**REPORT OF THE WORKING GROUP
ON FISH STOCK ASSESSMENT**
(Hobart, Australia, 8 to 19 October 2007)

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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.

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OPENING OF THE MEETING

1.1   The meeting of WG-FSA was held in Hobart, Australia, from 8 to 19 October 2007. The Convener, Dr S. Hanchet (New Zealand), opened the meeting and welcomed participants.

ORGANISATION OF THE MEETING AND ADOPTION OF THE AGENDA

2.1   The agenda of the meeting was discussed and it was agreed to add subitems on bottom fishing in CCAMLR high-seas areas, and bioregionalisation under Item 14.   The revised agenda was adopted (Appendix A).

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

REVIEW OF AVAILABLE INFORMATION

Data requirements specified in 2006

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 Scientific Committee and its working groups. Work relevant to WG-FSA was highlighted (WG-FSA-07/4) and included:

(i)   revision of the data forms for fine-scale catch and effort data (C1, C2, C3 and C5) and catch and effort reports (TAC data) to take explicit account of fish released alive (including tagged and released, cut-offs), and recaptured tagged individuals (CCAMLR-XXV, paragraph 12.44).   Consequential changes were made to the CCAMLR database.   The revised data forms were placed on the CCAMLR website in November 2006, and have been in use in 2006/07. A data map was also developed (WG-FSA-07/4, Table 1) to illustrate the relationship between the data fields used in these forms;

(ii)   initial validation of assessments involving CASAL using the input parameter files and associated papers submitted to WG-FSA. This work validated the input parameter files, and checked that the assessment results quoted in the accompanying papers could be reproduced using the available input files. The

validations confirmed the parameter files, MPD estimates and yield estimates for the preliminary assessments for *Dissostichus* spp. in Subarea 48.3, Division 58.5.2 and the Ross Sea (Subarea 88.1 and SSRUs 882A–B);

(iii)   development of a new routine to check vessels' positions reported in fishery and observer data (including tagging data). The routine was successfully used to identify errors (e.g. position error, date error) in fishery and/or observer data, and may be extended to other geo-referenced fishery datasets;

(iv)   development of a new routine to capture the history of fishing vessels operating in CCAMLR fisheries, using data available in the CCAMLR databases.

Data processing

3.2   The Secretariat had processed fishery and observer data from the 2006/07 season 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 data from the fishery in the South African EEZ in Subareas 58.6 and 58.7 and Area 51 (Prince Edward and Marion Islands) in 2006/07, and re-submitted data from the French EEZs in Division 58.5.1 (Kerguelen Islands) and Subarea 58.6 (Crozet Island).

3.3   The Working Group thanked Prof. G. Duhamel and Mr N. Gasco (France) for re-submitting the French data in CCAMLR format. These data have provided new information on the catch history of target and by-catch species, and allowed the development of catch-weighted length frequencies for *D. eleginoides* (see Appendices K and M).

3.4   The Secretariat began validation of data from 2006/07 prior to the meeting, and this procedure will be completed in the forthcoming intersessional period.

3.5   The Working Group recalled its request that the Scientific Committee and Commission consider the feasibility of using VMS data to validate positional data reported in fine-scale and observer data (SC-CAMLR-XXV, Annex 5, paragraph 3.6). The Working Group noted that the Secretariat's new position-checking routine (paragraph 3.1(iii)) provides an interim method, pending the outcome of the feasibility study.

Fishery Plans

3.6   The Secretariat has maintained the database which holds the information on Fishery Plans and updated data from 2006/07 to the time series.

Fisheries information

Catch, effort, length and age data reported to CCAMLR

3.7   Under the conservation measures in force in 2006/07, fishing took place in 13 fisheries targeting icefish (*Champsocephalus gunnari*), toothfish (*D. eleginoides* and/or *D. mawsoni*) and krill (*Euphausia superba*) (CCAMLR-XXVI/BG/17). Activities in exploratory fisheries were summarised in WG-FSA-07/4 (Table 4).

3.8   Three other fisheries targeting toothfish were conducted in the Convention Area in 2006/07:

- 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 CCAMLR Convention Area in 2006/07 are summarised in Table 1.

3.10   The Working Group noted the Secretariat's work in monitoring fisheries in 2006/07 (CCAMLR-XXVI/BG/17). This had resulted in the closure of 12 fishing areas and three fisheries. In addition, the fishery for *Dissostichus* spp. in Division 58.4.3b was closed following information received from the People's Republic of China (COMM CIRCs 07/69 and 07/70). All of the closures were triggered when the catches of *Dissostichus* spp. approached the catch limits.

3.11   The Working Group recalled that the Commission had requested that the Scientific Committee and WG-FSA review the effectiveness of the move-on rule for macrourids caught in exploratory fisheries (CCAMLR-XXV, paragraph 4.67). The application of this rule continued to be monitored by the Secretariat in 2006/07, and Members were advised when their vessels invoked part, or all of the criteria of the rule. Details were presented in WG-FSA-07/4, Table 2.

3.12   Immediately prior to the meeting, the Secretariat had updated background information, including tables and figures, in all Fishery Reports (SC-CAMLR-XXV, Annex 5, paragraph 13.23). Updates and revisions were made to the sections on the catch history of target species, including IUU catch estimates, and by-catch species, catch-weighted length frequencies, research hauls and tagging in exploratory fisheries, and harvest controls in 2006/07.

3.13   To assist with the Scientific Committee's request that Members and WG-FSA investigate the spatial distribution of *D. eleginoides* and *D. mawsoni* in Subarea 48.6 (SC-CAMLR-XXV, paragraph 4.153), the Secretariat had investigated the geographic distribution of these species and their distributions by latitude and depth. Based on fine-scale data, *D. eleginoides* occurred predominantly north of 55°S and was recorded only from SSRU A, while *D. mawsoni* occurred predominantly south of 54°S. *Dissostichus eleginoides* were caught in depths from 380 to 1 925 m and *D. mawsoni* were caught in depths from 610 to 2 040 m (WG-FSA-07/4, Figures 1 to 3).

3.14   The Working Group noted the results from trials using a PIT-D device attached to a modified Spanish-type longline in the fishery for *Dissostichus* spp. in the Ross Sea in 2006/07 (WG-FSA-07/43).   The device recorded pressure and temperature profiles and yielded information on sink rates. Sink rates ranged from 1.2 m s^{-1} near the surface, to 0.59 m s^{-1} immediately prior to the line settling on the sea floor. Water temperature was -0.2°C at the surface, increasing to 0.06°C at approximately 300 m depth, then decreasing to -0.05°C at fishing depths of 1 300–1 400 m.

Estimates of catch and effort from IUU fishing

3.15   WG-FSA reviewed the estimates of IUU catches in the Convention Area for 2006/07 prepared by the Secretariat and based on information submitted by 1 October 2007 (Table 2 and WG-FSA-07/10 Rev. 5). The deterministic method presently used by the Secretariat to estimate IUU fishing effort was the same method as used in previous years. This method used information on the number of vessels sighted/apprehended and reports of port inspections. Ancillary information on fishing trips and catch rates is 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. The Working Group endorsed these estimates for use in stock assessment and by ad hoc WG-IMAF (see Items 5, 7 and 8).

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

3.16   Catches of *Dissostichus* spp. in CCAMLR waters 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 2005/06 and 2006/07, were summarised in Table 4. As for previous seasons, most of the catch of *Dissostichus* spp. taken outside the Convention Area in 2005/06 and 2006/07 was reported from Areas 41 and 87.

3.17   Based on the historic fishing and trading patterns of vessels participating in the CDS, the Secretariat advised that catches reported outside the Convention Area in 2005/06 and 2006/07 indicated legitimate fishing activities and that there was no evidence to suggest that any misreporting had occurred.

3.18   The Working Group noted the small catches of *D. eleginoides* reported from the Indian Ocean outside the Convention Area (e.g. total of 35 tonnes from Areas 51 and 57 in 2006/07, see Table 4). The Working Group expressed concern that fishing for *D. eleginoides* in this region may not be sustainable.

3.19   The Working Group recalled its request for information on the sustainability of the *Dissostichus* resource in Area 41 in order to develop advice on the possible impact of fishing in Area 41 on the *Dissostichus* resource in the western section of Subarea 48.3 (SC-CAMLR-XXV, Annex 5, paragraph 3.22).

3.20   The Working Group noted the scientific observations collected on board a Ukrainian-flagged longliner fishing for *D. eleginoides* in Area 41 (WG-FSA-07/11). Observations

included biological data on the target species and by-catch species, information on fishing gear and interactions with seabirds and marine mammals. Depredation by sperm whales occurred on Scotia Bank and the Patagonian Shelf. The Working Group thanked the author for providing these observations.

Scientific observer information

3.21 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. Scientific observers have participated in 56 cruises so far in 2006/07: 50 cruises on vessels targeting *Dissostichus* spp. or *C. gunnari* (40 cruises on longliners; 9 cruises on trawlers; and 1 cruise on a pot vessel); and 6 cruises on vessels fishing for *E. superba*. Details of scientific observer deployments are reported in the Secretariat papers WG-FSA-07/6 Rev. 1, 07/7 Rev. 1, 07/8 Rev. 1, 07/9 and SC-CAMLR-XXVI/BG/8. Scientific observations were discussed under Items 7 and 11.

Inputs for stock assessment

Catch-at-length/age from fisheries

3.22 Scientific observers on board vessels in the Australian fisheries in Division 58.5.2 have collected toothfish otoliths since the fishery commenced in the 1996/97 season. A summary (WG-FSA-07/45) of the otolith collection housed at the Australian Antarctic Division indicates that over 21 000 otoliths have been collected from toothfish in Division 58.5.2 and more than 2 500 otolith pairs have been collected from recaptured tagged fish. More than 3 200 otoliths have been processed to provide size-at-age estimates from fish captured between 1997 and 2003. It is likely that sufficient otoliths have been collected from the main trawl ground to construct age–length keys, however, the cost-benefit of proceeding to age–length keys in terms of the cost and numbers of otoliths to be read versus the precision of stock assessment requires simulation analysis. The Working Group encouraged Australia to investigate the feasibility of constructing age–length keys for toothfish taking into account the different seasons, gear types and areas fished.

3.23 A summary of data collected on toothfish and the associated by-catch by all vessels participating in the longline fishery in Subareas 88.1 and 88.2 are provided in WG-FSA-07/28. All SSRUs in the two subareas except for SSRUs 881D and 882C have now been fished. The 2007 *D. mawsoni* catch was the second highest on record. A three-year experiment, begun in the 2005/06 season, to manage SSRUs within the two subareas was undertaken, in part, to simplify the administration of the fishery by having fewer catch limits. This appeared to be moderately successful, with only one catch limit being slightly exceeded in the 2005/06 season, and two catch limits exceeded in the 2006/07 season. Although there was a large overrun of the catch limit in the north region, the overall catch limit for Subarea 88.1 was only exceeded by 2%. The catch limit was not reached in Subarea 88.2.

Research surveys

3.24   Australia presented results from a random stratified trawl survey conducted on the plateau in Division 58.5.2 during 2007 (WG-FSA-07/46). Surveys of this division have been conducted since 1997 and have been designed to provide data on abundance of pre-adult *D. eleginoides* and juvenile and adult *C. gunnari* for use in assessments. The 2007 survey was conducted in June and July, with 159 randomly allocated sampling stations covering nine separate strata. The catch composition from the survey showed a similar result to 2006, with *D. eleginoides*, *C. gunnari*, *Channichthys rhinoceratus*, *Macrourus whitsoni* and *Lepidonotothen squamifrons* the most common species in the catch. Results of stock assessments are presented for *D. eleginoides* in WG-FSA-07/53 Rev. 1 and for *C. gunnari* in WG-FSA-07/47.

3.25   Germany conducted a bottom trawl survey on board the RV *Polarstern* around Elephant Island and the South Shetland Islands from 19 December 2006 to 3 January 2007. Information on species composition, biomass and size composition of the abundant fish species was provided (WG-FSA-07/22). Biomass estimates during this survey, compared to those found during the 2002 and 2003 surveys, were found to be much lower for *C. gunnari*, *Chaenocephalus aceratus*, *Chionodraco rastrospinosus*, *Gobionotothen gibberifrons*, *L. larseni* and *L. squamifrons* in both areas. However, biomass estimates of *Notothenia coriiceps* around the South Shetland Islands and *N. rossii* at South Shetland and Elephant Islands were higher during 2007 compared to previous surveys. The Working Group agreed that it would be very informative to have a paper provided in the future summarising the time series of biomass estimates and length frequencies for Subareas 48.1 and 48.2.

3.26   A concentration of *N. rossii* was found in the same location where aggregations of the species have been detected in 1975/76 and 1977/78 before they were depleted by the commercial fishery. Two aggregations of *N. coriiceps*, 10 n miles apart, were found on the King George Island shelf. The location of one of these concentrations was known since 1998. Observations on both *N. coriiceps* and *N. rossii* confirmed that both species are highly gregarious. They tend to form concentrations in small areas while the vast majority of the area is only thinly populated. The results from this survey confirmed earlier observations by WG-FSA (Kock et al., 2004) that a stratified random survey design appears to be inappropriate to assess the status of populations of *N. rossii* and *N. coriiceps* properly.

3.27   The proportion of juvenile *G. gibberifrons* decreased further compared to previous surveys due to the production of very poor year classes since the late 1990s. In contrast, recruitment of juveniles to the adult population appears to be normal on the other side of Bransfield Strait off the tip of the Antarctic Peninsula. Juveniles were numerous in research catches there.

3.28   A comparison of the variations in mean annual lengths and density distributions, using samples of fish collected during a 24-year period at Potter Cove (Subarea 48.1) was discussed (WG-FSA-07/52). Two commercially exploited species, *N. rossii* and *G. gibberifrons*, were compared to the ecologically similar but unexploited *N. coriiceps*. During the 24-year period, both commercially exploited species exhibited a decrease in abundance with initial increases in mean size and then a reduction in mean size. This is consistent with low-strength cohorts. The length-frequency distributions of *N. coriiceps* throughout the whole study period did not show any definite change in modal size, nor a pattern in mean lengths as was the case with the exploited species.

3.29   The Working Group noted the apparent lack of recruitment reported in both the German and Argentine studies, both reporting over long time periods. The lack of recovery after being commercially depleted is of concern.

3.30   The UK conducted a random stratified bottom trawl survey in Subarea 48.3 in August–September 2007 (WG-FSA-07/56). Previous surveys (except 1997) have been conducted during the austral summer, but this survey was undertaken in winter to provide information on seasonal changes in icefish distribution and to provide an abundance estimate immediately prior to WG-FSA. As in summer surveys, the main icefish aggregations were found to the northwest of South Georgia, although feeding intensity was less than during summer. Preliminary analysis of the data indicated that during winter the bathymetric distributions of many species are deeper than during summer, perhaps as a result of the deeper cold-water mixed layer. The large cohort of *C. gunnari* caught as 2+ fish during the 2006 survey dominated catches (now 3+), with a smaller cohort (2+) detected at modal size of 18–22 cm. The large *D. eleginoides* cohort, first detected at Shag Rocks as 1+ fish in 2003, were caught as 6+ fish on the South Georgia and Shag Rocks shelf.

3.31   France conducted a random stratified bottom trawl survey between 100 and 1 000 m in Division 58.5.1 (the northern part of the Kerguelen Plateau) in September–October 2006 (WG-FSA-07/16). The total biomass was approximately 245 000 tonnes with about half (124 000 tonnes) being *D. eleginoides*. It was noted that four of the species (*D. eleginoides, M. carinatus, Bathyraja eatonii* and *B. irrasa*) extend deeper than 1 000 m, the limit of the 2006 survey. Some shelf and slope species (*C. gunnari* and *N. rossii*) exhibit low levels of biomass when compared to previous survey results (1987/88 survey). Other species (*C. rhinoceratus* and *L. squamifrons*) seem to have increased, even doubled, their biomass during the period between the two surveys. Besides the commercial species, two non-commercial fish species were also abundant: *Zanclorhynchus spinifer* on the slope and *Alepocephalus* cf. *antipodianus* in the deep sea. The geographical and bathymetrical distributions of the species indicate that they occur in very stable concentrations which are found in the same localised areas during both surveys (POKER 2006 and SKALP 1987/88).

3.32   The Working Group congratulated Australia, France, Germany and the UK, on completing very complex research surveys in 2006/07 and for providing data and results in very short time periods. The Working Group appreciated the huge amount of effort and resources required to conduct surveys which are part of long-term data series.

Tagging studies

3.33   WG-FSA-07/36 presented some designs for equipment used in the Ross Sea to land and tag large fish. The paper identified the most important factors determining successful tagging of large fish as being the speed of operation and the handling of fish on board. The Working Group welcomed the development of techniques to ensure vessels can tag a representative sample of toothfish, including ensuring that large fish are handled and tagged such that their survivorship is high. The Working Group requested that the plans and protocols described in the paper be posted on the CCAMLR website, and technical coordinators be directed to this information by the Secretariat.

3.34   WG-FSA-07/40 presented a description of the tagging program in Subareas 88.1 and 88.2.   Overall, a total of 15 088 *D. mawsoni* have been reported as released and 458 recaptured since 2001; the equivalent numbers for *D. eleginoides* are 911 and 43 respectively. For the first time, long-distance movements of *D. mawsoni* were observed from toothfish tagged by fishing vessels. Six fish moved 400 to 600 km from the slope fisheries in SSRUs 881H, 881I and 881K to grounds off Terra Nova Bay and Ross Island in SSRU 881J. WG-FSA-07/40 also noted that the number of tags recaptured in the Ross Sea in 2007 by New Zealand vessels was higher than usual, and a large proportion were recaptured in a small number of discrete locations that had had intensive tagging in 2006. The Working Group noted that the nature of these observations suggested that assumptions of homogeneous mixing would need to be further investigated.

3.35   WG-FSA-07/40 also described the release and recapture rates of tags by vessels from different nations. The analysis presented in that paper found that recapture rates for tags released by vessels from different nations were different. The Working Group was very concerned at the low levels from some vessels, and that this created considerable uncertainty about the implementation of the tagging program by the fleet fishing in Subareas 88.1 and 88.2. The Working Group noted that this may be due to factors such as variable mortality rates due to different handling methods on different vessels.

3.36   The Working Group requested that the Scientific Committee and the Commission look at the reasons for the observed differences between rates that tags were recaptured from those released by vessels from different nations, and provide advice, for use in assessments, to the Working Group on how to resolve these observed differences.

3.37   WG-FSA-07/48 Rev. 1 presented an updated description of the tagging program in the Division 58.5.2 *Dissostichus* spp. fishery. A total of 15 190 toothfish have been tagged in Division 58.5.2, of which 3 131 have been recaptured in Division 58.5.2 and 35 have been recaptured in Division 58.5.1 and Subarea 58.6. Release and recapture rates are fishing method and area specific, with the great majority of tags released and recaptured in the relatively small area of the main trawl fishery, making it difficult to use tagging to inform assessments of the overall stock in Division 58.5.2.

3.38   Dr T. Carruthers (UK) presented a summary of the tagging program in Subarea 48.4 for the 2006/07 season (WG-FSA-07/32). The paper summarised results from the tagging experiment at the South Sandwich Islands. During the 2006/07 fishing season, one UK and one New Zealand vessel fished in Subarea 48.4, catching a total of 54 tonnes of toothfish. A total of 291 *D. eleginoides* and one *D. mawsoni* have been tagged, at a rate of 5.4 fish per tonne. Additionally, 100 rajids were tagged and released.

3.39   The objective of the tagging program was to estimate toothfish exploitation rates and abundance. During the three years of operation, 467 tags were released, and two recaptures have been recorded, both of which were 2006 releases that were recaptured in 2007. These were recaptured 84 and 14 km respectively from their released position. The number of recaptures was too low to provide an estimate of abundance.

3.40   The exploratory fishery has provided useful descriptive information about the spatial distribution of the target and by-catch species (WG-FSA-07/32). There was a correlation

between the CPUE distribution of toothfish (*D. eleginoides*) and Macrouridae, with both having higher catch rates to the north. There was less overlap in the distribution of Rajidae and toothfish, with Rajid catch rates higher in the east.

3.41   The Working Group recommended that the tagging experiment in Subarea 48.4 be continued, so that further data can be collected which may allow estimates of abundance to be calculated in the future.

3.42   The Working Group recalled its advice that, to avoid bias in assessments, tags should be released in proportion to the fished population. However, the Working Group noted, with concern, that some vessels did not achieve the required tagging rates in Divisions 58.4.1 and 58.4.2 and Subarea 88.2 (Appendices E, F and I; Table 5).

3.43   The Working Group requested that SCIC review the information that it would like from WG-FSA in future to allow it to address this issue.

3.44   Considering the advice in paragraph 3.42, the Working Group recommended that Conservation Measure 41-01, Annex C, be amended by changing the second sentence of paragraph 2(i) to read 'Vessels shall only discontinue tagging if they leave the fishery having tagged toothfish at the specified rate'.

3.45   The Working Group reviewed the utility of having photographs of tags submitted with data for recaptures to the Secretariat. The Secretariat reported that this practice assisted in verifying the correct tag details, where problems with the recording of tag numbers and colours still remain.

3.46   The Working Group recommended that the practice of taking photos of tags from recaptured fish be made a standard requirement of observers. This will require a change to Conservation Measure 41-01, Annex C, paragraph 2(v), deleting footnote 2 which specifies this as a trial year for 2007.

3.47   The quality of the photographs was also discussed, as this ranged from excellent, where the tag number could easily be identified, to poor where no details could be seen. The Secretariat explained that the main problems with the photographs were due to low resolution making the numbers impossible to read, photographs being taken from too far away, flare from the flash obscuring the tag, or photos being taken of tags with the number obscured or on the non-facing side. Observers are therefore requested to ensure that the tag number and details can easily be read from the photograph which is submitted with the logbook, and that the tag takes up the entire frame in the photograph. The Secretariat is requested to update the observer logbook to reflect this change.

3.48   The Working Group also recommended that the Secretariat produce a photograph tag template, which would be used to place behind the tag when photographed. This would act as a background for the photographs, giving the observers a fixed area to focus on and provide a colour reference guide to aid in the identification of the tags. The Secretariat estimated the cost of producing waterproof templates would be approximately A$1 500.

3.49   The Working Group considered the proposal for increased emphasis on tagging during the proposed 'Year of the Skate' (paragraphs 6.34 to 6.39). The Working Group recommended that adopting a uniform, T-bar tag design, with colouration and numbering

distinct from toothfish tags, would be appropriate, and that all skates should be double-tagged, with one tag in each wing, as proposed in WG-FSA-07/39. This would ensure that a uniform tagging protocol could be developed for inclusion in the CCAMLR *Scientific Observers Manual*, and considerations of tag shedding and tag-induced growth and mortality effects would be similar for skates tagged across all fisheries.

3.50   Dr D. Welsford (Australia) informed the Working Group that tagging of skates had been conducted in Division 58.5.2 for several years, using a double-tagging method consistent with that proposed for the Year of the Skate. Dr D. Agnew (UK) informed the group that a tagging program also existed in the Subarea 48.3 toothfish fishery. However, in both instances, and in the Ross Sea, tag recovery rates are low, and hence any skate tagging program would need to be focused to maximise the chances of getting useful numbers of recaptures.

3.51   The Working Group recommended that the Secretariat administer the tagging program for skates, in the first instance purchasing 50 000 tags to be distributed in 2007/08 in preparation for the Year of the Skate in 2008/09.

3.52   The Working Group noted the continuing advances in technology in producing tags which incorporate electronics including passive transponders, data loggers and acoustic tracking devices, and methods of automatically detecting and recording tag recaptures on board fishing vessels. The Working Group encouraged Members to consider application of such technologies to investigate key uncertainties for toothfish stocks such as fish behaviour and movement.

Management advice

3.53   The Working Group recommended that the protocols for tagging very large toothfish, and plans for equipment to assist with handling such fish described in WG-FSA-07/36, be posted on the CCAMLR website, and technical coordinators be directed to this information by the Secretariat.

3.54   In all exploratory fisheries, observers should take a photographic record of all tags recovered and forward these photographs and tags to the Secretariat. Footnote 2 in Conservation Measure 41-01, Annex C, paragraph 2(v), which specifies a trial of photographing tags in 2007, should be removed.

3.55   The Working Group requested that the Secretariat produce a waterproof template to assist observers with taking legible photographs of tag recaptures, to be distributed with tagging kits. The Secretariat should take responsibility for coordinating skate tagging programs in new and exploratory fisheries starting from the 2007/08 season, in preparation for the Year of the Skate in 2008/09.

3.56   All skate tags used by Members in exploratory fisheries should be purchased from the Secretariat for use in the 2008/09 season onwards. The Scientific Committee and SCAF should identify funds required by the Secretariat, which will be recovered through the sale of tags and tagging kits to Members undertaking exploratory fisheries.

3.57   The Working Group requested that the Scientific Committee and the Commission look at the reasons for the observed differences between rates that tags were recaptured from those released by vessels from different nations, and provide advice, for use in assessments, to the Working Group on how to resolve the observed differences.

3.58   The Working Group recommended that the tagging experiment in Subarea 48.4 be continued, so that further data can be collected that may allow estimates of abundance to be calculated in the future.

3.59   The Working Group requested that SCIC review the information that it would like from WG-FSA in future, to allow it to address the issue of reporting on vessels that have not met the required tagging rate in new and exploratory fisheries.

3.60   The Working Group recommended that Conservation Measure 41-01, Annex C, be amended by changing the second sentence of paragraph 2(i) to read 'Vessels shall only discontinue tagging if they leave the fishery having tagged toothfish at the specified rate'.

Biological parameters

3.61   No new biological parameter estimates were presented to WG-FSA. However, a summary of the biological properties of *C. gunnari* were provided in WG-FSA-07/12. The Working Group noted that no variance estimates were provided in association with statistical relationships, such as weight-at-length, because these were rarely available in the primary literature.

Stock structure and management areas

3.62   Aspects of the reproduction, size distribution and movements of *D. mawsoni* in Subareas 88.1 and 88.2 were reviewed in WG-FSA-07/35. Based on the presumed location and timing of spawning, and the probable early life-history characteristics of toothfish, it investigated models that mimic the drift of eggs and larvae over a 6- to 24-month period using an oceanic circulation model linked to the high-resolution global environmental model (HiGEM). The location of toothfish larvae after an 18- to 24-month period suggested by the models agreed moderately well with the distribution of the smallest toothfish taken in the toothfish fishery.

3.63   The paper hypothesised that *D. mawsoni* in Subareas 88.1 and 88.2 spawn to the north of the Antarctic continental slope, mainly on the ridges and banks of the Pacific-Antarctic Ridge. The spawning appears to take place during winter and spring, and may extend over a period of several months. Depending on the exact location of spawning, eggs and larvae become entrained by the Ross Sea gyres, and may either move west settling out around the Balleny Islands and adjacent Antarctic continental shelf, south onto the Ross Sea shelf, or eastwards with the eastern Ross Sea gyre settling out along the continental slope and shelf to the east of the Ross Sea in Subarea 88.2. As the juveniles grow in size they move west back towards the Ross Sea shelf and then move out into deeper water (>600 m). The fish gradually move northwards as they mature, feeding in the slope region in depths of 1 000–1 500 m, where they gain condition before moving north onto the Pacific-Antarctic ridge to start the

cycle again. Spawning fish may remain in the northern area for up to 2 to 3 years. They then move southwards back onto the shelf and slope where productivity is higher and food is more plentiful and where they regain condition before spawning.

3.64   The Working Group welcomed the development of a plausible life history for *D. mawsoni* in the Ross Sea region, and noted that it would assist in the development of operating models for future management strategy evaluation of toothfish resources. It noted that the paper was highly speculative, but that there are now some clear questions as well as a working hypothesis that can be used to focus the research raised by this modelling.

3.65   The Working Group noted that almost nothing is known about the early life history for *D. mawsoni*. The current belief is that the larval forms and eggs are pelagic, and that settlement may take as long as 18 to 24 months. Russian vessels have taken larval fish in krill trawls from the surface waters in areas >1 000 m depth. A crucial question is to determine the hatching time for *D. mawsoni*. It is known that the hatching time in *D. eleginoides* is about four months, but this is further north. In the colder southern waters it may be that *D. mawsoni* takes twice as long, which would alter the expectations of the distribution of different life stages greatly. Some other key questions are how do the fish get to the spawning grounds, and how long do they stay there once having arrived.

3.66   The Working Group considered there were three key processes driving the dynamics of toothfish populations:

(i)   pelagic component – can move very large distances
(ii)   juvenile component – small fish seem to be in shallower habitats
(iii)   location of the spawning fish – these areas seem to be very far apart from the juvenile areas.

3.67   The Working Group noted that some areas may be more important than others to different life stages of toothfish. There may also be some connection around the Antarctic with some source areas and sink areas (e.g. BANZARE Bank may well be a sink as small fish are rarely seen there). The paper represents a useful start to describing the general dynamics of these populations.

Depredation

3.68   No new estimates of removals due to depredation were presented to WG-FSA. WG-FSA-07/34 mentioned significant depredation of longline catches by cetaceans. It was noted that the use of pots significantly reduced or stopped depredations. The Working Group also noted that several papers considered mitigation of depredation which was taken up under 'Ecological interactions' (paragraphs 10.5 to 10.7). It further noted that such changes in longline gear may affect catch rates of toothfish and that this would need to be taken into account in future CPUE analyses.

PREPARATION FOR ASSESSMENTS AND ASSESSMENT TIMETABLE

Report of SG-ASAM

4.1   SG-ASAM met in Cambridge, UK, in April 2007 (Annex 8). The meeting focused on the development of methodologies for acoustic surveys of icefish (*C. gunnari*) and the review of the acoustic sampling protocols for krill (*E. superba*) for use by CCAMLR-IPY projects.

4.2   New information was presented on icefish acoustics from a UK survey in Subarea 48.3 and from data collected by a commercial vessel fishing in Subarea 48.3. The new data demonstrate that it is possible to visually discriminate icefish aggregations from other scatterers. SG-ASAM noted that icefish behaviour will impact on survey design, fish orientation, TS determination and species delineation, and recommended further research on icefish behaviour using a range of technologies and observation methods. SG-ASAM noted that in order to develop an acoustic estimate of icefish biomass it is essential to have data on target strength of icefish.

4.3   SG-ASAM addressed issues about data collection from commercial vessels and noted that an ICES Co-operative Report on this subject will be published in 2007.

4.4   SG-ASAM recommended that the TS of icefish and associated species continues to be studied using a variety of methods including *in situ* measurements, *ex situ* experiments on individuals and aggregations, and physics-based and empirical models.

4.5   SG-ASAM recommended that further work be undertaken to obtain density and sound-speed measurements for a range of Antarctic fish species, including icefish and myctophids, for input into TS models.

4.6   SG-ASAM recommended that a fourth meeting of the subgroup should be held in conjunction with the ICES WG-FAST meeting in 2009 to consider acoustic results from IPY surveys, development in TS modelling, and other new observations.   SG-ASAM recommended that the Data Manager should attend future meetings of SG-ASAM, and that the Secretariat cost associated with attending meetings away from Hobart should be included in the Scientific Committee's budget.

Report of WG-SAM

4.7   Dr C. Jones (WG-SAM Co-convener) presented the report of WG-SAM (Annex 7) with respect to issues of concern to WG-FSA and highlighted the major recommendations:

(i)   Refinements and new methods of parameter estimation (Annex 7, paragraphs 2.1 to 2.16):

(a)   summaries of the tag–release and recapture data should be developed for the statistical areas to assist WG-FSA;

(b)   further research is needed on the spatial pattern of tag recaptures and methods to describe movement;

(c)   WG-FSA consider the development of advice on how it should manage the collection of non-toothfish tagging data;

(d)   a new method for the calculation of effective sample size, and a method of detecting statistically significant systematic lack of fit of integrated model predictions of catch-at-age or catch-at-length frequencies was considered and WG-SAM encouraged further development of this approach for general use (Annex 7, paragraphs 2.11 to 2.13).

(ii)   New assessment methods (Annex 7, paragraphs 3.1 to 3.10 for finfish, and 3.14 to 3.20 for by-catch species):

(a)   a Leslie-DeLury depletion method for assessing toothfish on BANZARE Bank (Division 58.4.3b) is a useful approach to examine the status of stocks in that division and such examination will need to consider spatial aggregation of the fishery, the high level of IUU in this division, and the origin of recruits to this stock to ensure that the stock is not overexploited through fishing on both the recruits and adults as if they were separate stocks;

(b)   an alternative method for assessing toothfish using a TSVPA in Subareas 88.1 and 88.2 had been considered, but WG-SAM agreed that the data and fitting of the approach were not well explained in the paper and that the method needed to be presented to WG-SAM for further consideration following a set of general guidelines developed for introducing alternative assessment methods (Annex 7, paragraph 6.3).

(iii)   Review of preliminary available assessments for finfish (Annex 7, paragraphs 3.14 to 3.20 and 4.1 to 4.19):

(a)   recommendations were made for this year's assessment of toothfish in Subarea 48.3 and Division 58.5.2, including examination of preliminary results from sensitivity tests for an integrated assessment of Division 58.5.2;

(b)   a preliminary assessment of *D. mawsoni* in the Ross Sea was examined, noting a key uncertainty underlying the Ross Sea CASAL assessment is the impact of movements and spatial structure in the *D. mawsoni* population, with recommendations that the CASAL model be used to provide the assessment advice for *D. mawsoni* in Subareas 88.1 and 88.2, and that research priorities for the Ross Sea assessments in the medium term be those given in Annex 7, paragraphs 4.14 and 4.15;

(c)   the quality of data arising from different vessels can be quite variable and it was recommended that WG-FSA and the Scientific Committee consider procedures necessary to ensure the provision of consistent high-quality data for assessments in multi-vessel, multi-nation fisheries (Annex 7, paragraph 4.16);

(d)   a surplus production model implemented in a Bayesian framework for assessing rajid populations at South Georgia was examined, but it was noted that currently there is insufficient data to inform the assessment, that results were strongly dependent on the informed priors, and that tag–recapture data could improve the assessment if included as a harvest rate;

(e)   a preliminary integrated assessment of rajid populations in the Ross Sea using CASAL showed the uncertainties that need to be addressed in finalising an assessment in this region, resulting in a number of recommendations for improving data necessary for an assessment (Annex 7, paragraph 3.18), including issues related to species identification, catch sampling, improving estimates of age and growth, improving tagging protocols and additional survivorship experiments;

(f)   improving by-catch data was recognised to affect the workload of the scientific observers and that there needs to be consideration of priorities for by-catch species, which could be addressed by focusing each year on a particular species group, for example, 2008/09 could be the year of the rajid, and 2009/10 could be the year of the macrourid.

(iv)   Evaluation of management strategies (Annex 7, paragraphs 5.1 to 5.6):

(a)   an Assessment Strategy Evaluation (ASE) procedure was examined and considered promising for investigating a wide range of management strategies, and allowed investigation of sources of potential bias and error in assessments;

(b)   a management procedure that adjusts catch limits according to control decisions based on changes in CPUE trend and mean length of the catch was examined, noting that evaluations were undertaken using several alternative operating models;

(c)   Members were encouraged to develop management strategies suitable for use in *C. gunnari* fisheries.

