay			X	X		X	X	X
Pot fisheries:								
Russia	X							

Table 20: Proposed pro forma for Members submitting preliminary assessments of the potential for their proposed bottom fishing activities to have significant adverse impacts on VMEs. The pro forma is designed to be consistent with the requirements for proposals on exploratory fisheries and is based on the requirements set out in paragraph 7(i) in Conservation Measure 22-06.

1. Preliminary assessment of bottom fishing activities – Required Information

1.1 Scope

1.1.1 Fishing method(s) to be used
Longline type (Spanish/auto/trotline/pots)

1.1.2 Subarea/division
e.g. 88.1 and 88.2

1.1.3 Period of application
Year

1.2 Proposed fishing activity

1.2.1 Detailed description of gear
Please provide a detailed diagram of the gear configuration to be used (see WG-FSA-08/60 for example or diagrams available in the CCAMLR observer logbook). Include details of line type; line length (length range if necessary); hook type(s); numbers per line and spacing of hooks within a line (per vertical line for trotlines); weight material and mass; spacing of weights; anchor type; floats and spacing etc. for ***each vessel*** *included in this application/notification.*

1.2.2 Scale of proposed activity
Please provide estimates of total numbers of hooks and/or lines to be deployed.

1.2.3 Spatial distribution of activity
Please provide details of SSRUs or geographical regions within the subarea/division in which activities will take place including the depth range of fishing activities.

1.3 Mitigation measures to be used

Please provide details of modifications to gear configuration or methods of deployment aimed at preventing or reducing adverse impacts to VMEs.

2. Preliminary assessment of bottom fishing activities – Supporting Information

2.1 Assessment of known/anticipated impacts on VMEs

Please provide data or information available on the current state of knowledge of impacts of proposed fishing activities on VMEs within the area of activity.

2.1.1 Estimated spatial effort footprint
Please provide details of % area covered by fishing effort.

2.1.2 Summary of potential VMEs present within areas of activity
e.g. biogenic/geological; habitat area coverage/distribution; fragility/ vulnerability and resilience of habitats; species composition/endemism; life-history traits. Please provide details.

2.1.3 Probability of impacts
e.g. low/medium/high/unknown. Please provide details.

2.1.4 Magnitude/severity of the interaction of the proposed fishing gear with VMEs
e.g. associated mortality and spatial extent of impacts. Please provide details.

2.1.5 Physical and biological/ecological consequences of impact
e.g. loss of physical habitat structure or of keystone species or extinctions.

2.2 Estimated cumulative footprint

Please provide an estimated cumulative impact derived from information provided under 2.1.1 to 2.1.5 above and any additional information available from the Secretariat (e.g. historical fishing effort; habitat maps).

(continued)

Table 20 (continued)

2.3 Research activities related to provision of new information on VMEs

2.3.1 Previous research

Please provide a summary of research previously carried out in the proposed area of activity by your Member State (including national/regional/international research programs). This should include data collected in the previous season under 2.3.2 and details of data submitted to the Secretariat such as:

- *Indirect evidence (e.g. by-catch observation; species identification through sample collection and genetic and morphological analysis; acoustic or geomorphic data collection; other)*
- *Direct evidence (e.g. observations using camera gear or ROVs; other)*

2.3.2 In-season research

Please summarise details of the research planned during the proposed fishing activities by your Member State (including national/regional/international research programs). Please provide details of what data will be collected in order to document evidence of, or further knowledge on, VMEs within the areas of activities, including:

- *Indirect evidence (see examples above)*
- *Direct evidence (see examples above)*

2.3.3 Follow-on research

Please provide details of potential future research resulting from previous/in-season research, including collaborative work with other Member States or as part of national/regional/international research programs, including:

- *Indirect evidence (see examples above)*
- *Direct evidence (see examples above)*

Table 21: Summary table of mitigation measures and other actions for implementing Conservation Measure 22-06 in the 2008/09 season proposed by Members who submitted preliminary assessments of potential impacts of bottom fishing activities in 2008.

	Gear type in proposal	Summary of proposed actions by Members
Observer requirements	Autoline 1	By-catch of VME-related organisms would be monitored. Camera equipment would be deployed on longline sets.
	Autoline 2	Additional data collection by observers on by-catch on lines for which there are ≥5 specimens/thousand hooks.
Vessel requirements	Autoline 1	Cease fishing in any location where evidence is encountered (by-catch or video).
	Autoline 2	Education of observers and crew. Take steps to reduce loss of fishing gear. Move vessel from area where >25 specimens/thousand hooks are taken on a line.
	Autoline 3	≥20 specimens/thousand hooks on a line triggers research to document extent of VME.
	Spanish system	Evidence of VME – 15 specimens/thousand hooks when found together; 20 specimens/thousand hooks when observed far apart. Mitigation – not fish on same location (buffer of 1 n mile) when evidence is found. Research – parallel lines (at least 1 n mile apart) (100% observer coverage).
	Trotline	No mitigation measures needed.
Reporting requirements	Autoline 1	Report location of encounter with VME.
	Autoline 3	Single line encounter of ≥20 organisms/thousand hooks triggers notification and research plan.
	Spanish system	Report location where evidence of VME is found.

Table 22: List of tasks identified by WG-FSA for the 2008/09 intersessional period. The paragraph numbers (Ref.) refer to this report. * – priority tasks.

	Ref.	Task	Group	Members	Secretariat
		Review of available information			
	3.5	Consider catches of *D. eleginoides* reported from Divisions 58.4.1 and 58.4.3b.	SC-CAMLR		
	3.26	Review the application of the adjustment factor for trawl headline height used in surveys for *C. gunnari.*	SG-ASAM		
	3.38	Develop a better understanding of CPUE from trotlines.			
*	3.49	Return all physical tags and check for correct transcription of returned tags, including all alphanumeric characters.		✓	✓
	3.52	Procedure for inferring a satisfactory match between a tag recapture and release record should be documented and be algorithmic to minimise any subjectivity.		✓	✓
*	3.55	Undertake to identify the tagging details for all tags recovered.			✓
	3.58	Consider further ways of incorporating unmatched tag recaptures into the assessment.	WG-SAM		
	3.59	Consider using the tagging equipment provided by the Secretariat in all CCAMLR fisheries.		✓	✓
	3.60	Purchase tags from the Secretariat and participate in skate tagging during the Year-of-the-Skate.		✓	✓
	3.70	Construct an otolith reference collection for *D. mawsoni.*		✓	
		Preparation for assessments			
	4.7	Consider modifications to the design of surveys used to estimate the abundance of *C. gunnari.*		✓	
*	4.18	Develop a series of data quality metrics.		✓	✓
		Assessment and management advice			
	5.58	Consider how to design longline surveys and how to reconcile datasets from different types of fishing gear.	SG-SAM		
*	5.81	Tagging fish at the same rate as fishing in accordance with Conservation Measure 42-01.	SCIC		
	5.94, 5.97	Review harvest strategies and research programs for toothfish in the Ross Sea.	WG-SAM		
	5.124	Consider guidelines for establishing CCAMLR-sponsored research programs.	SC-CAMLR		

(continued)

Table 22 (continued)

	Ref.	Task	Group	Members	Secretariat
		Fish and invertebrate by-catch			
	6.23	Develop common methodology and reading methods for skates.	CON		
*	6.25–6.40	Participate in the Year-of-the-Skate in all *Dissostichus* spp. fisheries, with a tagging program focused on exploratory fisheries.		✓	✓
*	6.34	Revise observer logbook forms.			✓
*	6.46	Investigate coding systems for VME-related taxa.			✓
		Evaluation of threats arising from IUU fishing activities			
*	8.6	Investigate and document IUU gillnet activities.	SCIC	✓	
		Biology, ecology and demography of target and by-catch species			
	9.21	Update the Species Profile for *D. eleginoides.*	Subgroup on Biology and Ecology		
	9.23	Complete calibration work for ageing *C. gunnari* using otoliths and submit report.	CON		
		Consideration of VMEs			
	10.17	Include SSRU, subarea and division boundaries in map of fishing footprints.	WG-FSA		✓
*	10.20	Obtain updated seabed area information for the three depth strata from reliable sources for all SSRUs.			✓
	10.23	Improve methods for assessing footprints coupled with the developing assessments of risk in different areas.		✓	
	10.25	Develop a pro forma for the submission of preliminary assessments.	SC-CAMLR		
*	10.35	Consider the taxonomic detail requested to be recorded by observers.	TASO		
*	10.41	Improve the quality and quantity of data on benthos by-catch.		✓	
	10.48	Provide data and advice on VMEs and their vulnerability.	SCAR		✓
*	10.55	Consideration of VMEs and risk could be undertaken by WG-EMM and the consideration of mitigation measures be part of the work of WG-FSA.	SC-CAMLR		

(continued)

Table 22 (continued)