(v)   Other issues identified during last year's Scientific Committee meeting, including the potential of moving to multi-year or biennial stock assessments (Annex 7, paragraphs 6.11 to 6.18):

(a)   WG-SAM proposed terms of reference for its work (set out in Annex 7, paragraph 6.2) and a process by which WG-SAM will judge the utility for implementation of a method, procedure, or approach, which is set out in Annex 7, paragraph 6.3;

(b)   WG-SAM also provided guidance for other working groups that wish to have WG-SAM address their specific topics in the future, and to develop the annual WG-SAM agenda (set out in Annex 7, paragraphs 6.6 to 6.9);

(c)   WG-SAM considered the consequences of conducting assessments at multi-year intervals:

- it agreed that this represents a trade-off between the risk of gross errors in an assessment, and the considerable time saved in both the meeting of WG-FSA and intersessionally (see discussion in Annex 7, paragraphs 6.11 to 6.18), noting that the need for annual assessments would need to be decided by WG-FSA for each fishery, that trials such as those described in Annex 7, paragraph 6.13, could be undertaken for new model scenarios or species to evaluate the risks of different frequencies of assessments, and that WG-FSA should retain the option to undertake an assessment in any given year if new or refined methods of assessment become available or parameters used in the assessment are revised significantly;

- it agreed that where a toothfish stock is at or above target levels, and where assessments have been stable, then assessments of toothfish could be performed on a biennial cycle without incurring significant additional risk;

- it encouraged further work to evaluate the risks and determine robust indicators to trigger assessment updates.

4.8   The Working Group noted the consideration of the TSVPA method (WG-SAM-07/9) by WG-SAM and encouraged the authors to attend WG-SAM to help explain the use of the TSVPA and to answer questions being asked by that group. It further encouraged the use of the approach in Annex 7, paragraph 6.3, to help evaluate this method. Advice to the scientists involved in the application of the TSVPA to the Ross Sea toothfish assessment is further considered in paragraphs 4.26 and 4.27.

4.9   The Working Group also noted that intensive studies on by-catch species, such as the Year of the Skate, would be beneficial and encouraged the By-catch Subgroup to look at this further. It was also noted that skates would be appropriately given a high priority because of the global interest in elasmobranchs and the recognition that elasmobranchs tend to have lower productivity than many commercially fished species. In this context, it may be more appropriate to design strategies for avoidance and mitigation, in the same way such strategies have been adopted for seabirds, as compared to developing productivity models and assessments of sustainable yield. The subgroup was asked to consider for skates, mechanisms for assessing productivity and life history as well as technical consideration for avoidance and mitigation.

4.10   The Working Group endorsed the recommendations of WG-SAM to continue evaluating assessment and management strategies.

4.11   With respect to multi-year assessments, the Working Group agreed to consider this further during the meeting.

Review of preliminary stock assessment papers

4.12   The Working Group reviewed six preliminary stock assessments that were developed during the intersessional period. These included *D. eleginoides* in Subarea 48.3,

Division 58.5.2, Subarea 58.6/58.7 (Prince Edward Islands), *Dissostichus* spp. in Subarea 88.1/88.2 (Ross Sea), *Dissostichus* spp. in Division 58.4.3 and *C. gunnari* in Division 58.5.2

4.13   A preliminary assessment for *D. eleginoides* in Subarea 48.3 (WG-FSA-07/29) was presented by Dr R. Hillary (UK).   The paper detailed an updated CASAL assessment incorporating 2007 CPUE data, catch-at-length data and updated mark–recapture data.   The paper also described improvements to the fit-of-tag data through (i) estimating a length-based ogive for tag-induced mortality, and (ii) relating tag-induced growth retardation to size. Further, a new model was presented that used estimates of catches-at-age from 1998 to 2006 based on random sampling of otoliths collected over that period.   The latter model demonstrated some improvements, although several poor fits remained.   The predicted spawning stock biomass and the yields from all models presented were slightly higher than was estimated last year.

4.14   The Working Group noted that the relatively poor fit to the tag data remains an issue for the assessment of this fishery, and agreed that there are several factors that could influence this, including a potential cryptic biomass (which could result in a greater abundance of recruits than tags would indicate), variations in mortality, recruitment and growth.   The Working Group noted that fits-to-age data appear reasonable, and that fits using the new age-based model were slightly better than the updated model.   However, the same problem of underestimation of tags in younger fish and overestimation of tags in older fish remains.

4.15   Dr A. Constable (Australia) suggested that age-based selectivity may not provide appropriate estimation of a growth curve if there is length-based selectivity operating. Mr A. Dunn (New Zealand) recommended attempting length-based selectivity.   The Working Group noted that yield and projections for the new methods are similar to the model updated from last year.   Mr Dunn suggested that accounting for variability in recruitment estimates can improve estimates of B_0 and may have been the cause of the more precise estimates of B_0 in the age-based model.

4.16   The Working Group recommended using the updated assessment for this year, and agreed that the new assessment approaches look promising.   It recommended that the new approaches presented in WG-FSA-07/29 be reviewed and evaluated during next year's meeting of WG-SAM.

4.17   A preliminary assessment for *D. eleginoides* in Division 58.5.2 using the CASAL modelling approach (WG-FSA-07/53) was presented by Dr S. Candy (Australia).   The assessment included 2007 season data updates, and 2006 data not available for WG-FSA in 2006. Included were the following refinements: (i) estimation of the CV for length given age; (ii) use of non-informative priors for year-class strength parameters; (iii) separate selectivity parameters used for the pre-2005/06 compared to the 2005/06–2006/07 fishing seasons for the main trawl ground; (iv) separate selectivity parameters for the late (within-year) seasons compared to the combined early (within-year) seasons for the main trawl ground; and (v) the use of an improved method of determining effective sample size for commercial catch-at-length data. The assessment demonstrated sensitivities to the inclusion of different datasets and to the choices of parameters used in both the stock assessment and projections.

4.18   The Working Group suggested that age data would improve the assessment considerably, and recommended that progress be made in ageing otoliths that are currently

available (WG-FSA-07/45). It was agreed that the use of mark–recapture data is currently not appropriate due to most releases taking place in a relatively small area and non-mixing, resulting in biomass levels reflecting only localised abundance (WG-FSA-07/48 Rev. 1). Until the difficulties with the use of mark–recapture data are resolved, the Working Group agreed that recruitment surveys currently provide the best means of establishing current stock status as an absolute index of abundance.

4.19   The Working Group noted that the *D. eleginoides* CASAL assessment in Division 58.5.2 used a multivariate normal approximation of the variability in parameters rather than using an MCMC, and that this may have implications in the assessment, given differences in the way that they explore variability between parameters. Mr Dunn suggested that it would be desirable to run the assessment using different starting points to confirm that the MPD solution is the global minimum. Dr Candy tested this, and determined that B_0 was very stable, and that the average difference using different starting values is 0.1%. The Working Group agreed that this was small, and that the assessment could be carried forward as presented in WG-FSA-07/53 Rev. 1.

4.20   A presentation on the assessment of the Prince Edward Island (South African EEZ in Subareas 58.6 and 58.7) *D. eleginoides* fishery using the ASPM model (WG-FSA-07/34 Rev. 1) was given by Dr R. Leslie (South Africa). In this assessment, a two-fleet (longline and pot) ASPM was used to update the assessment of the status of *D. eleginoides*. Most fishing in the South African EEZ takes place in Subareas 58.6 and 58.7 and Area 51. The assessment made use of all catches, standardised catch rates and catch-weighted length frequencies from the longline fishery. The model used biological parameters very similar to those currently used in Subarea 48.3. The paper also presented a sensitivity analysis where depredation was explicitly included in the model.

4.21   The Working Group noted that the two-fleet model used to conduct the assessment was not available for review during the meeting. The Working Group recommended that all relevant code be submitted to the Secretariat when a method or preliminary assessment is tabled for consideration by WG-FSA or WG-SAM. It was recommended by the Working Group that future assessments consider use of CPUE estimated by means of the GLMM, which may result in a less precipitous drop in catch rates during the early years of the fishery, and a potentially better model fit.

4.22   The Working Group recognised continuing potential issues surrounding the disparity between the EEZ boundaries of Prince Edward Island and the statistical zones from which data, such as IUU, are reported.

4.23   Preliminary assessments for *Dissostichus* spp. in Subareas 88.1 and 88.2 were presented in WG-FSA-07/37 and WG-SAM-07/9.

4.24   WG-FSA-07/37 presented a CASAL integrated assessment of the Ross Sea fishery (Subarea 88.1 and SSRUs 882A–B) that updated the 2006 assessment using new parameter estimates along with revised catch, catch-at-age and tag–recapture data. The Working Group noted that the inclusion of the 2007 recaptures of 2006 tags released had the most substantive impact on the model estimates.

4.25   The Working Group considered models using tag–recapture data from all vessels versus New Zealand vessels only, and noted the lower recapture rate by non-New Zealand

vessels, particularly in the early years, resulted in a more optimistic assessment. The Working Group considered that these lower recapture rates may be related to different distributions of fishing effort by different vessels, to poorer survival of tagged fish, or to poorer detection rates. The Working Group agreed that the model continued to use mark–recapture information from New Zealand vessels only, until the reasons for the disparity in return rates is better understood or substantially reduced (paragraphs 3.34 to 3.36).

4.26 Dr K. Shust (Russia) noted that the area of the Ross Sea is considerably greater than Subarea 48.3, yet the estimates of available biomass for *Dissostichus* spp. between the two areas are not substantially different, nor are long-term precautionary yields. Dr Constable suggested that the reason for the apparent lower density of toothfish biomass in the Ross Sea could be related to food-web dynamics, where the Ross Sea region has generally lower productivity than the Scotia Arc. The Working Group agreed that these considerations are important and should be considered in further research.

4.27 WG-SAM-07/9 updated the application of an alternative assessment method for the Ross Sea *Dissostichus* spp. fishery by means of a TSVPA. The Working Group agreed that further work needed to be presented to WG-SAM for consideration and adopted as a suitable method before the method could be used in WG-FSA. Dr Shust discussed how to progress this work with the incoming Convener of WG-SAM, Dr Constable, and other members who participated in both WG-FSA and WG-SAM. It was agreed that the following would need to be addressed in a future submission to WG-SAM in order to improve the understanding of how the TSVPA works and for reviewing the efficacy of using the method given the uncertainties in the different datasets:

(i) A full paper detailing the method and its implementation needs to be compiled from existing work and presented to WG-SAM with further consideration of its implementation as discussed in the following points.

(ii) Simulated (theoretical) data need to be developed for a number of fishery–stock scenarios and those data be analysed using CASAL and the TSVPA in order to compare how the two methods perform using data from known population and fishery attributes.

(iii) Mathematical and statistical details of how the input data for the TSVPA are generated from the available datasets used in CASAL, including any pooling of the data in space and/or time, need to be provided.

(iv) Descriptions need to be provided on the methods for deriving the CPUE indices, including how the indices are standardised to account for differences and variability between vessels, times of year, location of fishing and so forth.

(v) Descriptions are needed on how uncertainty is treated in both the assessments and evaluation of yield.

4.28 A preliminary assessment of the exploratory fishery for *Dissostichus* spp. in Division 58.4.3b (BANZARE Bank; WG-FSA-07/44) was presented by Dr Welsford. The paper developed the initial exploration considered during the WG-SAM meeting (WG-SAM-07/8) by analysing the C2 fine-scale catch and effort data held by CCAMLR for

the fishery in this division presented to WG-SAM in 2007, as well as descriptive analyses of the B2 biological data submitted by scientific observers on board vessels in the BANZARE fishery.

4.29   The Working Group noted that there was insufficient overlap of individual vessels in their operations between seasons to permit meaningful standardisation of the CPUE. However, the analyses presented to the Working Group showed strong evidence for depletion of toothfish at the scale of individual fishing grounds in the 2004/05 and 2005/06 seasons with the CPUE in the recent season being comparatively low and showing no trend. The Working Group also noted several inconsistencies between historical catch rates and catch compositions and those reported in the 2006/07 season, with *D. eleginoides* dominating in catches in one ground for the first time, and some observers reporting no biological information on important by-catch groups reported in the vessels' catch records.

4.30   The Working Group expressed deep concern regarding the substantial level of IUU fishing in this division, and noted that this can have a considerable effect on the data used for assessment purposes. The Working Group was further concerned about the lack of information on the origin of young fish contributing to the fishable biomass in Division 58.5.3b, and recommended that it would be worthwhile to examine fishery and population characteristics of *Dissostichus* spp. in divisions adjacent to BANZARE Bank with the aim of identifying potential sources of recruitment to the stock.

Preliminary assessments for *C. gunnari*

4.31   A preliminary assessment for the estimation of a precautionary yield of icefish in the vicinity of Heard Island (Division 58.5.2) for the 2007/08 CCAMLR season was presented in WG-FSA-07/47. This paper provided a preliminary assessment of yield based on results from the 2007 survey (WG-FSA-07/46), using standard short-term projection assessment methods previously employed for icefish in this division.

4.32   The Working Group noted that the population contains a large 1+ cohort, which is likely to have resulted from the spawning activity by mature 4+ fish evident in the population in 2006. Yields are projected to increase over the next two seasons as the biomass of this year class increases and recruits to the fishery. The Working Group noted that this dynamic of a single abundant year class dominating the population is typical of this stock and agreed that the preliminary assessment described in the paper was an appropriate scenario to proceed with for the assessment.

4.33   No preliminary assessments were provided to the Working Group for *C. gunnari* in Subarea 48.3. However, the Working Group reviewed the results of a trawl survey in Subarea 48.3 (WG-FSA-07/56), and agreed that information from this survey should be used for an assessment of this stock for the 2007/08 and 2008/09 fishing seasons.

Assessments to be carried out and assessment timetable

4.34   Assessment issues addressed during the course of WG-FSA were identified by the Scientific Committee during the previous year's CCAMLR meeting, the WG-SAM meeting, papers available to WG-FSA, and assessment subgroup discussions during WG-FSA.

4.35   With regard to the assessment of *D. eleginoides* in Subarea 48.3, the Working Group agreed that only the integrated assessment using CASAL be used to provide management advice for the 2007/08 fishing season for *D. eleginoides* in Subarea 48.3.

4.36   With regard to the assessment of *D. eleginoides* in Division 58.5.2, the Working Group agreed that the integrated assessment using CASAL, as described in WG-FSA-07/53 Rev. 1, be used to provide management advice for the 2007/08 fishing season for *D. eleginoides* in Division 58.5.2.

4.37   The Working Group reviewed the results of the bottom trawl survey conducted in Division 58.5.1 (Kerguelen), and discussed the potential of conducting an assessment of this division. However, the data from the survey were not available to the Working Group for further analysis. It was agreed that it would be advantageous to draw together all available data from the Secretariat with the aim of scoping the potential of a future assessment. This included a general characterisation of the fishery (spatial and temporal), CPUE and catch-at-age information. The Working Group concluded that this information would be required in order to formulate options for a future assessment of this stock.

4.38   The Working Group agreed that the assessment for the Ross Sea management area (Subarea 88.1 and SSRUs 882A–B) be based on the 2007 reference case (hereafter labelled the base-case) described in WG-FSA-07/37. The model was a CASAL Bayesian integrated sex- and age-model that used catch-at-age observations for the shelf, slope and north fisheries (WG-FSA-07/28) and the tag–release data from New Zealand vessels from 2000/01 to 2005/06 and their recaptures by New Zealand vessels from 2001/02 to 2006/07 (WG-FSA-07/40).

4.39   The Working Group did not have any new information for SSRU 882E on which to base new advice. The Working Group recommended that the catch limit for 2006/07 be carried forward for 2007/08. For SSRUs 882C, D, F and G, the Working Group could provide no new advice, but noted that the catches in these areas had provided some useful biological data for toothfish. Therefore, the Working Group recommended the current catch limits in these SSRUs be continued for the 2007/08 season.

4.40   The Working Group agreed that the approach presented in the preliminary assessment in the South African EEZ in Subareas 58.7 and 58.6 (Prince Edward Island; WG-FSA-07/34 Rev. 1) would be sufficient for generating management advice for this area.

4.41   The Working Group agreed that assessment of *C. gunnari* in Subarea 48.3 and Division 58.5.2 be undertaken for the 2007/08 and 2008/09 fishing seasons using the short-term projection approach, as has been employed in previous assessments of this stock.

4.42   All assessment work was undertaken by primary authors of preliminary assessments, and reviewed independently. Tasks of independent reviewers are listed in WG-FSA-06/6 Rev. 1, paragraph 6.3. The outcomes of the assessments were reported in the Fishery Reports.

4.43   The Working Group suggested that WG-SAM consider a standard set of diagnostics to help identify the quality of fits, and suggested the potential use of an MSE to determine what data might be needed to differentiate between important competing hypotheses.

ASSESSMENTS AND MANAGEMENT ADVICE

New and exploratory fisheries in 2006/07 and notifications for 2007/08

5.1   In 2006 the Commission agreed to seven exploratory longline fisheries for *Dissostichus* spp. in the 2006/07 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 2006/07. Activities in the exploratory fisheries are outlined below and summarised in Table 6.

5.2   Notifications for exploratory fisheries in 2007/08 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. There were no notifications for new fisheries, and no notifications were received for fisheries in closed areas.

5.3   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.

5.4   Unstandardised CPUE data for *Dissostichus* spp. caught in exploratory longline fisheries between 1996/97 and 2006/07 are summarised in Table 8.

5.5   Under Conservation Measure 41-01, each longline vessel fishing in exploratory fisheries for *Dissostichus* spp. is 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 Divisions 58.4.3a and 58.4.3b and three fish per tonne in Divisions 58.4.1 and 58.4.2. In 2006/07, 5 530 *Dissostichus* spp. were reported to have been tagged and released in the exploratory fisheries (Table 9).   In 2006/07, 244 tags were recovered (Table 10).

Progress towards assessments of new and exploratory fisheries

5.6   The Working Group noted that further progress had been made this year in assessing stocks of *Dissostichus* spp. in the Ross Sea to develop management advice (see Appendix I and paragraphs 5.89 to 5.106).

5.7   The Working Group considered WG-FSA-07/44, which undertook an analysis of CPUE in Division 58.4.3b using the Leslie depletion analysis. The Working Group thanked Australia for its work, and agreed that it was valuable, however, the Working Group was currently unable to provide estimates of yield from this fishery due to high levels of IUU fishing in that division (see paragraphs 5.77 to 5.79).

5.8   For the other subareas and divisions in which exploratory fisheries are conducted, the Working Group was unable to develop management advice based on assessments of yield and is therefore unable to provide any new advice on catch limits for these fisheries. The reported catches in these fisheries are summarised in Table 11.

5.9   Given the large number of notifications for 2007/08, the Working Group reiterated the urgent need to develop a means for estimating abundance and providing assessments of stock status in exploratory fisheries other than in Subareas 88.1 and 88.2.

Data requirements and research protocols using commercial vessels

5.10   The Working Group noted that three notifications of intent to conduct toothfish longline research using commercial vessels under the provisions of Conservation Measure 24-01 had been received this year.

5.11   The Working Group recognised that the purpose of allowing research harvest under the terms of Conservation Measure 24-01 is to ensure that data are collected which will eventually allow an assessment of fish stocks in the sampled area to be completed. The Working Group also recognised the need to restrict initial effort, such as provided in Conservation Measure 41-09 (paragraph 12), to prevent over-harvesting before sufficient data are obtained to conduct an assessment. Some standardisation of effort (number of hooks per line) must be done to ensure catch limits (e.g. 10 tonnes) are not exceeded.

5.12   For areas where no fishing has occurred, such as closed SSRUs, research should be conducted in two stages. The first stage should establish if the proposed area warrants further research. Data collected should establish catch rates, species composition, by-catch and potential for having significant adverse impact on vulnerable marine ecosystems.

5.13   If the potential for commercial fishing is established, subsequent research must provide data in addition to those above. This would include data on stock structure (length-frequency, tissue samples and otoliths), catch required to estimate CPUE, and the establishment of a long-term tagging program which will be designed to ensure sufficient fish are tagged and sufficient recaptured fish are obtained to allow a stock assessment to be completed.

5.14   Dr Constable undertook some preliminary analyses concerning the design of longline survey activities to assess the average CPUE of an area. In the first instance, he presented routines developed in R (R development team, 2007) by Mr J. McKinlay (Australia) to evaluate the uncertainty in the estimate of CPUE given a specified catch limit for a survey (the routines have been deposited with the Secretariat). Mr McKinlay's trials used data from the fishery on BANZARE Bank. The important features of these routines are:

(i)   the data from the fishery can be subset by year, location, longline characteristics and so forth;

(ii)   a number of replicate samples can be taken from the subset to simulate random samples from the areas fished in the commercial fishery, with each replicate longline retaining its characteristics of number of hooks, catch and CPUE;

(iii)   the number of longlines in the sample is governed by the random sequence that results in the last line exceeding the catch limit and, hence, the number of lines in a sample will vary depending on the catch of each line;

(iv)   summary statistics for each random sample are generated, including the total catch (kg and number), total hooks, total lines and CPUE (kg and number per hook);

(v)   the combined summary statistics across the replicate trials can then be plotted as box plots;

(vi)   an example output of results is illustrated in Figure 1, which also can include plots of the location of the subset, frequency plot of the number of hooks on each line and summary diagnostic plots showing key attributes of the samples. This is output to a pdf file.

5.15   These analyses were further enhanced to determine the probability of an estimate of CPUE arising from a survey being within 25% of the true value, where the true value is the grand mean CPUE from the dataset used in the resampling (this probably approaches one as the trial sample fraction of the dataset approaches one (the enhanced routines are available from the Secretariat)). A total of 1 000 replicate trials for each of eight different survey catch limits (5, 10, 20, 30, 40, 50, 75 and 100 tonnes) were undertaken by resampling from toothfish longline fishery datasets for Divisions 58.4.1, 58.4.2, 58.4.3b and 58.4.4. The results of these trials are shown for each division in Figure 2 and Table 12, where the data from a division is pooled (All) and then disaggregated by year.

5.16   The Working Group thanked Dr Constable and Mr McKinlay for their work and noted the following:

(i)   the analyses are very useful for showing the variability in CPUE in the restricted areas fished to date in these divisions;

(ii)   the results presented in Figure 2 and Table 12 could be used as a preliminary guide in considering minimum designs for research surveys in these divisions;

(iii)   the research catch for estimating CPUE in a single survey would need to be in excess of 40 tonnes for most areas, given the variability in CPUE and that the CPUE data used in this analysis is highly aggregated and may not reflect the greater variability in CPUE across the larger areas;

(iv)   simulation work will need to be undertaken to determine what the fishery research catch regime will need to be if a trend in CPUE needs to be detected.

5.17   The Working Group encouraged further work with these simulations and recommended that WG-SAM be asked to consider the optimal research design for estimating the mean CPUE of an area for use in developing advice on catch limits for an area.

5.18   The Working Group agreed that an adequate tagging effort will require an estimate of how many tags are required and how many years will be required to obtain recaptured fish. The catch (tonnes) of toothfish required to ensure the success of the tagging program must be specified. The type of shots needed to characterise an area may be determined by simulation.

5.19   Dr Hillary developed notes on how to link key tagging and biological parameters, such as the tagging rate per tonne, the catch biomass, reporting rate, natural mortality and the potential underlying biomass of a previously unassessed stock/population to the (potential) accuracy of an abundance estimate coming from a tagging program.

5.20   The method was tested using toothfish data from Subareas 48.3 and 48.4 – both have tagging programs, but while the stock in Subarea 48.3 is assessed, the toothfish population in Subarea 48.4 is not. For Subarea 48.3, the 2007 abundance CV predicted from the releases in 2006 was close, but slightly less than that predicted by the full CASAL assessment, and the likely reasons for this were given. For Subarea 48.4, the potential abundance CV was estimated for the last three years' catch levels, the maximum number of tag releases achieved and three postulated underlying exploitable biomass levels for Subarea 48.4. For all possibilities, an abundance CV between 0.45 and 0.7 was predicted. The key result is that there is a clear trade-off between the catch/effort taken/applied to a given population and the tagging rate achieved, with respect to the resultant accuracy of the tagging abundance estimate.

5.21   As an illustrative example, a simple calculation was undertaken that detailed the required catch biomass that would need to be taken to achieve a 33% CV in the estimated abundance, for 'low', 'medium' and 'high' tag rates per tonne and underlying exploitable biomass levels. Table 13 details the results of this example. If a given precision is required in the abundance estimate from a tagging program, there is a clear dependency on what tag rate is achieved and what the underlying biomass might be, in terms of what catch limit will be required.

5.22   The details of this work, along with some work on suggestions made by the subgroup related to this approach will be presented at the next WG-SAM meeting.

5.23   Finally, the Working Group agreed that completion of a long-term tagging protocol, as well as other research on toothfish, will require cooperation, collaboration and consistency among surveys over several seasons. For example, New Zealand has collected data in SSRU 881A during the last two years and any subsequent research surveys will need to be consistent with this effort.

Role of SSRUs to ensure stock assessments
and sustainability are achieved

5.24   The use of SSRUs to manage toothfish stocks in new and exploratory fisheries was reviewed by the Working Group. It noted that SSRUs were initially defined in the Ross Sea and East Antarctica to try to aggregate fishing effort to better understand stocks in some areas and to ensure sufficient sampling to estimate CPUE and recapture probabilities in the mark–recapture program. It was intended that after stock assessments were made in those initial areas that other areas would then be fished. In doing so, protocols to ensure adequate scientific information is provided, must be developed. For example, a protocol to determine CPUE in the closed areas needs to be developed because CPUE is not constant over all areas and furthermore there is no relation between CPUE and bottom area. Specifically, the level of fishing and tagging effort required to ensure assessment of stocks in those areas must be provided.

5.25   It was noted that by restricting data to that gained from a commercial fishery that was constrained to fish in certain SSRUs, it is difficult to gain information on such issues as the geographic and depth distribution of the target fish, as well as differing length composition of toothfish among areas. In addition, the Commission has been asked to allow harvesting in SSRUs now closed (CCAMLR-XXVI/37).

5.26   However, the Working Group also noted that toothfish do, on occasion, move over a large area and in the long term would move in and out of closed SSRUs so this should not hamper fishing.

5.27   The Working Group noted that the catch limits for toothfish in Subareas 88.1 and 88.2 in the Ross Sea were changed as part of a three-year experiment (SC-CAMLR-XXIV, paragraphs 4.163 to 4.166). The experiment will end after the 2007/08 season. It was suggested that if the concentrated sampling protocol was abandoned before the end of the experiment and fishing effort was dispersed, the tagging program would be diluted, which would adversely affect the ability of the Scientific Committee to provide management advice. Before altering the effort distribution, the Working Group noted that consideration will need to be given on how to avoid negative effects on the assessments by such changes in effort distribution.

5.28   Therefore, it was agreed that methodological work on designing research experiments should be developed for consideration by WG-SAM in 2008. This would allow WG-FSA to develop protocols to ensure adequate information can be provided by the fisheries. The Working Group invited papers on such topics as fishing operations and protocols, data collection structure, role of SSRUs, relationship between geographical distributions, bottom surface and sea currents, relationship with interannual ice coverage and others.

5.29   The Working Group also noted that research vessels which notify and fish specific areas are asked to provide a full report of the effort within 12 months (Conservation Measure 24-01, paragraph 4(c)), however, it was requested that a report be submitted in time for consideration of its 2008 meeting. This task could be aided by the development of pro formas for research proposals and research summaries.

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

5.30   Japan submitted a notification to conduct scientific research in 2007/08 (COMM CIRC 07/109 and SC-CAMLR-XXVI/9). The notification is to conduct research on the distribution and population structure of toothfish in Divisions 58.4.4a and 58.4.4b. The survey vessel will use longlines and is expected to take no more than 150 tonnes of toothfish. The notification falls under paragraph 3 of Conservation Measure 24-01. Conservation Measures 41-01 and 32-10 may also apply to this notification. 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 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. Completion of the research plan will require 240 shots during which up to 150 tonnes of toothfish may be taken.

5.31   The Working Group expressed appreciation to Japan for providing its proposal which represented a great deal of thought and work.

5.32   The Working Group noted that commercial harvesting of toothfish in Division 58.4.4 was prohibited in 2002 because rapidly declining fish stocks attributed to intense IUU fishing activities. Toothfish stocks were believed to have been depleted to the point that any fishery was not viable. Furthermore, the Working Group agreed, based on information of recovery of stocks in other regions, that it was unlikely that toothfish stocks in Division 58.4.4 have substantially recovered since 2002.

5.33   The Working Group also agreed that much of the information proposed to be collected can be obtained from relatively small catches. For example, information on stock structure (genetic samples) could be obtained from relatively few fish or biological data, such as fish size, may be obtained from relatively few fishing lines.

5.34   At present, the amount of toothfish catch specified in Conservation Measure 24-01, Annex A, to support tagging studies is set at 10 tonnes although, as discussed above (paragraphs 5.19 to 5.22), larger catches may be needed to estimate CPUE and to support a tagging program. However, the Working Group agreed that catch rates required for such assessments may be greater than is sustainable. Therefore, it would be difficult to justify catches as large as 150 tonnes to support a tagging program. The Working Group suggested that catch levels of no more than 10–20 tonnes in each SSRU were appropriate in the absence of further justification to show how the data will be used in an assessment and that the recovery of fish stocks will not be impeded.

5.35   Dr M. Naganobu (Japan) thanked the Working Group for its scientific assessment and indicated he understood its views; however, he stressed the importance of evaluating the effect of the management action taken in 2002 when the fishery was closed. Without the proposed Japanese survey no information on the current status of the stock will be available, hence prohibiting any formal evaluation of the effectiveness of the management action taken. He proposed that catch from the proposed research survey will not exceed 103 tonnes which was the precautionary catch limit set in 2001 before the fishery was closed in 2002. This amount is expected to be safe for the stock, and he prefers that the proposal to take no more than 103 tonnes be considered not only by the Working Group, but also by the Scientific Committee and the Commission.

5.36   Spain submitted two notifications to conduct scientific research in 2007/08 (COMM CIRC 07/114). One notification is to fish in SSRU 881A while the second notification is to fish in SSRUs 5841D, F and H. The survey vessel will use longlines and is expected to take no more than 10 tonnes of toothfish per SSRU (plus by-catch). The notification falls under paragraph 2 of Conservation Measure 24-01. Conservation Measures 41-01, 41-09 and 41-11 also apply to this notification.

5.37   The Working Group thanked Spain for providing its notifications for comments; however, it agreed that it would have benefited from having a Spanish scientist attend the meeting. The notifications did not provide sufficient scientific information on which advice could be provided in many aspects.

5.38   The Working Group noted its comments above that all research effort in an area should be done in cooperation and collaboration with other ongoing and proposed efforts. In

this case, there have been extensive tagging efforts by New Zealand in Subarea 88.1. The Working Group also noted that Conservation 41-09 (paragraph 12) limits research fishing to a single vessel in each of SSRUs 881A, D, E and F during the entire season.

5.39 Australia submitted a notification to conduct scientific research in 2007/08 (COMM CIRC 07/117). The notification is to conduct research on the status of toothfish and major by-catch species in Division 58.4.3b. The survey vessel will use longlines and will take approximately 50 tonnes of finfish, but Australia indicated it is likely that the survey may catch in excess of 50 tonnes of finfish and more than 10 tonnes of toothfish. The notification falls under paragraph 3 of Conservation Measure 24-01. Conservation Measures 41-01 and 41-07 may also apply to this notification. The specific research objectives for the survey are to: (i) quantify the relative abundance of toothfish and major by-catch species available to the longline method across BANZARE Bank; (ii) determine the demographic characteristics of the target and major by-catch species across BANZARE Bank (i.e. size distribution, sex ratios, reproductive status); and (iii) collect biological material which can be used to determine the relationships between toothfish stocks in the southwestern Indian Ocean sector.

5.40 The Working Group expressed appreciation to Australia for providing its proposal for review. The Working Group noted, as indicated in its proposal, that under Conservation Measure 24-01 (paragraph 1), catches taken in any area where catch levels exist will be considered as part of the catch limit, and in areas with a zero catch limit, the catches taken will be considered to be the catch limit for the season in that area.

5.41 Dr Constable noted that fishery data exists in Division 58.4.3b, but it is very patchy, therefore the present proposal is to conduct a standardised random survey across the entire area. This will be the first such effort and standardised CPUE data will greatly enhance the ability of the Working Group to determine the biomass of toothfish in this division and to better understand the relative importance of the existing fishery grounds to the stock in this division.

General comments relative to Conservation Measure 24-01

5.42 The Working Group recognised the utility of providing a provision for Members to conduct research surveys in order to obtain assessment information which otherwise might not be available. However, it also recognised the possibility that this measure had the potential to be utilised to conduct commercial harvesting under the guise of research.

5.43 The Working Group encouraged the Scientific Committee to review this conservation measure to ensure it was consistent with its intended purpose. Specifically, the Working Group felt all efforts notified under this provision should be required to provide a research proposal to WG-FSA on which scientific advice could be offered to the Scientific Committee. In addition, the Working Group suggested that all notifications which proposed taking toothfish should be required to include research proposals for review by the Working Group. Finally, as noted above, it would be highly desirable for Members submitting research proposals using commercial vessels to ensure appropriate scientists attend the Working Group meetings.

General management advice for new and exploratory fisheries

5.44   The Working Group reiterated the necessity for Members fishing in exploratory fisheries for *Dissostichus* spp. to conduct the fishery-based research outlined in Conservation Measure 41-01, and that the data are submitted to the Secretariat in a timely manner.

5.45   In addition, the Working Group reiterated the importance for Members to conduct tagging and to submit data as part of the Research and Data Collection Plan (Conservation Measure 41-01). Members should also be urged to emphasise to their vessels the need to look out for tagged fish and submit accurate tag–recapture data to the Secretariat in a timely manner (see also paragraphs 3.35 and 3.36).

5.46   The Working Group did not attempt to determine whether the notifications for exploratory fisheries satisfied the requirements of Conservation Measure 21-02.

5.47   With the exception of Subareas 88.1 and 88.2, the Working Group was unable to provide any new advice on catch limits for *Dissostichus* spp. or any by-catch species in any of the exploratory fisheries.

5.48   For the other areas and divisions in which exploratory fisheries are conducted, the Working Group reiterated the urgent need to develop a means for estimating abundance and providing assessments of stock status for all exploratory fisheries. In this context, it noted that with the continuing tagging programs in a number of areas, in the medium to long term it may be possible to obtain mark–recapture estimates of abundance provided that sufficient tags are deployed each year.

5.49   The Working Group drew the attention of the Scientific Committee to the fact that there are significant differences in the tagging rates achieved by different Members in some areas, and not in others (WG-FSA-07/40; paragraph 3.35). It is important to understand whether this is due to operational constraints which might suggest differences in mark–recapture model parameters, or to other reasons.

5.50   The Working Group further drew the Scientific Committee's attention to the fact that in the 2006/07 season, several vessels either did not conduct, or did not report, research sets in the exploratory fisheries in Subarea 48.6, Divisions 58.4.2, 58.4.3a and 58.4.3b as required under Conservation Measure 41-01, Annex C (Table 2 in Appendices D, F, G and H). The Working Group encouraged Flag States to ensure that research sets are completed and reported, as the data collected from these activities are essential for developing assessments.

5.51   There are similar differences in by-catch rates between Members, and between different areas which need to be understood (paragraph 6.9).

5.52   The Working Group recalled the advice of CCAMLR-XXIV (paragraph 4.51) that, where possible, vessels should release rays from the lines by cutting the snoods when rays are still in the water, unless requested not to do so by the observer during the biological sampling period.

5.53   Noting the considerations in the by-catch section paragraph 6.38, the Working Group recommended that Conservation Measure 33-03 be amended to include the following paragraph after paragraph 3:

> 'Unless otherwise requested by observers, vessels, where possible, should release rays from the line by cutting snoods and, when practical, removing the hooks'.

Dissostichus spp. Subarea 48.6

5.54   Three vessels (Japan, Republic of Korea and Norway) fished in the exploratory fishery in Subarea 48.6 in 2006/07.   The precautionary catch limit for *Dissostichus* spp. was 910 tonnes and the total catch was 113 tonnes. Information on this fishery is summarised in Appendix D.

5.55   The fishery was operated predominantly in SSRU A and the main species caught is *D. eleginoides* over the course of the fishery.

5.56   There was no evidence of IUU fishing in 2006/07.

5.57   A total of 128 toothfish was tagged and released during in 2006/07. Two tagged toothfish were recaptured during this season.

5.58   Four Members (Japan, Republic of Korea, New Zealand and South Africa) and a total of eight vessels notified their intention to fish for toothfish in Subarea 48.6 in 2007/08.