	Ref.	Task	Group	Members	Secretariat
		Scheme of International Scientific Observation			
*	11.8(i)	Include detailed descriptions of the gear that vessels intend to use along with their notifications for exploratory fisheries.		✓	
*	11.8(ii)	Update C2 data form.			✓
*	11.8(iii)	Report sections of line that are joined under water as two independent sets.		✓	
*	11.8(iv) 11.8(ix)	Update observer logbook forms.			✓
	11.8(v)	Develop photographic guides to macroscopic maturity staging of *Dissostichus* spp.		✓	
	11.4(ii)(d) 11.8(vi)	Undertake a statistical analysis of the required sampling level of *Dissostichus* spp. for the collection of biological, age and length data.	WG-SAM		
	11.8(vii)	Implement a sampling rate of one *D. eleginoides* and one *D. mawsoni* per 150 hooks with a minimum of five fish of each species per line.		✓	
		Future assessments			
	12.1	Consider using dietary information and condition to tune the natural mortality parameter in *C. gunnari* assessments.		✓	
	12.2	Advice on what assessments would be appropriate for grenadiers, and advice on the research and data collection.	WG-SAM		
	12.3, 12.4, 5.119	Examine methods for determining the relative depletion and recovery status of the stock of *Dissostichus* spp.	WG-SAM		
	12.5	Consider designs that would be capable of standardising gear effectively between surveys.	WG-SAM		
*	12.7	Develop a formal procedure for biennial assessments.	WG-SAM		
*	12.8–12.9	Encourage participation in the work of WG-FSA.		✓	

(continued)

Table 22 (continued)

	Ref.	Task	Group	Members	Secretariat
		Future work			
	13.2–13.5	Activities of subgroups.			
*	13.8	Develop a Science Plan.	SC-CAMLR		
	13.24	Notify scientific research activities in accordance with Conservation Measure 24-01, and meet reporting requirements.		✓	
		Other business			
	14.3	Submit the data on *D. mawsoni* in McMurdo Sound.		✓	

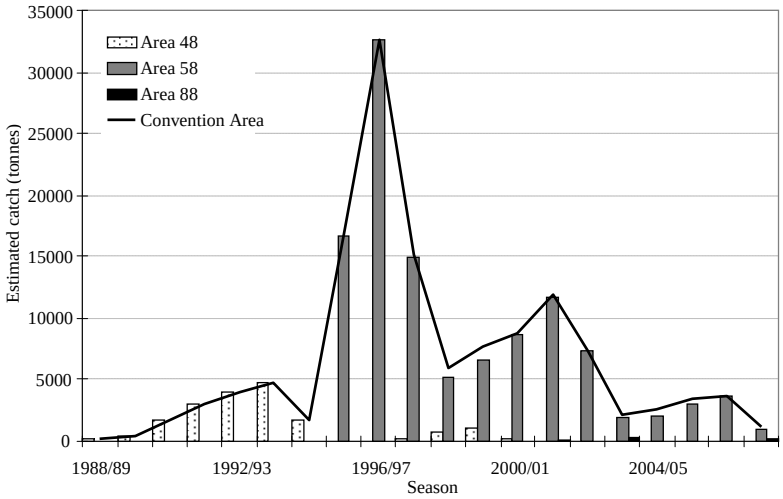


Figure 1: Catch history of *Dissostichus* spp. taken by IUU fishing in the Convention Area. IUU fishing was first detected in 1988/89, and estimates are derived from longlining and gillnetting activities. (Source: WG-FSA-08/10 Rev. 2 and SC-CAMLR reports.)

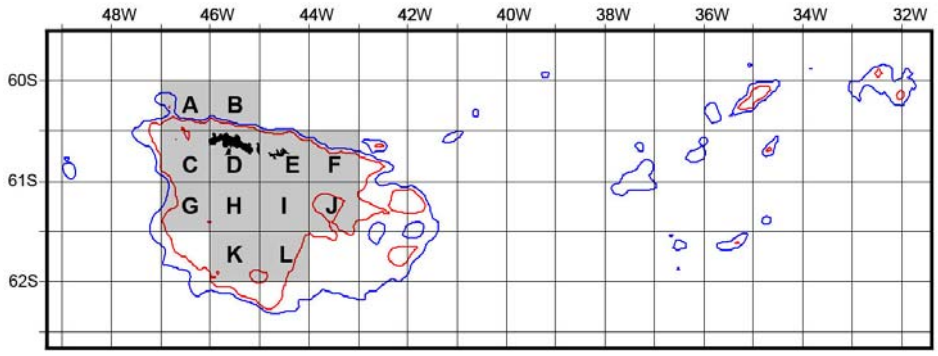


Figure 2: Operational area for phase I of the experimental harvest regime for the crab fishery in Subarea 48.2.

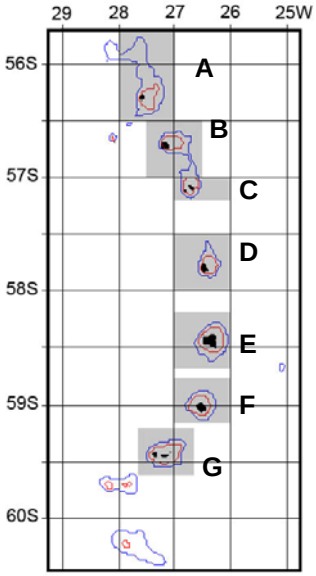


Figure 3: Operational area for phase I of the experimental harvest regime for the crab fishery in Subarea 48.4.

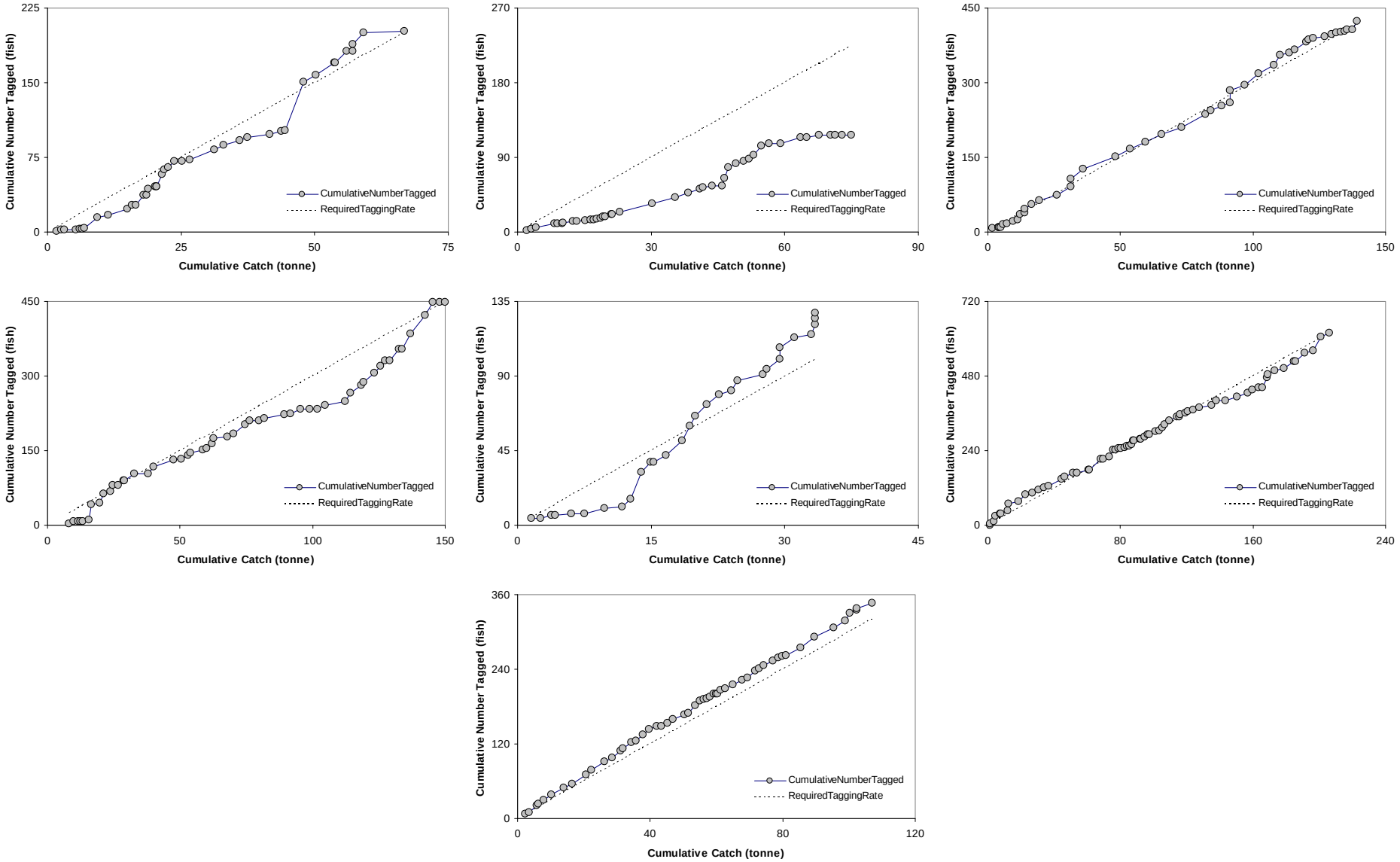
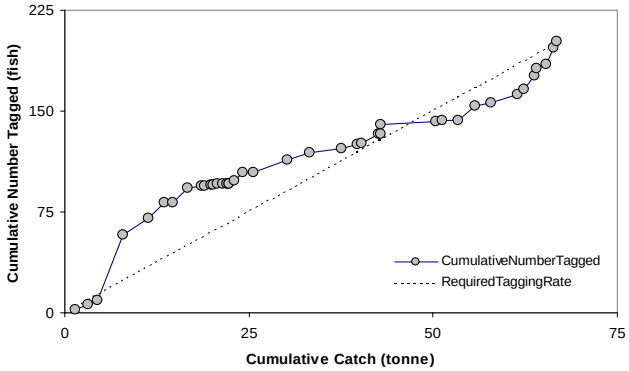
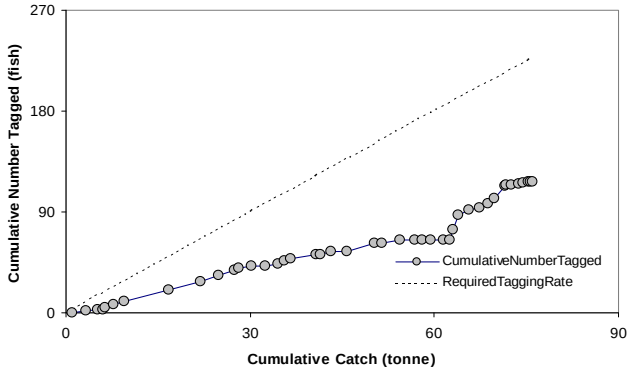
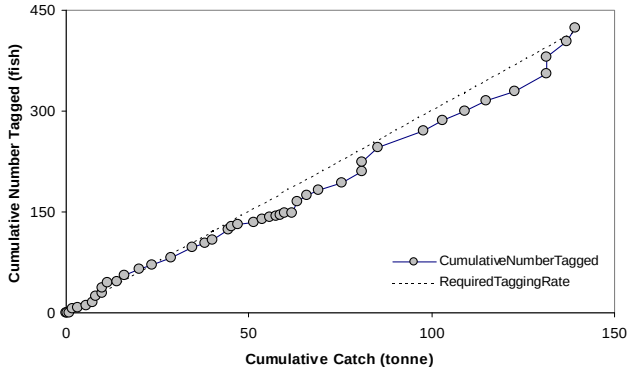
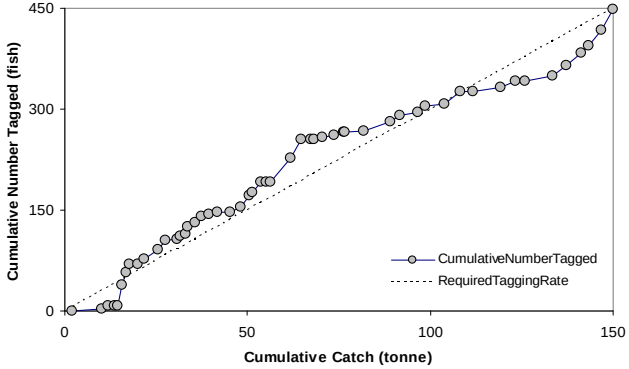


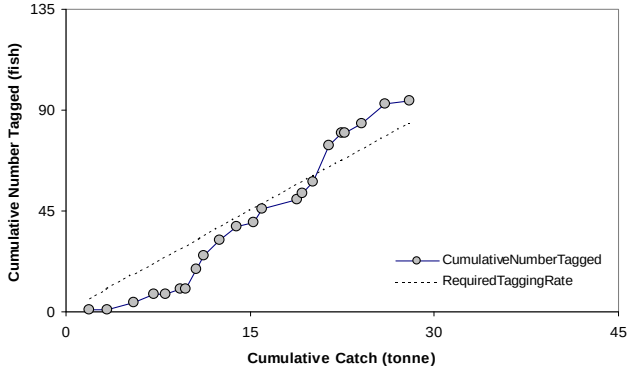
Figure 4: Cumulative catch of *Dissostichus* spp. versus cumulative number of *Dissostichus* spp. tagged for each vessel engaged in the exploratory fisheries for *Dissostichus* spp. in Subarea 58.4 in 2007/08 (source: catch – C2 data; number of fish tagged – scientific observer data). **NB: Figure 4 was corrected subsequent to the WG-FSA-08 meeting. The corrigendum follows on the next page.**

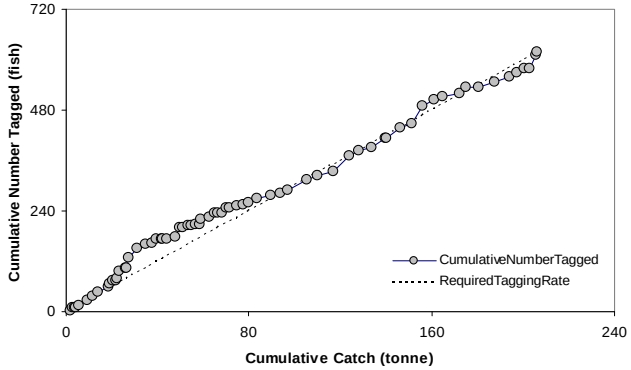












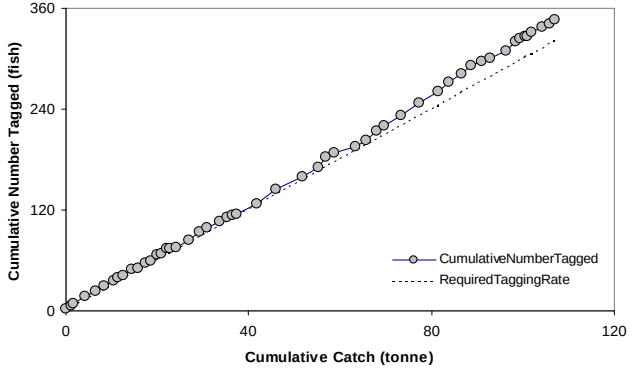


Figure 4 corrigendum

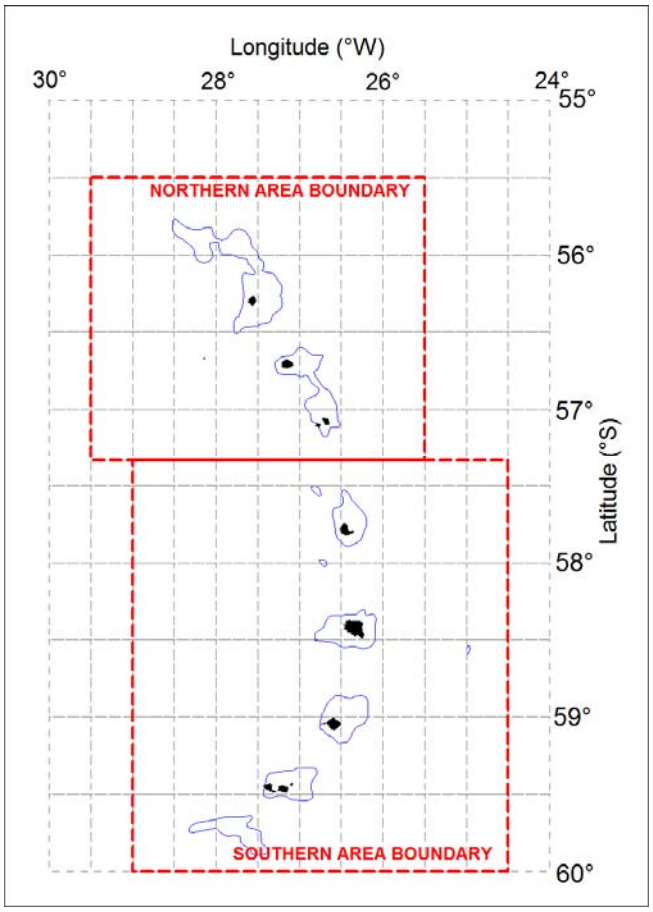


Figure 5: Positions of the boundaries of the Northern Area and Southern Area in Subarea 48.4. The 1 000 m depth contour is indicated.