Management advice for Subarea 48.6

5.59   Given the concentration of fishing effort within SSRU A, the Working Group recommended that this SSRU be separated into two SSRUs along longitude 1.5°E (Figure 3). This separation would be beneficial for increasing information about catch rates by distributing a greater number of research sets over a larger area. The catch limit could be split between the two new SSRUs.

5.60   The Working Group noted that the catch limit for the *Dissostichus* spp. exploratory fishery in Subarea 48.6 had not been reviewed since 1997 when the catch limit was estimated based on seabed areas and catch rates from the Subarea 48.3 *D. eleginoides* fishery (SC-CAMLR-XVI, paragraphs 9.53 to 9.71).   As it is now understood that there is considerable variation in catch rates across the Convention Area, the Working Group considered that the catch limit in place for this subarea was no longer precautionary.

5.61   The Working Group recommended that all the requirements of the fishery, including fishery-based research (Conservation Measure 41-01), by-catch limits (Conservation Measure 33-03) and associated measures, be carried forward to the 2007/08 season.

Dissostichus spp. Subarea 58.4

Dissostichus spp. Division 58.4.1

5.62   Four Members (Republic of Korea, Namibia, Spain and Uruguay) and four vessels fished in the exploratory fishery in Division 58.4.1 in 2006/07. The precautionary catch limit for toothfish was 600 tonnes and the reported catch was 645 tonnes. The catch limit was slightly over-run in all three SSRUs open to fishing. Information on this fishery is summarised in Appendix E.

5.63   The fishery targeted *D. mawsoni* and operated in SSRUs C, E and G. Information on IUU activities indicated that 612 tonnes of toothfish were taken in 2006/07.

5.64   A total of 1 507 toothfish was tagged and released during the 2006/07 season. Three tagged toothfish were recaptured during this season.

5.65   Eight Members (Australia, Japan, Republic of Korea, Namibia, New Zealand, Spain, Ukraine and Uruguay) and a total of 15 vessels notified their intention to fish for toothfish in Division 58.4.1 in 2007/08.

Dissostichus spp. Division 58.4.2

5.66   Two Members (Republic of Korea and Namibia) and three vessels fished in the exploratory fishery in Division 58.4.2 in 2006/07. The precautionary catch limit for toothfish was 780 tonnes and the reported catch was 124 tonnes. Information on this fishery is summarised in Appendix F.

5.67   The fishery targeted *D. mawsoni* and operated in SSRUs A and E. Information on IUU activities indicated that 197 tonnes of toothfish were taken in 2006/07.

5.68   A total of 248 toothfish was tagged and released during the 2006/07 season. One tagged toothfish was recaptured during this season.

5.69   Eight Members (Australia, Japan, Republic of Korea, Namibia, New Zealand, Spain, Ukraine and Uruguay) and a total of 15 vessels notified their intention to fish for toothfish in Division 58.4.2 in 2007/08.

Dissostichus spp. Division 58.4.3a

5.70   Two Members (Japan and Spain) and two vessels fished in the exploratory fishery in Division 58.4.3a in 2006/07. The precautionary catch limit for toothfish was 250 tonnes and the reported catch was 4 tonnes. Information on this fishery is summarised in Appendix G.

5.71   The fishery operated in SSRU A. There was no evidence of IUU fishing in 2006/07.

5.72   A total of nine toothfish was tagged and released during the 2006/07 season. No tagged toothfish was recaptured during this season.

5.73   One Member (Uruguay) and one vessel notified their intention to fish for toothfish in Division 58.4.3a in 2007/08.

Dissostichus spp. Division 58.4.3b

5.74   Four Members (Japan, Namibia, Spain and Uruguay) and four vessels fished in the exploratory fishery in Division 58.4.3b in 2006/07.   The precautionary catch limit for toothfish was 300 tonnes and the reported catch was 253 tonnes. Information on this fishery is summarised in Appendix H.

5.75   The fishery operated in SSRU A.   Information on IUU activities indicated that 2 293 tonnes of toothfish were taken in 2006/07.

5.76   A total of 289 toothfish was tagged and released in 2006/07. One tagged toothfish was recaptured during this season.

5.77   WG-FSA-07/44 developed further the initial exploration of the C2 fine-scale catch and effort data held by CCAMLR for the fishery in this division presented to WG-SAM in 2007, as well as descriptive analyses of the observer data submitted from vessels in the BANZARE fishery.

5.78   CPUE data for BANZARE Bank show high levels of heterogeneity in catch and effort. These areas have sustained effort and show evidence of depletion within a single season (Figure 4). By-catch levels are also variable; however, the uneven level of data collection on by-catch between vessels makes assessment of status impossible.

5.79   The paper recommended that WG-FSA evaluate management options in Division 58.4.3b, including the lowering of catch limits commensurate with the rapid and unsustainable depletion seen in the fishery, the development of SSRUs to better represent the concentrated nature of the fishery in Division 58.4.3b, commensurate management of areas that are obviously depleted, and the design of a longline survey to attempt to verify some of the trends in catch rates and catch composition seen in the main fishing areas.

5.80   Six Members (Australia, Japan, Republic of Korea, Namibia, Spain and Uruguay) and a total of 11 vessels notified their intention to fish for toothfish in Division 58.4.3b in 2007/08.

Management advice for *Dissostichus* spp. in Subarea 58.4

5.81   In 2006 the Scientific Committee noted several features of exploratory *Dissostichus* spp. fisheries in the southern Indian Ocean (Subarea 58.4) which gave cause for concern as to the status of the resource in this area, and the lack of a scientific basis for setting catch limits (SC-CAMLR-XXV, paragraphs 4.184 to 4.192). In its management advice for this and other exploratory fisheries, the Scientific Committee requested urgent consideration by Members of methods for collecting data and of assessing these stocks.

5.82   The Working Group requested submissions by Members on stock structure, biological parameters (e.g. growth, length–weight relationship, maturity), recruitment and methods for assessment of these stocks.

5.83   The Working Group recommended that the minimum tag rate be at least three fish per tonne for Subarea 58.4 and that the Scientific Committee consider whether a higher rate should be applicable for each of the divisions of Subarea 58.4 which:

(i)   was commensurate with the size of the fishery and the stock abundance in the division;

(ii)   took into account the practical considerations of maintaining a high-quality tagging program.

5.84   The Working Group recommended that a depletion analysis similar to that applied to Division 58.4.3b and presented in WG-FSA-07/44 be completed for Divisions 58.4.1 and 58.4.2.

5.85   The Working Group recommended that Division 58.4.3b be divided into two SSRUs with the line of division running along latitude 60°S. This division would separate the main fishing grounds and could be used to better manage those grounds (Figure 5).

5.86   The Working Group recommended that the precautionary catch limit for *Dissostichus* spp. in Division 58.4.3b, which was 300 tonnes, should be reviewed given the rapid and unsustainable depletion seen in the fishery.

5.87   The Working Group further recommended that the new southern SSRU from the recommended division of Division 58.4.3b be closed to fishing for the 2007/08 season, given the rapid and unsustainable depletion seen in the fishery.

5.88   Dr Naganobu expressed the view that the priority is to decrease the level of IUU occurring in Division 58.4.3b before considering a closure of part or all of the division, as this is the reason why the stock has sustained such a high level of depletion.

Dissostichus spp. Subareas 88.1 and 88.2

5.89   In 2006/07, eight Members (Argentina, Republic of Korea, New Zealand, Norway, Russia, South Africa, UK and Uruguay) and 15 vessels fished in the exploratory fishery in Subarea 88.1. The fishery was closed on 2 February 2007 and the total reported catch of *Dissostichus* spp. (excluding research fishing) was 3 093 tonnes (101% of the limit) (CCAMLR-XXVI/BG/17, Table 3). The following SSRUs were closed during the course of fishing:

• SSRUs B, C and G closed on 28 December 2006, triggered by the catch of *Dissostichus* spp. (total catch 584 tonnes; 164% of the catch limit);

• SSRUs H, I and K closed on 2 February 2007, triggered by the catch of *Dissostichus* spp. (total catch 2 080 tonnes; 104% of the catch limit).

The IUU catch for the 2006/07 season was estimated to be zero tonnes. Information on this fishery and management advice is summarised below (paragraphs 5.101 to 5.106).

5.90   Nine Members (Argentina, Republic of Korea, Namibia, 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 2007/08.

5.91   Five Members (Argentina, Norway, Russia, UK and Uruguay) and seven vessels fished in the exploratory fishery in Subarea 88.2. The fishery closed on 31 August 2007 and the total reported catch of *Dissostichus* spp. was 347 tonnes (63% of the limit) (CCAMLR-XXVI/BG/17). SSRU E was closed on 4 March 2007, triggered by the catch of *Dissostichus* spp. (total catch 325 tonnes; 95% of the catch limit). Information on this fishery and management advice is summarised below (paragraphs 5.101 to 5.106).

5.92   Seven Members (Argentina, New Zealand, Norway, Russia, Spain, UK and Uruguay) and a total of 15 vessels notified their intention to fish for *Dissostichus* spp. in Subarea 88.2 in 2007/08.

5.93   The Fishery Report for *Dissostichus* spp. in Subareas 88.1 and 88.2 is contained in Appendix I.

5.94   In 2005 the Working Group recommended that Subareas 88.1 and 88.2 be split into two areas for stock assessment purposes: (i) the Ross Sea (Subarea 88.1 and SSRUs 882A–B), and (ii) SSRU 882E.

5.95   The catch limits for Subarea 88.1 and 88.2 SSRUs in the Ross Sea were changed as part of a three-year experiment (SC-CAMLR-XXIV, paragraphs 4.163 to 4.166). To assist administration of the SSRUs, the catch limits for SSRUs 881B, C and G were amalgamated into a 'north' region and those for SSRUs 881H, I and K were amalgamated into a 'slope' region. Within Subarea 88.2, SSRU 882E was treated as a separate SSRU with its own catch limit, whilst SSRUs 882C, D, F and G were amalgamated with a single catch limit.

5.96   In all seasons, there was a broad mode of adult fish at about 120–170 cm. In 2005/06, there was a strong mode at about 60 cm in Subarea 88.2. These fish were predominantly caught at the edge of the continental shelf in SSRUs 882F and G. This mode was not apparent in 2006/07, as there was no fishing on the shelf in these SSRUs in 2006/07.

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

5.98   In 2006/07, all vessels in Subarea 88.1 achieved a tagging rate of one toothfish per tonne of toothfish landed. In Subarea 88.2, four of the seven vessels failed to achieve the required tagging rate: the *Antartic II* (Argentina), *Frøyanes* (Norway), *Argos Georgia* (UK) and *Argos Helena* (UK).

5.99   Since 2000/01, more than 15 000 *Dissostichus* spp. have been tagged in Subareas 88.1 and 88.2 (WG-FSA-07/40), and about 500 tagged fish were recaptured. Since 2000/01, a total of 6 989 *D. mawsoni* have been tagged by New Zealand vessels in the Ross Sea (Subarea 88.1 and SSRUs 882A–B) and 179 of these were recaptured by New Zealand vessels. The New Zealand vessel data were used as inputs for the base-case model (WG-FSA-07/37).

5.100 The CASAL model, using catch-at-age and tag–recapture data and *D. mawsoni* biological parameters, was used to estimate the current and initial population size, and to calculate the long-term annual yield that would satisfy the CCAMLR decision rules.

Management advice for *Dissostichus* spp.
in Subareas 88.1 and 88.2

5.101 The constant catch for which there was median escapement of 50% of the median pre-exploitation spawning biomass level at the end of the 35-year projection period for the Ross Sea (Subarea 88.1 and SSRUs 882A–B) was 2 700 tonnes. At this yield, there is a less than 10% chance of spawning biomass dropping to less than 20% of the initial biomass. A yield of 2 700 tonnes is therefore recommended.

5.102 For SSRU 882E, the Working Group did not have any new information on which to base new advice. The Working Group recommended that the catch limit for 2006/07 be carried forward for 2007/08. A yield of 353 tonnes is therefore recommended for 2007/08.

5.103 For SSRUs 882C, D, F and G, the Working Group could provide no new advice, but noted that the catches in these areas had provided some useful biological data for toothfish. Therefore, the Working Group recommended the current catch limits in these SSRUs be continued for the 2007/08 season.

5.104 The Working Group recommended that the allocation method used to set the 2005/06 catch limits for SSRUs in Subarea 88.1 be continued for the 2007/08 season.

5.105 The Working Group recalled its advice that the current designations of SSRUs in Subareas 88.1 and 88.2 are almost certainly not optimal, but a detailed revision of these would require, at least, a consolidated movement model for fish in these subareas, which is not yet available. Such a revision should take account not only of the principal target species, but also of by-catch species and ecosystem considerations.

5.106 The Working Group noted that there was considerable uncertainty about the implementation of the tagging program by the fleet fishing in Subareas 88.1 and 88.2 (paragraphs 3.35 and 3.36). The Working Group also noted that there may be a number of reasons for the differences between observed recapture rates of tags released by vessels from different nations. The Working Group requested that the Scientific Committee and the Commission look at the reasons for these differences, and provide advice to the Working Group on how to resolve the observed differences between rates that tags were recaptured from those released by vessels from different nations.

Dissostichus eleginoides South Georgia (Subarea 48.3)

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

5.108 In 2005, Subarea 48.3 was subdivided into areas, one containing the South Georgia–Shag Rocks (SGSR) stock and other areas, to the north and west, that do not include the

SGSR stock. Within the SGSR area, three management areas (A, B and C) were defined (Conservation Measure 41-02, Annex A). Catch limits for the areas to the north and west were set at zero for 2006/07.

5.109 The catch limits for *D. eleginoides* in the 2006/07 season for areas A, B and C were 0 (excepting 10 tonnes for research fishing), 1 066 and 2 488 tonnes respectively, with an overall catch for SGSR of 3 535 tonnes. The total declared catch was 3 535 tonnes. There was no recorded IUU catch for the 2006/07 season. Catches in areas A, B and C were 7, 976 and 2 552 tonnes respectively.

5.110 The standardised GLMM CPUE analyses were updated. The CPUE data display high levels of variability up to 1995, and lower variability from 1996 to the present, the apparent discontinuity arising during a period of major and rapid change in the structure of the fleet and management of the fishery. Major changes occurring between 1993 and 1996 include changes in the spatial distribution of fishing, a change in the nationalities fishing, the introduction of 100% observer coverage and a shift to night setting and a winter fishery.

5.111 During 2006/07, a further 4 653 tagged *Dissostichus* spp. have been released in SGSR, bringing the total number of tagged fish released to around 17 800. In 2007, 530 recaptures of tagged fish were reported.

5.112 The Working Group agreed on a single CASAL assessment model, which was structurally similar to that presented at WG-FSA-06. A simple update of that assessment (which included both low $M = 0.13$ and low $L_\infty = 152.8$ cm) resulted in a reduced estimate of B_0, principally due to the influence of the 2006 tag returns. Table 6 in Appendix J outlines the data and parameters used in the assessment model, as well as the structure of the model.

5.113 Likelihood profiles were presented for the base-case in Appendix J, Figures 15 and 16). Recent CPUE, the length-frequency data, and the tag data are consistent in their information on a level of B_0 (around 100 000 tonnes). It is clear that the tag data are the primary data source with respect to information on likely upper limits of B_0 (and, consequently, absolute levels of abundance) and give a consistent estimate of current, and, hence, historic abundance. It is also clear from the likelihood profiles that, as the number of releases and recaptures increases, so does the amount of information held in the tagging data on absolute levels of abundance. A new proposed assessment model was presented in WG-FSA-07/29, utilising catch-at-age data, new tagging parameters and estimating year-class strength. The Working Group recommended that the new model be reviewed at the next WG-SAM meeting.

5.114 Stock status and the long-term yield were calculated using the MCMC samples for the updated assessment model, as was done last year, with the appropriate long-term yield being 3 920 tonnes. The critical decision rule was the requirement that spawning biomass at the end of a 35-year projection period should be 50% of the initial spawning biomass.

5.115 As outlined in the Fishery Report (Appendix J), there were still some trends in the fits to the mark–recapture data which may be due to complex interactions between the various assumptions about natural mortality-at-age, tagging parameters, growth and selectivity. Investigation of the driving factors behind these trends should be undertaken intersessionally. It was acknowledged that the results of this investigation may have implications for all current assessments.

Management advice

5.116 The Working Group recommended that the catch limit for toothfish in Subarea 48.3 (SGSR stock) should be 3 920 tonnes for the 2007/08 fishing season.

5.117 The Working Group noted that the current model had produced a yield of 3 920 tonnes when updated with catch, length-frequency, CPUE and tagging data from 2007. It noted that some uncertainties with the assessment remain, such as the fits to the tag data. A significant revision of the model is under development, which will allow direct estimation of present and future recruiting cohort strength, which is not possible with the current model. The catch limit for 2008/09, if estimated with this new model, may be different from 3 920 tonnes.

5.118 The catch limits for management areas A, B and C should be adjusted in a pro-rata manner to 0 (excepting 10 tonnes for research fishing), 1 176 and 2 744 tonnes respectively. By-catch limits for skates/rays and macrourids should be similarly revised to 196 and 196 tonnes respectively.

Dissostichus eleginoides Kerguelen Islands (Division 58.5.1)

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

5.120 The catch of *D. eleginoides* reported for this division to 31 August 2007 was 3 438 tonnes. Only longlining is currently permitted in the fishery. The estimated IUU catch for the 2006/07 season was zero inside the French EEZ. Some IUU fishing may occur outside the EEZ as reported in WG-FSA-07/10 Rev. 5.

5.121 Analyses show a general decreasing trend in the standardised CPUE up until 2003 followed by a period up to the current year for which the CPUE estimates are relatively constant.

5.122 The survey being conducted on the FV *Austral* at Kerguelen from September to October 2006 completed 207 trawls and 639 toothfish have been tagged. The Working Group encouraged further tagging.

5.123 By-catch removals are important for this fishery, and the majority of the catch is processed, but no stock assessment is available for evaluation of the impact on affected populations. Skates started to be cut off in December 2006.

Management advice

5.124 The Working Group encouraged the estimation of biological parameters for Kerguelen. The Working Group encouraged the development of a stock assessment for this area, and 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 stock 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.

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

5.126 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.

5.127 The Working Group noted that France had made significant progress in mitigating by-catch, including area/season closures (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)

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

5.129 The catch limit of *D. eleginoides* in Division 58.5.2 west of 79°20'E for the 2006/07 season was 2 427 tonnes (Conservation Measure 41-08) for the period from 1 December 2006 to 30 November 2007. The catch of *D. eleginoides* reported for this division as of 5 October 2007 was 1 956 tonnes. Of this, 1 338 tonnes (68%) was taken by trawl and the remainder by longline. The estimated IUU catch for the 2006/07 season, 0 tonnes, was the lowest since IUU fishing began in 1995/96.

5.130 The von Bertalanffy growth parameters from the 2005 assessment were replaced in the 2006 assessment and for this year by a mean length-at-age vector based on the von Bertalanffy growth curve with an early age adjustment for fish less than five years. Natural mortality was assumed to be 0.13 $year^{-1}$ as for the other toothfish assessments.

5.131 Additional length-at-age samples for fish of age >20 years can be obtained from the longline fishery. The complete holdings of otoliths that have been collected from research surveys, commercial trawl and longline fisheries were summarised for the Working Group (WG-FSA-07/45) and this indicates the large potential for further ageing work to provide improvements to the assessment. The Working Group encouraged such work for both improving the growth model and providing catch-at-age data to future assessments.

5.132 The Working Group endorsed the refinements to the assessment based on the CASAL model introduced at WG-FSA-06 with similar CASAL models used for Subareas 48.3 and 88.1 and SSRU 882E. This assessment has a number of differences to those assessments including:

• the use of survey data as observations of young fish;

• tagging data are unable to be used in the assessment because of the underestimation of biomass that would arise from the current localised concentration of tag releases and recaptures;

- recruitment is modelled without assuming a stock–recruitment relationship, and variability in recruitment is estimated from the vector of year-class strengths estimated in the model.

5.133 The Working Group also noted that the assessment of yield can be sensitive to the number of age classes in the population and agreed as in WG-FSA-06 that the assessment be based on a population with the plus class at 35 years rather than 50 years because of the absence of evidence that the fish grow appreciably after 35 years.

5.134 The CASAL assessment used abundance-at-length estimated from the surveys, catch-at-length from the fisheries and standardised CPUE time series to estimate current and initial population size and year-class strengths since 1981. These results were then used in projections to estimate the long-term annual yield that satisfies the CCAMLR decision rules for toothfish.

5.135 A revision of the WG-FSA-06 CASAL assessment was presented in WG-FSA-07/53 Rev. 1 which involved refinements to the WG-FSA-06 assessment including: (i) updates to the data from the 2007 season and incorporating 2006 data unavailable for the previous assessment; (ii) modifications to the CASAL model specification; (iii) modification to the method of data weighting used for parameter estimation; and (iv) modification to the method of incorporating recruitment variability in forward projections using a two-year running mean to smooth the annual estimates of number of age-1 recruits. During the meeting, the stability of the parameter estimation was confirmed by starting the estimation from a range of initial parameter values.

5.136 Long-term annual yield was estimated to be 2 500 tonnes giving 50.5% escapement with a probability of depletion of 0.08.

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 2007/08 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 31 August 2007 was 333 tonnes. Only longlining is currently permitted in the fishery. The estimated IUU catch for the 2006/07 season was zero inside Subarea 58.6 as reported in WG-FSA-07/10 Rev. 5.

5.140 Depredation on toothfish catches by killer whales has become a major problem for this longline fishery.

5.141 Analyses show a general decreasing trend in standardised CPUE to 2002/03 with a subsequent slight increase in 2003/04 and 2005/06 and a decrease for the 2006/07 season.

5.142 During the season, 677 toothfish were tagged by observers on board commercial vessels. The Working Group encouraged France to continue with its tagging program.

5.143 By-catch removals are important for the fishery, but only a small part of the catch is processed, and no stock assessment is available for evaluation of the impact on affected populations. Skates started to be cut off in December 2006.

Management advice

5.144 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.

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

5.146 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.

5.147 The Working Group noted that France had made significant progress in mitigating by-catch, including area/season closures (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)

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

5.149 The catch limit of *D. eleginoides* in the South African EEZ for the 2006/07 season was 450 tonnes for the period from 1 December 2006 to 30 November 2007. The catch reported for Subareas 58.6 and 58.7 as of 5 October 2007 was 125 tonnes, all of which was taken by longlines. The IUU catch for the 2006/07 season was assumed to be equal to the IUU catch in 2004/05 at 156 tonnes.

5.150 Cetacean depredation of longline catches is reported to be significant, implying that total removals are greater than just the estimated fishery catches. It was noted that the pot fishery, which avoided depredation, operated only in 2004 and 2005.

5.151 The CPUE series was updated for the meeting and, as in previous years, the biological parameters from Subarea 48.3 were used.

5.152 An augmented two-fleet ASPM that used catches, standardised CPUE, and catch-at-length data was used to estimate a long-term annual yield. The results from the model were

only slightly sensitive to whether or not cetacean depredation was included in the calculations and whether or not year-specific weights were used with the CPUE indices. The model estimated the spawning biomass of the resource to be between 37 and 40% of its average pre-exploitation level, although significant uncertainties remain in the assessment.

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

5.153 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

5.154 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)

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

5.156 In the 2006/07 fishing season the catch limit set for *C. gunnari* in Subarea 48.3 was 4 337 tonnes. During the 2006/07 season the fishery caught 3 940 tonnes by the end of October 2007. The fishery remains open until 14 November 2007 and it is anticipated that the full catch will be taken.

5.157 In September 2007 the UK undertook a random stratified bottom trawl survey of the South Georgia and Shag Rocks shelves (WG-FSA-07/56). The survey did not achieve as many trawl stations as previous surveys, and hauls were separated into eight strata (rather than the 12 used in 2006) to generate a standing stock estimate. Whilst the estimated mean value of the standing stock decreased by 8% from 105 000 tonnes in January 2006 to 98 000 tonnes in September 2007, the lower one-sided CI decreased by 35% from 37 500 to 23 400 tonnes.

5.158 The catch-weighted length frequencies obtained from the trawl survey (WG-FSA-07/56) indicated that the population was dominated by a strong cohort of 3+ fish, with a 2+ cohort present that may not have been fully sampled by the survey.

5.159 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 2007 survey.

5.160 Most input parameters for the assessment remained unchanged from 2006 except for selectivity, which reverted to the pre-2006 form (see SC-CAMLR-XXV, Annex 5, paragraph 5.130 for explanation of change in 2006).

Management advice

5.161 The Working Group recommended that the catch limit for *C. gunnari* should be set at 2 462 tonnes in 2007/08 and 1 569 tonnes in 2008/09 based on the outcome of the short-term assessment.

5.162 The Working Group recognised that the spawning of *C. gunnari* has little spatial overlap with the fishery and that the requirement of vessels fishing between 1 March and 31 May to undertake 20 research trawls is likely to increase the risk of seabird mortality. The Working Group recommended that the existing Conservation Measure 42-01 be amended to:

(i) remove the requirement that vessels fishing between 1 March and 31 May be required to undertake 20 research trawls (as detailed in Conservation Measure 42-01, Annex A);

(ii) that the catch during 1 March to 31 May not be limited to 25% of the catch limit.

5.163 The Working Group recommended that the impact of changes in Conservation Measure 42-01 should be reviewed at WG-FSA-08, particularly with respect to the maturity of fish caught throughout the year and the timing of fishing effort (particularly during the March–May period).

Champsocephalus gunnari Heard Island (Division 58.5.2)

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

5.165 The catch limit of *C. gunnari* in Division 58.5.2 for the 2006/07 season was 42 tonnes for the period from 1 December 2006 to 30 November 2007. The catch reported for this division as of 5 October 2007 was 1 tonne.

5.166 Due to a lack of significant targeting of *C. gunnari* in 2006/07, no catch-weighted length frequency was available. A large 1+ 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–July 2007.

5.167 The short-term assessment was implemented in the GYM, using the one-sided bootstrap lower 95% confidence bound of total biomass from the 2007 survey, and equalled 220 tonnes. All other parameters were the same as in previous years.

Management advice

5.168   The Working Group recommended that the catch limit for *C. gunnari* in 2007/08 be no more than 220 tonnes.

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

5.170   The Working Group recommended that further work on developing a management procedure for *C. gunnari* is a high priority (SC-CAMLR-XXIV, Annex 5, Appendix M, paragraph 26).

Assessment and management advice for other fisheries

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

5.171   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.

5.172   Germany conducted a bottom trawl survey in the Elephant Island–South Shetland Islands (part of Subarea 48.1) from 19 December 2006 to 3 January 2007 (WG-FSA-07/22, see also paragraphs 3.25 to 3.27). The Working Group concluded that biomass of most finfish stocks was found to be lower than during the last surveys in 2002 and 2003. They are currently not at a level which would allow reopening of the fishery.

Management advice

5.173   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)

5.174   The Working Group developed a Fishery Report for *D. eleginoides* in Subarea 48.4 (Appendix Q). A mark–recapture experiment in Subarea 48.4 started in 2004/05 and this is the third year of the experiment. Two vessels from the UK and New Zealand fished in the area in 2006/07 and continued the tagging program. A total of 467 *D. eleginoides* and 11 *D. mawsoni* (total 478 fish) have been tagged and released, and two *D. eleginoides* have been recaptured in the subarea. In addition, one fished tagged in Subarea 48.4 was recaptured

in Subarea 48.3. It is expected that the mark–recapture experiment will continue in Subarea 48.4 over the 2007/08 fishing season in order to assist in the assessment of the toothfish population structure and size in accordance with Conservation Measure 41-03.

Management advice

5.175 The Working Group noted that Conservation Measure 41-03 is in force until the end of the 2007/08 season. Further, it noted that the results from the tagging experiment would be reported at the 2008 meeting, and this would provide an opportunity for WG-FSA to review the results, and develop the assessment and management of this fishery, including fishery-based research requirements. Given the current low rates of tagging, an extension of the current experiment for one or two further years may be required.

5.176 Future development of this fishery may include a similar tagging experiment for *D. mawsoni* in the southern region of Subarea 48.4, and the introduction of catch limits for by-catch species.

Stone crabs (*Paralomis* spp.) (Subarea 48.3)

5.177 Stone crabs were not exploited in the 2006/07 season. No proposal for the harvest of crabs has been received by CCAMLR for the 2007/08 season.

Management advice

5.178 Stone crabs are subject to Conservation Measure 52-01 and 52-02 regulating the fishery and experimental harvest of crabs. The Working Group recommended that these conservation measures remain in force.

Squid (*Martialia hyadesi*) (Subarea 48.3)

5.179 The exploratory fishery on *M. hyadesi* was subject to Conservation Measure 61-01. No new information on the species was available. No new request has been submitted to CCAMLR to continue exploratory fishing on this species in 2007/08.

Management advice

5.180 The Working Group recommended that the existing Conservation Measure 61-01 remain in force.

FISH AND INVERTEBRATE BY-CATCH

6.1   The long-term status of by-catch taxa has been identified as an issue for urgent attention by the Scientific Committee (SC-CAMLR-XXI, Annex 5, paragraphs 5.151 to 5.153). The key issues that need to be addressed are:

- assessment of the status of by-catch taxa (particularly rajids and macrourids)
- assessment of the expected impact of fisheries on by-catch species
- consideration of mitigation measures.

6.2   The Working Group identified the following areas of particular interest for the 2007 meeting:

(i)   review of by-catch in longline and finfish trawl fisheries to include:
        (a)   comparison between vessel-reported and observer-recorded data
        (b)   differences in by-catch between autoline and Spanish longline systems
        (c)   the fate of skates caught in longline fisheries;

(ii)   development of assessments of by-catch species;

(iii)   developing protocols for reporting benthic by-catch;

(iv)   proposals for the Year of the Skate in 2008/09;

(v)   mitigation trials to reduce macrourid by-catch;

(vi)   review the move-on rule for macrourid by-catch in new and exploratory fisheries (Conservation Measure 33-03).

6.3   The Working Group agreed that consideration of by-catch issues in the krill fishery for 2006/07 would not be considered under this agenda item but would be dealt with under section 10 'Considerations of ecosystem management'.

Estimation of by-catch in longline fisheries

6.4   Fine-scale (C2) data estimates of total removals of by-catch species reported from longline fisheries within the CAMLR Convention Area are shown in Tables 14 and 15. Observer by-catch data for longline fisheries for the 2006/07 season are summarised in WG-FSA-07/6 Rev. 1. By-catch limits were not reached for any species.

Rajids

6.5   Reported retained rajid by-catch (as a percentage of *Dissostichus* spp. catch) in longline fisheries within the Convention Area in 2006/07 was low (<4% *Dissostichus* spp. catch) except in those areas where almost all rajids are retained and processed (French EEZs: Division 58.5.1 and Subarea 58.6) as highlighted in SC-CAMLR-XXIV, Annex 5, Appendix N, paragraph 22.

6.6   The numbers and fate of *Dissostichus* spp., macrourids, rajids and 'Other species' reported in 2006/07 in fine-scale data are detailed in Table 15. With the exception of the French EEZs, a large proportion of skates were cut off lines in most regions.

6.7   Total catch of rajids in tonnes (Table 16) was estimated by summing the numbers caught and released in the C2 data and multiplying by the mean weight of skates caught in each subarea derived from corresponding C2 data (except for Division 58.5.1 and Subarea 58.6 for which these data were not available). Estimates of total catches in Subarea 48.3 and Division 58.4.3b were around 50% of the catch limit and 81% of the catch limit in Subarea 88.1. The Working Group noted that many skates survive being cut off, and that longline catches do not represent total removals, however, the fate of cut-off skates remains uncertain and further survival experiments are essential to derive estimates of total removals of skates.

6.8   Comparative estimates of total catches (by number and weight) were also derived from the observer data reported during tally periods on L5 forms and are given in Table 17. Extrapolated estimates were calculated by raising numbers recorded in tally periods using the percentage of hooks observed by set and then multiplying by area-specific average weights (derived from biological data on L6 forms) to give tonnes.

6.9   Estimates of rajid by-catch from extrapolated observer data (Table 17) are similar to those based on C2 data (Table 16) for most areas. Exceptions include estimates from Subareas 48.4, 58.6 and 88.1 which were between two- and 60-times lower and from Division 58.4.3b which was approximately four-times higher. Lower observer estimates may be a result of difficulties in observing cut-offs and the higher estimate in Division 58.4.3b might result from vessels under-reporting cut-offs in this area.

6.10   Observer data from the L11 forms was extracted to investigate the fate and condition of skates caught on longlines in 2006/07 (Table 18). The Working Group noted the practical limitations in reporting of rays (see WG-FSA-07/39) and inconsistencies in reporting amongst observers. For example, not all rays reported under each discard fate have a corresponding release condition recorded, and in some cases an incorrect release condition code is recorded which does not correspond logically to the discard fate given to the same animal.

6.11   Comparison of numbers of skates recorded on L5 and L11 forms also indicates that observers may, in some cases, be double-recording skates. The Working Group recommended that the observer instructions be amended to indicate that individual skates are recorded on either the L5 or the L11 form, but not on both.

        Macrourids

6.12   By-catch rates for macrourids (as a percentage of *Dissostichus* spp. catch) for the 2006/07 fishing season ranged from 3.9 to 27.1% (Table 14). By-catch limits were not reached in any subarea.

6.13   In comparison with the 2005/06 season, the by-catch of macrourids was similar in Subarea 48.3, reduced in Subareas 88.1 and 88.2, but increased in Divisions 58.5.2 (from

26 to 61 tonnes) and 58.5.1 (French EEZ; 339 to 476 tonnes) (Tables 14 and 15). A small number of macrourids were reported as 'released' in Division 58.4.1 and Subarea 88.1 (Table 15), but are highly unlikely to survive.

6.14   The differences in the by-catch of macrourids between Spanish and autoline systems in Subareas 48.3, 48.6 and 88.1 and Division 58.5.2 are detailed in Table 19. Catches of macrourids were generally higher with the autoline system, but relative catches of macrourids by autoliners have declined substantially in the last two seasons in Subarea 88.1. The Working Group welcomed the decline (relative and absolute) in macrourid catch in Subarea 88.1 and considered that this may be a consequence of the move-on rule (Conservation Measure 33-03) encouraging vessels to fish in areas of lower macrourid abundance and the modification to Conservation Measure 41-01 that removed the requirement to space research lines 5 n miles apart, thus allowing vessels to avoid areas of high macrourid biomass.

6.15   In the 2006/07 data there is some variation between observer-extrapolated catch estimates (Table 17) and the C2 catch data for macrourids (Tables 14 and 15). Observer estimates were higher in Subareas 48.3, 48.6, 58.7, 88.1 and 88.2 and Divisions 58.4.3a and 58.4.3b than the fine-scale data, while in Divisions 58.4.1, 58.4.2 and 58.5.2 and Subarea 58.6 observer-extrapolated estimates were lower than the fine-scale data. In Subareas 48.3 and 88.1, where macrourid catches were highest, the observer estimates were higher than the C2 data, but were still below the catch limits. Differences between the two estimates could be due to a number of different factors. Average weight of macrourids and catch rates will vary both within and between sets, and scaling observer data up from tally period observations assumes catch rates and fish weights are constant for the entire set.

6.16   The Working Group noted the lack of a field for reporting 'lost' fish in the L5 form during tally periods. Instructions direct observers to record 'all fish that are discarded, including tagged and released fish and those cut off or flicked off, are recorded in the discard section'. However, it also states that 'fish lost at the surface should not be counted as a discard', so there is no scope for recording numbers of fish lost for species other than skates which can be reported on the L11 forms. Dr Leslie reported that macrourids have been known to be lost from lines at the surface.

6.17   The Working Group recommended that the longline and pot tally forms be amended to reflect catch definitions in the C2 form.