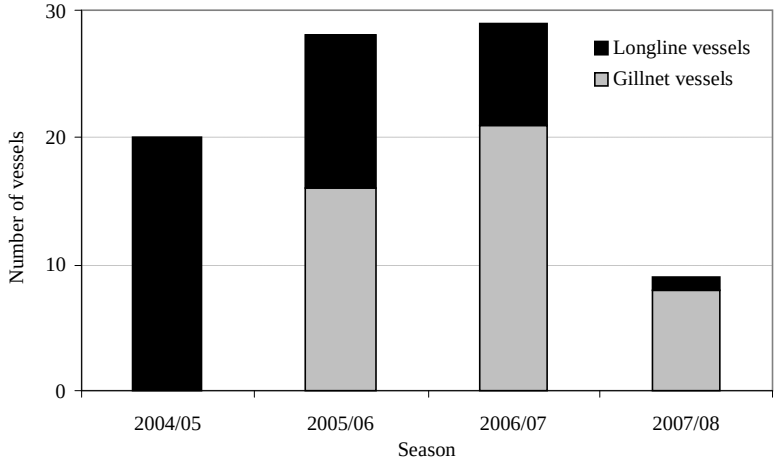
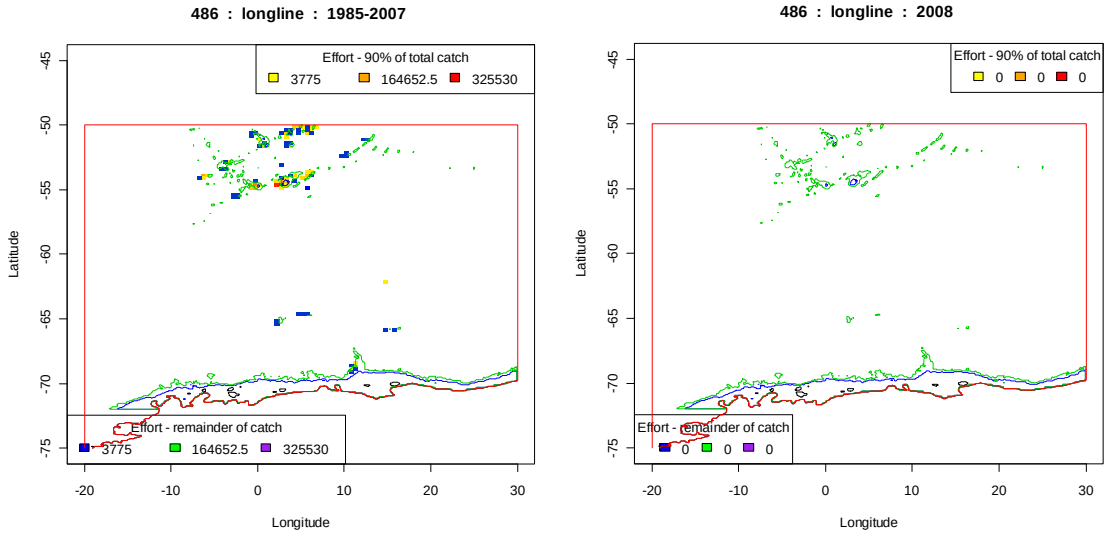


Figure 6: Estimated number of longline and gillnet vessels engaged in IUU fishing in the Convention Area since 2004/05. Note that some vessels have the capacity to deploy gillnets and longlines. (Source: WG-FSA-08/10 Rev. 2 and SC-CAMLR reports.)

(a) Subarea 48.6



(b) Division 58.4.1

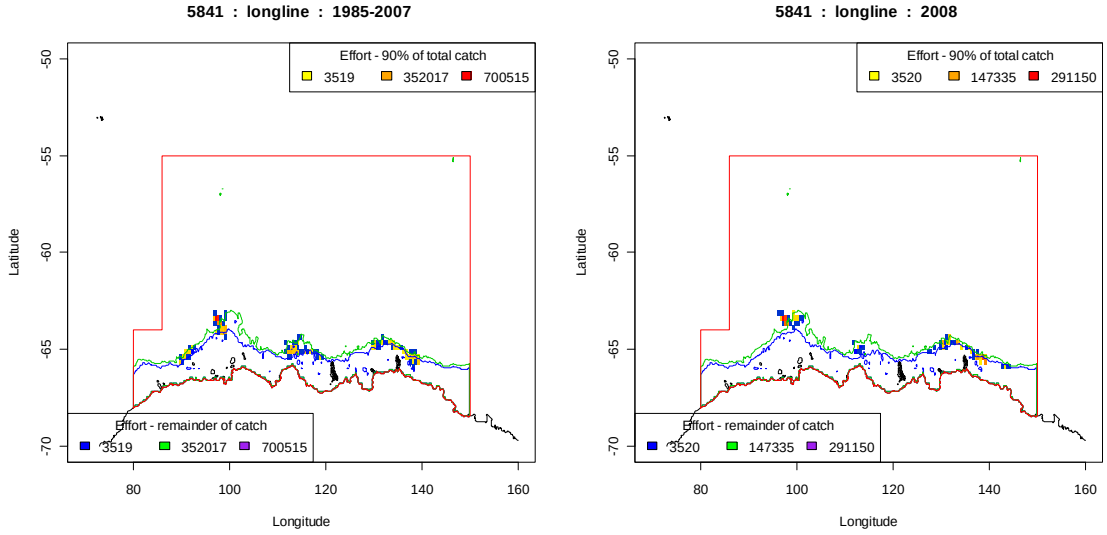
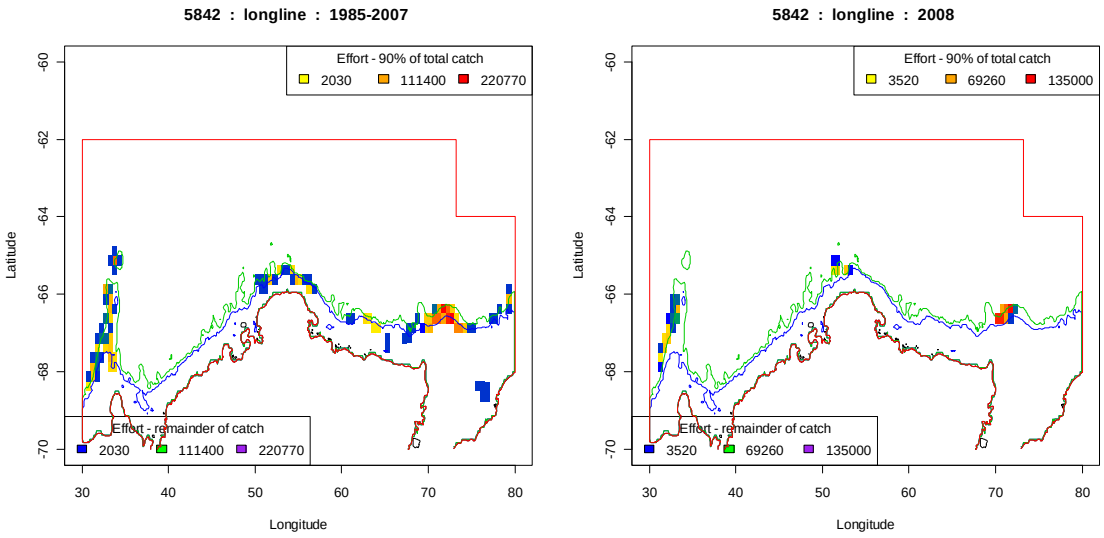


Figure 7: Maps showing longline effort (aggregate number of hooks), subdivided to show effort contributing to 90% of the total catch (target and by-catch species) and effort responsible for the remaining 10% of the catch. In each map, two 3-colour colour ramps are used to distinguish values within each of these groups. Coastline and islands (black), 1 000 m isobath (blue), 2 000 m isobath (green) and the statistical boundary (red). Cells are 0.25° latitude by 0.5° longitude. An aggregate map for effort from 1985–2007 is shown along with a separate map for effort in the 2007/08 season. This figure is available in colour on the CCAMLR website.

(continued)

Figure 7 (continued)