        Other species

6.18   By-catch of other species were generally low (<4% of *Dissostichus* spp. catch), the exception being Division 58.4.3a, where 1 tonne (20.9%) of 'Other species' was caught, with 4 tonnes of toothfish.

6.19   Observer data (WG-FSA-07/6 Rev. 1) provided information on the species composition of the 'Other species' listed in the fine-scale by-catch data (Tables 14 and 15). In the Division 58.4.3a longline fishery, where 'Other species' accounted for 20.9 % (by weight) of the catch in the fine-scale data, the observer data shows that 32 % of the catch (by number) was *Antimora rostrata*. The observer data also suggested that *A. rostrata* was the

principal by-catch species attributed to 'Other species' in the Subareas 88.1, 88.2 and 48.3 toothfish longline fisheries. Table 18 provides catch estimates of *A. rostrata* derived from observer data recorded in the L5 forms.

Estimation of by-catch in trawl fisheries

6.20 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 (C1) data are detailed in Table 20. Observer by-catch data from trawl fisheries in 2006/07 were summarised in WG-FSA-07/7 Rev. 1.

6.21 The by-catch in the trawl fishery for *C. gunnari* in Subarea 48.3 was negligible and less than 2005/06 despite a doubling in the catch of the target species. The decline in by-catch was probably due to higher catch rates of *C. gunnari* with fewer hauls undertaken to attain the quota.

6.22 In the Division 58.5.2 *C. gunnari* fishery, the by-catch of *C. rhinoceratus* was three-times greater than the catch of the target species, and only took 1 tonne of the target species.

6.23 The principal by-catch species in the Division 58.5.2 toothfish trawl fishery were *C. rhinoceratus*, *L. squamifrons*, rajids and macrourids. Catches were below catch limits, but it should be noted that catch limits are for the trawl and longline fisheries combined. Note that the data in Table 11 of WG-FSA-06 (SC-CAMLR-XXV, Annex 5) are incorrect for Division 58.5.2.

6.24 The Working Group noted the difficulties that observers had in estimating the percentage of the catch observed during the period in the trawl fishery. The Working Group therefore recommended a change to the trawl tally period form (T3) to record the weight of sub-samples and to record counts of each species retained or discarded.

Assessments

6.25 No new assessments for by-catch species were presented to the Working Group. The Working Group recommended that by-catch limits should remain unchanged for the 2007/08 season.

6.26 The priority by-catch taxa for which assessments of status are required are macrourids and rajids (SC-CAMLR-XXI, Annex 5, paragraph 5.154).

6.27 Two papers presented preliminary assessment models for rajids in the Convention Area, but both identified that insufficient data was available to develop a full assessment. In WG-SAM-07/4 the catch histories, growth parameters and commercial catch-at-length frequencies for Antarctic skates and rays are updated and the paper reports on the development of an assessment model for Antarctic skates and rays.

6.28 WG-SAM-07/11 presented a preliminary assessment of rajid populations in Subarea 48.3 using a surplus production model implemented in a Bayesian framework. This model was used because insufficient tagging data were available to carry out alternative

approaches such as an integrated assessment. Model estimates of abundance and exploitation rates were both uncertain and strongly dependent on prior estimates of the intrinsic rate of increase. The model should therefore be considered a risk assessment, but its integrated design has the potential to incorporate future tagging data.

6.29 The Working Group reiterated the urgent need for assessments of macrourids and rajids in assessed and new and exploratory fisheries in the Convention Area. Dr Hanchet informed the Working Group of a New Zealand survey to the Ross Sea in 2008 that is intended to assess macrourid abundance.

6.30 The Working Group noted that by-catch limits do not imply that a sustainable fishery is possible for these species. By-catch limits are, in most cases, based on a percentage of the *Dissostichus* spp. catch, rather than any knowledge of sustainable levels of exploitation. All fisheries should aspire to keep by-catch rates to a minimum.

Benthic by-catch

6.31 The Working Group recognised the urgent need to quantify benthic by-catch in bottom trawl and longline fisheries, particularly with respect to slow-growing and habitat-forming species such as corals (Agenda Item 14.1).

6.32 The Working Group noted that identification of benthic by-catch to species, genus or even family level is difficult. The Working Group recommended that suitable area-specific benthic identification guides be developed for use by observers. The Working Group recommended that, during the biological sampling period, observers be tasked to identify (to phyla) and weigh benthic by-catch.

6.33 The Working Group noted that the identification and quantification of benthic by-catch does not take account of the interaction of the fishing gear with benthos. Some gears do not catch or retain benthic by-catch, but are likely to impact on the benthos, and this needs to be assessed by other methods.

Proposed 'Year of the Skate'

6.34 The Working Group recommended the proposal to make 2008/09 the CCAMLR Year of the Skate as proposed in WG-FSA-07/39, recognising that enhanced data collection and tagging are essential to develop assessments.

6.35 The Working Group recommended that the Year of the Skate should incorporate all *Dissostichus* spp. fisheries in the Convention Area, with a tagging program focusing on new and exploratory fisheries. Assessed fisheries already have tagging programs in place (see paragraph 3.50).

6.36   In preparation for the Year of the Skate, the Working Group identified the following priorities:

(i)   formation of a subgroup to communicate intersessionally and coordinate planning;

(ii)   development of detailed, region-specific, identification guides for skates based on characters that can easily be determined on vessels by observers;

(iii)   modification of the L11 form (for 2008/09) to capture detailed information about the fate of skates (see below);

(iv)   the skate tagging program in new and exploratory fisheries be revised (see WG-FSA-07/39) and tested in 2007/08 prior to being adopted by all vessels in 2008/09;

(v)   that the Secretariat be asked to coordinate the skate tagging program in new and exploratory fisheries, and be the repository of skate tagging kits for the new and exploratory fisheries.

6.37   The Working Group recommended modifications to the L11 form for the 2008/09 season to provide more detailed information on the fate of captured skates including the following:

(i)   was the skate retained, lost, released with tag, released without tag, or unknown?

(ii)   for released skates, was it released at the surface or out of the water?

(iii)   was the hook still in or had it been removed?

(iv)   what was the health and fate of the fish when released[1]: excellent health, average, poor, dead, uncertain, or predated on release?

(v)   record pelvic length in preference to total length and include a schematic diagram on the form to illustrate measurement of pelvic length;

(vi)   include an estimated weight category with three options: small (<5 kg), medium (5–10 kg) and large (>10 kg);

(vii)   allow the collection of sex and male maturity data;

(viii) species drop-down menu be limited to skate species only.

6.38   The Working Group considered the proposal to bring all captured skates on board prior to release to increase the probability of tag detection (WG-FSA-07/39). The Working Group agreed that bringing skates on board[2] would increase tag detection, assist in identification, permit the condition of skates to be better determined and allow length measurements to be taken. However, the Working Group recognised that it may not be

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[1]   Definitions of excellent, good and poor health need to be developed.
[2]   Or brought to the vessel side to be examined.

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practical to bring skates on board on all vessels. The Working Group recommended that in the 2007/08 season, where possible, skates be brought on board prior to release, with a view to making this mandatory in 2008/09.

6.39   The Working Group recognised that increased observer effort on skate data collection will likely impact on observer work on other by-catch species such as macrourids, but it is envisaged that a 'Year of the Macrourid' may follow in 2009/10 following appropriate preparatory work.

Mitigation of macrourid by-catch

6.40   WG-FSA-07/33 presented the results of experimental trials carried out in Subareas 48.3, 88.1 and 88.2, testing different hook and bait types as mitigation measures to reduce the by-catch of macrourids on autoline vessels. Hook types did not influence catch rates of macrourid or target species significantly. Mackerel bait greatly reduced catch rates of both macrourids and toothfish, and was therefore not considered a useful mitigation measure alone. A follow-on proposal (WG-FSA-07/31) from the UK to undertake further trials using different weighting mechanisms in conjunction with different bait types was discussed. The Working Group agreed that although trials testing mitigation measures should be encouraged, they must be reviewed to ensure that the experimental designs are robust and able to assess impacts on all species, including species not targeted by the mitigation measure.

6.41   The Working Group also agreed that where considerable changes in gear configuration were to be tested in trials (e.g. trotline), provision for this to be recorded as a different gear-type by the vessel must be made. Currently there is no way of separating data from gear types other than Spanish and autoline systems in C2 data. The Working Group recommended that the C2 form be modified to allow other gear types to be recorded.

Review of Conservation Measure 33-03

6.42   Conservation Measure 33-03 limits by-catch in new and exploratory fisheries. At the 2006 meeting, the Scientific Committee requested that WG-FSA-07 review the by-catch move-on rule (Conservation Measure 33-03, paragraph 5):

'If the catch of *Macrourus* spp. taken by a single vessel in any two 10-day periods* in a single SSRU exceeds 16% of the catch of *Dissostichus* spp. by that vessel in that SSRU in those periods, the vessel shall cease fishing in that SSRU for the remainder of the season.' (*A 10-day period is defined as day 1 to day 10, day 11 to day 20 or day 21 to the last day of the month.)

6.43   The move-on rule was enforced on seven occasions during the 2005/06 season (in Subareas 88.1 and 88.2) and on nine occasions during 2006/07 (Subareas 48.6, 88.1, 88.2 and Division 58.4.1). The Working Group noted that the last two seasons had seen a reduction in macrourid by-catch in Subarea 88.1 from 462 tonnes in 2004/05 to 153 tonnes in 2006/07, which may be attributed to the conservation measure. The Working Group also noted that other macrourid mitigation measures apply to new and exploratory fisheries, such as Conservation Measure 33-03 (paragraph 4).

6.44   The Working Group noted that it is possible, for operational reasons, that a vessel may fish for a single day during a 10-day period with a high catch of macrourids and this would count as the first 10-day period, making a vessel reluctant to fish in the SSRU again.

6.45   SC-CAMLR-XXVI/8 presented three potential modifications to the move-on rule. In Option 1, the move-on rule is not triggered until 50% of the macrourid catch limit is reached. The Working Group considered that this option may allow vessels to catch macrourids without constraint early in the season and agreed that it is not an appropriate management measure. Options 2 and 3 proposed modifying the conservation measure by requiring vessels to have fished for a threshold number of days in an SSRU during a reporting period. The Working Group welcomed the proposals and considered a fourth option in which a threshold level of macrourid catch is required by each vessel, in each 10-day period in each SSRU to trigger the move-on rule.

6.46   The Working Group examined daily catch rates (mean and maximum) of macrourids in new and exploratory fisheries and noted that the mean daily catch rates of macrourids in 2006/07 were 306 kg day^{-1} in Subarea 88.1 and 121 kg day^{-1} in Subarea 48.6, and considered that a threshold level should be set at approximately five days at the mean daily catch rate in Subarea 88.1. The Working Group therefore agreed that a threshold macrourid catch level of 1 500 kg be added to the conservation measure.

6.47   The Working Group recommended that paragraph 5 of Conservation Measure 33-03 be amended as follows:

> 'If the catch of *Macrourus* spp. taken by a single vessel in any two 10-day periods* in a single SSRU exceeds 1 500 kg in each 10-day period and exceeds 16% of the catch of *Dissostichus* spp. by that vessel in that SSRU in those periods, the vessel shall cease fishing in that SSRU for the remainder of the season.' (*A 10-day period is defined as day 1 to day 10, day 11 to day 20 or day 21 to the last day of the month.)

6.48   The Working Group recommended that the alteration to Conservation Measure 33-03 be reviewed at WG-FSA in 2008, particularly examining the effect of the change on macrourid catches and catch rates.

Management advice

6.49   The Working Group recommended that the observer instructions be amended to indicate that individual skates are recorded on either the L5 or the L11 form, but not on both.

6.50   The Working Group recommended that the observer longline and pot tally forms be amended to reflect catch definitions in the C2 form.

6.51   The Working Group recommended a change to the trawl tally period form (T3) to record the weight of sub-samples and to record counts of each species retained or discarded.

6.52   The Working Group recommended that 2008/09 be the CCAMLR Year of the Skate.

6.53   The Working Group recommended that the Year of the Skate should incorporate all *Dissostichus* spp. fisheries in the Convention Area, with a tagging program focusing on new and exploratory fisheries.

6.54   The Working Group recommended that in the 2007/08 season, where possible, skates be brought on board prior to release, with a view to making this mandatory in 2008/09.

6.55   The Working Group recommended modifications to the L11 form for the 2008/09 season to provide more detailed information on the fate of captured skates.

6.56   The Working Group recommended that the C2 form be modified to allow gear types other than Spanish and autoline systems to be recorded.

6.57   The Working Group recommended that paragraph 5 of Conservation Measure 33-03 be amended as follows:

> 'If the catch of *Macrourus* spp. taken by a single vessel in any two 10-day periods* in a single SSRU exceeds 1 500 kg in each 10-day period and exceeds 16% of the catch of *Dissostichus* spp. by that vessel in that SSRU in those periods, the vessel shall cease fishing in that SSRU for the remainder of the season.' (*A 10-day period is defined as day 1 to day 10, day 11 to day 20 or day 21 to the last day of the month.)

6.58   The Working Group recommended that the alteration to Conservation Measure 33-03 be reviewed at WG-FSA in 2008, particularly examining the effect of the change on macrourid catches and catch rates.

INCIDENTAL MORTALITY OF MAMMALS AND SEABIRDS
ARISING FROM FISHING

7.1   In previous years, WG-FSA has included in its report a detailed summary of the ad hoc WG-IMAF report, and the latter has been added as an appendix to the WG-FSA report. Given the status of WG-IMAF as an autonomous ad hoc working group of the Scientific Committee, and that few IMAF experts are present during the adoption of the WG-FSA report to provide comment on the WG-FSA summary of the WG-IMAF report, WG-FSA recommended the following:

- this year the advice from ad hoc WG-IMAF to the Scientific Committee should be presented as a Scientific Committee document and it should be translated as it has been in past years; in addition, the full report of WG-IMAF should be presented as a stand-alone document for consideration of the Scientific Committee;

- in future years, the entire report of ad hoc WG-IMAF would be treated as a separate working group report and annexed to the report of the Scientific Committee;

- WG-FSA's consideration of Agenda Item 7 will this year, and in future, be restricted to comments arising from consideration of the report of ad hoc WG-IMAF.

7.2   The Working Group noted from the report of ad hoc WG-IMAF that considerable progress has been made in reducing the incidental mortality of Convention Area seabirds and mammals in Convention Area fisheries over the last decade. These reductions have been achieved primarily through modifications of gear and fishing seasons. The detailed discussion of the construction and performance of different gears in the ad hoc WG-IMAF report is of considerable value to WG-FSA.

7.3   WG-FSA and ad hoc WG-IMAF have both recommended that information on the specific type of longline gear that is used on each haul be recorded by vessels on C2 data forms.

7.4   The Working Group recommended a change to the C2 form to record the number of hooks attached to sections of longline which are lost per set. This information would also be of use to ad hoc WG-IMAF.

Management advice

7.5   Noting that there may be unrecorded mortality associated with lost sections of longline, and that this may impact on calculations of stock and by-catch status, WG-FSA recommended that information on the number of hooks that are lost attached to sections of longline during fishing be recorded by vessels on C2 data forms.

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 a trial matrix for estimating the uncertainty associated with IUU fishing events, and noted that this work will be reviewed by SCIC (WG-FSA-07/10 Rev. 5).

8.2   WG-FSA agreed that the method currently used by the Secretariat could be further improved by the addition of a measure of the local density of licensed vessels. Such a measure would reflect the ability of licensed vessels to detect (i.e. sight) IUU fishing. Various measures were discussed, including the number of days in a season when legal vessels are present in an area. Such measures would provide an estimate of the probability of detecting an IUU fishing event, and may indicate areas where such a probability was low.

8.3   The Working Group requested that the Secretariat consider including a measure of the local density of licensed vessels in the tables it prepared on IUU fishing (e.g. Table 1 in WG-FSA-07/10 Rev. 5). Low probabilities of detection of IUU fishing may lead to an underestimation of the catch from IUU fishing reported in Table 3.

Review of historical trends in IUU fishing activity

8.4   The Working Group reviewed the catch history of *Dissostichus* spp. taken by IUU fishing in the Convention Area (Table 3). This time series had been updated using estimates reported in WG-FSA-07/10 Rev. 5.

8.5   IUU fishing activities peaked in the mid-1990s in areas which nowadays are well patrolled. Routine surveillance in the sub-Antarctic Indian Ocean led to a gradual reduction in IUU fishing, from an estimated total of 32 673 tonnes of *Dissostichus* spp. taken by IUU fishing in 1996/97, to 2 178 tonnes in 2003/04.

8.6   Since 2003/04, the available information indicates that IUU fishing activities have moved to the high-latitude regions of the Indian Ocean (Subarea 58.4), and have increased in intensity. For the last two years this has included a significant amount of IUU catch from gillnet vessels. The estimated total catch of *Dissostichus* spp. taken by IUU fishing in 2006/07 was 3 615 tonnes, most of which was taken in Division 58.4.3b (2 293 tonnes).

8.7   The Working Group expressed concern at this shift and increase in IUU fishing. The extent of fishing grounds for *Dissostichus* spp. in Subarea 58.4 is much smaller than that in Subarea 88.1, yet the estimated total removals from Subarea 58.4 are comparable to the catches reported in Subarea 88.1.

8.8   The Working Group noted that the estimated catch from IUU fishing in Division 58.4.3b in 2006/07 was 7.6-times greater than the precautionary catch limit for the exploratory longline fishery in that division. This is the third consecutive year of high IUU catches and it was agreed that this high level of IUU fishing in Subarea 58.4 was unsustainable.

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

Review of information to the meeting

9.1   Eighteen papers were provided to WG-FSA which contained biological and ecological information on either target species or by-catch species. They could be roughly divided into five groups of papers:

(i)   identification guides – 3
(ii)   aspects of the biology of *D. mawsoni* – 5
(iii)   the diet of juvenile *D. eleginoides* – 1
(iv)   by-catch species in the longline fishery (also dealt with by the By-catch Subgroup) – 2
(v)   aspects of the biology and ecology of icefish and *Patagonotothen guntheri* – 7.

9.2   Summaries of working documents containing biological information will be available in the *CCAMLR Scientific Abstracts* and therefore are not repeated here.

9.3   The three identification guides included the identification of fish caught along with *E. superba*, a field guide to the main Ross Sea fish caught in the *D. mawsoni* fishery, and the

determination of Antarctic skates. The field guide to fish associated with *E. superba* aggregations permits the rapid identification of more than 40 species (WG-EMM-07/32). The field guide to Ross Sea fish covers 27 taxa. Identification was provided to the species level if possible. However, for a number of groups (liparids, zoarcids, bathydraconids and the genera *Pogonophryne* and *Muraenolepis*), the key remained still at the family or genus level (WG-FSA-07/41). The key to skates of the Southern Ocean revealed a much larger heterogeneity in some characters than hitherto thought. A number of specimens have been tentatively assigned new species status (WG-FSA-07/27).

9.4 Papers on *D. mawsoni* span a wide range, including the use of stones in toothfish stomach in revealing bottom structure, morphological features, gametogenesis and stomach content with respect to the most abundant fish and squid species. WG-FSA-07/35 provided the first hypothetical life cycle of *D. mawsoni*. WG-FSA-07/58 noted that *D. mawsoni* take up stones from the sea floor randomly and that this information could be used as an additional means to reveal the geological structure of the Antarctic continental shelf and slope. Males and females of *D. mawsoni* were mostly in maturity stage III in December–February, which was in line with observations that the species spawns in July–August (WG-FSA-07/38 Rev. 2, 07/49). The most important food items of *D. mawsoni* in the Amundsen Sea in 2006/07 were the grenadier *M. whitsoni*, the icefish *Chionobathyscus dewitti* and the mesopelagic ionah fish *Notolepis coatsi*, and the cephalopods *Mesonychoteuthis hamiltoni*, *Psychroteuthis glacialis* and *Kondakovia longimana*. The prey composition underlined the notion that *D. mawsoni* are fast-swimming predators with a wide food spectrum (WG-FSA-07/50). Widespread information on the biology and ecology of *D. mawsoni* was condensed into a hypothetical life cycle of the species augmented by some computer animation which hypothetically showed the drift of early life stage animals into and out of the Ross Sea. The Working Group welcomed this attempt although it was well aware of the fact that the hypothesised life cycle is likely to change while new information comes in.

9.5 The distribution and diet of juvenile *D. eleginoides* was described from four annual trawl surveys around Shag Rocks and South Georgia (WG-FSA-07/P4). Most juveniles were caught on the Shag Rocks shelf and the northwest of South Georgia. Stomach content analysis revealed that juvenile toothfish were largely piscivorous. The diet consisted mostly of *P. guntheri* at Shag Rocks while various nototheniid fish and *E. superba* formed the diet around South Georgia.

9.6 Analyses of recent commercial catches, research surveys and data on larval and postlarval fish coupled with historical information indicated that *C. gunnari* spawns inshore in bays and over the shelf to the northeast of the island from January to June (WG-FSA-07/55). The current conservation measure restricts the catch limit during the presumed spawning period from March to May. In case the commercial fishery remains restricted to the northwest of South Georgia, this conservation measure is unlikely to protect spawning aggregations as intended (paragraph 5.162).

9.7 The icefish *C. dewitti* is a common by-catch in longlining in the Ross Sea (WG-FSA-07/25). Fifty per cent of the fish were mature at 34–36 cm and 3–4 years of age. Spawning appears to occur in February–March. Unvalidated maximum ages of 8–11 years were obtained. The analysis of biological information of *Pseudochaenichthys georgianus* on the South Georgia shelf from 1986 to 2006 suggested that fish grow fast in the first four years, as do other icefish species (WG-FSA-07/21). Stomach content analyses in 2005 and 2006 indicated that the species is a pelagic or semipelagic predator taking overwhelmingly krill,

while nototheniids and other channichthyids form only a minor part of the diet. WG-FSA-07/P1 provided further insight into the biology of the icefish *Chaenodraco wilsoni* off the tip of the Antarctic Peninsula and in the Cosmonauts and Commonwealth Seas. Fish spawn in October–November. Absolute fecundity is low and does not exceed 2 000–3 000 eggs. Fish fed almost exclusively on krill. They are unlikely to exceed 10 years of age.

9.8   The distribution of *P. guntheri* is restricted to the Shag Rocks area where it occurs from 111 to 470 m depth (WG-FSA-07/P3). They feed on the copepod *Rhincalanus gigas* when they are smaller (<14 cm) and take the hyperiid *Themisto gaudichaudii* and krill when they grow larger.

9.9   Mercury levels in five species of Antarctic fish from the Ross Sea were highly variable both within and between the five species (WG-FSA-07/24). The low level of mercury in *D. mawsoni* relative to its prey species and the four-fold difference in mercury concentrations between it and *D. eleginoides* were unexpected. They can only be explained by a lower rate of mercury assimilation and/or a higher rate of mercury elimination by *D. mawsoni*.

9.10   The Working Group agreed on the following three topics for the meeting in 2008 and encouraged Members to submit papers on:

- stock structure in *D. eleginoides*
- reconstruction of the life history of *D. eleginoides* in different areas
- a field guide for skates in the Southern Ocean.

9.11   The Working Group felt that more credit needs to be paid to empirical field work and its presentation within WG-FSA. Field work is essential in underpinning assessment work. Steps aimed in that direction are the workshops held by WG-FSA at regular intervals on special topics, such as: the Workshop on Approaches to the Management of Icefish in 2001; the focus on certain specific topics in the submission of biological papers to WG-FSA in the last few years; review papers submitted to WG-FSA, such as 'A hypothetical life cycle for Antarctic toothfish *Dissostichus mawsoni in* Antarctic waters of CCAMLR Statistical Area 88' (WG-FSA-07/35); and the Species Profiles. The Working Group envisaged that it will have more time to dedicate to the results of empirical field work once assessment work is conducted on a biennial basis (paragraphs 12.9 to 12.13).

Species profiles

9.12   The compilation of species profiles of those three species currently exploited in the Southern Ocean was initiated in 2005. These species profiles should condense all biological information into one concise paper which is currently spread over a large number of publications and working group papers which are not readily available to readers outside CCAMLR. It was decided to publish those species profiles in a special volume of *CCAMLR Science* and update an electronic version of these papers continuously thereafter.

9.13   A species profile of *D. mawsoni* was completed at the 2006 meeting of CCAMLR. The second species profile of *C. gunnari* was completed before the 2007 meeting of CCAMLR and is currently under review. The outstanding species profile on *D. eleginoides* is likely to be submitted in the course of 2008. All three species profiles are likely to be

available for final consideration and adoption by WG-FSA at its 2008 meeting. The publication of the special volume of *CCAMLR Science* is likely to occur in the course of 2009.

Otolith network

9.14   No report on the progress of work in the CCAMLR Otolith Network (CON) has been submitted to CCAMLR this year.

CONSIDERATION OF ECOSYSTEM MANAGEMENT

Report of the Workshop on the Fisheries and
Ecosystem Models in the Antarctic (FEMA)

10.1   Developments in evaluating ecosystem effects of the Convention finfish fisheries were discussed at the FEMA workshop (SC-CAMLR-XXVI/BG/6, paragraphs 45 to 48). WG-FSA recognised that this had been an important opportunity for interaction between the three working groups of the Scientific Committee. They noted that although Ecosystem Approaches to Fishing (EAF) had been an integral aspect of the management of the krill fishery, less direct attention had been paid to it in managing the icefish and toothfish fisheries and there had been no suitable forum for discussing this work within CCAMLR.

10.2   The Working Group generally agreed that the workshop had provided a good opportunity to review progress on ecosystem modelling for some of CCAMLR's finfish fisheries. It recognised the need for the further development of ecosystem models which could take into account the complex interactions between predators, target species, prey and other fisheries. It agreed that the ecosystem modelling should focus in the short to medium term on developing minimum realistic models to assess potential risks to the ecosystem. However, it recognised that the complex nature of some of the interactions means that the results from such models would need to be considered in a strategic rather than tactical sense. It also noted the value of following the 'best-practice' approach recommended by FAO in the development of the model.

10.3   WG-FSA discussed the future integration of the work of WG-FSA, WG-EMM and WG-SAM on ecosystem modelling:

- It agreed that in the first instance the ecosystem/multi-species models would need to be evaluated by WG-SAM.

- It also agreed that the results of ecosystem/multi-species models could be discussed under the WG-FSA agenda item 'Consideration of ecosystem management'. This would provide a useful forum for considering input into the fish, squid and invertebrate components of the ecosystem models.

- While the current WG-FSA agenda allowed only restricted time for discussion, it was hoped that a move to multi-year intervals between full assessments may provide greater opportunities for the discussion of the ecosystem effects of fishing.

• WG-FSA also agreed that interactions of the target fish species with top predators and with krill and the krill fishery may best be considered within the WG-EMM agenda under its consideration of the status of the krill-centric ecosystem.

Management advice

10.4   Further substantial work to elucidate the role of fish in various Antarctic ecosystems and describe their importance as predators of krill in quantitative terms (see Murphy et al., 2007) is required in the near future. In order to achieve this, close collaboration between WG-FSA and WG-EMM is essential. WG-FSA recommended that the Scientific Committee consider holding a further workshop in 2009 or 2010.

Depredation

10.5   Four working group papers and one observer report described attempts to reduce depredation of longlines by killer whales and sperm whales:

(i)   WG-FSA-07/11 described the use of a mammal exclusion device in longlining operations in FAO Area 41 outside the CAMLR Convention Area. The exclusion device is a protection (cone) net and slides down over the hooks and catch as soon as the line is hauled. The design is shown in Figure 6. In addition, bunches of kapron (artificial fibre) filaments were fastened to outside the net. Estimating the effects of this gear modification has been difficult. However, depredation became negligible after the protection net had been introduced.

(ii)   A similar modification to the longline had been introduced to the Chilean longline fishery along the southern South American coast (WG-FSA-07/14) (Figure 7) with great success. The Chilean longline fishery was able to reduce estimated depredation by killer whales and sperm whales by two-fold.

(iii)   A similar exclusion device to reduce depredation was introduced in the Uruguayan longline fishery from 40° to 50°S (WG-FSA-07/23, Figure 4). The exclusion device reduced depredation from 71% of the sets to 27%. When using exclusion devices, catch rates increased from 15.53 to 23.03 kg hour^{-1}. In addition to cetaceans, depredation occurred also by sleeper sharks (*Somniosus* spp.) which usually become hooked and die. Depredation by sleeper sharks has also been mentioned elsewhere. However, quantitative information on the importance of depredation by sleeper sharks and to what extent sleeper sharks might be affected by longline activities is lacking.

(iv)   Trials using cone nets in longlining have also been conducted by the UK at South Georgia in 2006 (WG-FSA-07/31 and scientific observer report from the *Jacqueline*). Initial results were promising, and the UK intends to proceed with further, more extensive trials in the 2007/08 season.

(v)   An 'Orca Acoustic Sphere Device' suspended from the side of the vessel has been reported by the UK observer as being used on the Spanish *Viking Bay* to

deter killer whales, but it had only been successful on the first day. From the second day onwards, no obvious effects of the deterrent could be detected and killer whales were observed as close to the vessel as in cases when no deterrent devices had been used. Pingers attached at intervals along the longline had no effect on depredation (scientific observer report from the *Viking Bay*).

10.6   The Working Group endorsed the attempts to reduce depredation by cetaceans in longline fisheries. In addition, the Working Group recommended adding a column to the C2 form to indicate if and when exclusion devices have been used on board longliners. However, the Working Group also noted that CPUE may be affected by such mitigation measures. Experimental work to compare effects of mitigation on data critical for assessments should be conducted.

10.7   The new exclusion devices may affect skates negatively. Skates caught on hooks protected by the new exclusion devices could be compressed over the considerable time of the hauling process. This may impair their chances to survive the hauling process substantially. The Working Group recommended that further research is needed to explore any negative effects of the new devices on the survival rate of skates.

Review of the CCAMLR *Scientific Observers Manual*

10.8   WG-FSA-07/54 summarised the suggestions made by WG-EMM to address the requests made by the Scientific Committee in relation to the *Scientific Observers Manual* for the krill fishery. Three main issues of high priority had been identified by the Scientific Committee:

(i)   understand the differences in selectivity between the various krill fishing gear configurations;

(ii)   determine the level of by-catch of fish larvae in the krill fishery;

(iii)   determine the level of warp strikes by seabirds and incidental mortality of seals.

10.9   The Working Group endorsed considerations on the fish larvae by-catch protocol and the sample storage and post-cruise analysis issues as set out in WG-FSA-07/54. The Working Group reiterated previous requests to assess the impact the krill fishery might have on recruitment of Antarctic fish and to what extent the krill fishery may add to 'natural' mortality of Antarctic fish at an early stage. These assessments require close collaboration between WG-FSA and WG-EMM.

10.10   A number of studies from the early 1980s to the mid-1990s underpinned previous notions that the by-catch of larval, post-larval and juvenile fish has the potential to impact on the recruitment of species such as *C. gunnari* and other species (Iwami et al., 1996; Nevinsky and Shust, 1996). Since then, very few studies have been undertaken to further elucidate the impact a krill fishery might have on recruitment in Antarctic fish stocks. This problem was accentuated when the technology of continuous pumping of krill was introduced in 2003/04 (SC-CAMLR-XXIII, paragraphs 4.2, 4.3, 4.11 and 4.16) with more vessels recently using this new technology. The Working Group recommended that additional research be initiated to better estimate the impact the krill fishery might have on larval, post-larval and juvenile fish

of a larger number of species. The Working Group welcomed activities by Japan, Russia and the UK to produce identification keys to fish taken in the krill fishery. It recommended that these activities be combined and that one concise key be produced in the near future. In order to speed up the compilation of such a key, the Working Group recommended that, as a first step, the Russian key to early life stages of Antarctic fish, which was published by VNIRO with graphs provided by Yefremenko in 1986 and contains ≈16 pages in A5 format, be translated by the Secretariat as soon as possible. As soon as the translation is available, scientists from Japan, Russia and the UK and any other interested nations should come together to produce a concise key to the identification of Antarctic larval, post-larval and juvenile fish (Annex 4, paragraph 4.37).

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-07/6 Rev. 1, 07/7 Rev. 1, 07/8 Rev. 1 and 07/9.

11.3   The following cruises were conducted during the 2006/07 season:

(i)   Longline: Forty cruises with scientific observers (international and national) on board all vessels. Ten cruises were undertaken in Subarea 48.3 by 10 vessels, one cruise was undertaken in Subarea 48.4, three cruises were undertaken by three vessels in Subarea 48.6, six cruises were undertaken by six vessels in Divisions 58.4.1, 58.4.2, 58.4.3a and 58.4.3b, two cruises were conducted by one vessel in Division 58.5.2, three cruises were conducted by two vessels in Subareas 58.6 and 58.7 and 15 cruises were undertaken in Subareas 88.1 and 88.2 by 15 vessels.

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

(iii)   Trawl – krill: Six scientific observation programs were conducted by five internationally designated scientific observers on board krill vessels operating in the Convention Area. As observer coverage is not mandatory, and because of the limited amount of fine-scale data available for the krill fishery for 2007 to date, it is not possible to estimate the proportion of effort that was observed.

(iv)   One pot cruise targeting *D. eleginoides* was conducted during the 2006/07 season. This cruise was undertaken in Subarea 48.3 by the Uruguayan vessel *Punta Ballena* with an international scientific observer on board.

11.4   The ability of WG-FSA to supply the best scientific advice to the Scientific Committee is dependant on the CCAMLR Scheme of International Scientific Observation.

11.5   In 2006, the Working Group considered that the Scheme of International Scientific Observation could be used to help determine levels of reporting and detection of tag–recapture events on board fishing vessels. It recommended that work be carried out by Members in the intersessional period to determine whether methods could be developed in which the scheme could be used for this purpose.

11.6   The Working Group suggested changes to the logbook to facilitate the recording of losses to catches, such as by depredation, in fisheries in the CAMLR Convention Area. These changes bring the observer logbook in line with the vessel reporting format (C2 form) (see paragraph 6.17).

11.7   Although observer information from commercial vessels is a key input to the work and advice provided by two groups (WG-FSA and ad hoc WG-IMAF), several papers (WG-FSA-07/25, 07/27, 07/36, 07/37 07/39, 07/40, 07/41, 07/44 and 07/54) prepared for this session of WG-FSA identified uncertainties in key data used for assessments of target species and of by-catch species. These problems are of sufficient seriousness that deficiencies in the data available has impacted on the work of WG-FSA, and on the recommendation that WG-FSA can make to the Scientific Committee and the Secretariat, e.g. the assessment of *Dissostichus* spp. in Subarea 88.1.

11.8   Conflicting demands on the observers' time and conflicting priorities also seem to result in variation in the quality and quantity of other data and on activities required to verify catch records or biological parameters used in assessments.

11.9   There are also current and ongoing issues with the recording of by-catch and new developments in the krill fishery.

11.10 Considering the above and the discussions by the Scientific Committee last year (SC-CAMLR-XXV, paragraphs 2.9 to 2.21), the Working Group agreed that an appropriate option would be to form an ad hoc technical subgroup to consider the observer issues.

Advice to the Scientific Committee

11.11 An ad hoc technical group that reports to the Scientific Committee should be constituted to discuss issues in relation to the Scheme of International Scientific Observation identified as impacting on the work of the Scientific Committee, as well as other technical issues related to at-sea implementation of management measures in the Convention Area:

(i)   The ad hoc technical group should comprise experienced observers, regional observer coordinators, representatives of fishers and operators, science representatives and the Secretariat, as well as any other expertise identified as necessary.