(c) Division 58.4.2



(d) Division 58.4.3a

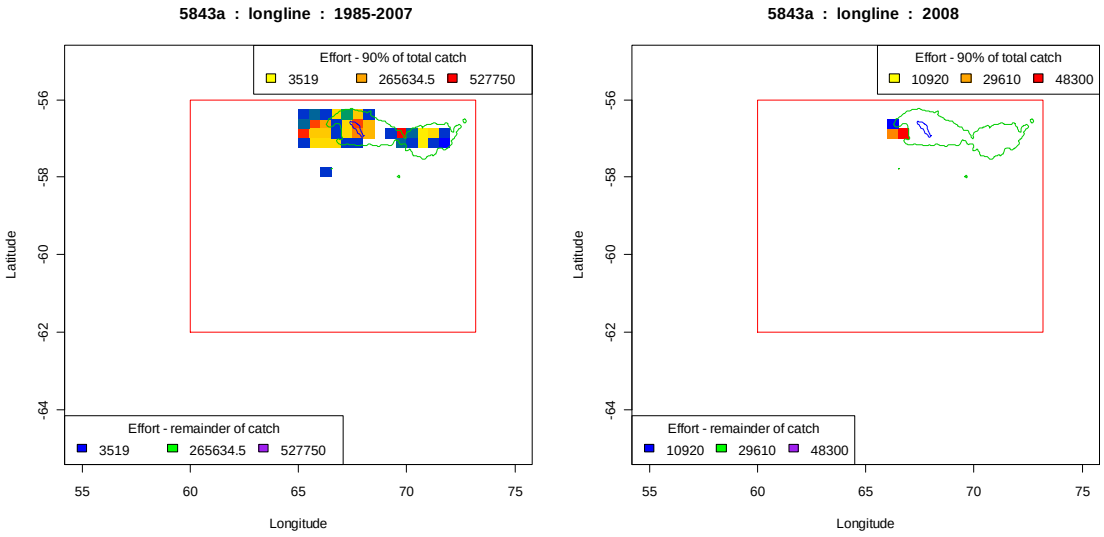


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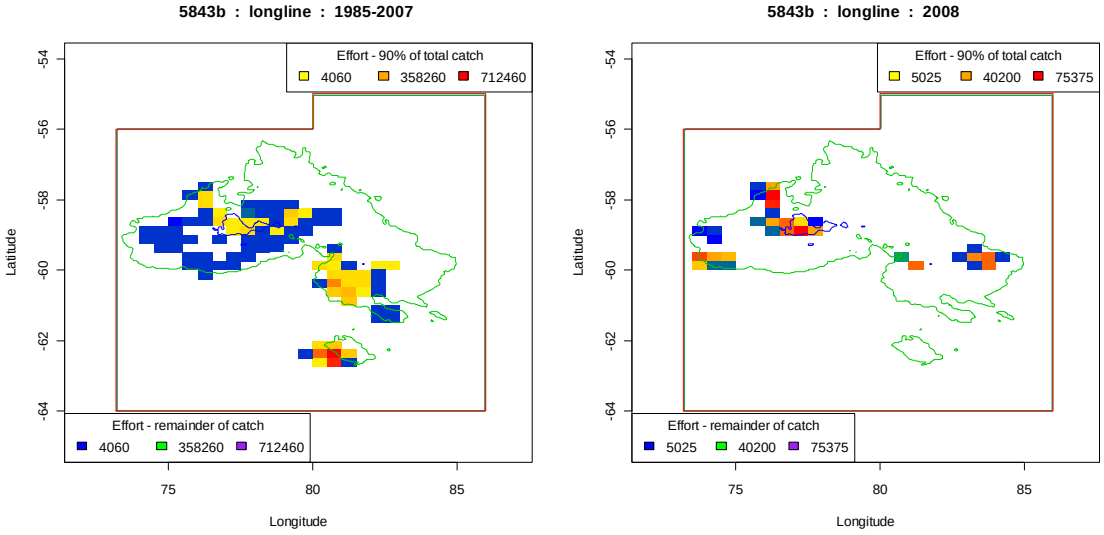
Figure 7 (continued)

(e) Division 58.4.3b



(f) Divisions 58.4.4a and 58.4.4b

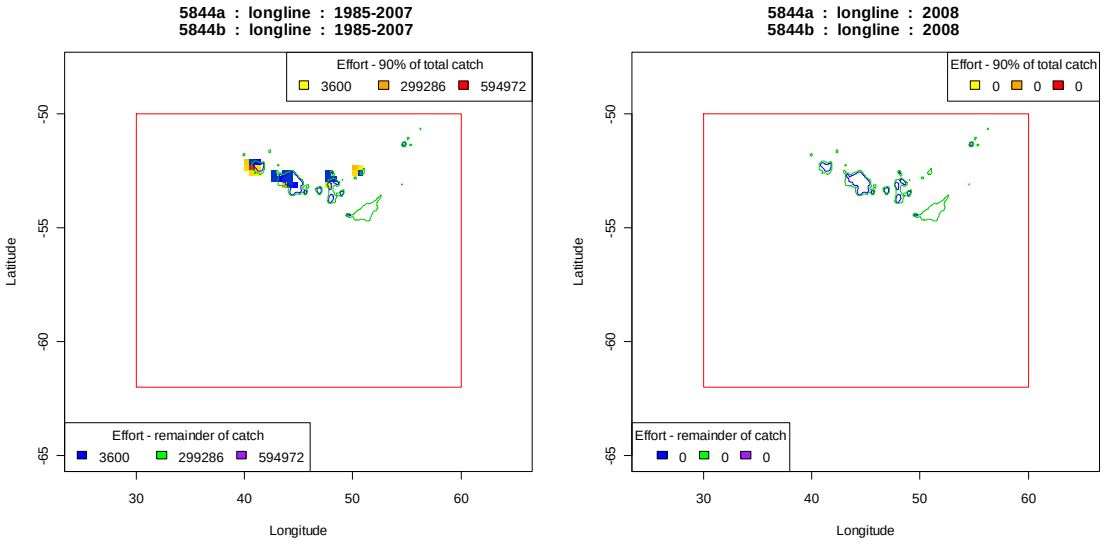


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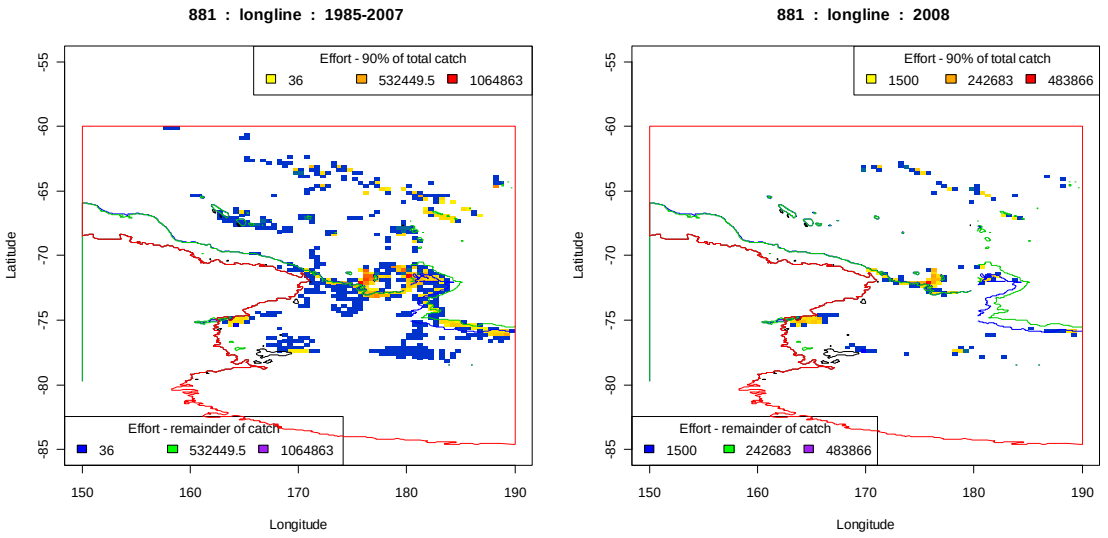
Figure 7 (continued)