(ii)   The following issues should be specifically addressed:

(a)   ensuring an equivalent level of training and accreditation for observers across the Convention Area, considering the results provided in SC-CAMLR-XXVI/BG/9 Rev. 1, which indicated that levels of training across all Member States is variable;

(b)   the context of the specific data types collected, and their use in developing management advice. This would further enable observers to focus on collecting important data, rather than data which is redundant, or would be better collected through remote sensing if required, e.g. estimates of sea-surface temperature or sea state;

(c)   design of a sampling and data collection protocol for recording by-catch of benthic invertebrate fauna to enable the identification and description of vulnerable marine ecosystems (VMEs) (paragraphs 6.31 to 6.33 and Agenda Item 14.1);

(d)   time management and prioritisation of observer tasks, considering that any increase in workload for observers is likely to cause issues for the quality of data able to be collected by observers, as well as the range of target species, gear types and stage of development of fisheries and research priorities within the Convention Area;

(e)   additional tasks that will be required by the proposed Year of the Skate and the impact that these additional tasks will have on the workload of observers and on the quality of other required tasks (paragraphs 6.34 to 6.39);

(f)   consideration of technological improvements in data capture and management systems, and the potential for increased use of hardware and software to improve the quality and quantity of data collected by observers. This could include semi-automated methods of observing fisheries operations, measuring catch and by-catch and wildlife interactions using cameras and portable computers;

(g)   exchange of expertise and experience between technical coordinators and experienced observers on methods of recruiting, training and managing observers, and systems of acquisition, quality assurance, securing and delivering observer data to the Secretariat;

(h)   review the *Scientific Observers Manual* and the electronic logbooks to incorporate outcomes from the meeting;

(i)   any other technical issues related to at-sea implementation of management measures in the Convention Area.

(iii)   The Working Group proposed that the ad hoc technical group develop a matrix as an aid to prioritise the tasks undertaken by scientific observers. A skeleton design is presented in Table 21. The columns of the matrix are:

(a)   User Group: The groups within CCAMLR that use the data fields. The suggested user groups are WG-FSA, ad hoc WG-IMAF, SCIC and SC-CAMLR;

(b)   Data Type: A broad category for the type of data considered in a group of table rows;

(c) Description: A sub-category of the data type and/or a detailed description of the specific data considered in a particular row of the matrix;

(d) Use: How the particular data will be utilised by that particular user group. Note that if a particular specific data type is utilised differently by two or more user groups it may appear multiple times in the matrix, e.g. in the example matrix (Table 21). Vessel sightings data are utilised differently by WG-FSA and by SCIC;

(e) Optimal Collection: How, from a statistical and/or scientific view-point the data should be collected in an ideal scenario. This could include the frequency of sampling, whether the samples should be collected using a random or stratified sampling procedure, the ideal sample size etc.;

(f) Practical limitations: Practical considerations with respect to sample collection, i.e. what aspects of the Optimal Collection above will be attainable under practical conditions and taking cognisance of the other tasks that the observer must undertake, e.g. although the ideal may be to collect a specific type of data from every set, it may only be possible to sample every second set.

(iv) The Scientific Committee should advise on a suitable time and place for the ad hoc technical group to meet, bearing in mind that many of the scientists that are involved in WG-FSA and in ad hoc WG-IMAF would also be likely to be relevant to this technical group.

11.12 Advice to the Scientific Committee regarding the Scheme of International Scientific Observation may also be found in paragraphs 3.53 to 3.55 (tagging) and 6.49 to 6.51 (by-catch).

FUTURE ASSESSMENTS

12.1 The Working Group identified the following work needed for future assessments, noting that the first four items have the highest priority in the coming year:

(i) Undertake methodological work to design research programs for exploratory fisheries (paragraph 5.28), including consideration of:

(a) optimal designs for:

• estimating CPUE of an area for use in developing advice on catch limits for an area (paragraph 5.17);

• tagging rates and catches needed for estimating suitably precise recapture rates in exploratory fisheries (paragraph 5.18);

(b) approaches to identify precautionary catch limits when assessments are not possible, noting differences between areas yet to be fished compared to areas where stock depletion is known to have occurred.

(ii)   Undertake evaluations of assessment methods and management strategies for assessed fisheries, including, as a priority, evaluations of management strategies for *C. gunnari* (paragraph 4.10).

(iii)   Development of methods for estimating abundance and productivity of key by-catch species, notably rajids and macrourids.

(iv)   Developing approaches to minimise the effects of changing gears or implementing by-catch mitigation measures in toothfish fisheries on assessments of CPUE and stock status, including the potential confounding of mitigation measures and whether or not depredation is occurring.

(v)   Development of pro formas for presentation of:

    (a)   preliminary assessments, including diagnostics, sensitivity test etc. (WG-SAM) (paragraph 4.43);

    (b)   stock assessments in fishery reports (WG-SAM).

(vi)   Evaluation of approaches to considering recruitment in assessments of yield, including:

    (a)   alternative models of recruitment in assessments of stock status, such as stock–recruitment relationships and modelling recruitment variability with or without such relationship;

    (b)   methods to estimate parameters;

    (c)   how recruitment is represented in projections used to estimate yield.

(vii)   Advance toothfish assessments by considering:

    (a)   methods to estimate and include the length-specific trends seen in tag growth-shock and mortality (Appendix J, paragraph 43);

    (b)   the estimation of growth parameters within the assessment model for *D. eleginoides* in Subarea 48.3 (Appendix J, paragraph 43);

    (c)   approaches to trends seen in tag–recapture fits in the assessment of *D. eleginoides* in Subarea 48.3 (Appendix J, paragraph 43);

    (d)   development of methods for estimating natural mortality;

    (e)   examination of data weighting methods used in current integrated assessments.

(viii) Consider issues in the application of TSVPA to toothfish assessments (paragraph 4.27).

(ix)   Consideration of the optimal survey design and stratification of icefish surveys in Subarea 48.3 and the effects of different stratification schemes on the assessments (Annex O, paragraph 18).

(x)   Review a proposed modelling approach of impacts of fisheries mortalities on petrel populations.

(xi)   Develop approaches in support of assessments of VMEs and the scale of disturbance by fishing gears (paragraph 14.40).

Subarea 48.3 – *D. eleginoides*

12.2   With regard to future developmental work for the stock assessment model used for this stock, the Working Group noted that the new model presented in WG-FSA-07/29 was a marked improvement on the updated model used this year for stock assessment purposes. The main features of work suggested for the development of this new model were:

• investigation of the best way to both estimate and include the length-specific trends seen in tag growth-shock and mortality;

• suitable values of future recruitment variability to be used when calculating the yields via projections, given that this model now estimates year-class strength;

• the correct way to estimate the growth parameters within the assessment model, and the potential implications of fixing the t_0 parameter as was done in the paper;

• further investigate the mechanism(s) driving the apparent trends seen in the tag–recapture fits;

• the inclusion of sexual dimorphism within the model.

Division 58.5.2 – *D. eleginoides*

12.3   The Working Group noted the successful progress in developing an integrated assessment of *D. eleginoides* in CASAL. It agreed that further work could be undertaken to refine this assessment, including examining:

(i)   whether the model could be developed as a two-sex model;

(ii)   whether improvement in the model structure can be made to allow the inclusion of tagging data in the assessment;

(iii)   construction of age–length keys, if possible, as an alternative method for estimating densities of cohorts given the lack of defined modes in the length-density data;

(iv)   optimal sampling schemes for establishing age–length keys.

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Subareas 58.6, 58.7, South African EEZ – *D. eleginoides*

12.4   The Working Group encouraged South Africa to consider:

(i)   requesting that rather than making assumptions about cetacean depredations, scientific observers on board its vessels should report on the extent of cetacean activity and to collect data on toothfish remains on longline hooks evidencing cetacean predation;

(ii)   in the absence of research surveys, to consider a 'commercial survey' conducted as a component of commercial operations whereby certain locations are fished in a systematic manner each year to provide an index that is comparable over time.

Subarea 88.1 – *D. mawsoni*

12.5   The Working Group recommended that, in order to distinguish between different methods for providing advice on harvest strategies, the robustness of different assessment methods for achieving the objectives of the Commission be evaluated using simulation evaluation methods.

12.6   The Working Group also recommended that alternative assessment methods be reviewed for application to the Ross Sea assessment, including the CASAL integrated assessment method (WG-FSA-07/37) and the TSVPA method (WG-SAM-07/9).

Subarea 48.3 – *C. gunnari*

12.7   The Working Group identified a number of future research requirements for the intersessional period:

(i)   the acoustic protocol for assessing *C. gunnari* in Subarea 48.3, including:

(a)   discrimination of *C. gunnari* from other acoustic scatterers
(b)   further improvements in TS estimates for *C. gunnari*
(c)   age-specific patterns in daily vertical distribution of *C. gunnari*
(d)   combination of trawl and acoustic indices for stock assessment;

(ii)   consideration of optimal survey design and stratification, particularly the survey coverage of the southern shelf, and the effects of different stratification schemes on the assessments;

(iii)   development of an icefish population model.

Division 58.5.2 – *C. gunnari*

12.8   The Working Group agreed that further work on developing a management procedure for *C. gunnari* is a high priority (SC-CAMLR-XX, Annex 5, Appendix D).   It also recommended that biological parameters and cohort progression be reviewed based on survey and catch data.

Frequency of future assessments

12.9   The Working Group reviewed the advice of WG-SAM with respect to multi-year assessments.   In particular, it noted discussions set out in Annex 7, paragraphs 6.11 to 6.18. The Working Group agreed that movement toward conducting assessments at multi-year intervals represents a trade-off between the risk of gross errors in an assessment, and the considerable time saved in the meeting of WG-FSA, enabling faster progress with other topics of high priority, as well as continued evaluation and refinement of existing approaches.

12.10   The Working Group noted WG-SAM's conclusion that the risk of an over-catch of two- and three-times the estimated yields for one and two years in a row to South Georgia and Ross Sea toothfish stocks was very small.   The Working Group further noted WG-SAM's contention that where a toothfish stock is at or above target levels, and where assessments have been stable, then assessments of toothfish could be performed on a biennial cycle without incurring significant additional risk.

12.11   Based on this advice, the Working Group supported moving toward biennial assessment cycles for *Dissostichus* spp. It was noted that WG-FSA already conducts biennial assessments for the *C. gunnari* fisheries in Subarea 48.3 and Division 58.5.2 and, although there are considerable differences between assessment approaches for these two species groups, there is precedent in CCAMLR for managing fisheries using multi-year catch limits. It was agreed that it would be premature at this time to consider triennial assessment cycles for *Dissostichus* spp.

12.12   The Working Group agreed that WG-FSA would retain the option to undertake an assessment in any given year if, for example, any of the following factors were to occur during the intersessional period:

(i)   new or refined methods of assessment become available and recommended by WG-SAM for use in the assessment;

(ii)   parameters used in the assessment are revised significantly; or

(iii) a large IUU catch (unless this was anticipated in the assessment).

The need to undertake an annual assessment should be decided for each fishery.

12.13   The Working Group acknowledged that data such as catch, CPUE, and tag–recapture will be updated on an annual basis.   While contribution of the information may influence advice on precautionary yield in an annual assessment, the evaluation of risk by WG-SAM indicated that forgoing this information for one year would likely have a small influence on the stability of the stock, given the 35-year projection period used in the decision rules.   The

Working Group agreed that there would need to be further work to evaluate and determine the robustness of other indicators, such as sudden changes in CPUE or tag–recapture rates, before they could be added to the list in paragraph 12.12 to trigger assessment updates.

Management advice

12.14 The Working Group noted that assessments of long-term precautionary yield for *Dissostichus* spp. in the Ross Sea and Subarea 48.3 and Division 58.5.2 had been moderately stable in the last few years, and stocks were at or above target levels. The Working Group requested information from the Scientific Committee on the procedural steps to enable multi-year assessments.

FUTURE WORK

Intersessional work

13.1   Future work identified by the Working Group is summarised in Table 22 and Annex 6, Table 21 (ad hoc WG-IMAF), 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 these summaries list the tasks identified at the meeting or associated with established meeting procedures, and do not include ongoing tasks undertaken by the Secretariat, such as data processing and validation, publications and routine preparations for meetings.

13.2   The Working Group reviewed its activities in 2006/07. WG-SAM had produced valuable work and information that had contributed to the assessments and review of information available to WG-FSA. The Working Group thanked Drs Jones and Constable for co-convening WG-SAM and providing significant guidance to the development of assessment models. The Working Group also thanked its subgroups and the Secretariat for their contributions to its work.

13.3   WG-FSA encouraged the subgroups to continue their work in the forthcoming intersessional period, focusing, where possible, on a small number of key issues identified at the meeting and summarised in Table 22. In addition, the subgroups provide a conduit for information on a wide range of related research. The Working Group reminded participants that membership to the subgroups was open to all.

13.4   The Working Group agreed to the following intersessional work plan for the subgroups (coordinators are listed in brackets):

- Subgroup on By-catch (Drs M. Collins and R. Mitchell (UK)) will review and further develop the assessment of the status of by-catch species and groups, estimation of by-catch levels and rates, assessment of risk and mitigation measures.

- Year-of-the-Skate Coordination Group (Drs Welsford, Hanchet and Mitchell and the Secretariat) to plan and develop the requirements for the Year of the Skate in 2008/09.

- Subgroup on Tagging (Mr Dunn, Dr Welsford and the Secretariat) will review and further develop the tagging programs and the treatment of tagging data, the structure of the tagging database and the tagging protocol, the characterisation of tagging programs in the Convention Area, including skates and rays and tagging in EEZs, and the Secretariat-based coordination of tagging efforts in exploratory fisheries.

- Subgroup on the Observer Program (Drs Leslie and Welsford and the Secretariat) will review and further develop the observer protocols, the *Scientific Observers Manual* and priorities for scientific observers in various fisheries.

- Subgroup on Biology and Ecology (Drs K.-H. Kock (Germany) and Welsford) will review the literature, identify gaps in knowledge and update and coordinate the development of species profiles.

- CON (Dr M. Belchier (UK)) will review and further develop ageing techniques and age estimation, the development of the CCAMLR ageing database, and advise on the distribution of *D. eleginoides* and *D. mawsoni* in the fisheries in Subarea 58.4 using otolith morphology.

- Subgroup on Ecosystem Interactions (Dr Kock) will review the literature and facilitate interactions with WG-EMM and SG-ASAM.

- Subgroup on IUU Fishing (Dr Agnew and the Secretariat) will review and further develop approaches for improved estimation of IUU fishing and total removals, and develop the time series of catches estimated from IUU fishing.

13.5   Each subgroup was requested to develop a work plan for the intersessional period, in consultation with the appropriate colleagues, members of WG-SAM and WG-EMM where appropriate, the Convener of WG-FSA and the Chair of the Scientific Committee.

13.6   In addition, the Working Group assigned other tasks to the Secretariat and/or Members.

13.7   The responsibilities for coordinating the intersessional activities of ad hoc WG-IMAF are set out in Annex 6, Table 21.

Meeting of WG-SAM

13.8   During the course of its meeting, the Working Group identified a number of matters which were referred to WG-SAM (paragraphs 12.1 to 12.7).

Meeting of an ad hoc technical group

13.9   The Working Group identified the need for an ad hoc technical group to discuss and develop matters related to the Scheme of International Scientific Observation and fishery-based data collections (paragraph 11.11). The Working Group envisaged that such a technical

group would report to the Scientific Committee and address issues of importance to WG-FSA, ad hoc WG-IMAF and WG-EMM. Advice was sought from the Scientific Committee on establishing an ad hoc technical group and arrangements for a meeting.

Meeting of SG-ASAM

13.10 The Working Group noted that the next meeting of SG-ASAM was scheduled for 2009 (Annex 8, paragraph 84).

Fishery Reports

13.11 The Working Group requested that the Secretariat continue updating the Fishery Reports and include a section on the development of catch limits in each fishery.

OTHER BUSINESS

Bottom fishing in CCAMLR high-seas areas

14.1 The Working Group noted that the Scientific Committee has been tasked to review the criteria for determining what constitutes significant harm to benthos and benthic communities (Conservation Measure 22-05; CCAMLR-XXV, paragraphs 11.25 to 11.37). It also noted that, in 2006, the United Nations General Assembly (UNGA) agreed the Sustainable Fisheries Resolution (61/105), which calls upon States and RFMOs or other arrangements to take immediate action to ensure fish stocks are managed sustainably and to protect VMEs, including seamounts, hydrothermal vents and cold-water corals, from destructive fishing practices. More specifically, UNGA Resolution 61/105 calls upon States and RFMOs and other arrangements to regulate and manage all bottom fisheries in high-seas areas so as to prevent significant adverse impacts on VMEs by no later than 31 December 2008 (UNGA Resolution 61/105, OP80 – OP91).

14.2 In order to facilitate the work of the Scientific Committee and to assist the Commission in meeting the timetable in the UN resolution, the Working Group discussed processes that could be used to help specify operational requirements of fishers and the research and data collection requirements necessary to meet these obligations. It noted that many existing processes and procedures have been established in CCAMLR that enable these requirements to be met. This discussion provides advice on how these issues might be considered and developed by the Scientific Committee and Commission.

14.3 SC-CAMLR-XXVI/10 discusses how these tasks need consideration of the relationship between bottom fisheries, benthic habitats and related ecosystems and how they also require consideration of the steps needed to ensure that destructive fishing practices are eliminated. The paper provides definitions for 'destructive fishing practices', 'vulnerable marine ecosystems' and 'significant harm' as per Conservation Measure 22-05, noting that the term 'significant adverse impacts' as described in UNGA Resolution 61/105 is equated with

the term 'significant harm'. It elaborates important concepts that underpin these definitions, including consideration of the scales of effects and the resistance and resilience of species. It then proposes a process for addressing these issues, including:

(i)   methods for immediately evaluating interactions between bottom fisheries and marine habitats;

(ii)   consideration of processes for managing bottom fisheries and whether they will eliminate destructive fishing practices.

14.4   The Working Group thanked Drs Constable and R. Holt (USA) for providing this paper to the Scientific Committee to help progress consideration of this issue. It noted that the principles elaborated in this paper would be considered further by the Scientific Committee but agreed that:

(i)   a **destructive fishing practice**[3] is one that has the potential to result in:

   (a)   prejudicing of the conservation status of one or more species; and/or
   (b)   significant loss of habitat; and/or
   (c)   significant disruption of ecosystem processes;

(ii)   the concept of **vulnerability** of an ecosystem to fishing needs to accommodate consideration of:

   (a)   the direct interactions of the gear with the organisms (through death, injury or displacement) and how that might impact on population and ecosystem processes of those organisms, along with

   (b)   the spatial extent of the impacts (immediate as well as cumulative over many deployments of the gear) on both the organisms affected and the processes to which those organisms contribute (considered relative to the spatial extent of the organisms and their ecological processes), as well as

   (c)   the length of time those direct impacts may cause the system to deviate from where it would have been in the absence of fishing, particularly if fishing were to cease;

(iii)   **significant harm** would arise if the structure and function of the ecosystem are altered outside the natural variation (spatial and temporal) expected in an ecosystem in the absence of fishing and/or the time to recover is inconsistent with natural rates of recovery, where:

   (a)   natural variability is reflected in the spatial mosaic of patches and the temporal dynamics of organisms within and between patches, which could be represented as probabilities of finding the different states in space and time;

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[3]   Here, 'fishing practice' is considered as a combination of the fishing method, including mitigation devices, combined with the spatial, temporal and operational limits on the use of the method.

(b)   significant harm would therefore be changes in the occurrence (and types) of patches in the spatial mosaic of assemblages and/or changes in the different states of non-target species over time, such as variability and magnitude of abundance.

14.5   The Working Group noted that some assemblages are easily classified as vulnerable when they are characterised by slow-growing, habitat-forming, sessile species that, once dislodged by fishing gear, cannot recover except by settlement and growth of new larvae from distant areas. Bottom fishing in these areas may cause new patches to arise that are much larger than the natural patches formed by natural disturbances. Repeated fishing could cause an accumulation of disturbed patches at a rate much faster than the natural frequency of patch formation. In considering the implementation of the 2006 UNGA Resolution 61/105, the avoidance of significant interaction with these types of assemblages will be an important first step in eliminating destructive bottom fishing practices, although other types of assemblages may be important to consider under the circumstances described above. Some of these assemblages have been identified in the UNGA Resolution 61/105, including cold-water coral communities (also known as deep-water or deep-sea corals), sponge communities and other communities associated with seamounts, hydrothermal vent communities and methane cold-seep communities.

14.6   The Working Group noted that these requirements are encapsulated in the objectives of CCAMLR. Article II.3(b) requires the maintenance of the ecological relationships and the restoration of depleted populations. It also noted that concepts of resistance, resilience and recovery are identified in Article II.3(c) where CCAMLR must prevent changes or minimise the risk of changes in the marine ecosystem which are not potentially reversible over two or three decades. Importantly, the Working Group agreed that there was sufficient evidence globally that benthic habitats comprising slow-growing, habitat-forming, sessile species could take much longer than three decades to recover from significant fisheries disturbances.

14.7   The Working Group also noted that past practice of CCAMLR indicates a variety of mechanisms and policies that could be used to substantially help ensure bottom fisheries do not cause significant adverse impacts on VMEs. These are included in:

(i)   Article IX;

(ii)   the exploratory fisheries conservation measure (Conservation Measure 21-02);

(iii)   past new and exploratory fisheries measures that have been used to avoid benthic impacts (Conservation Measures 41-05, 41-11) and undertake experimental work to investigate whether impacts might arise if fishing were to proceed (Conservation Measures 43-04 [186/XVIII], 212/XIX);

(iv)   existing approaches to avoid and mitigate by-catch of finfish, birds and marine mammals, including approaches to acquiring information through research or fishery data collection activities and for using that information to advise on appropriate conservation measures;

(v)   the regulatory framework considered by the Scientific Committee (SC-CAMLR-XVIII, paragraphs 7.11 to 7.23; SC-CAMLR-XIX, paragraphs 7.2 to 7.20) and Commission (CCAMLR-XIX, paragraphs 10.2 to 10.8).

14.8   The Working Group agreed that important questions to be addressed in an evaluation of potential adverse impacts are:

(i)   What are the likely effects of fishing on species and assemblages in the areas being fished, including consideration of their resistance and resilience, and what are the likely rates of recovery of species and the spatial mosaic in the fished areas if fishing were to cease?

(ii)   What are the size and ecosystem attributes, including species, of the fished area to date, paying attention to the potential effects on the natural spatial mosaic?

(iii)   How much of the ecosystem attributes could have been affected by fishing overall, including areas outside the fished areas, and will the rate of recovery deviate from natural rates of recovery as a consequence?

14.9   The Working Group also agreed that the following tasks would contribute to this evaluation:

(i)   mapping of geomorphic features (e.g. SC-CAMLR-XVI/BG/27), which can be used to document the broad physical habitats in the benthic environment;

(ii)   identification of the types of organisms, including habitat-forming species, and ecosystem processes likely to be present in the physical habitats, which can be documented from available biological and ecological knowledge, as well as consider their resistance and resilience to the bottom fishing method being used in the area;

(iii)   quantification of the footprint of bottom fishing in each of the geomorphic features from the location of shots combined with the effort associated with each shot (e.g. swept area or length of line);

(iv)   generation of summary statistics on the potential area and ecosystem attributes affected by bottom fishing activities.

14.10   In considering these tasks, the Working Group noted that the work undertaken at the Workshop on Bioregionalisation of the Southern Ocean (Annex 9) could assist in this process, including papers submitted to the Scientific Committee on the benthic regionalisation (SC-CAMLR-XXVI/BG/28) and the mapping of geomorphic features in the Southern Ocean (SC-CAMLR-XXVI/BG/27).

14.11   The Working Group also agreed that there will need to be specific requirements of fisheries to provide data to assist in identifying vulnerable marine ecosystems in need of protection. It noted that studies such as the research program by Australia to develop camera gear for deployment by observers on fishing gears (longlines, trawls and pots) to investigate potential interactions of bottom fishing gears with benthic habitats (SC-CAMLR-XXVI/BG/30) could provide an approach for assisting this work. A general process for assisting the Commission in this task is considered further below.

History of bottom fishing in the CCAMLR high-seas areas

14.12 Large catches of demersal finfish species were taken from throughout the Southern Ocean in the 1970s and 1980s. The records of these catches do not contain detailed information of catch rates or location and are difficult to use in understanding the footprint of this historical fishing.

14.13 Since then bottom fishing in high-seas areas of CCAMLR can be categorised as follows:

(i)   finfish fisheries, which primarily used bottom trawls, in Subareas 48.1 and 48.2 were closed in 1990;

(ii)   since the late 1990s, bottom fishing activities have been primarily using longlines in Subareas 48.6, 88.1, 88.2 and 88.3 and Divisions 58.4.1, 58.4.2, 58.4.3a and 58.4.3b;

(iii)   benthic habitats in high-seas areas specifically protected from bottom fishing include the continental shelf in Divisions 58.4.1 and 58.4.2;

(iv)   high-seas areas closed to bottom fishing include long-term closures in Subareas 48.1 and 48.2 and annual closures in the exploratory toothfish fisheries in SSRUs in Subareas 88.1 and 88.2 and Divisions 58.4.1 and 58.4.2;

(v)   IUU fishing in the Convention Area is undertaken using bottom longlines and gillnets.

Effective fishing footprint

14.14 On behalf of the Working Group, Dr Constable undertook an analysis of the footprint of bottom fishing to illustrate the manner in which such analyses might be undertaken in this process. Data processing code was developed in R (R Development Team, 2007) and archived with the Secretariat. In this analysis, data held in the CCAMLR database were separated into 'longline', 'trawl' and 'pot' gears. Data were pooled across all target species that could be taken by deploying the fishing gear on the bottom. Over a specified time interval, all catch and effort is summed in grid cells (as an example, 0.25° latitude x 0.5° longitude was used, intending to approximate 15 x 15 n miles for most of the Convention Area). For most high-seas areas, the time series of catches is relatively small. Thus, data were pooled across years as well.

14.15 The 'effective fishing footprint' was identified by the Working Group to comprise areas of greatest interest to fisheries production (catch) in the region of interest (statistical area) for the time period of interest (in this case, all years). Areas of investigative or scientific research activities, as well as pilot fishing, were considered to be less important in defining a fishing footprint even though these shots are archived in the CCAMLR database. In this respect, the Working Group defined the effective fishing footprint as comprising those grid cells that contribute to a fixed proportion, say 90%, of the total catch of target species from a management unit – the main catch – and those cells that are outliers – the remainder of the catch. For all cells with effort, including cells with zero CPUE, the cells are ranked from the

greatest catch to the least and the cumulative proportional contribution to the total catch of each successive cell is determined. The cells are then separated into those cells contributing to the main catch and those contributing to the remainder. The cumulative proportions of each cell are plotted against the total catch for that cell along with additional plots showing the total effort in the respective cells. The effort in each cell of the two groups of cells can be plotted on the maps for scrutiny by the Scientific Committee and its working groups in order to:

(i)   understand which areas are of greatest interest to the fishery, as well as

(ii)   provide an indication of the potential levels of interaction between the specified fishing gear and benthic habitats in those areas.

14.16 The total effort deployed in each cell has been plotted for consideration by the Working Group and are available from the Secretariat if needed for further consideration by the Scientific Committee or Commission. However, in this report, presentations of the effective footprint simply divide the cells into the main catch and the remainder of the catch, leaving out the scaling of effort in each cell. This is to take account of the data confidentiality provisions in public presentation of CCAMLR catch and effort data.

14.17 The Working Group agreed that this method of plotting the data displayed all the information necessary for the Scientific Committee and the Commission to consider the characteristics of the fishing footprint and, in particular, the effective fishing footprint. It noted that these plots can also show the potential interactions of bottom fishing with benthic habitats by comparing the results with the topographic features shown by the bathymetry contours.

14.18 The Working Group also noted that it may be of interest to characterise the footprint as the cells contributing to say, 90%, of the effort in the area.

14.19 In evaluating the potential effects of fishing on VMEs in a given area, the Working Group noted that a method for assessing the amount of seabed directly affected by the gears would be useful. It suggested that information and research materials be collated on:

(i)   direct interactions of gears, including the types and spatial extent of disturbance that might arise from different gears and fishing methods;

(ii)   how the area directly affected by gears may be determined for each shot of a fishery.

The latter methods could then be used to better evaluate the potential spatial extent of disturbance of VMEs at scales less than the resolution of the cell size used in evaluating the effective fishing footprint.

14.20 Plots for the high-seas statistical divisions and subareas are shown in Figures 8 to 16. Only longlining results are presented because location data for trawling in high-seas areas was patchy. No pots have been reported to have been used in high-seas areas.

Annual process

14.21   The Working Group considered an overall procedure for managing the interactions of bottom fishing with the benthic environment in order to avoid significant adverse impacts on VMEs. It noted that avoiding significant adverse 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.

14.22   This draft procedure identifies critical elements to be developed by the Scientific Committee in helping the Commission implement UNGA Resolution 61/105. In so doing, the draft procedure substantially adopts existing practice in CCAMLR in implementing the precautionary approach to avoiding significant adverse impacts rather than managing the impacts after they have arisen. The Working Group agreed that a procedure of this kind will not have substantial quantities of data from Antarctica and the Southern Ocean to readily classify VMEs and identify areas necessary for their conservation.   It was therefore considered important to be able to acquire data through a standard overarching process and, where evidence of VMEs is found, a specific process would be set in train to provide interim protection while sufficient data are collected to enable the Commission to judge whether continued protection of an area is needed or not.

14.23   The proposed procedure is shown in Figure 17.

14.24   The draft process is built on the current process in exploratory fisheries where a notification (proposal for bottom fishing) is considered, a data collection plan (Research and Data Collection Plan – RDCP) developed and the areas open to fishing are the only areas subject to fishing operations in the current season. The data arising from those operations are then used by the Scientific Committee and its working groups to assess and evaluate the proposed fishing operations for the next season. The addition of a Fisheries Operations Plan (FOP) provides clear specification of actions required to help avoid significant adverse impacts during a season. In this case, it is envisaged to be of a similar form to the inclusion of current by-catch move-on provisions in conservation measures and the mitigation measures needed to avoid by-catch of seabirds but with some potential additional actions needed to manage interactions with VMEs.

14.25   The Working Group noted that UNGA Resolution 61/105 envisages a process for identifying VMEs and establishing measures to avoid significant adverse impacts within a season and in the longer term. It recognised that the absence of data will create uncertainty as to whether VMEs could be adversely impacted by bottom fisheries. As a result, the Working Group agreed that there will need to be a progression of classification of areas from open areas to vulnerable areas, the latter of which would have specific requirements on fishing activities.   Areas would likely differ in their associated requirements for data collection, mitigation and actions.   In the absence of data from a particular location, the evidence required to trigger actions may be much smaller than for areas where data on by-catch and other interactions have been accumulating for some time.   Similarly, areas with a greater potential for a type of habitat, assemblage or ecosystem to be significantly adversely affected by a small number of shots of a particular type of gear, may require lower trigger levels for actions than areas where the assemblages are likely to be more robust to those types of gears, e.g. the difference between sponge habitats and muddy habitats.

14.26   In this process, areas are likely to fall into four general categories:

(i)   **Open areas (effective fishing footprint)**, which would normally be larger management areas, in which approved commercial fishing activities would occur according to a FOP and an RDCP.

(ii)   **Areas outside the effective fishing footprint** would have no commercial fishing operations in the current season but other activities may be permitted to enable the development of appropriate FOPs and RDCPs.

(iii)   **Potentially vulnerable areas**, which would be identified on the basis of accumulated evidence, over one or more years, from commercial fishing or research activities, would have only restricted designated activities while it is confirmed whether or not VMEs exist in the area (RDCP) or a strategy (Mitigation Development Strategy – MDS) can be developed to mitigate and/or avoid interactions of the fishery with prospective VMEs predicted from the evidence.

(iv)   **Vulnerable areas**, which are envisaged to have been assessed to have VMEs, will be added to a Register of Vulnerable Areas (RVA), a Conservation Management Plan (CMP) developed and specific activities designated, if needed, to assist in the implementation of the CMP and/or the development of mitigation/avoidance strategies for particular gears (MDS).

14.27   The size of areas that might be considered in this classification scheme will vary depending on the size of the potential VME in an area and the scale of fishing operations (in the case of identifying the effective fishing footprint). Some areas may be equivalent in size to a fishing shot while others may be very large areas covering a complex mosaic of benthic habitats.   This could potentially lead to a mosaic of vulnerable areas.   Each year, consideration would need to be given as to whether a mosaic of smaller vulnerable areas would better be managed in a combined larger area, thereby making such areas easier to administer from the perspective of both the fisheries and the Commission.

14.28   The Working Group noted that there are practical management considerations in the designation of areas bounding VMEs and the effective fishing footprint (see paragraph 14.39(i)).

14.29   The Working Group noted that different gears and operations used by different vessels will differ in the nature and potential for their interactions with benthic environments. The potential of an individual vessel to affect benthic habitats may also vary in space and time. These vessel-specific characteristics of the interactions will require a regular process for assessing and evaluating the potential for areas to be vulnerable to significant adverse impacts by fishing operations.

14.30   An annual or regular cycle is envisaged to consider proposals for bottom fishing in high-seas areas and to consider, using updated information collected from activities in the areas, whether areas should be added to the RVA as either Potentially Vulnerable or as a VME.

14.31 The following documents, which may be vessel, gear and/or area specific, will have the following functions in this process:

(i) **Fisheries Operations Plan (FOP)** will specify the evidence needed to trigger action with respect to VMEs and the types of actions needing to be taken, both of which will be dependent on the gear, the location and the types of habitat (or ecosystems) that may be expected to be encountered in those locations (see below).

(ii) **Research and Data Collection Plan (RDCP)** will specify:

(a) protocols for observers to collect data needed to facilitate an assessment of potential interactions of the gears with habitat (or the ecosystem);

(b) protocols for collecting data that would trigger action;

(c) specific fishery-independent and/or fishery-dependent research that may be needed to resolve issues in this process, particularly for areas that are considered potentially vulnerable, e.g. experimental or comparative work across a range of locations may be needed to establish the nature and extent of VMEs in the area of interest.

(iii) **Mitigation Development Strategy (MDS)** is an option that could be pursued to develop avoidance and/or mitigation strategies for the fishing vessel in order to operate in a 'Potentially Vulnerable' or Vulnerable Area without causing significant adverse impacts.

(iv) **Register of Vulnerable Areas (RVA)** is the record of the location and attributes of VMEs in high-seas areas of CCAMLR, including areas declared as Vulnerable Areas, Potentially Vulnerable Areas and those areas notified during a season as having evidence of a VME, and would be maintained by the CCAMLR Secretariat and used by vessels to identify where different types of fishing operations can and cannot occur during a season.

(v) **Conservation Management Plan (CMP)** specifies requirements, such as avoidance (closure of an area is an option) and/or mitigation strategies for specific gear types, for ensuring the avoidance of significant adverse impacts on VMEs identified to be in an area.

14.32 During the course of fishing operations, it is expected that the catch will be monitored for benthos by-catch and/or other evidence of the presence of VMEs in the fishing location. Specific data collection protocols, e.g. the use of cameras on longlines to determine effects of deployment and retrieval of anchors, may be required. The Working Group agreed that a trigger for action is needed, based on by-catch or other information obtained during fishing operations. In principle, a trigger similar to those used for triggering the move-on rule for finfish by-catch could be used. The trigger will be partly dependent on measures in place to protect VMEs, including the extent of areas already closed to fishing.

14.33 The Working Group discussed the potential nature of a trigger. For example, a trigger could be a quantity of benthos by-catch, say 25 litres of benthos in the case of longlining or 0.5 tonnes for trawls, accumulated over a specified number of shots, say two, within an area

of, say, 5 n miles, recognising that the quantity of benthos landed on a vessel is not likely to be great for non-trawl gears and, for trawls as well, is likely to be lost in part or whole during retrieval. Use of camera systems may be required to confirm the nature and extent of VMEs.

14.34 Observers will need to monitor benthos by-catch to assist in the evaluation by the Scientific Committee after each season. Consideration needs to be given as to what data need to be collected to assist with this evaluation.