(g) Subarea 88.1



(h) Subarea 88.2

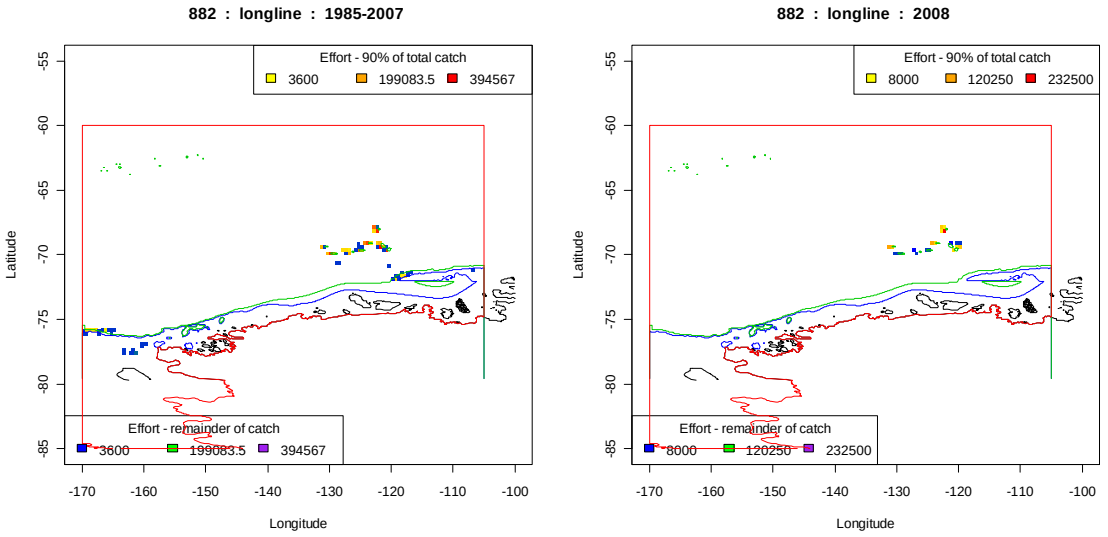


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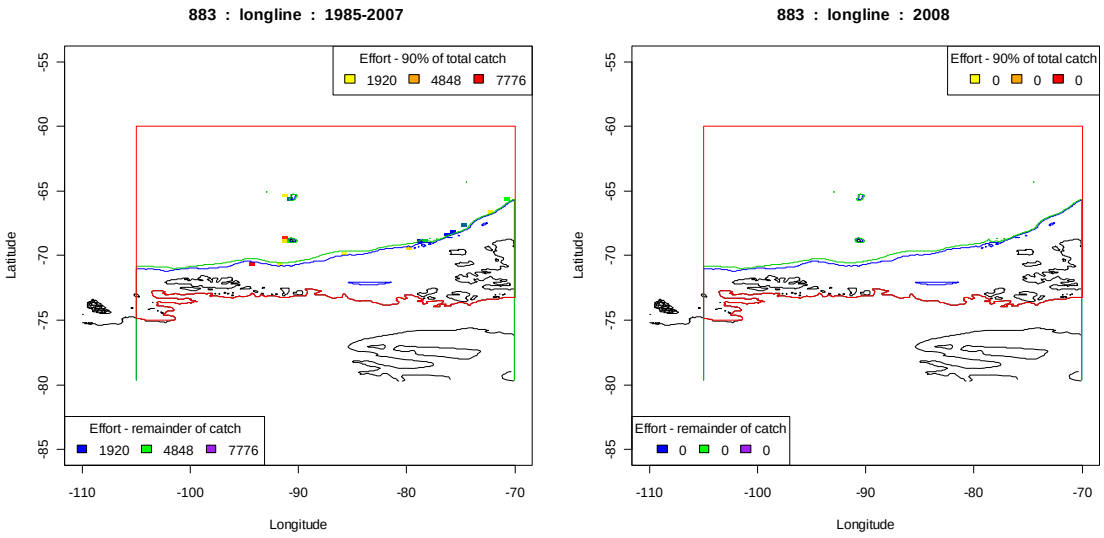
Figure 7 (continued)

(i) Subarea 88.3



APPENDIX A

AGENDA

Working Group on Fish Stock Assessment
(Hobart, Australia, 13 to 24 October 2008)

1. Opening of the meeting

2. Organisation of the meeting and adoption of the agenda

    2.1 Organisation of meeting
    2.2 Subgroup organisation and coordination

3. Review of available information

    3.1 Data requirements specified in 2007
        3.1.1 Development of the CCAMLR database
        3.1.2 Data processing
        3.1.3 Fishery plans

    3.2 Fisheries information
        3.2.1 Catch and effort data reported to CCAMLR
        3.2.2 Estimates of catch and effort from IUU fishing
        3.2.3 Catch and effort data for toothfish fisheries in waters adjacent to the Convention Area
        3.2.4 Scientific observer information

    3.3 Inputs for stock assessment
        3.3.1 Catch-at-length/age from fisheries
        3.3.2 Research surveys
        3.3.3 CPUE analyses
        3.3.4 Tagging studies
        3.3.5 Biological parameters
        3.3.6 Stock structure and management areas
        3.3.7 Depredation

4. Preparation for assessments and assessment timetable

    4.1 Report from the Working Group on Statistics, Assessments, and Modelling (WG-SAM)
    4.2 Review of preliminary stock assessment papers
    4.3 Assessments to be carried out and assessment timetable

5. Assessments and management advice

    5.1 New and exploratory fisheries
        5.1.1 New and exploratory fisheries in 2007/08
        5.1.2 New and exploratory fisheries notified for 2008/09
        5.1.3 Progress towards assessments of other exploratory fisheries
        5.1.4 Update Fishery Report for Subarea 48.6
        5.1.5 Update Fishery Reports for divisions in Subarea 58.4
        5.1.6 Update Fishery Report for Subareas 88.1 and 88.2
        5.1.7 Research protocols for commercial fishing vessels

    5.2 Update Fishery Reports for the following assessed fisheries
        5.2.1 *Dissostichus eleginoides* South Georgia (Subarea 48.3)
        5.2.2 *Dissostichus eleginoides* Kerguelen Islands (Division 58.5.1)
        5.2.3 *Dissostichus eleginoides* Heard Island (Division 58.5.2)
        5.2.4 *Dissostichus eleginoides* Crozet Islands (Subarea 58.6)
        5.2.5 *Dissostichus eleginoides* Prince Edward and Marion Islands (Subarea 58.6/58.7)
        5.2.6 *Champsocephalus gunnari* South Georgia (Subarea 48.3)
        5.2.7 *Champsocephalus gunnari* Heard Island (Division 58.5.2)

    5.3 Assessment and management advice for other fisheries
        5.3.1 Antarctic Peninsula (Subarea 48.1) and South Orkney Islands (Subarea 48.2)
        5.3.2 South Sandwich Islands (Subarea 48.4)
        5.3.3 Crabs (*Paralomis spinosissima* and *P. formosa*) (Subarea 48.3)
        5.3.4 *Martialia hyadesi* (Subarea 48.3)

6. Fish and invertebrate by-catch

    6.1 Assessment of the status of by-catch species and groups
    6.2 Estimation of by-catch levels and rates
    6.3 By-catch reporting
    6.4 Assessment of risk
    6.5 Mitigation measures

7. Incidental mortality of mammals and seabirds arising from fishing (ad hoc WG-IMAF Report)

8. Evaluation of the threats arising from IUU activities

    8.1 Development of approaches for estimating total removals of toothfish
    8.2 Review of historical trends in IUU activity

9. Biology, ecology and demography of target and by-catch species

    9.1 Review information available to the meeting
    9.2 Species profiles
    9.3 CCAMLR otolith network

10. Considerations of ecosystem management

    10.1 Ecological interactions (e.g. multi-species, benthos, depredation etc.)
    10.2 Bottom fishing activities and vulnerable marine ecosystems(VMEs)
    10.3 Interactions with WG-EMM
    10.4 Development of ecosystem models

11. Scheme of International Scientific Observation

    11.1 Report from the Technical Group for At-Sea Observations (TASO)
    11.2 Summary of information extracted from observer reports and/or provided by technical coordinators
    11.3 Implementation of observer program
        11.3.1 *Scientific Observers Manual*
        11.3.2 Sampling strategies
        11.3.3 Priorities

12. Future assessments

    12.1 Generic and specific work for developing assessments
    12.2 Frequency of future assessments

13. Future work

    13.1 Organisation of intersessional activities in subgroups
    13.2 Second Workshop on Fisheries and Ecosystem Models in the Antarctic
    13.3 Intersessional meetings
        13.3.1 Meeting of WG-SAM
        13.3.2 Meeting of ad hoc TASO
        13.3.3 Meeting of SG-ASAM

14. Other business

15. Adoption of the report

16. Close of the meeting.

APPENDIX B

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(Hobart, Australia, 13 to 24 October 2008)

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APPENDIX C

LIST OF DOCUMENTS

Working Group on Fish Stock Assessment
(Hobart, Australia, 13 to 24 October 2008)

WG-FSA-08/1	Provisional Agenda and Provisional Annotated Agenda for the 2008 Meeting of the Working Group on Fish Stock Assessment (WG-FSA)
WG-FSA-08/2	List of participants
WG-FSA-08/3	List of documents
WG-FSA-08/4	CCAMLR fisheries: 2008 update Secretariat
WG-FSA-08/5 Rev. 1	A summary of observations on board longline vessels operating within the CCAMLR Convention Area during the 2007/08 season Secretariat
WG-FSA-08/6 Rev. 1	Summary of observations aboard trawlers operating in the Convention Area during the 2007/08 season Secretariat
WG-FSA-08/7 Rev. 2	A summary of scientific observations related to Conservation Measures 25-02 (2007), 25-03 (2003) and 26-01 (2006) Secretariat
WG-FSA-08/8	Summary of observations aboard pot vessels operating in the Convention Area during the 2007/08 season Secretariat
WG-FSA-08/9	Review of CCAMLR activities on monitoring marine debris in the Convention Area Secretariat
WG-FSA-08/10 Rev. 2	Estimation of IUU catches of toothfish inside the Convention Area during the 2007/08 fishing season Secretariat
WG-FSA-08/11	Fishing activity and seabird-vessel attendance near the northern Antarctic Peninsula J.A. Santora, K.S. Dietrich (USA) and D. Lombard (Canada) (submitted to *Mar.Ornithol.*)

WG-FSA-08/12	Comparative characteristics of basic biological parameters of two toothfish species in high-latitude seas of the Antarctic A.K. Zaytsev (Ukraine)
WG-FSA-08/13	New records of deep-sea skates (Rajidae, Chondrichthyes) from the Crozet Archipelago S.P. Iglésias, N. Gasco and G. Duhamel (France)
WG-FSA-08/14	Some field materials on area and season of Antarctic toothfish spawning V. Prutko (Ukraine) (*CCAMLR Science*, submitted)
WG-FSA-08/15	CCAMLR tagging program Secretariat
WG-FSA-08/16	Operational difficulties in implementing the CCAMLR tagging protocol in Division 58.4.1 in 2007/08 A.T. Lozano and O. Pin (Uruguay)
WG-FSA-08/17	Age estimation and lead-radium dating of Antarctic toothfish (*Dissostichus mawsoni*) C.M. Brooks, A.H. Andrews, J.R. Ashford, G.M. Cailliet, N. Ramanna and C. Lundstrom (USA)
WG-FSA-08/18	Spatial distribution and age structure of the Antarctic toothfish (*Dissostichus mawsoni*) in the Ross Sea, Antarctica C.M. Brooks and J.R. Ashford (USA) (*CCAMLR Science*, submitted)
WG-FSA-08/19	Classification guide for potentially vulnerable invertebrate taxa in the Ross Sea longline fishery S. Parker, D. Tracey, E. Mackay, S. Mills, P. Marriott, O. Anderson, K. Schnabel, D. Bowden and M. Kelly (New Zealand)
WG-FSA-08/20	Updated biological parameters for the Antarctic starry skate (*Amblyraja georgiana*) from the Ross Sea M.P. Francis and S. Mormede (New Zealand)
WG-FSA-08/21	Revised age and growth estimates for Antarctic starry skate (*Amblyraja georgiana*) from the Ross Sea M.P. Francis (New Zealand) and M.J. Gallagher (*CCAMLR Science*, submitted)
WG-FSA-08/22	A characterisation of the toothfish fishery in Subareas 88.1 and 88.2 from 1997/98 to 2007/08 M.L. Stevenson, S.M. Hanchet and A. Dunn (New Zealand)

WG-FSA-08/23	Preliminary analysis of *Dissostichus mawsoni* by-catch during bottom and krill fishing (Statistical Division 58.4.2) L.K. Pshenichnov (Ukraine)
WG-FSA-08/24	Beach debris survey – Main Bay, Bird Island, South Georgia 2006/07 F. Le Bouard (UK)
WG-FSA-08/25	Fishing equipment, marine debris and hydrocarbon soiling associated with seabirds at Bird Island, South Georgia, 2007/08 D. Fox (UK)
WG-FSA-08/26	Beach debris survey and incidence of entanglement of Antarctic fur seals (*Arctocephalus gazella*) at Signy Island, South Orkney Islands, 2007/08 M.J. Dunn and C.M. Waluda (UK)
WG-FSA-08/27	Entanglement of Antarctic fur seals (*Arctocephalus gazella*) in man-made debris at Bird Island, South Georgia, during the 2007 winter and 2007/08 breeding season E.W.J. Edwards (UK)
WG-FSA-08/28	Groundfish survey in CCAMLR Subarea 48.3 in April 2008 with preliminary assessment of mackerel icefish M.A. Collins, R.E. Mitchell, C.E. Main, J. Lawson, J. Watts, J. Slakowski, L. Featherstone and O. Rzewuski (UK) (submitted to *Polar Biol.*)
WG-FSA-08/29	Identifying patterns in diet of mackerel icefish (*Champsocephalus gunnari*) at South Georgia using bootstrapped confidence intervals of a dietary index C.E. Main, M.A. Collins, R. Mitchell and M. Belchier (UK) (*Polar Biol.*, submitted)
WG-FSA-08/30	A review of the methods used to release skates (rajiids), with or without tags, in Antarctic exploratory fisheries J.M. Fenaughty (New Zealand)
WG-FSA-08/31	Biomass estimates and size distributions of demersal finfish on the Ross Sea shelf and slope from the New Zealand IPY-CAML survey, February–March 2008 S.M. Hanchet, M.L. Stevenson (New Zealand), C. Jones (USA), P.M. Marriott, P.J. McMillan, R.L. O'Driscoll, D. Stevens, A.L. Stewart and B.A. Wood (New Zealand) (*CCAMLR Science*, submitted)

WG-FSA-08/32	Indicative estimates of biomass and yield of Whitson's grenadier (*M. whitsoni*) on the continental slope of the Ross Sea in Subareas 88.1 and 88.2 S.M. Hanchet, D. Fu and A. Dunn (New Zealand) (*CCAMLR Science*, submitted)
WG-FSA-08/33	Age and growth of spiny icefish (*Chaenodraco wilsoni* Regan, 1914) off Joinville-D'Urville Islands (Antarctic Peninsula) M. La Mesa, A. De Felice (Italy), C.D. Jones (USA) and K.-H. Kock (Germany) (*CCAMLR Science*, submitted)
WG-FSA-08/34	Feeding and food interrelationships of Antarctic toothfish (*D. mawsoni* Norman, 1937) (Perciformes, Nototheniidae) in near-continental waters of the Indian Ocean Antarctic area and on the BANZARE Bank A.F. Petrov and I.G. Istomin (Russia) (*CCAMLR Science*, submitted)
WG-FSA-08/35	On the study of fecundity and eggs size of Antarctic toothfish (*Dissostichus mawsoni* Norman 1937) S.V. Piyanova. A.F. Petrov and N.V. Kokorin (Russia) (*CCAMLR Science*, submitted)
WG-FSA-08/36	Proposal to vary the requirement to test sink rates for integrated weight longline (IWL) gear prior to entering the Convention Area I. Hay (Australia)
WG-FSA-08/37 Rev. 1	Report on Australian fishing effort and seabird by-catch in fisheries outside the Convention Area T. Hewitt and I. Hay (Australia)
WG-FSA-08/38	Effect of stern-setting tunnel on the sink rate of integrated weight longline (IWL) I. Hay and G. Robertson (Australia)
WG-FSA-08/39	Research plan for toothfish by *Shinsei Maru No. 3* in 2008/09 Delegation of Japan
WG-FSA-08/40	Proposal for revising Conservation Measure 41-04(2007): Limits on the Exploratory Fishery for *Dissostichus* spp. in Statistical Subarea 48.6 in the 2008/09 Season Delegation of Japan
WG-FSA-08/41	The analysis of feeding activity and diet composition of Antarctic toothfish (*D. mawsoni*) in the Ross and Amundsen Seas in the fishing season 2006/07 N.V. Kokorin (Russia)

WG-FSA-08/42	The role of fish as predators of krill (*Euphausia superba*) and other pelagic resources in the Southern Ocean K.-H. Kock (Germany), D.J. Agnew (UK), E. Barrera-Oro (Argentina), M. Belchier, M.A. Collins (UK), S. Hanchet (New Zealand), L. Pshenichnov (Ukraine), K.V. Shust (Russia), D. Welsford and R. Williams (Australia)
WG-FSA-08/43	Revised assessment of toothfish stocks in Divisions 58.4.1 and 58.4.2 D.J. Agnew, C. Edwards, R. Hillary, R. Mitchell (UK) and L.J. López Abellán (Spain) (*CCAMLR Science*, submitted)
WG-FSA-08/44	Preliminary results of trials testing modified longline gear 'trotlines' in presence of cetaceans in Subarea 48.3 R.E. Mitchell, J. Clark, P. Reyes, L. Jones, J. Pearce, C.E. Edwards and D. Agnew (UK)
WG-FSA-08/45	Proposal for revising Conservation Measures 24-02 (2005) and 41-03 (2006) in relation to Subarea 48.4 Delegation of the United Kingdom
WG-FSA-08/46	Proposal for an extension to the mark–recapture experiment to estimate toothfish population size in Subarea 48.4 J. Roberts and D. J. Agnew (UK)
WG-FSA-08/47	Update on items of interest to WG-IMAF N. Walker (New Zealand)
WG-FSA-08/48	Investigating length at maturity of Antarctic toothfish (*Dissostichus mawsoni*) based on scientific observers' data S. Mormede, S. Parker and P. Grimes (New Zealand) (*CCAMLR Science*, submitted)
WG-FSA-08/49	Year of the Skate sampling protocol: learning from the 2007/08 season sampling protocol on NZ vessels S. Mormede (New Zealand)
WG-FSA-08/50	The Ross Sea Antarctic toothfish fishery: review of the 3-year experiment and development of medium-term research objectives and an operational framework for the fishery Delegation of New Zealand
WG-FSA-08/51	Updated preliminary results of an ecological risk assessment for seabirds and marine mammals with risk of fisheries interactions S. Waugh, D. Filippi, N. Walker (New Zealand) and D.S. Kirby

WG-FSA-08/52	An assessment of artificial bait (NORBAIT™) as a means of reducing the incidental catch of *Macrourus* and other by-catch species in high-latitude toothfish fisheries J.M. Fenaughty (New Zealand)
WG-FSA-08/53	Methods for implementing Conservation Measure 22-06: an impact assessment framework for bottom-impacting fishing methods in the CCAMLR Convention Area B. Sharp, S. Parker and N. Smith (New Zealand) (*CCAMLR Science*, submitted)
WG-FSA-08/54	A non-hierarchical taxonomic key for seabird identification in the Heard Island and McDonald Islands and Kerguelen Island fisheries J. Fielding, T. Lamb, B. Wienecke (Australia) and N. Gasco (France)
WG-FSA-08/55	The Australian skate tagging program at Heard Island and McDonald Islands, CCAMLR Division 58.5.2 G.B. Nowara and T. Lamb (Australia)
WG-FSA-08/56	Preliminary assessment of mackerel icefish (*Champsocephalus gunnari*) in the vicinity of Heard Island and McDonald Islands (Division 58.5.2), based on a survey in July 2008, using the generalised yield model D.C. Welsford (Australia)
WG-FSA-08/57	Report on a longline survey conducted by the FV *Janas* in may 2008 on BANZARE Bank, and an assessment of the status of *Dissostichus* spp. in Division 58.4.3b D. Welsford, T. Robertson and G. Nowara (Australia) (*CCAMLR Science*, submitted)
WG-FSA-08/58	Estimating the swept area of demersal longlines based on *in situ* video footage D. Welsford and R. Kilpatrick (Australia) (*CCAMLR Science*, submitted)
WG-FSA-08/59	Field identification guide to Heard Island and McDonald Island (HIMI) benthic invertebrates T. Hibberd and K. Moore (Australia)
WG-FSA-08/60	The autoline system – an updated descriptive review of the method with recommendations to clarify CCAMLR conservation measures regulating longline fisheries within the Convention Area J.M. Fenaughty (New Zealand)