14.35 The Working Group considered three possible actions that could help fishing operations avoid significant adverse impacts during a season and for facilitating post-season evaluation of VMEs in the area:

(i)   move-on to another location and stay away from the area until an evaluation has been undertaken by the Scientific Committee and its working groups. To be successful, consideration will need to be given to methods for:

(a)   identifying the location of the Potentially Vulnerable Area given the fishing method being used, which may include noting, say, the location of the by-catch on a longline[4];

(b)   designating the Potentially Vulnerable Area given the fishing method being used and the uncertainty in locating where the benthos was caught, say specifying a 5 n mile area surrounding a trawl or a similar distance surrounding the location corresponding to where on a longline the benthos may have been caught;

(ii)   designated research activities, which might include a fixed number of repeat sampling (fishing or other research shots) and/or the use of cameras to gather data for use by the Scientific Committee in the evaluation of whether VMEs are present in the area;

(iii)   temporarily closing the location (as specified according to the move-on provision) to all vessels, which could be facilitated by having the CCAMLR Secretariat listing the area as a temporary closure in the RVA and notifying all vessels.

14.36 The Working Group agreed that each of these actions may require separate triggers and that a within-season closure of a location to all vessels may not be easy to administer.

14.37 The evaluation of potential benthic interactions and classification of areas will use all relevant data submitted to the Scientific Committee and its working groups. It is not expected that the analysis would only be restricted to data arising from the triggering of actions because some data may be accumulated in locations over many shots by many vessels without actions being triggered. Such a scenario is plausible when the benthos may not be easily retained by the gears.

14.38 The data for the evaluation may come from current and historical records of by-catch in fishing operations, and research activities in the Convention Area (e.g. WS-BSO-07/10

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[4]   Mr J. Fenaughty (New Zealand) indicated that benthos observed on landing in the Ross Sea was likely to have come from an area up to 2 km from the point where the landing occurred.

Rev. 1), which may include photographic or video materials, research survey data, as well as proximate data (proxies) derived from other studies. For example, geomorphological features can be good proxies for benthic habitats in many areas (e.g. SC-CAMLR-XXVI/BG/27). These would be a useful guide for identifying seamounts that have already been classified as potentially vulnerable in UNGA Resolution 61/105. Other proximate studies may also be used to help identify species, habitats or areas as potentially vulnerable. Strategies could then be developed in an RDCP to be undertaken as designated activities to ascertain whether an area should be placed on the RVA or not, such as requiring the use of camera gear on a number of shots in specified locations.

14.39 The Working Group noted the following:

(i) Measures to manage Vulnerable and Potentially Vulnerable Areas, including the specification of boundaries, will need to account for the degree to which management tools might be effectively used in this task. For example, the boundaries of areas should be easy to interpret by fishing vessels and the degree of compliance able to be monitored effectively. In this case, a small vulnerable area may require a larger boundary than just surrounding the VME in order to be confident that gears will not inadvertently interact with the VME as well as being sufficiently large to be able to effectively identify the location of a vessel relative to the VME (using VMS or other methods).

(ii) The requirements for research and data collection with respect to VMEs is most likely to be greatest in the early stages of a fishery in an area. It is expected that as a fishery progresses, a better understanding and the implementation of measures to avoid significant adverse impacts on VMEs will result in a clearer understanding of the requirements of fishers in eliminating destructive fishing practices. The Working Group noted that the mitigation of seabird by-catch in the Convention Area is a good illustration of this process.

(iii) As attributes of VMEs are likely to exist in areas at the scale of a shot rather than at the scale of management units, then a process needs to accommodate smaller scales of interactions of fisheries not currently considered in management of by-catch.

(iv) The development of camera gear for routine deployment by observers on fishing gears (SC-CAMLR-XXVI/BG/30) means that routine observations of the interactions of gears with benthic habitats during the course of routine fishing operations could be a useful method for routine monitoring of fishing with respect to VMEs.

Future work

14.40 The Working Group recognised that the full development of the process will require further work in both the Scientific Committee and the Commission in the intersessional period to meet the requirements of UNGA Resolution 61/105. It noted that such work could include, *inter alia*:

(i)   development of rules and data collection requirements needed to trigger actions for different gears and situations during a season with respect to avoidance of Potentially Vulnerable Areas and the gathering of data to assist in identifying VMEs;

(ii)   identifying the method for specifying areas in which evidence of VMEs is detected in order that interim within-season protection could be established either for the vessel concerned or the fishing fleet;

(iii)   developing an approach, including data requirements, for annual assessments of benthic interactions of bottom fishing and identification of Vulnerable and Potentially Vulnerable Areas;

(iv)   consideration of the requirements for observations and reporting;

(v)   consideration of the available management approaches to avoid and mitigate interactions with VMEs;

(vi)   further consideration of the relationship between effective fishing footprint and geomorphological features;

(vii)   a method for assessing the amount of seabed directly affected by the gears, such as through the use of cameras, where such methods could then be used to better evaluate the potential spatial extent of disturbance of VMEs at scales less than the resolution of the cell size used in evaluating the effective fishing footprint.

14.41   The Working Group drew the attention of the Scientific Committee to existing practices and how these can be advanced to accommodate the requirements of UNGA Resolution 61/105 with respect to avoiding significant adverse impacts on vulnerable marine ecosystems. The process described here is an elaboration of the by-catch procedures already in place and shows the advances in CCAMLR of the ecosystem approach to managing fisheries.

14.42   The Working Group noted that:

(i)   having a clear process, such as the one described here, makes it easier to understand what needs to be done and when and how this work contributes to CCAMLR achieving its objectives and complying with UNGA Resolution 61/105. It shows that in the absence of data, precautionary measures will need to be taken to ensure significant adverse impacts do not inadvertently arise while the data are being collected;

(ii)   this process will require regular, if not annual, work.

14.43   The Working Group requested the Scientific Committee consider how the annual work that will arise from addressing UNGA Resolution 61/105 can be accommodated in the already large workload of the working groups. It noted that there are insufficient resources at present in the Secretariat and in the Scientific Committee to do the work required to fulfil these obligations.

Bioregionalisation

14.44 The Working Group considered the results of the Workshop on Bioregionalisation of the Southern Ocean (Annex 9), particularly in relation to benthic regionalisation and the distribution of fish and invertebrate fauna. It noted that a number of papers were also made available to WG-FSA to assist with this consideration.

14.45 SC-CAMLR-XXVI/BG/27 shows methods and results for classifying Antarctic sea-floor geomorphology as a guide to benthic bioregionalisation. It is an update of results first developed for the Bioregionalisation Workshop, the method of which was described in WS-BSO-07/8. The method uses publicly available bathymetry and geophysical data to map geomorphic features of the Antarctic continental margin and adjoining ocean basins at scales of 1:1–5 million. The geomorphic features identified and their properties can be related to major habitat characteristics such as sea-floor type (hard versus soft), ice-keel scouring, sediment deposition or erosion and current regimes. Where more detailed data are available, shelf geomorphology provides a guide to the distribution of the shelf benthic communities recognised by a number of authors. For areas off the shelf, the relationships between physical environmental parameters and the benthic biota are more poorly known, however, geomorphic mapping provides insights into major processes that are likely to influence benthic habitats. This study of sea-floor geomorphology from the Antarctic shows that there is enough data available already to produce a meaningful benthic bioregionalisation for an area as poorly known as the Antarctic continental margin and surrounding oceans. Studies of shelf biota that have tried to link the physical environment with benthic communities have found links strong enough to suggest that geomorphology is a useful first-pass tool for mapping the distribution of communities.

14.46 SC-CAMLR-XXVI/BG/28 is an update by the conveners of the Workshop on Bioregionalisation of the Southern Ocean on the benthic bioregionalisation of the Southern Ocean. The update finalised the work that was undertaken at the Workshop. It was agreed at the Workshop that physical variables could be used to produce primary physical regionalisations of the Southern Ocean and that benthic and pelagic zones should be considered separately. The paper provides a description of the process and results of the primary benthic regionalisation completed at the Workshop and subsequent refinements to this regionalisation, including the use of additional data which could not be incorporated at the Workshop. The process and results of evaluating the physical regionalisation with biological data are also described.

14.47 WS-BSO-07/10 Rev. 1 described an analysis of benthic invertebrate megafaunal community patterns of shelf habitats within the Atlantic sector of the Southern Ocean. Trawl catches were collected from four scientific surveys across five CCAMLR subareas of Area 48. The region for which the greatest complexity of data was available, the northern Antarctic Peninsula and the South Shetland Islands, revealed a two-layered pattern based on the standardised total biomass data and the composition of phyla that contributes to that biomass. By referencing physical oceanographic data for the region, a pattern of shelf faunal zonation was described, where the benthic invertebrate communities on the northern shelves of the South Shetland Islands and the northern Antarctic Peninsula were separated into two zoogeographic zones based on the physical properties of the ACC and the Weddell water masses that meet and mix in this region. Super-imposed on this geographic pattern are the apparent effects of disturbance regimes such as iceberg scouring or commercial bottom

trawling, which work at smaller spatial scales. The procedure represented a potential methodology that could be used to describe broad patterns of epibenthic invertebrate megafauna.

14.48 The Working Group recalled the book by Dr Shust (1998, 2001) on fish and fish resources of the Antarctic in which he analysed the distributions of Antarctic finfish species and how they relate to the geomorphology and hydrological structure of the Antarctic area. He described eight zones in this work based on a number of indicator species:

I. Circum-Antarctic – Southern Polar Front (SPF), including the SPF itself and the northern periphery of the Antarctic Circumpolar Current (ACC). Indicator species – *Electrona carlsbergi*.

II. South Georgia Shelf, including South Georgia and Shag Rocks shelf waters. Indicator species – *Notothenia rossii, Champsocephalus gunnari, Patagonotothen guntheri* and *Dissostichus eleginoides*.

III. Kerguelen Shelf, including Kerguelen, Heard and McDonald (and close lying banks) Island shelf waters. Indicator species – *N. rossii rossii, C. gunnari, Lepidonotothen squamifrons* and *D. eleginoides*.

IV. Ob and Lena underwater rises. Indicator species – *L. squamifrons*.

V. Transitional–South Antilles, including South Shetland and South Orkney shelf waters. Indicator species – *N. rossii, C. gunnari* and *Gobionotothen gibberifrons*.

VI. West Antarctic Coastal, including shelf waters of the northern Antarctic Peninsula, Joinville and D'Urville Islands. Indicator species – *Chaenodraco wilsoni, Trematomus eulepidotus, Pleuragramma antarcticum, G. gibberifrons, L. larseni* and *L. nudifrons*.

VII. Near-continental Deep-water (300–600 m), including the submerged shelf, island shelves, rises in near-continental seas. Indicator species – *P. antarcticum, Chionodraco myersi, D. mawsoni* and *Trematomus* spp.

VIII. Near-continental Shallow-water (50–300 m), including inner-shelf rises. Indicator species – *C. wilsoni, T. newnesi* and *T. eulepidotus*.

14.49 Dr Shust further elaborated noting that the distribution of these main finfish species show geomorphological features and that oceanography influences the distribution and abundance of dominant finfish species. An important question will be to determine how much exchange there is amongst populations in the different locations.

14.50 The Working Group noted the similar conclusions being drawn from all of this work, and that there are some broad regional characteristics of the Southern Ocean, such as those shown by the finfish regionalisation above. It agreed that geomorphology and oceanography combine to form heterogeneity of habitats at much smaller scales than the statistical areas of CCAMLR, as shown in the studies in SC-CAMLR-XXVI/BG/27 and WS-BSO-07/10 Rev. 1. In the first instance, a characterisation of the geomorphology of the Southern Ocean provides

an important foundation for a regionalisation in this region. It agreed that WS-BSO-07/10 Rev. 1 provides a useful method for developing a finer-scale bioregionalisation from that identified by geomorphology.

ADOPTION OF THE REPORT

15.1   The report of the meeting was adopted.

CLOSE OF MEETING

16.1   Dr Hanchet 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   As this was Dr Hanchet's last year as Convener of WG-FSA, he welcomed the incoming Convener, Dr Jones, to the position.

16.3   Dr Constable, on behalf of the Working Group, thanked Dr Hanchet for providing expert guidance during his four-year term as Convener, which saw the Working Group achieve significant developments, including the introduction of assessments in exploratory fisheries and the consideration of multi-year assessments. Dr Hanchet's leadership had contributed greatly to the work of WG-FSA and the Scientific Committee.

16.4   In closing the meeting, Dr Hanchet, on behalf of the Working Group, acknowledged Dr Sabourenkov's career contribution to the work of the Scientific Committee and its working groups, as well as that of the Commission and SCIC. Dr Sabourenkov will be retiring in early 2008, after serving in the Secretariat for 24 years. The Working Group wished Dr Sabourenkov well in his retirement.

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 the 2006/07 season. **Bold:** fishery closed on advice from the Secretariat. (Source: catch and effort reports submitted by 5 October 2007 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-06	14-Nov-07[a]	42-01 (2006)	3 940	4 337	91
	58.5.2	Trawl	01-Dec-06	30-Nov-07	42-02 (2006)	1	42	3
Dissostichus eleginoides	48.3	Longline, pot	01-May-07	**24-Aug-07**	41-02 (2006)	3 535	3 554	99
	48.4	Longline	01-Apr-07	30-Sep-07	41-03 (2006)	54	100	54
	58.5.1 French EEZ[b]	Longline, trawl	ns	ns	ns	3 438	ns	
	58.5.2	Longline, trawl	01-Dec-06	30-Nov-07	41-08 (2006)	1 956	2 427	81
	58.6 French EEZ[b]	Longline	ns	ns	ns	333	ns	
	58 South African EEZ[c]	Longline	ns	ns	ns	126	ns	
Dissostichus spp.	48.6	Exploratory longline	01-Dec-06	30-Nov-07	41-04 (2006)	113	910	12
	58.4.1	Exploratory longline	01-Dec-06	**13-Mar-07**	41-11 (2006)	645	600	108
	58.4.2	Exploratory longline	01-Dec-06	30-Nov-07	41-05 (2006)	124	780	16
	58.4.3a	Exploratory longline	01-May-07	**31-Aug-07**	41-06 (2006)	4	250	2
	58.4.3b	Exploratory longline	01-May-07	30-Jun-07	41-07 (2006)	253	300	84
	88.1	Exploratory longline	01-Dec-06	**02-Feb-07**	41-09 (2006)	3 096	3 072[d]	101
	88.2	Exploratory longline	01-Dec-06	31-Aug-07	41-10 (2006)	347	567[d]	62
Euphausia superba	48	Trawl	01-Dec-06	30-Nov-07	51-01 (2006)	104 364	4 000 000	3
	58.4.1	Trawl	01-Dec-06	30-Nov-07	51-02 (2006)		44 0000	
	58.4.2	Trawl	01-Dec-06	30-Nov-07	51-03 (2006)		450 000	
Lithodidae	48.3	Pot	01-Dec-06	30-Nov-07	52-01 (2006)	1[e]	1 600	0
Martialia hyadesi	48.3	Exploratory jig	01-Dec-06	30-Nov-07	61-01 (2006)		2 500	

[a] Under review
[b] Data reported by France for fishing to August
[c] From Subareas 58.6 and 58.7
[d] Includes research fishing (see measure)
[e] By-catch in fishery for *D. eleginoides*
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 the 2006/07 season. The estimates are derived from information on longliners and gillnetters. (Source: WG-FSA-07/10 Rev. 5)

Subarea/division	Estimated start of IUU fishing	No. of vessels sighted	Additional no. of vessels extrapolated to 30 Nov 07	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 to 1 Sep 07 (not extrapolated)
		1	2	3	4	5	6	7
48.3	1991						2.1	0
58.4.1	2005	4	1.2	5.2	218	309	2.8	612
58.4.2	2002	2	0.6	2.6	109	200	1.8	197
58.4.3a	2003						0.8	0
58.4.3b	2003	20	6	26	1092	1183	2.1	2293
58.4.4	1996	1	0.3	1.3	55	146	2.0	109
58.5.1	1996	2	0.6	2.6	109	200	3.7	404
58.5.2	1997						1.9	0
58.6	1996						0.6	0
58.7	1996						0.5	0
88.1	2002						4.8	0
88.2	2006						2.9	0
Total		29						3615

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-07/10 Rev. 5 and SC-CAMLR reports.)

| Season | Subarea or 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		1 46					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
All seasons	844	17 945	1 209	1 065	98	5 457	7 116	35 640	23 485	26 822	13 673	355	15	133 724

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 2005/06 and 2006/07. (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-07/10 Rev. 5; CDS catch – data to October 2007, with the allocation between EEZ and high seas based on the Secretariat's knowledge of vessel activity such as licence information, vessel size and   trip duration.)

2005/06 season

Inside	Subarea/division	Reported catch	IUU catch	Total CCAMLR	*Catch limit*
	48.3	3 535		3 535	*3 556*
	48.4	19		19	*100*
	48.6	163		163	*910*
	58.4.1	421	597	1 018	*600*
	58.4.2	164	192	356	*780*
	58.4.3	449	1 903	2 352	*550*
	58.4.4	0	104	104	*0*
	58.5.1	5 156	144	5 300	*0 outside EEZ*
	58.5.2	2 528	74	2 602	*2 584*
	58.6	801	55	856	*0 outside EEZ*
	58.7	124		124	*0 outside EEZ*
	88.1	2 969		2 969	*2 964*
	88.2	514	15	529	*487*
	88.3	0		0	*0*
	Unknown		336	336	*0*
	Total inside	16 843	3 420	20 263	

Outside	Area	CDS catch EEZ	CDS catch high seas	Total outside CCAMLR	
	41	1 986	3 179	5 165	
	47		230	230	
	51	3		3	
	57			0	
	81	407		407	
	87	3 985	0	3 985	
	Total outside	6 381	3 409	9 790	

| Global total | | | | 30 053 | |

2006/07 season (to 5 October 2007)

Inside	Subarea/division	Reported catch	IUU catch	Total CCAMLR	*Catch limit*
	48.3	3 535		3 535	*3 554*
	48.4	54		54	*100*
	48.6	113		113	*910*
	58.4.1	645	612	1 257	*600*
	58.4.2	124	197	321	*780*
	58.4.3	257	2 293	2 550	*550*
	58.4.4	0	109	109	*0*
	58.5.1	3 438	404	3 842	*0 outside EEZ*
	58.5.2	1 956	112	1 956	*2 427*
	58.6	357	24	357	*0 outside EEZ*
	58.7	101		101	*0 outside EEZ*
	88.1	3 096		3 096	*3 072*
	88.2	347		347	*567*
	88.3	0		0	*0*
	Total inside	14 023	3 615	17 638	

(continued)

Table 4 (continued)

Outside	Area	CDS catch EEZ	CDS catch high seas	Total outside CCAMLR
	41	1 178	2 620	3 798
	47		321	321
	51	15	20	35
	57			0
	81	299	407	299
	87	4 623	8	4 631
	Total outside	6 115	2 969	9 084
Global total				26 722

Table 5: 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 2006/07 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. * reported catch of *Dissostichus* spp. < 5 tonnes. (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 (251)	5.25
	UK	*Argos Helena*	40 (40)	6.44
	Total		292 (291)	
48.6 (1)	Japan	*Shinsei Maru No. 3*	99 (76)	1.00
	Korea, Republic of	*Jung Woo No. 2*	18 (14)	2.8
	Norway	*Frøyanes*	11 (1)	1.57
	Total		128 (91)	
58.4.1 (3)	Korea, Republic of	*Insung No. 1*	732 (9)	(>500 fish)
	Namibia	*Antillas Reefer*	3 (0)	0.13
	Spain	*Tronio*	502 (5)	(>500 fish)
	Uruguay	*Paloma V*	270 (231)	2.29
	Total		1507 (245)	
58.4.2 (3)	Korea, Republic of	*Insung No. 1*	88 (0)	4.36
	Korea, Republic of	*Jung Woo No. 2*	74 (0)	1.94
	Namibia	*Antillas Reefer*	86 (0)	1.32
	Total		248 (0)	
58.4.3a (1)	Japan	*Shinsei Maru No. 3*	4 (4)	1.83*
	Spain	*Tronio*	5 (5)	2.23*
	Total		9 (9)	
58.4.3b (1)	Japan	*Shinsei Maru No. 3*	112 (37)	1.02
	Namibia	*Antillas Reefer*	49 (47)	2.06
	Spain	*Tronio*	81 (0)	1.00
	Uruguay	*Paloma V*	47 (43)	1.24
	Total		289 (127)	

Table 5 (continued)

Subarea or division (required rate)	Flag State	Vessel name	*Dissostichus* spp. tagged and released		
			Number of fish		Tagging rate
88.1 (1)	Argentina	*Antartic II*	228	(0)	1.45
	Korea, Republic of	*Insung No. 22*	352	(20)	1.16
	Korea, Republic of	*Jung Woo No. 2*	198	(19)	1.24
	New Zealand	*Avro Chieftain*	289	(0)	1.06
	New Zealand	*Janas*	184	(0)	1.13
	New Zealand	*San Aotea II*	385	(10)	1.25
	New Zealand	*San Aspiring*	463	(1)	1.11
	Norway	*Frøyanes*	168	(0)	1.11
	Russia	*Volna*	103	(0)	1.04
	Russia	*Yantar*	371	(0)	1.11
	South Africa	*Ross Mar*	51	(0)	1.00
	UK	*Argos Georgia*	240	(20)	1.01
	UK	*Argos Helena*	270	(3)	1.36
	Uruguay	*Ross Star*	152	(2)	1.14
	Uruguay	*Viking Sur*	141	(0)	1.34
	Total		3595	(75)	
88.2 (1)	Argentina	*Antartic II*	2	(0)	0.05
	Norway	*Frøyanes*	97	(0)	0.89
	Russia	*Volna*	55	(0)	1.03
	Russia	*Yantar*	100	(0)	1.01
	UK	*Argos Georgia*	0		0*
	UK	*Argos Helena*	14	(0)	0.46
	Uruguay	*Viking Sur*	10	(0)	1.07
	Total		278	(0)	

Table 6: Participation in exploratory fisheries for *Dissostichus* spp. in 2006/07. Participating Members includes Members who submitted notifications but did not fish. (Source: WG-FSA-07/4)

Subarea/division	Participating Member	Number of vessels fishing	*Dissostichus* spp. catch (tonnes)	
			Limit	Reported
Exploratory fisheries in Area 48 (Atlantic Ocean sector)				
48.6	Japan	1		
	Korea, Republic of	1		
	New Zealand	-		
	Norway	1		
Total		3	910	113
Exploratory fisheries in Area 58 (Indian Ocean sector)				
58.4.1	Australia	-		
	Korea, Republic of	1		
	Namibia	1		
	New Zealand	-		
	Spain	1		
	Uruguay	1		
Total		4	600	645

(continued)

Table 6 (continued)

Subarea/division	Participating Member	Number of vessels fishing	*Dissostichus* spp. catch (tonnes)	
			Limit	Reported
58.4.2	Australia	-		
	Korea, Republic of	2		
	Namibia	1		
	New Zealand	-		
	Spain	-		
	Uruguay	-		
Total		3	780	124
58.4.3a	Japan	1		
	Korea, Republic of	-		
	Spain	1		
Total		2	250	4
58.4.3b	Australia	-		
	Japan	1		
	Korea, Republic of	-		
	Namibia	1		
	Spain	1		
	Uruguay	1		
Total		4	300	253
Exploratory fisheries in Area 88 (Southwest Pacific sector)				
88.1	Argentina	1		
	Korea, Republic of	2		
	New Zealand	4		
	Norway	1		
	Russia	2		
	South Africa	1		
	Spain	-		
	UK	2		
	Uruguay	2		
Total		15	3072*	3096
88.2	Argentina	1		
	New Zealand	-		
	Norway	1		
	Russia	2		
	Spain	-		
	UK	2		
	Uruguay	1		
Total		7	567*	347

* Includes research fishing (see conservation measure).

Table 7: Number of vessels notified in exploratory longline fisheries for *Dissostichus* spp. in the 2007/08 season (a), and corresponding number of participating Members, number of vessels and catch limits agreed in conservation measures in force in the 2006/07 season (b). (Source: CCAMLR-XXVI/12)

Member notifications	Number of vessels notified per subarea/division						
	48.6	58.4.1	58.4.2	58.4.3a	58.4.3b	88.1	88.2
(a) Exploratory longline fisheries for *Dissostichus* spp. in the 2007/08 season							
Argentina						2	2
Australia		1	1		1		
Japan	2	1	1		2		
Korea, Republic of	4	5	5		4	5	
Namibia		2	2		2	1	
New Zealand	1	3	2			4	4
Russia						2	2
South Africa	1		1			1	1
Spain		1	1		1	1	1
Ukraine		1	1				
UK						3	3
Uruguay		1	1	1	1	2	2
Number of Members	4	8	9	1	6	9	7
Number of vessels	8	15	15	1	11	21	15
(b) Conservation measures in force in the 2006/07 season							
Number of Members	4	6	6	3	6	9	7
Number of vessels	1[1]	10	9	1[1]	1[1]	21	16
Target species catch limit (tonnes)	910	600	780	250	300	3032	547

[1] Maximum number per country at any one time.

Table 8: Unstandardised CPUE (kg/hook) of *Dissostichus* spp. in exploratory longline fisheries reported between 1996/97 and 2006/07. (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
48.6	486A								0.04	0.07	0.16	0.11
	486D											0.05
	486E									0.08		0.13
58.4.1	5841C									0.13	0.18	0.15
	5841E									0.22	0.10	0.13
	5841G									0.20	0.22	0.24
58.4.2	5842A									0.08	0.08	0.13
	5842C							0.10		0.07	0.17	
	5842D							0.19	0.06		0.03	
	5842E							0.21	0.11	0.14	0.22	0.15
58.4.3a	5843aA									0.05	0.05	0.02
58.4.3b	5843bA								0.09	0.16	0.16	0.13

Table 8 (continued)

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
88.1	881A	0.01				0.02		0.16			0.08	0.05
	881B	0.05	0.03			0.16	0.25	0.27	0.11	0.55	0.07	0.33
	881C					0.44	0.87	0.58	0.31	0.53	1.07	0.71
	881E		0.07	0.06		0.03		0.05	0.08	0.28		0.02
	881F		0.00					0.03				0.16
	881G		0.06	0.02		0.13	0.12	0.16	0.12	0.15	0.63	
	881H		0.17	0.26	0.38	0.41	0.72	0.45	0.21	0.73	0.60	0.38
	881I		0.37	0.23	0.28	0.28	0.43	0.20	0.16	0.44	0.39	0.34
	881J			0.09	0.18	0.04			0.04	0.21	0.36	0.36
	881K		0.32	0.15	0.39		0.45		0.01	0.32	0.50	
	881L					0.12			0.10	0.14	0.16	
88.2	882									0.38		
	882A						0.82		0.11	0.48	0.54	
	882B								0.06			
	882D										0.43	0.31
	882E							0.35	0.42	0.70	0.33	0.22
	882F										0.26	0.02
	882G										0.03	

Table 9: Number of *Dissostichus* spp. tagged and released in exploratory longline fisheries. (Source: scientific observer data submitted to CCAMLR.)

Subarea/ division	Season							
	2000/01	2001/02	2002/03	2003/04	2004/05	2005/06	2006/07	Total
48.6				4	62	146	128	340
58.4.1					462	469	1 507	2 438
58.4.2					342	136	248	726
58.4.3a					199	104	9	312
58.4.3b					231	175	289	695
88.1	326	756	1 068	1 752	3 221	2 977	3 085	13 185
88.2		12	94	433	341	444	264	1 588
Total	326	768	1 162	2 189	4 858	4 451	5 530	19 284

Table 10: Number of tagged *Dissostichus* spp. recaptured in exploratory longline fisheries. (Source: scientific observer data submitted to CCAMLR.)

Subarea/ division	Season							
	2000/01	2001/02	2002/03	2003/04	2004/05	2005/06	2006/07	Total
48.6						3	2	5
58.4.1							3	3
58.4.2							1	1
58.4.3a						6		6
58.4.3b					1	6	1	8
88.1	1	4	13	40	59	70	204	391
88.2				10	17	28	33	88
Total	1	4	13	50	77	113	244	502

Table 11: 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	127	110	297	3 120	411	4 594
2005/06	163	421	164	89	361	2 969	514	4 680
2006/07	113	645	124	4	253	3 096	347	4 581
Total	333	1 547	551	203	917	16 287	1 793	21 630

Table 12: Summaries of data used in simulation trials of the probability that the mean CPUE estimated from a longline survey for *Dissostichus* species is within 25% of the true CPUE when a catch limit is fixed for the survey. For each of the areas for which data was extracted from the CCAMLR database, the number of records (shots) is shown along with the mean CPUE (kg). Statistics are shown for all data and for each year where data is present.

	All	2000	2001	2002	2003	2004	2005	2006	2007
58.4.1									
Records	902						285	215	402
CPUEMean	0.175						0.169	0.193	0.169
58.4.2									
Records	569				141	45	163	108	112
CPUEMean	0.150				0.181	0.091	0.101	0.213	0.144
58.4.3b									
Records	652					19	160	191	282
CPUEMean	0.144					0.087	0.159	0.160	0.128
58.4.4									
Records	373	319	54						
CPUEMean	0.063	0.067	0.041						

Table 13: Catch biomass levels required to attain a 33% CV in the estimated abundance for three representative levels of tag rate per tonne and exploitable biomass. The natural mortality and tagging mortality/detection rates were those used in Subarea 48.3. EB is the exploitable biomass of the stock/population in question and all biomass levels are in tonnes, and tpt signifies the tags per tonne.

CV = 33%	EB = 5 000	EB = 10 000	EB = 20 000
Tag rate = 2.5 tpt	131	186	264
Tag rate = 5 tpt	92	132	187
Tag rate = 7.5 tpt	76	108	153

Table 14: Catches for macrourids, rajids and other species taken as by-catch from longline fisheries in 2006/07, 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	3333	131	3.9	177	4	0.1	177	27	0.8	-
48.4	54	14	25.7	-	2	3.2	-	0	0.6	-
48.6	112	13	11.5	146	0	0.0	100	2	1.6	120
58.4.1	634	41	6.5	96	0	0.0	50	2	0.3	60
58.4.2	124	7	5.7	124	0	0.3	50	0	0.4	60
58.4.3a	4	0	11.1	26	0	0.5	50	1	20.9	20
58.4.3b	251	17	6.7	159	3	1.2	50	1	0.4	20
58.5.1 French EEZ	3184	476	15.0	na	379	11.9	na	0	0.0	na
58.5.2	624	61	9.8	360	8	1.3	120	1	0.1	50
58.6 French EEZ	333	90	27.1	na	83	25.0	na	0	0.0	na
58 South African EEZ	112	7	6.1	na	0	0.0	na	1	0.7	na
88.1	3096	153	4.9	485	38	1.2	152	43	1.4	160
88.2	347	54	15.6	88	0	0.0	50	13	3.6	100

Table 15: Number of macrourids, rajids and other species caught or released from longline fisheries in 2006/07, and reported in fine-scale data.

Subarea/division	*Dissostichus* spp.		Macrourids		Rajids		Other species	
	Caught	Released	Caught	Released	Caught	Released	Caught	Released
48.3	755 789	3 873	83 408	0	519	9 265	19 849	20
48.4	3 668	292	13 208	0	285	6 515	518	98
48.6	6 150	255	12 528	0	3	0	1 868	0
58.4.1	25 006	767	35 695	9	13	0	2 281	9
58.4.2	3 711	160	5 500	0	61	0	537	0
58.4.3a	506	12	535	0	8	0	675	0
58.4.3b	10 733	286	22 714	0	840	1 267	1 209	67
58.5.1 French EEZ	681 321	0	268 316	0	64 259	0	0	0
58.5.2	111 616	580	78 036	0	1 030	7 693	9 375	1
58.6 French EEZ	68 941	0	64 250	0	21 227	0	0	0
58 South African EEZ	17 921	26	5 687	0	0	0	584	0
88.1	120 367	3 564	121 989	6	4 802	7 352	99 586	42
88.2	10 063	271	52 283	0	16	0	15 036	1

Table 16: Estimated total catch in tonnes of rajids (including those cut off or released) in 2006/07 derived from fine-scale (C2) data.

Subarea/division	Rajids					
	Caught	Released	Estimated total catch (tonnes)	Mean weight (kg)	Catch limit (tonnes)	% of catch limit
48.3	519	9 265	72.6	7.42	177	41.0
48.4	285	6 515	41.7	6.13	-	-
48.6	3	0	0.0	6.83	100	0.0
58.4.1	13	0	0.1	8.12	50	0.2
58.4.2	61	0	0.3	5.22	50	0.6
58.4.3a	8	0	0.0	2.88	50	0.0
58.4.3b	840	1 267	7.5	3.57	50	15.0
58.5.1 French EEZ	64 259	0	358.6	5.58*	na	na
58.5.2	1 030	7 693	68.9	7.90	120	57.4
58.6 French EEZ	21 227	0	64.4	3.03*	na	na
58 South African EEZ	0	0	0.0	2.87*	na	na
88.1	4 802	7 352	97.2	7.99	152	63.9
88.2	16	0	0.1	7.95	50	0.3

* Derived from observer biological data (L6) as no weight data were available within fine-scale data.

Table 17: Observed (numbers) and estimated catches (numbers and weight) of macrourids, rajids and *Antimora rostrata* derived from observer (L5) data.

Subarea/division	Observed macrourids (*n*)	Extrapolated macrourids (*n*)	Extrapolated macrourids (tonnes)	Observed rajids (*n*)	Extrapolated rajids (*n*)	Extrapolated rajids (tonnes)	Observed *Antimora* (*n*)	Extrapolated *Antimora* (*n*)	Extrapolated *Antimora* (tonnes)
48.3	29 328	89 852	156	2 463	7 490	65.13	5 323	15 271	23.56
48.4	4 445	10 744	14	16	43	0.26	98	261	0.35
48.6	9 689	19 523	24	0	0	0.00	869	1 750	2.89
58.4.1	11 189	19 504	27	1	2	0.02	4	6	0.01
58.4.2	646	646	1	0	0	0.00	5	5	0.01
58.4.3a	204	599	1	143	340	1.28	273	695	1.03
58.4.3b	12 027	26 420	25	1 554	2 360	30.57	191	593	0.92
58.5.1	-	-	-	-	-	-	-	-	-
58.5.2	13 784	37 400	56	4 128	11 042	61.62	211	559	0.86
58.6	1 696	8 956	13	8	43	0.13	171	1 032	1.42
58.7	3 240	13 481	19	7	25	0.07	194	1 341	1.84
88.1	63 035	111 611	212	4 638	6 598	43.71	1 566	2 503	4.49
88.2	33 800	54 351	80	3	30	0.21	2 964	5 436	8.55

Table 18: Fate and condition of skates captured in longline fisheries determined from observer data (L11) during the 2006/07 season.

Fate	Condition	48.3	48.4	48.6	58.4.1	58.4.2	58.4.3a	58.4.3b	58.5.2	58.6	58.7	88.1	88.2
Cut off the line	1	51	15				14					4	
	2	8	3				3					83	
	3	252	49		1		3	1	1			217	2
	4	907	278	1			2		48			872	
	Not recorded	839	285	0	0		0	0	0			60	0
	Total	2 057	630	1	1		22	1	49			1 236	2
Landed and discarded	1	22	15			10			38			14	
	2	1		1	5	5			7			14	
	3	11		2	4	29			2			87	
	4	61			3	18			110			62	
	Not recorded	4	0	0	0	0			0			0	
	Total	99	15	3	12	62			157			177	
Lost at the surface/dropped off by itself	1						1					3	
	2						1					3	
	3	3	3									103	
	4	26	2									14	
	Not recorded	53	1				0					1	
	Total	82	6				2					124	
Shaken/flicked off/removed with a gaff	1	5											
	2	1					5					1	
	3	5								20	22		
	4	5										3	
	Not recorded	4	1				0			0	0	0	
	Total	20	1				5			20	22	4	
Tagged and released	1								3				
	2								2			4	
	3								79			32	
	4	73							94			366	
	Not recorded	1							0			1	
	Total	74							178			403	

(continued)

Table 18 (continued)

Fate	Condition	48.3	48.4	48.6	58.4.1	58.4.2	58.4.3a	58.4.3b	58.5.2	58.6	58.7	88.1	88.2
Fish landed and retained on board	1								171			145	3
	2								240			21	
	3								381			440	
	4								95			1	
	Not recorded								1			18	0
	Total								888			625	3

Released condition code refers to the status of released animals.

1: Rajid is dead. No movement of spiracles. No response when touched.

2: Rajid is alive. Life-threatening injuries (e.g. crushed or missing jaws/mouthparts, prolapsed intestines, severely ripped muscles in the oesophagus and mouth).

3: Rajid is alive. Injuries serious enough to possibly reduce survival post release (e.g. large areas of ripped soft tissue in the oesophagus and mouth, small areas of ripped muscle).

4: Rajid is alive and in good condition or may have some small injury that is not deemed to be life threatening (e.g. small areas of ripped tissue and muscles of the pectoral fins; hook puncture wounds in the soft tissue of the mouthparts).

Table 19: Macrourid by-catch (tonnes) as a percentage of *Dissostichus* spp. (tonnes) catch in Subareas 48.3, 48.6 and 88.1 and Division 58.5.2. Derived from fine-scale (C2) data.

Season	Subarea/division							
	48.3		48.6		58.5.2		88.1	
	Autoliner	Spanish	Autoliner	Spanish	Autoliner	Spanish	Autoliner	Spanish
1994/95	25.44	0.34						
1995/96	6.32	4.69						
1996/97	-	1.87						
1997/98	1.58	3.47					22.32	
1998/99	1.66	0.48					9.69	
1999/00	1.95	0.82					10.46	
2000/01	3.74	0.50					24.50	13.11
2001/02	-	2.65					11.61	
2002/03	3.78	1.28			0.99		21.78	0.52
2003/04	9.74	1.60		4.05	7.67		33.22	7.01
2004/05	14.03	1.73		2.30	10.78		27.65	6.33
2005/06	6.79	1.19		6.05	4.00		16.95	2.51
2006/07	5.31	2.23	9.37	11.8	9.8		6.13	2.34

Table 20: Catches (tonnes) of target species and by-catch from trawl fisheries in 2006/07, and reported in fine-scale data. ANI – *Champsocephalus gunnari*; GRV – *Macrourus* spp.; KRI – *Euphausia superba*; LIC – *Channichthys rhinoceratus*; NOR – *Notothenia rossii*; NOS – *Notothenia squamifrons*; SGI – *Pseudochaenichthys georgianus*; SRX – *Rajid* spp.; SSI – *Chaenocephalus aceratus*; TOP – *Dissostichus eleginoides*; TOT – *Dissostichus* spp.

Subarea/ division	Target species	Catch (tonnes)											
		Target	ANI	GRV	KRI	LIC	NOR	NOS	SGI	SRX	SSI	TOT	Other
48.1	KRI	7 147	0	0	7 147	0	0	0	0	0	0	0	0
48.2	KRI	38 033	0	0	38 033	0	0	0	0	0	0	0	0
48.3	KRI	4 055	0	0	4 055	0	0	0	0	0	0	0	0
48.3	ANI	4 091	4 091	0	0	0	0	0	<1	0	0	0	<1
58.5.2	ANI	1	1	0	0	3	0	<1	0	<1	0	<1	<1
58.5.2	TOT	1 349	0	9	0	14	0	17	0	13	0	1 349	3

Table 21:   Suggested outline of a matrix to list and prioritise observer tasks. See text for further explanation.

User group	Data type	Description	Use	Optimal collection	Practical limitations
FSA	Length frequency (sex-specific)	Target species	Critical input to size- and age-based assessment models.	Random sample from every shot or set.	May not be possible to sample every catch due to time constraints. Limited sample size. The size of the fish.
		By-catch species	Will be required input if size- or age-based assessment models are developed for any of the by-catch species.	Random sample from every shot or set.	May not be possible to sample every catch due to time constraints. Limited sample size.
	Biological (target and by-catch species)	Weight	Used to determine length–weight and age–weight regressions to convert model output in numbers to biomass.		
		Maturity stage and/or gonad weight	Maturity ogives (preferably determined annually) required model input.		
		Otoliths	Required input to age-based models.		
	Catch composition	Estimates of total removals per species. Note this requires estimation of additional mortality, e.g. discards, fish lost from lines, depredations etc.	Estimates of total removals are essential input to assessment models. Estimates of the fate (survivorship) of live released animals needed to estimate total mortality.		
	Tagging	Tag and recapture information (toothfish and skates)	Used in tag–recapture assessment models.	Data on all tagged and recaptured animals and on the number of animals examined for tags.	
	Vessel sightings	Reports of unknown and IUU vessels active in the area.	Estimates of IUU catch included as part of the total removals for stock assessment models.		
	Conversion factors	Relationship between processed and green weight.	Used to estimate the green weight from the reported processed weight.		

(continued)

Table 21 (continued)

User group	Data type	Description	Use	Optimal collection	Practical limitations
IMAF	Incidental mortality	Record mortality of seabirds and marine mammals.	Estimate mortalities within the Convention Area caused by fishing.		
IMAF	Seabirds and marine mammal interactions with fishing gear	Record entanglement and injury to seabirds and marine mammals.	Estimate mortalities within the Convention Area caused by fishing.		
IMAF		Trawl warp strikes	Estimate mortalities within the Convention Area caused by trawling.		
IMAF	Implementation of mitigation measures	Description and specification of mitigation measures (L2 data).	To assess the performance of the measures to review attainment of minimum requirements.		
IMAF	Interactions with predators	Fish depredation			
SCIC	Implementation of mitigation measures	Data related to compliance with various elements of mitigation measures in force.	To evaluate compliance with various mitigation measures in force.		
SCIC	Vessel sightings	Reports of unknown and IUU vessels active in the area.	Used to monitor IUU activity.		
Scientific Committee	Fishery statistics and biological data for both target and by-catch species	Review of summarised observer data on removals of target and by-catch species.	To evaluate performance of conservation measures in force.		
Scientific Committee	Implementation of mitigation measures	Review of summarised observer data on incidental mortality and mitigation measures.	To evaluate performance of conservation measures in force.		

Table 22: List of tasks identified by WG-FSA for the 2007/08 intersessional period. The paragraph numbers (Ref.) refer to this report. E – established practice. Priority: high priority (1); general request (2).

	Task	Ref.	Priority	Action required Members/Subgroups	Action required Secretariat
	Organisation of the meeting				
1.	Submit papers to WG-FSA-08 in accordance with the guidelines.	E	1	Members to implement	Coordinate and implement
2.	Circulate list of documents with agenda items at start of meeting.	E	1	Convener to implement	Assist
	Review of available information				
3.	Submit data in a timely manner and using current CCAMLR formats.	E	1	Members to implement	Assist
4.	Process fishery, observer and survey data submitted to CCAMLR.	E	1		Implement
5.	Validate data and liaise with Members to resolve inconsistencies.	E	1	Members to assist	Implement
6.	To the extent possible, update the tables, figures and general text of data in the Fishery Reports, and add a section on the history of the development of catch limits.	13.11	1		Implement
7.	Update estimates of reported catches, catches from IUU fishing and total removals by season and area within the Convention Area.	E	1	Members to provide information on IUU fishing by 1 October	Implement
8.	Update estimates of catches reported in CDS data by season and area outside the Convention Area.	E	1		Implement
9.	Update information on scientific observations.	E	1		Implement
10.	Update Fishery Plans.	E	2		Implement
11.	Notify research surveys.	E	1	Members to implement	
12.	Conduct statistical evaluation of new methods to assess the performance of new gear, its selectivity and impact on ecosystem components.	E	2	Members to implement	
13.	Provide information of the sustainability of the *Dissostichus* resource on the Scotia Ridge.	3.19	2	Members to implement	Archive

Task	Ref.	Priority	Action required	
			Members/Subgroups	Secretariat
Assessments and management advice				
14. Investigate reasons for differences between rates that tags were recaptured from those released by vessels from different nations, and advise on how to resolve these observed differences.	3.36, 5.49, 5.106	1	Scientific Committee and Commission to consider	
15. Continue the tagging experiment in Subarea 48.4, so that further data can be collected which may allow estimates of abundance to be calculated in the future.	3.41, 5.175	1	Members to implement	
16. Review compliance with requirements in exploratory fisheries and advise on the information which WG-FSA should provide to SCIC in future to allow it address this issue.	3.43	1	SCIC to consider	
17. Revise C2 data form.	6.56, 7.5, 10.6	1	Members to implement	Implement
18. Develop management strategy evaluations.		1	Members to implement	
Fish and invertebrate by-catch				
19. Review and further develop the assessment of the status of by-catch species and groups, estimation of by-catch levels and rates, assessment of risk and mitigation measures.	13.4	1	Subgroup on By-catch to coordinate	Assist
20. Plan and develop the requirements for the Year of the Skate in 2008/09.	13.4	1	Coordination group to implement	Assist
21. Understand variations in reported by-catch rates between Members, and between different areas.	5.51	1	Members to implement	Assist
22. Bring all rajids on board, where possible, prior to release.	6.38	1	Members to implement	
23. Provide data for the analysis of by-catch at the start of the meeting.	E	1	Subgroup on By-catch to coordinate	Implement
24. Conduct further research to explore any negative effects of new by-catch exclusion devices on the survival rate of skates.	10.7	1	Members to implement	

Task	Ref.	Priority	Action required	
			Members/Subgroups	Secretariat
Evaluation of threats arising from IUU activities				
25. Review and further develop approaches for improved estimation of IUU fishing and total removals and develop the time series of catches estimated from IUU fishing.	13.4	1	Subgroup on IUU Fishing to coordinate	Assist
26. Consider including a measure of the local density of licensed vessels in the tables WG-FSA prepared on IUU fishing.	8.3	2		Implement
Biology, ecology and demography of target and by-catch species				
27. Review the literature, identify gaps in knowledge and update and coordinate the development of species profiles.	13.4	1	Subgroup on Biology and Ecology to coordinate	Assist
28. Review and further develop ageing techniques and age estimation, the development of the CCAMLR ageing database, and advise of the distribution of *Dissostichus* spp. in the fisheries in Subarea 58.4 using otolith morphology.	13.4	1	CCAMLR Otolith Network to coordinate	Assist
29. Consider publishing the species profiles in a special volume of *CCAMLR Science* and update an electronic version of these papers continuously thereafter.	9.12, 9.13	2	Authors to implement	Implement
Consideration of ecosystem management				
30. Review the literature and facilitate interactions with WG-EMM and SG-ASAM.	13.4	1	Subgroup on Ecosystem Interactions to coordinate	Assist
31. Further develop close collaboration between WG-FSA and WG-EMM, with a view to holding a workshop in 2009 or 2010.	10.4	2	Members to contribute	Assist
32. Assess the impact the krill fishery might have on recruitment of Antarctic fish and to what extent the krill fishery may add to 'natural' mortality of Antarctic fish at an early stage.	10.9	2	Members to implement	
33. Translate the Russian key to early life stages of Antarctic fish.	10.10	1		Implement
34. Further develop CCAMLR's work on evaluation of the impact of bottom fishing in high-seas areas.	14.40–14.43	1	Scientific Committee and Commission to consider	

Task	Ref.	Priority	Action required	
			Members/Subgroups	Secretariat
New and exploratory fisheries				
35. Conduct the fishery-based research including tagging, outlined in Conservation Measure 41-01, and submit the data to the Secretariat in a timely manner.	5.44, 5.45, 5.50	1	Members to implement	Archive
36. Look out for tagged fish and submit accurate tag–recapture data to the Secretariat in a timely manner.		1	Members to implement	Archive
37. Undertake a depletion analysis for Divisions 58.4.1 and 58.4.2.	5.84	2	Members to implement	Assist
38. Develop the assessments in exploratory fisheries for *Dissostichus* spp. in Subareas 48.6, 58.4 and 88.2.	4.30, 5.48, 12.1	1	Members to implement	Assist
39. Further develop the assessment of *Dissostichus* spp. in Subarea 88.1.	12.5, 12.6	1	Members to implement	Assist
40. Review and further develop the tagging programs and the treatment of tagging data.	13.4	1	Subgroup on Tagging to coordinate	Assist
Scheme of International Scientific Observation				
41. Review and further develop the observer protocols, the *Scientific Observers Manual* and priorities for scientific observers in various fisheries.	13.4	1	Subgroup on the Observer Program to coordinate	Assist
42. Use only current versions of CCAMLR data forms.	E	1	Members to implement	Assist
43. Update the *Scientific Observers Manual* and data forms.	E	1		Implement
44. Produce a photograph tag template, which would be used to place behind the tag when photographed.	3.48	1	Members to use	Implement
45. Observers/vessels to take time-stamped photographs of all returned tags and forward them to the relevant tagging program coordinator and the Secretariat.	3.46	1	Members to implement	Archive
46. Continue to coordinate the tagging program for toothfish.	E	1	Subgroup on Tagging to provide guidance	Implement
47. Administer the tagging program for skates during the Year of the Skate.	3.49–3.51, 3.56	1	Subgroup on Tagging to provide guidance	Implement

|	Task	Ref.	Priority	Action required	
				Members/Subgroups	Secretariat
48.	Consider the applications of new technology to investigate key uncertainties for toothfish stocks, such as fish behaviour and movement.	3.52	2	Members to implement	Assist
49.	Place the protocols for tagging very large toothfish, and plans for equipment to assist with handling such fish described in WG-FSA-07/36, on the CCAMLR website, and advise technical coordinators.	3.53	1	Members to implement	Implement
50.	Revise observer data forms.	6.50, 6.51, 6.55	1	Members to implement	Implement
51.	Contribute to the work of the ad hoc Technical Group.	11.11	1	Members to implement	Assist
	Future assessments				
52.	Further develop the assessment of *D. eleginoides* in Subarea 48.3.	12.2	1	Members to implement	Assist
53.	Further develop the assessment of *D. eleginoides* in Division 58.5.2.	12.3	1	Members to implement	Assist
54.	Further develop the assessment of *D. eleginoides* in the South African EEZ.	12.4	1	Members to implement	Assist
55.	Further develop the assessments of *D. eleginoides* in the French EEZs.	5.124, 5.144	1	Members to implement	Assist
56.	Further develop the assessment of *C. gunnari* in Subarea 48.3.	12.7	1	Members to implement	Assist
57.	Further develop the assessment of *C. gunnari* in Division 58.5.2.	12.8	1	Members to implement	Assist
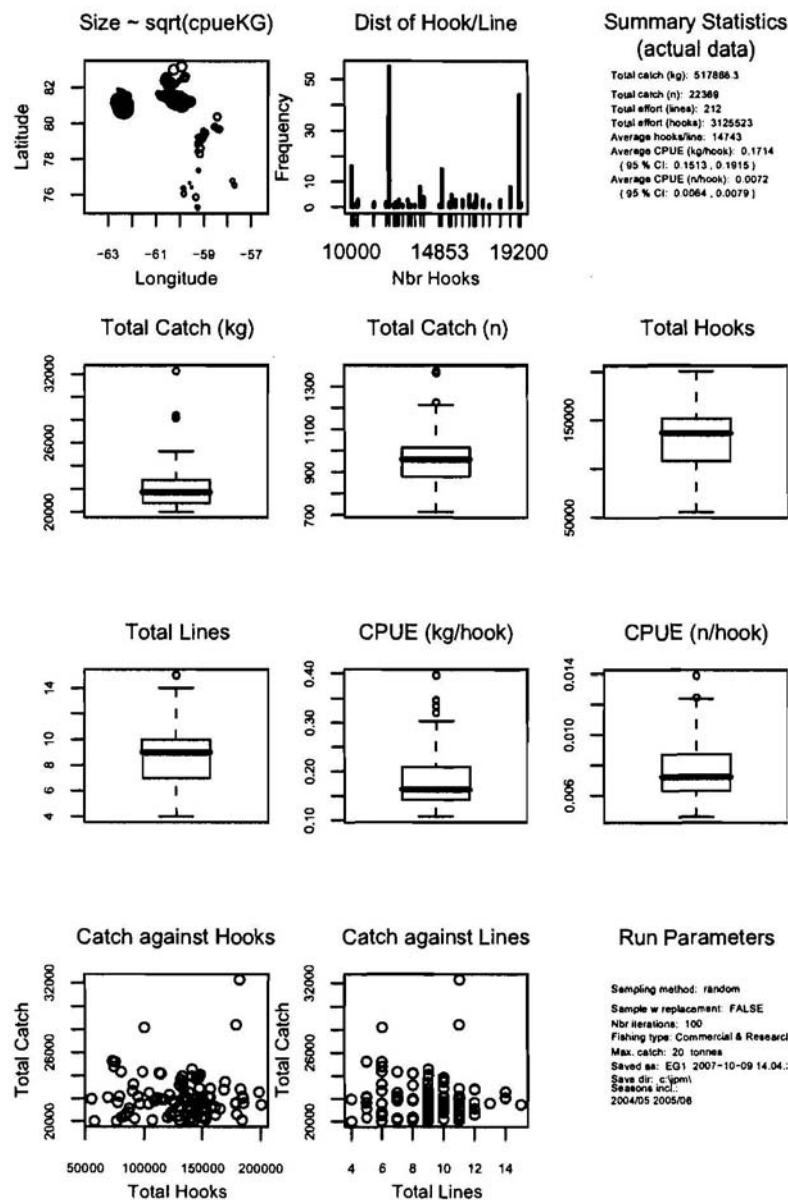
Figure 1: Results from an example run from a simulator to examine the precision of estimates of CPUE expected from a longline survey of *Dissostichus* species when a catch limit is fixed for the survey. Simulation trials are based on actual fisheries data for an area extracted from the CCAMLR database (in this case Division 58.4.3b). Details for each row of panels are:

Top row – summaries of the data selected in the simulation along with their summary statistics, including a bubble plot showing catches of shots and their locations, as well as the frequency of lines with different numbers of hooks.

Second and third rows – box plots summarising the outcomes from the replicate trials (100 in this case) indicating the total catch (kg and number) taken in the survey and total hooks and lines deployed, and the resulting estimates of mean CPUE (in kg and number of fish).
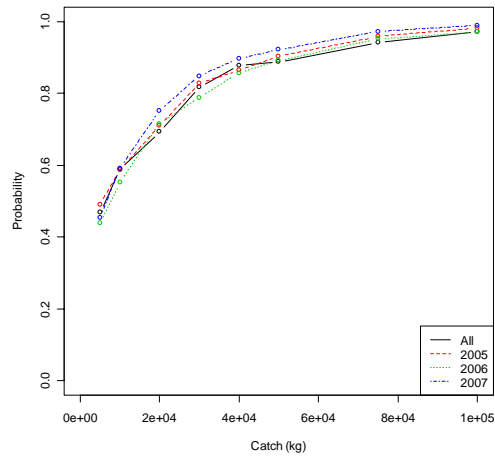
Fourth row – simple plots of total catch against total hooks for each replicate and total lines deployed, along with the parameters of the run.

Division 58.4.1
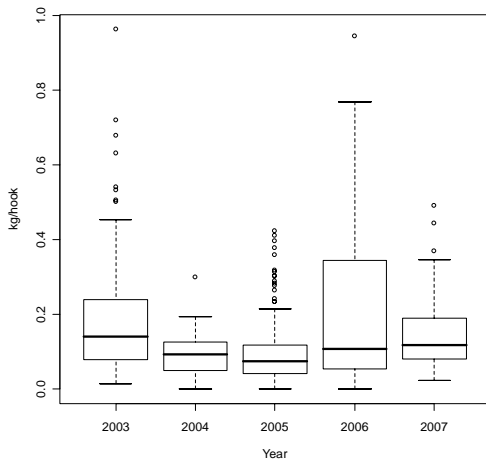
Total hooks – 9 080 386; Total catch – 1 535 204 kg
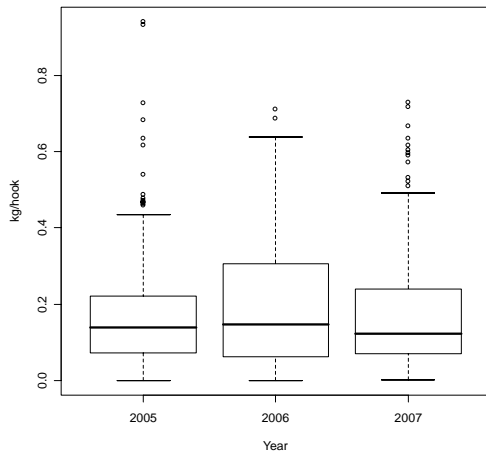
Division 58.4.2

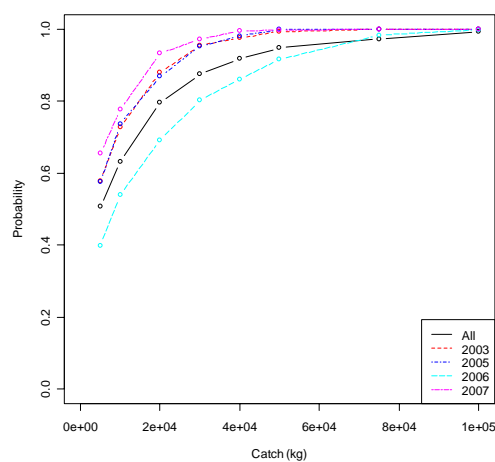Total hooks – 3 827 955; Total catch – 540 527.1 kg

Figure 2: Results of simulation trials of the probability that the mean CPUE estimated from a longline survey for *Dissostichus* species is within 25% of the true CPUE when a catch limit is fixed for the survey. Simulation trials are based on actual fisheries data for an area extracted from the CCAMLR database. Right panels summarise the data extracted for an area for each year of data. Left panels show the probabilities of the estimated CPUE being within 25% of the true value for a range of survey catch limits. In these trials, the probabilities were determined for all data pooled into a single trial and then trials undertaken for each year for which there was sufficient data to do the simulation. Results are shown for data from Divisions 58.4.1, 58.4.2, 58.4.3b and 58.4.4.

Division 58.4.3b

Total hooks – 6 708 084; Total catch – 919 975 kg
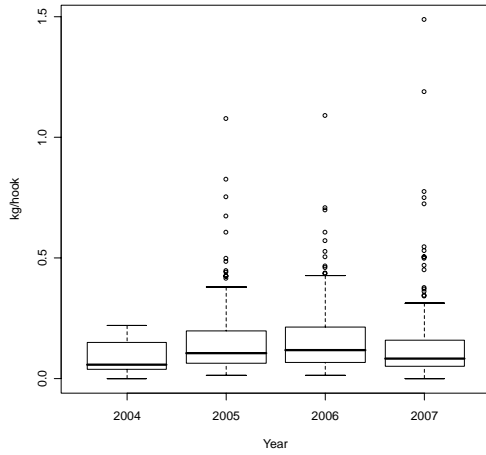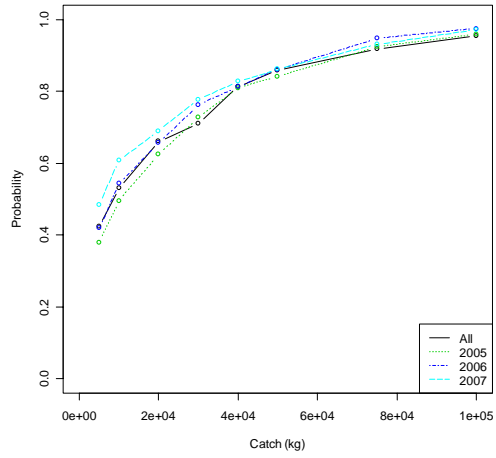
Division 58.4.4

Total hooks – 1 795 685; Total catch – 149 170.3 kg
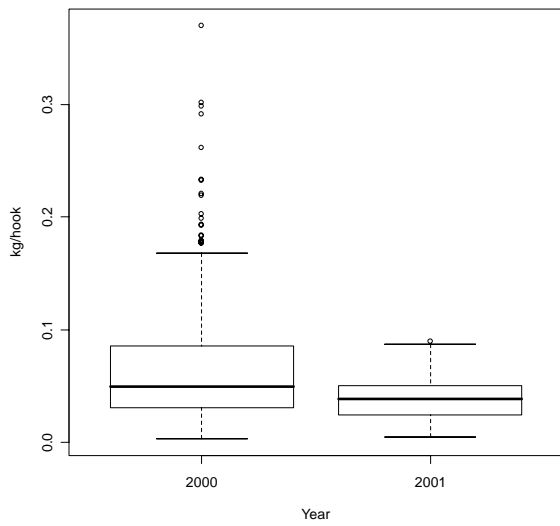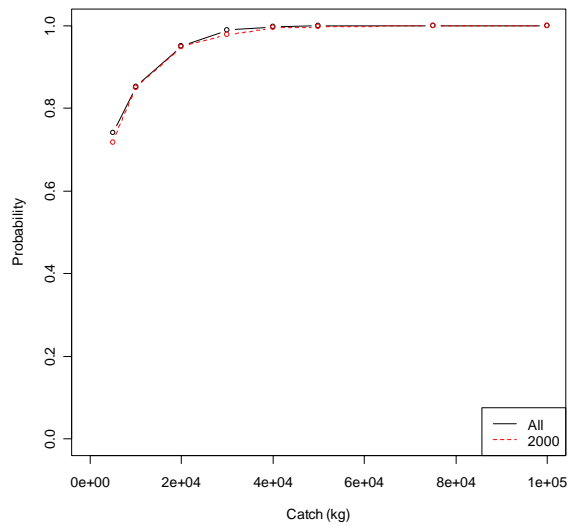
Figure 2 (continued)
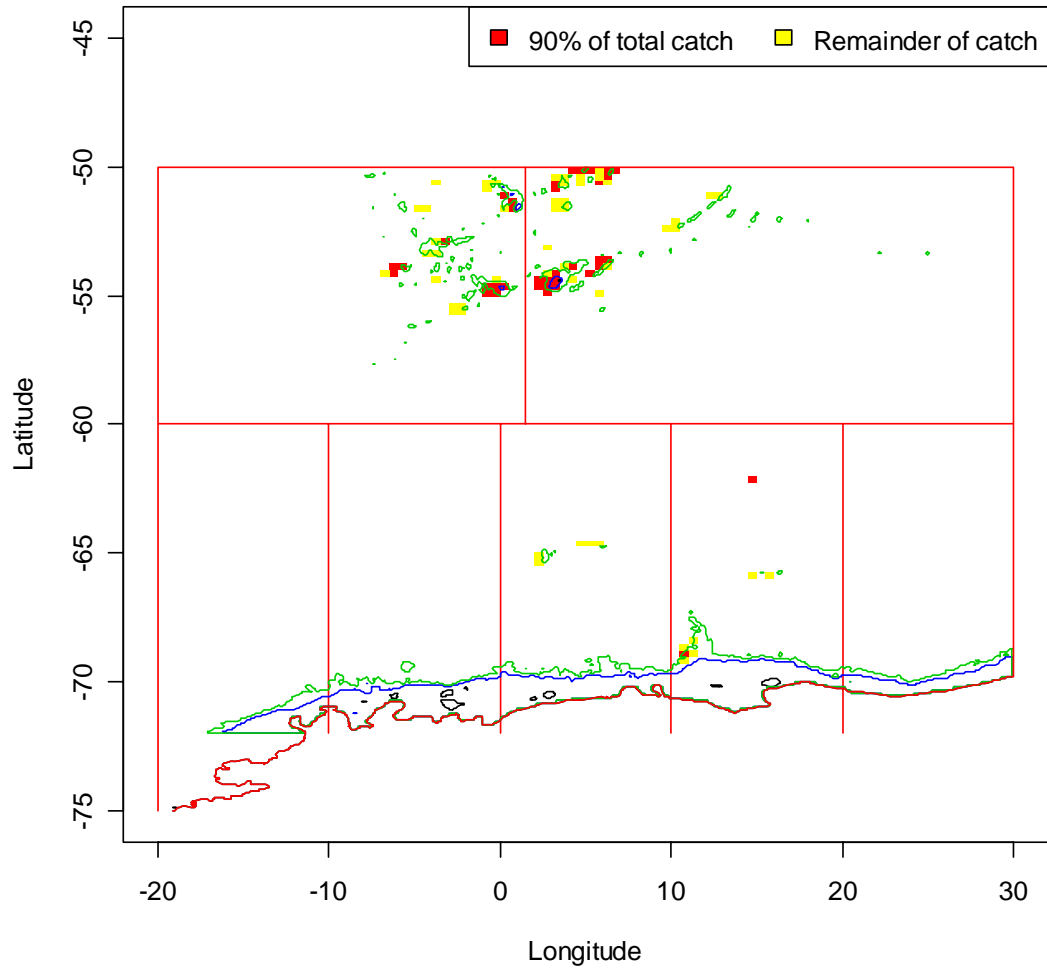
Figure 3:   Map of Subarea 48.6 showing the proposed subdivision of the existing northern SSRU A into two smaller SSRUs. This map also includes the catch information discussed in section 14 (see Figure 8).

Leslie Depletion for Ground A (weight), Banzare Bank Antarctic Toothfish
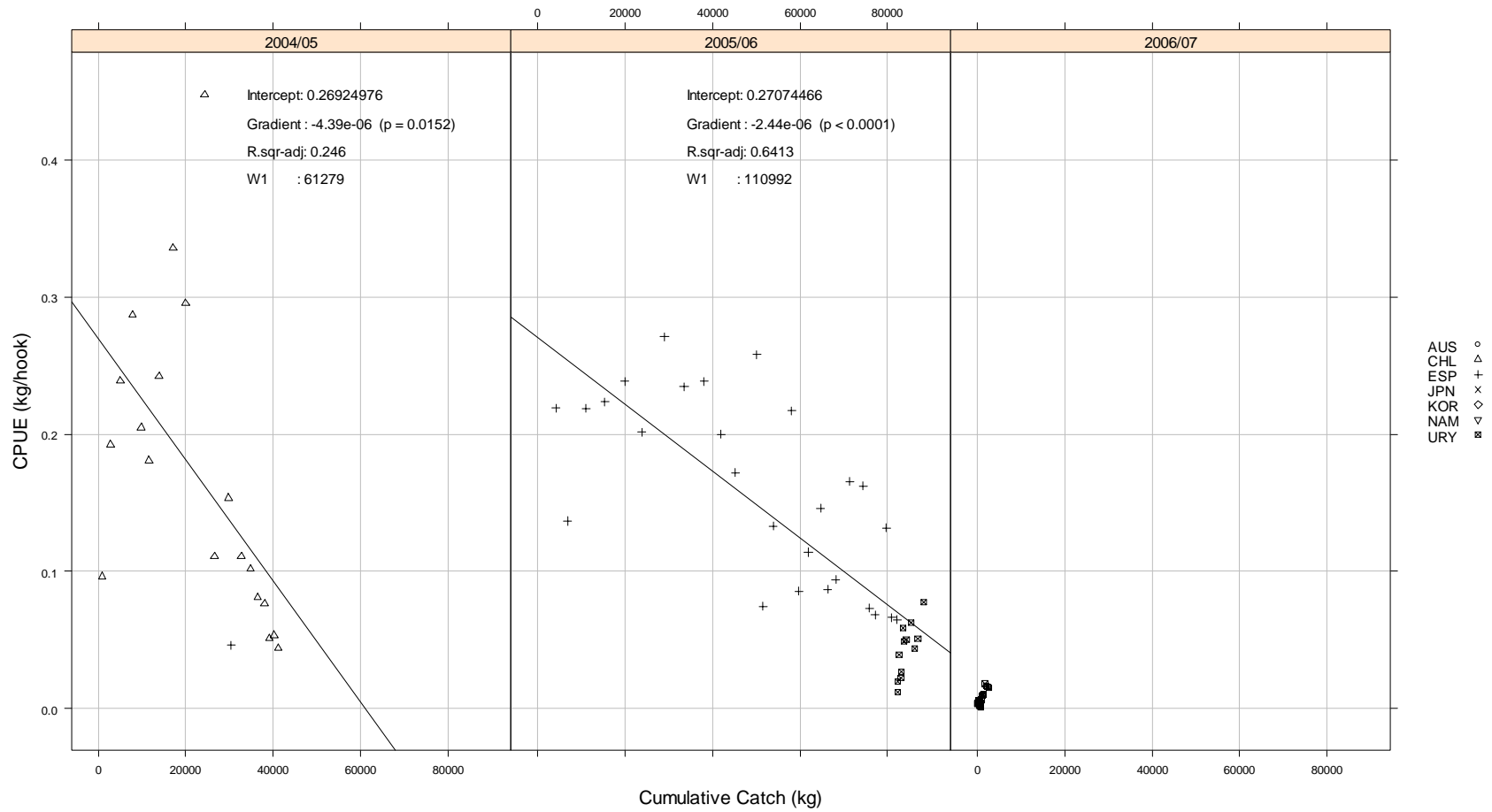
Figure 4:   Plots of CPUE (kg/hook) against cumulative catch (kg) of *Dissostichus mawsoni* for primary fishing grounds A and B in Division 58.4.3b (BANZARE Bank) in seasons 2003/04–2006/07. Fitted regression lines have been added to those relationships showing a significant negative slope, indicating significant depletion of available toothfish biomass within the 2004/05 and 2005/06 seasons. CPUE in 2006/07 is shown to be consistently very low in Ground A. Panel inserts show regression parameters and estimates of initial biomass in kilograms (W1).