WG-FSA-08/61	Report of the Second Meeting of the Seabird Bycatch Working Group (Hermanus, South Africa, 17–18 August 2008) ACAP Seabird Bycatch Working Group
WG-FSA-08/62	Application to undertake winter scientific research in CCAMLR Subarea 88.1 (SSRUs 881B, 881C and 881G) in the 2008/09 season Delegation of New Zealand
WG-FSA-08/63	Expected tag–recapture rates from new and exploratory fisheries for *Dissostichus* spp. J.P. McKinlay and D.C. Welsford (Australia) (*CCAMLR Science*, submitted)
WG-FSA-08/64	A risk management framework for avoiding significant adverse impacts of bottom fishing gear on Vulnerable Marine Ecosystems K. Martin-Smith (Australia) (*CCAMLR Science*, submitted)
WG-FSA-08/65	Conveners' Report of the WG-IMAF Workshop K. Rivera and N. Smith (Co-conveners of ad hoc WG-IMAF)
Other Documents	
WG-FSA-08/P1	Population subdivision in the Antarctic toothfish (*Dissostichus mawsoni*) revealed by mitochondrial and nuclear single nucleotide polymorphisms (SNPs) K. Kuhn and P.M. Gaffney (*Ant. Sci*., 20 (4): 327–338 (2008) doi:10.1017/S0954102008000965)
WG-FSA-08/P2	Recruitment and body size in relation to temperature in juvenile Patagonian toothfish (*Dissostichus eleginoides*) at South Georgia M. Belchier and M.A. Collins (*Mar. Biol.*, 155 (5): 493–503 (2008) 10.1007/s00227-008-1047-3)
WG-FSA-08/P3	Oxygen and carbon stable isotopes in otoliths record spatial isolation of Patagonian toothfish (*Dissostichus eleginoides*) J.R. Ashford and C.M. Jones (*Geochimica et Cosmochimica Acta*, 71: 87–94 (2007) doi:10.1016/j.gca.2006.08.030)

WG-FSA-08/P4	Otolith chemistry reflects frontal systems in the Antarctic Circumpolar Current J.R. Ashford, A.I. Arkhipkin and C.M. Jones (*Mar. Ecol. Progr. Ser.*, 351: 249–260 (2007) doi: 10.3354/meps07153)
WG-FSA-08/P5	Otolith chemistry indicates population structuring by the Antarctic Circumpolar Current J.R. Ashford, C.M. Jones, E.E. Hofmann, I. Everson, C.A. Moreno, G. Duhamel and R. Williams (*Can. J. Fish. Aquat. Sci*., 65: 135–146 (2008) doi:10.1139/F07-158)
WG-FSA-08/P6	Slope currents around the Kerguelen Islands from demersal longline fishing records Y.-H. Park, N. Gasco and G. Duhamel (France) (*Geophys. Res. Lett.*, 35 L09604 (2008) doi:10.1029/2008GL033660)
CCAMLR-XXVII/12	Summary of notifications for new and exploratory fisheries 2008/09 Secretariat
CCAMLR-XXVII/13	Notification of Norway's intention to conduct an exploratory trawl fishery for *Euphausia superba* in the 2008/09 season Delegation of Norway
CCAMLR-XXVII/14	Notifications of Argentina's intention to conduct exploratory longline fisheries for *Dissostichus* spp. in the 2008/09 season Delegation of Argentina
CCAMLR-XXVII/15	Notification of Australia's intention to conduct an exploratory longline fishery for *Dissostichus* spp. in the 2008/09 season Delegation of Australia
CCAMLR-XXVII/16	Notifications of Chile's intention to conduct exploratory longline fisheries for *Dissostichus* spp. in the 2008/09 season Delegation of Chile
CCAMLR-XXVII/17	Notifications of Japan's intention to conduct exploratory longline fisheries for *Dissostichus* spp. in the 2008/09 season Delegation of Japan
CCAMLR-XXVII/18	Notifications of the Republic of Korea's intention to conduct exploratory longline fisheries for *Dissostichus* spp. in the 2008/09 season Delegation of the Republic of Korea

CCAMLR-XXVII/19	Notifications of New Zealand's intention to conduct exploratory longline fisheries for *Dissostichus* spp. in the 2008/09 season Delegation of New Zealand
CCAMLR-XXVII/20	Notifications of Russia's intention to initiate new pot fisheries for crab in the 2008/09 season Delegation of Russia
CCAMLR-XXVII/21 Rev. 1	Notifications of Russia's intention to conduct exploratory longline fisheries for *Dissostichus* spp. in the 2008/09 season Delegation of Russia
CCAMLR-XXVII/22	Notifications of South Africa's intention to conduct exploratory longline fisheries for *Dissostichus* spp. in the 2008/09 season Delegation of South Africa
CCAMLR-XXVII/23	Notifications of Spain's intention to conduct exploratory longline fisheries for *Dissostichus* spp. in the 2008/09 season Delegation of Spain
CCAMLR-XXVII/24	Notifications of the United Kingdom's intention to conduct exploratory longline fisheries for *Dissostichus* spp. in the 2008/09 season Delegation of the United Kingdom
CCAMLR-XXVII/25	Notifications of Uruguay's intention to conduct exploratory longline fisheries for *Dissostichus* spp. in the 2008/09 season Delegation of Uruguay
CCAMLR-XXVII/26	Preliminary assessments of known and anticipated impacts of proposed bottom fishing activities on vulnerable marine ecosystems Collated by the Secretariat
CCAMLR-XXVII/BG/15	Implementation of conservation measures in 2007/08 Secretariat
SC-CAMLR-XXVII/5	Report of the Working Group on Statistics, Assessments and Modelling (St Petersburg, Russia, 14 to 22 July 2008)
SC-CAMLR-XXVII/8	Action plan aimed at reducing seabird by-catch in the French EEZs in Statistical Division 58.5.1 and Subarea 58.6 Delegation of France

SC-CAMLR-XXVII/10	Récapitulatif des contributions françaises concernant les recommandations du comité scientifique sur la mortalité accidentelle des oiseaux marins Délégation française
SC-CAMLR-XXVII/12	Environmental, spatial, temporal and operational effects on the incidental mortality of birds in the longline fishery in the Crozet and Kerguelen areas 2003–2006 Delegation of France
SC-CAMLR-XXVII/13	Notification of vulnerable marine ecosystems in Statistical Division 58.4.1 Delegation of Australia
SC-CAMLR-XXVII/BG/1	Catches in the Convention Area in the 2006/07 and 2007/08 seasons Secretariat
SC-CAMLR-XXVII/BG/6	Report of the ad hoc Technical Group for At-Sea Operations (St Petersburg, Russia, 19 and 20 July 2008)
SC-CAMLR-XXVII/BG/7	Attendance of Science Officer at the Second Meeting of the ACAP Seabird Bycatch Working Group (Hermanus**,** South Africa, 17 to 18 August 2008) Secretariat
SC-CAMLR-XXVII/BG/8	Etude d'évaluation de l'impact des pêcheries sur les populations de pétrels à menton blanc *Procellaria aequinoctialis* et de pétrels gris *Procellaria cinerea* aux îles Crozet et Kerguelen Délégation française
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WG-EMM-08/27	Trophic study of Ross Sea Antarctic toothfish (*Dissostichus mawsoni*) using carbon and nitrogen stable isotopes S.J. Bury, M.H. Pinkerton, D.R. Thompson, S. Hanchet, J. Brown and I. Vorster (New Zealand)
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WG-EMM-08/43	Trophic overlap of Weddell seals (*Leptonychotes weddelli*) and Antarctic toothfish (*Dissostichus mawsoni*) in the Ross Sea, Antarctica M.H. Pinkerton, A. Dunn and S.M. Hanchet (New Zealand)
WG-SAM-08/8	Towards the balanced stock assessment of Antarctic toothfish in the Ross Sea D. Vasilyev and K. Shust (Russia)
WG-SAM-08/13	Development of a methodology for data quality assessment D.A.J. Middleton and A. Dunn (New Zealand)

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