(continued)

Leslie Depletion for Ground B (weight), Banzare Bank Antarctic Toothfish

2003/04
Intercept: 0.21658274
Gradient : -1.942e-05 (p = 0.1341)
R.sqr-adj: 0.222
W1 : 11153

2004/05
Intercept: 0.53323493
Gradient : -2.21e-06 (p < 0.0001)
R.sqr-adj: 0.3848
W1 : 241013

2005/06
Intercept: 0.42125917
Gradient : -2.44e-06 (p < 0.0001)
R.sqr-adj: 0.3574
W1 : 172340

2006/07

AUS ○
CHL △
ESP +
JPN ×
KOR ◇
NAM ▽
URY ⊠

CPUE (kg/hook)

Cumulative Catch (kg)
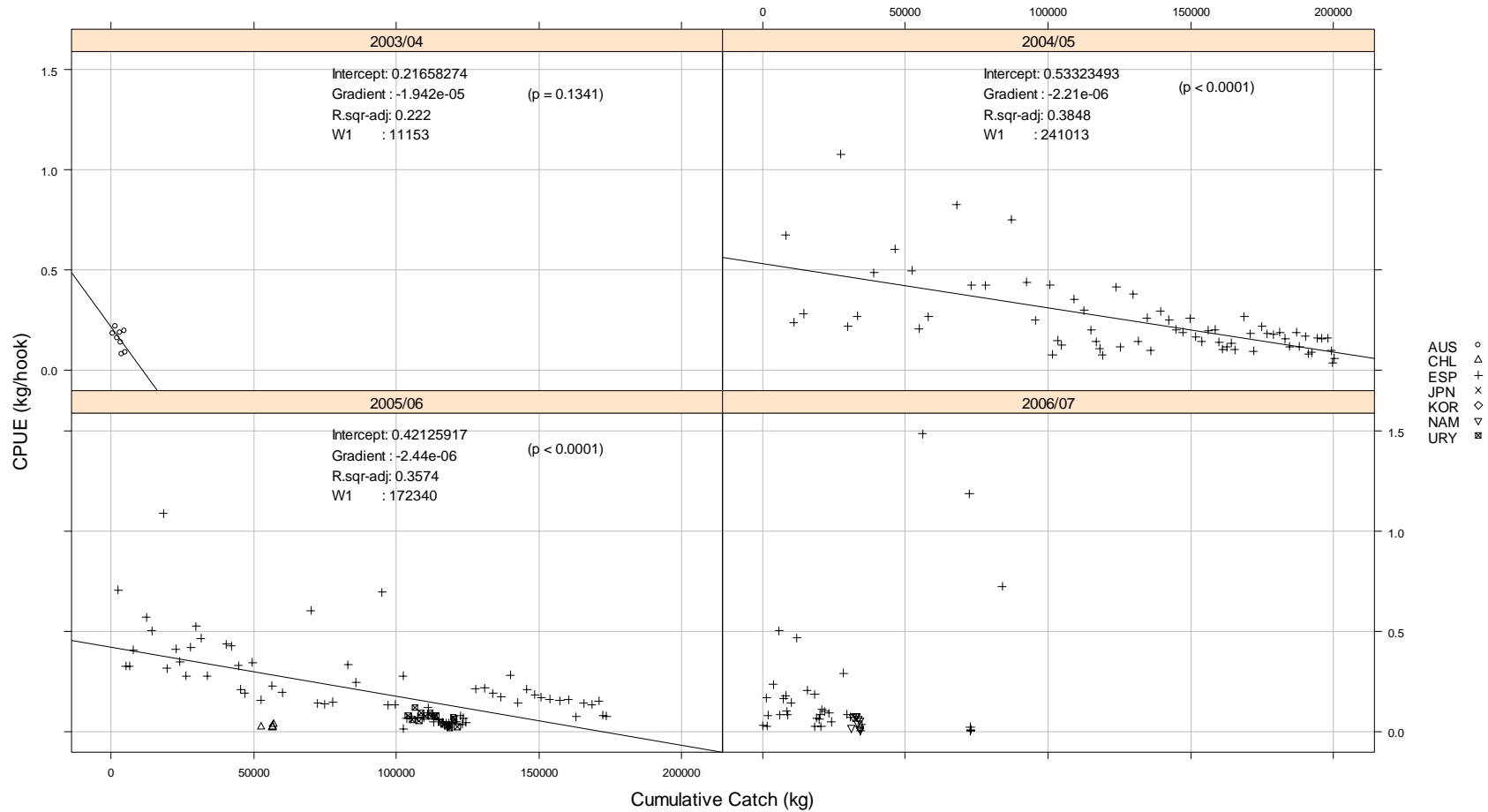
Figure 4 (continued)

Figure 5: Map of Division 58.4.3b showing the proposed subdivision into two small SSRUs. This map also includes the catch information discussed in section 14 (see Figure 11).
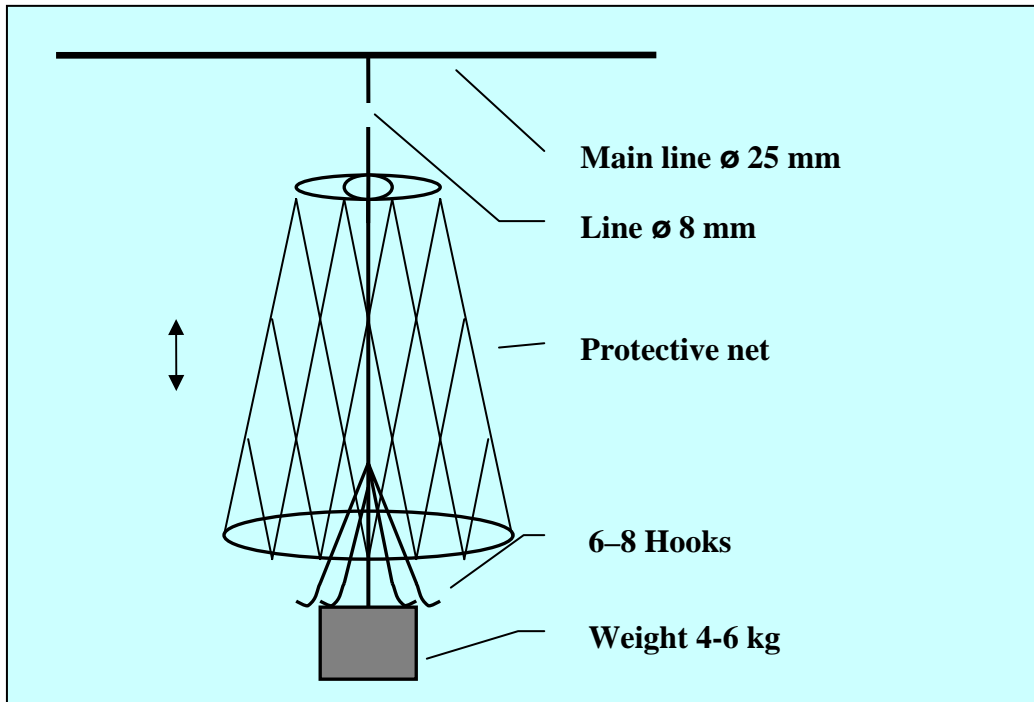
Figure 6: Cetacean exclusion device in a Russian longliner fishing off the Patagonian shelf as described in WG-FSA-07/11.
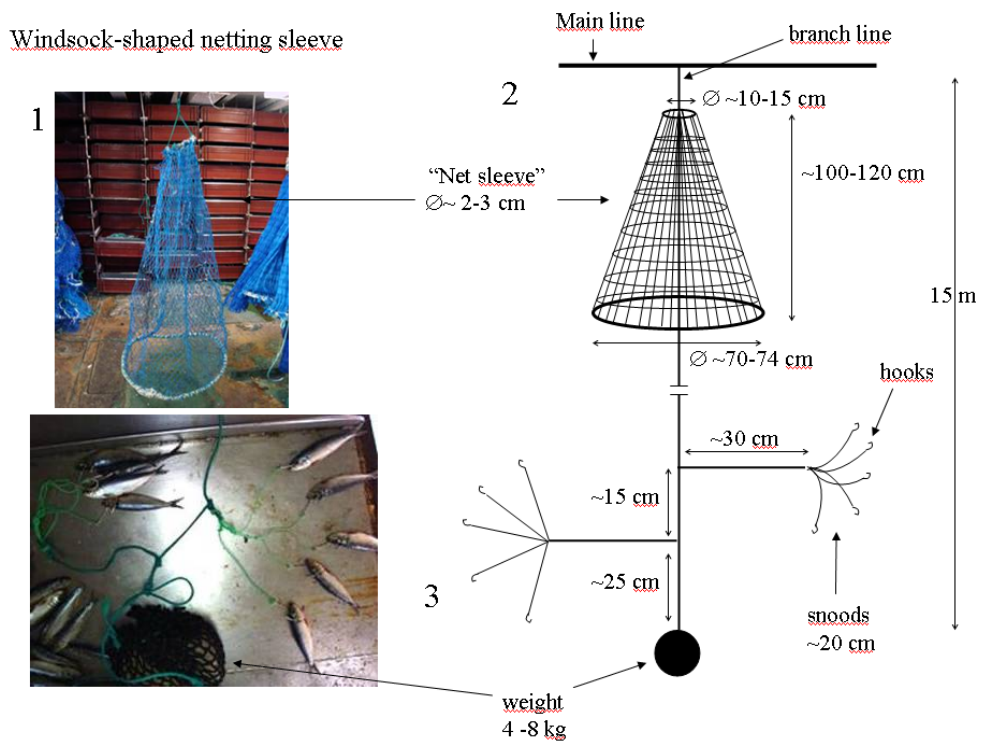
Figure 7: Cetacean exclusion device in Chilean longliners fishing off the southwest coast of Chile as described in WG-FSA-07/14.
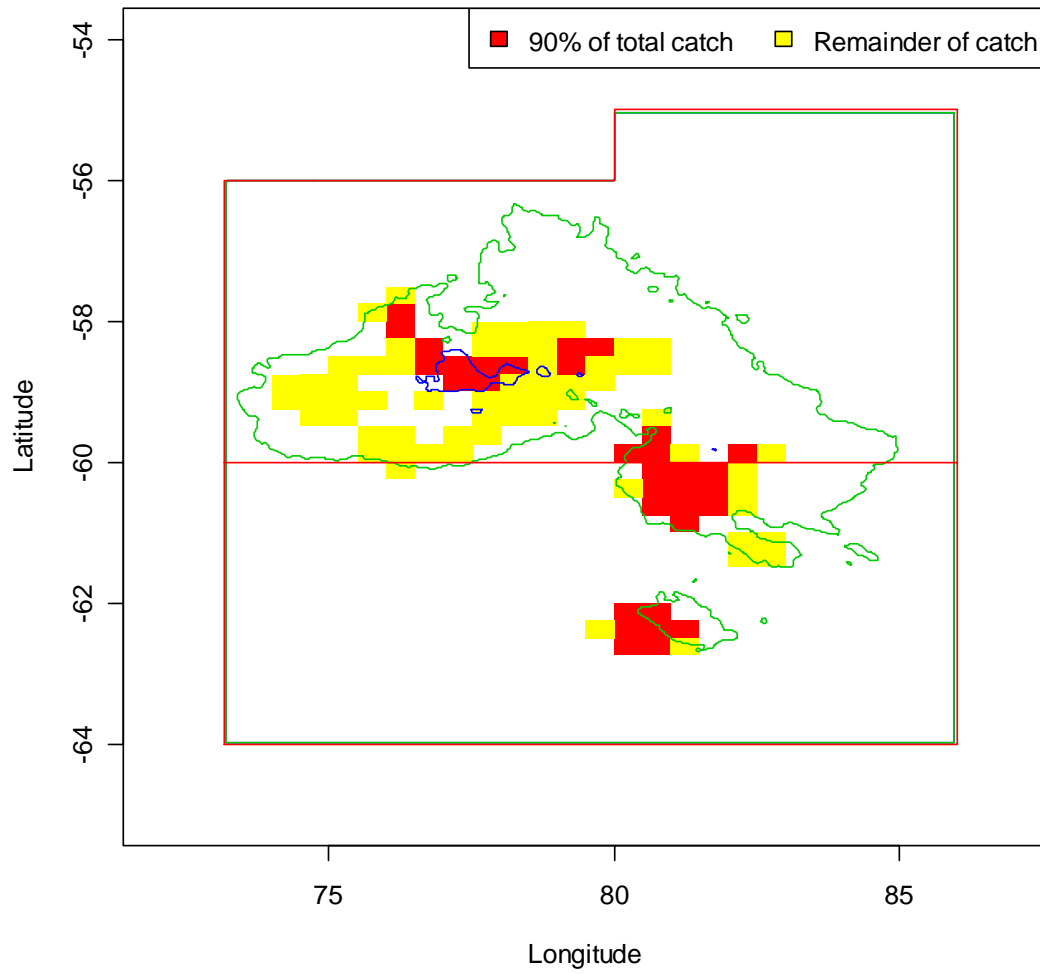
(a)

(b)

Figure 8*:   Effective fishing footprint for longline fishing effort (hooks) in Subarea 48.6 (all years).

(a)   Cumulative proportion for successively ranked cells of total catch of targeted species with cells ranked from highest to lowest (left panel). In the right panel, the total effort (hooks) in each cell is shown in a corresponding position on the y-axis. Dotted horizontal lines on both panels reflect the 90 percentile where the accumulated catch from all cells below the line contribute to 90% of the total catch of targeted species in the area over the sample period.

(b)   Map showing 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. Relative effort in each cell is archived with the Secretariat. Cells contributing to 90% of the total catch of targeted species in the area are shown with red (dark) shading, with the outlier cells contributing to the remainder of the catch shown with yellow (light) shading.

(a)

(b)

Figure 9*: Effective fishing footprint for longline fishing effort (hooks) in Division 58.4.1 (all years).

(a) Cumulative proportion for successively ranked cells of total catch of targeted species with cells ranked from highest to lowest (left panel). In the right panel, the total effort (hooks) in each cell is shown in a corresponding position on the y-axis. Dotted horizontal lines on both panels reflect the 90 percentile where the accumulated catch from all cells below the line contribute to 90% of the total catch of targeted species in the area over the sample period.

(b) Map showing 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. Relative effort in each cell is archived with the Secretariat. Cells contributing to 90% of the total catch of targeted species in the area are shown with red (dark) shading, with the outlier cells contributing to the remainder of the catch shown with yellow (light) shading.

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* This figure is available in colour on the 'Publications' page of the CCAMLR website www.ccamlr.org/pu/e/e_pubs/sr/07/toc.htm.
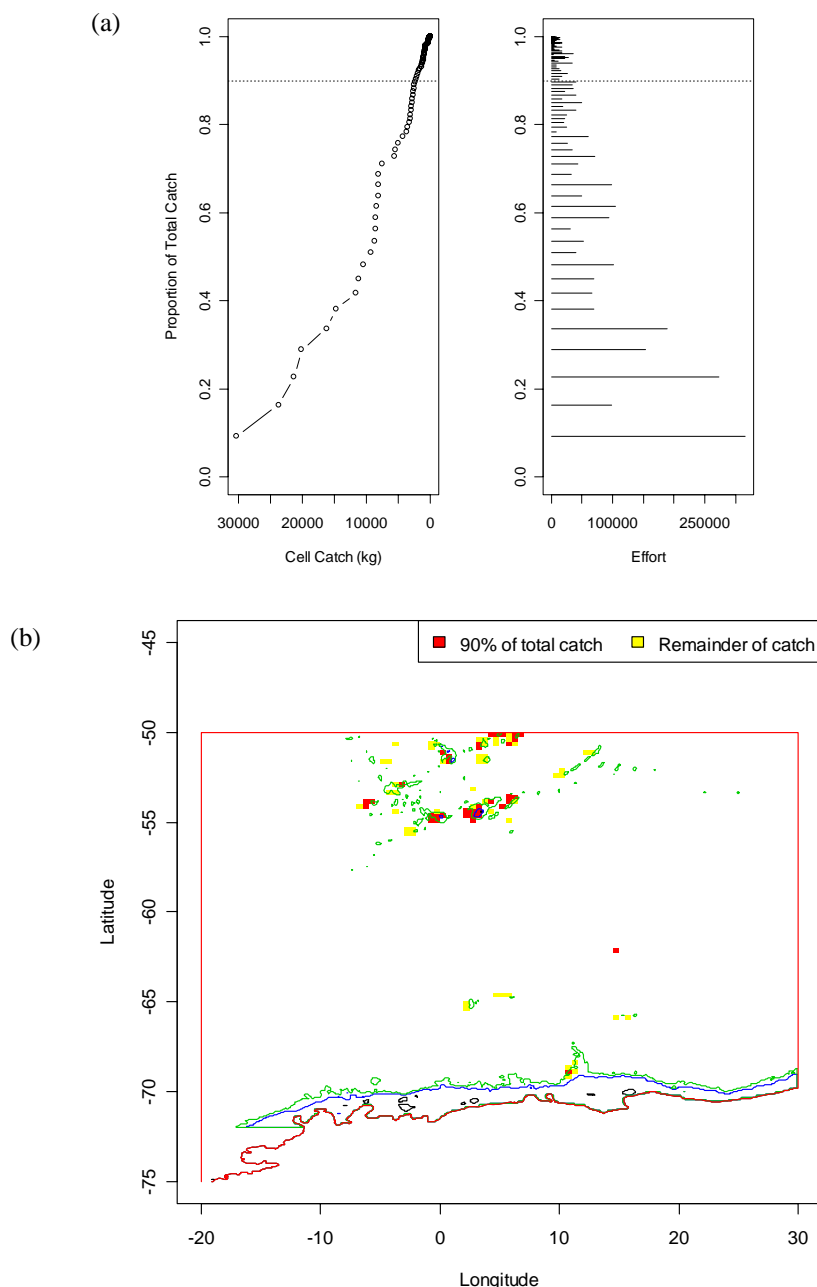
(a)

(b)

Figure 10*: Effective fishing footprint for longline fishing effort (hooks) in Division 58.4.2 (all years).

(a) Cumulative proportion for successively ranked cells of total catch of targeted species with cells ranked from highest to lowest (left panel). In the right panel, the total effort (hooks) in each cell is shown in a corresponding position on the y-axis. Dotted horizontal lines on both panels reflect the 90 percentile where the accumulated catch from all cells below the line contribute to 90% of the total catch of targeted species in the area over the sample period.

(b) Map showing 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. Relative effort in each cell is archived with the Secretariat. Cells contributing to 90% of the total catch of targeted species in the area are shown with red (dark) shading, with the outlier cells contributing to the remainder of the catch shown with yellow (light) shading.

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* This figure is available in colour on the 'Publications' page of the CCAMLR website www.ccamlr.org/pu/e/e_pubs/sr/07/toc.htm.
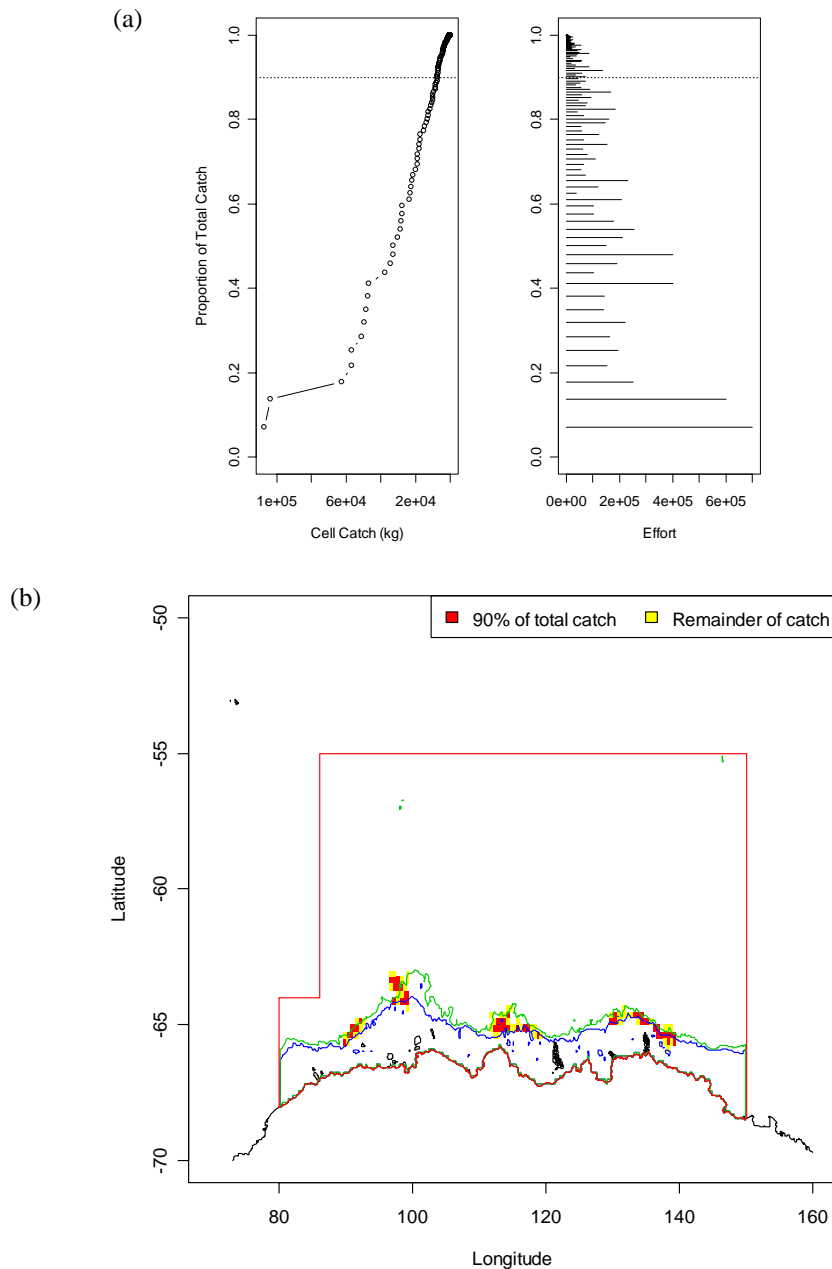
Figure 11*: Effective fishing footprint for longline fishing effort (hooks) in Division 58.4.3a (all years).

(a)   Cumulative proportion for successively ranked cells of total catch of targeted species with cells ranked from highest to lowest (left panel). In the right panel, the total effort (hooks) in each cell is shown in a corresponding position on the y-axis. Dotted horizontal lines on both panels reflect the 90 percentile where the accumulated catch from all cells below the line contribute to 90% of the total catch of targeted species in the area over the sample period.

(b)   Map showing 1 000 m isobath (blue), 2 000 m isobath (green) and the statistical boundary (red). Cells are 0.25° latitude by 0.5° longitude. Relative effort in each cell is archived with the Secretariat. Cells contributing to 90% of the total catch of targeted species in the area are shown with red (dark) shading, with the outlier cells contributing to the remainder of the catch shown with yellow (light) shading.
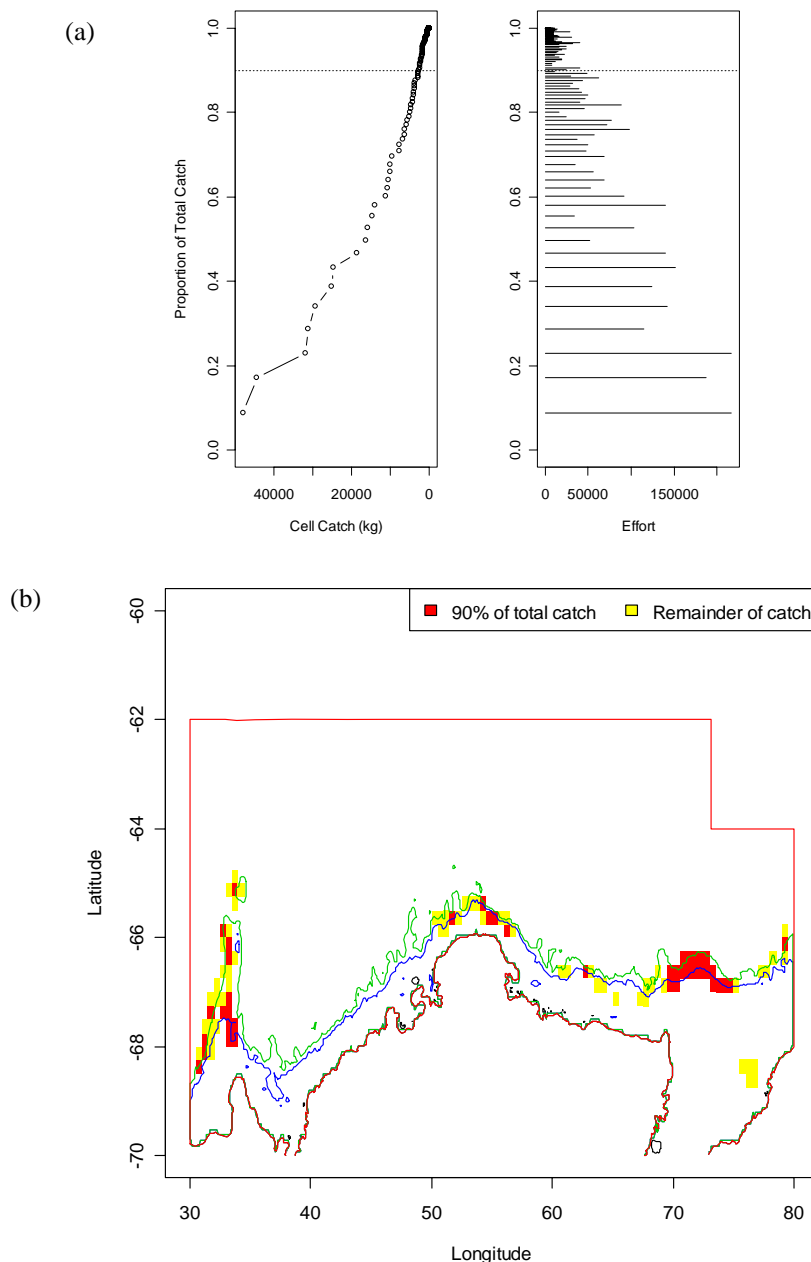

(a)

(b)

Figure 12*: Effective fishing footprint for longline fishing effort (hooks) in Division 58.4.3b (all years).

(a)   Cumulative proportion for successively ranked cells of total catch of targeted species with cells ranked from highest to lowest (left panel). In the right panel, the total effort (hooks) in each cell is shown in a corresponding position on the y-axis. Dotted horizontal lines on both panels reflect the 90 percentile where the accumulated catch from all cells below the line contribute to 90% of the total catch of targeted species in the area over the sample period.

(b) Map showing 1 000 m isobath (dark), 2 000 m isobath (light) and the statistical boundary (straight line).   Cells are 0.25° latitude by 0.5° longitude.   Relative effort in each cell is archived with the Secretariat. Cells contributing to 90% of the total catch of targeted species in the area are shown with red (dark) shading, with the outlier cells contributing to the remainder of the catch shown with yellow (light) shading.

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*   This figure is available in colour on the 'Publications' page of the CCAMLR website www.ccamlr.org/pu/e/e_pubs/sr/07/toc.htm.
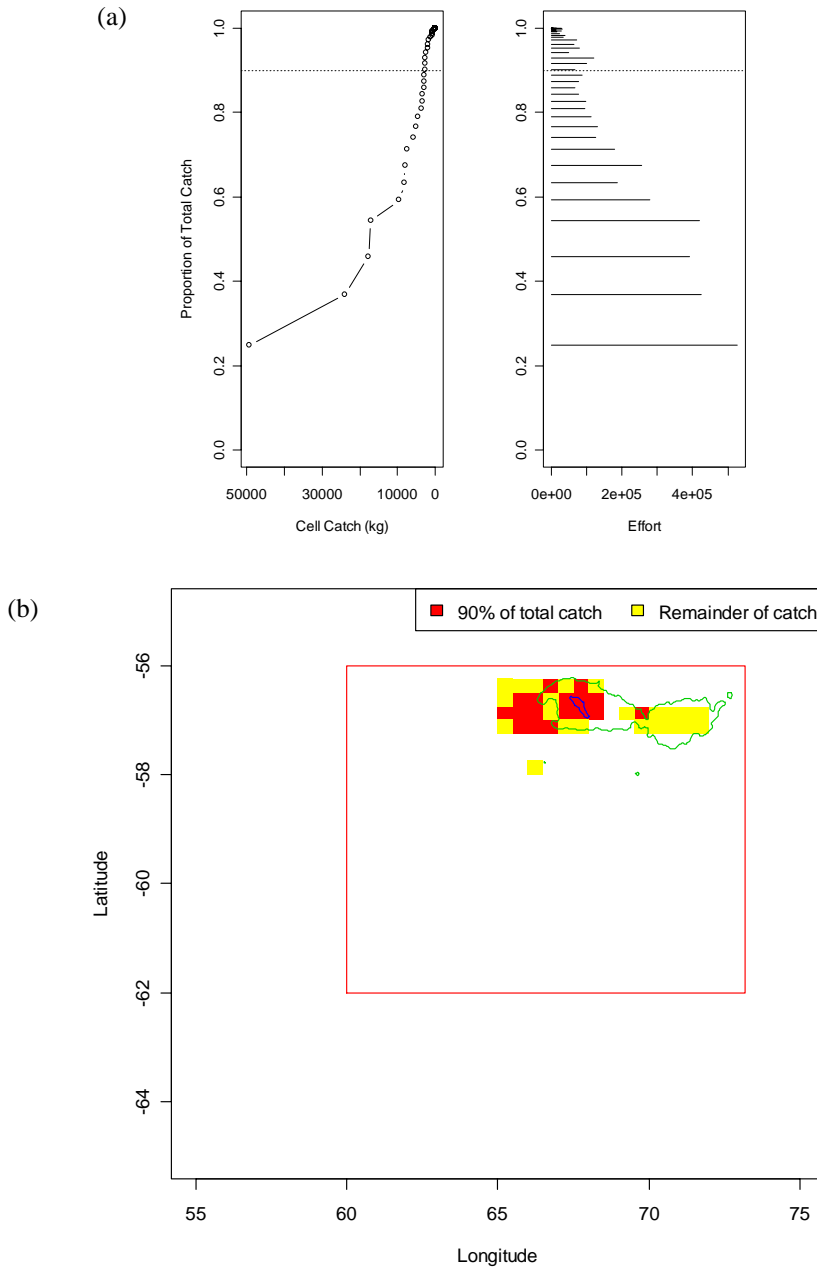
(a)

(b)

Figure 13*:   Effective fishing footprint for longline fishing effort (hooks) in Division 58.4.4 (all years).

(a)   Cumulative proportion for successively ranked cells of total catch of targeted species with cells
ranked from highest to lowest (left panel). In the right panel, the total effort (hooks) in each cell is shown
in a corresponding position on the y-axis. Dotted horizontal lines on both panels reflect the 90 percentile
where the accumulated catch from all cells below the line contribute to 90% of the total catch of targeted
species in the area over the sample period.

(b)   Map showing 1 000 m isobath (blue), 2 000 m isobath (green) and the statistical boundary (red).
Cells are 0.25° latitude by 0.5° longitude. Relative effort in each cell is archived with the Secretariat.
Cells contributing to 90% of the total catch of targeted species in the area are shown with red (dark)
shading, with the outlier cells contributing to the remainder of the catch shown with yellow (light)
shading.

(a)

(b)

Figure 14*: Effective fishing footprint for longline fishing effort (hooks) in Subarea 88.1 (all years).

(a) Cumulative proportion for successively ranked cells of total catch of targeted species with cells ranked from highest to lowest (left panel). In the right panel, the total effort (hooks) in each cell is shown in a corresponding position on the y-axis. Dotted horizontal lines on both panels reflect the 90 percentile where the accumulated catch from all cells below the line contribute to 90% of the total catch of targeted species in the area over the sample period.

(b) Map showing 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. A plot showing total effort in each cell is archived with the Secretariat. Cells contributing to 90% of the total catch of targeted species in the area are shown with red (dark) shading, with the outlier cells contributing to the remainder of the catch shown with yellow (light) shading.

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* This figure is available in colour on the 'Publications' page of the CCAMLR website www.ccamlr.org/pu/e/e_pubs/sr/07/toc.htm.
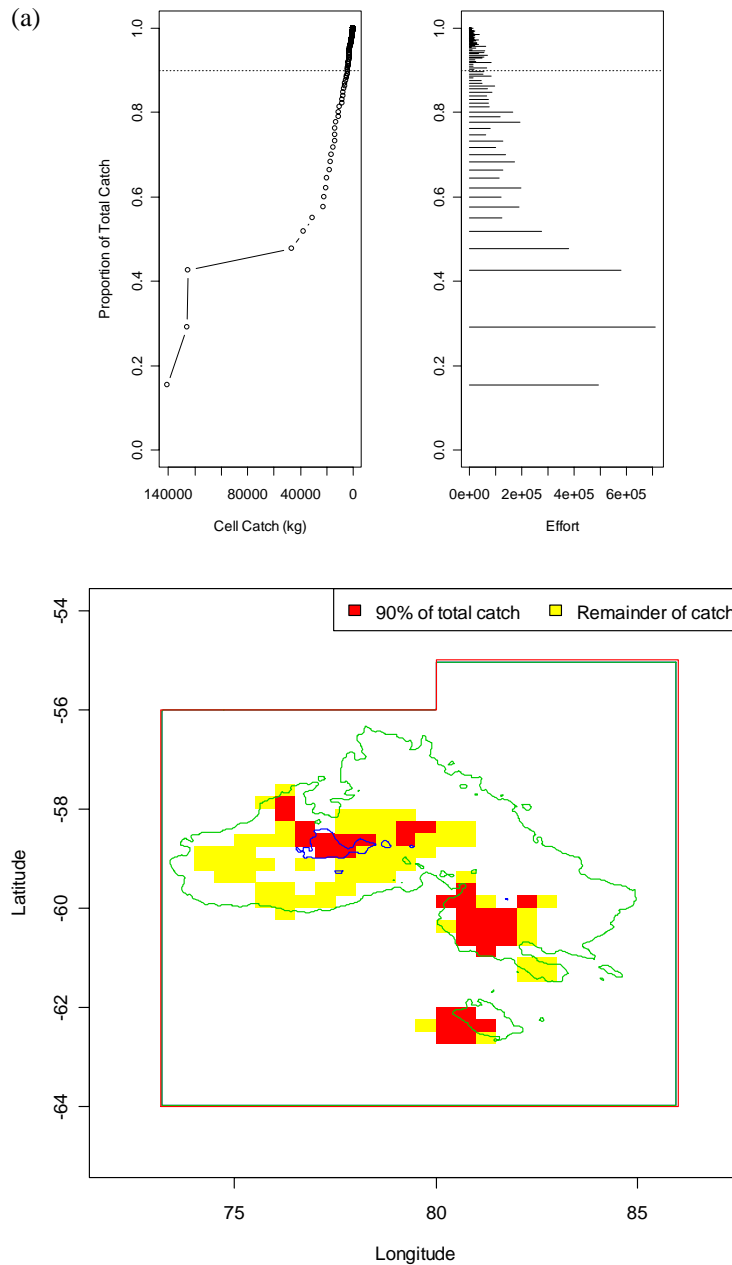
381

(a)

(b)
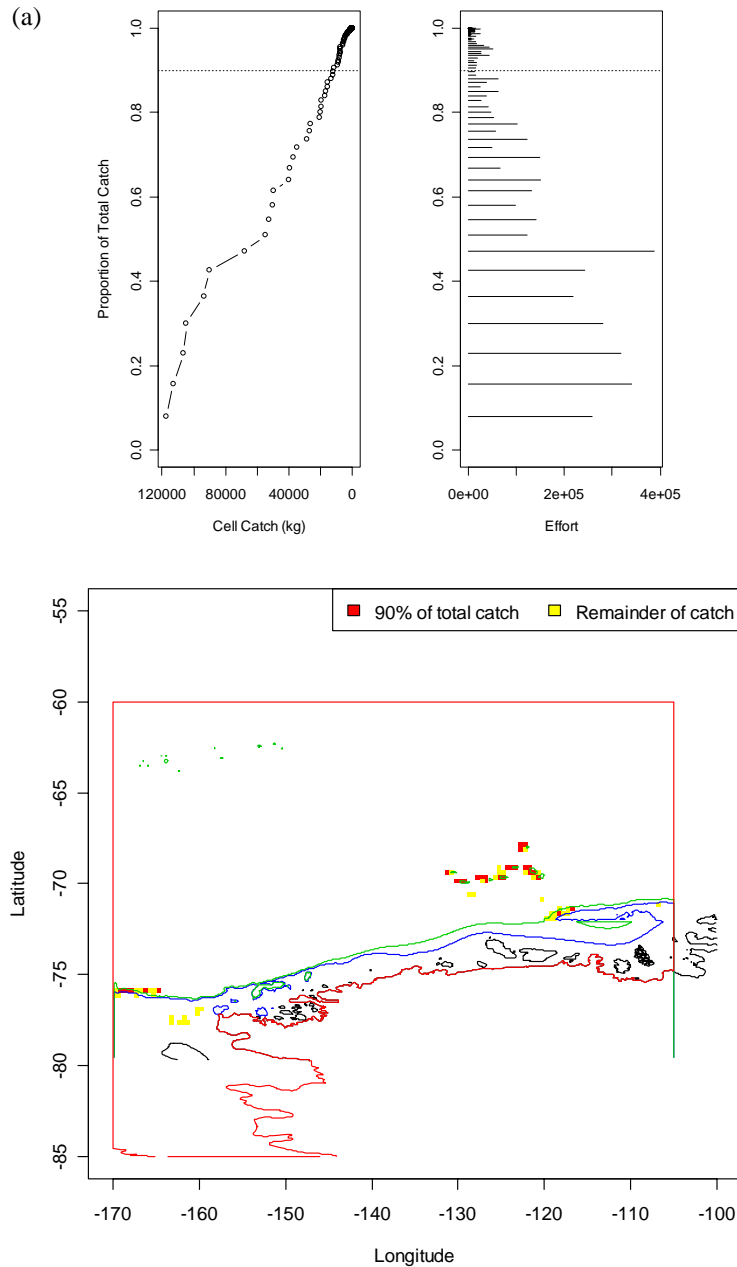
Figure 15*: Effective fishing footprint for longline fishing effort (hooks) in Subarea 88.2 (all years).

(a) Cumulative proportion for successively ranked cells of total catch of targeted species with cells ranked from highest to lowest (left panel). In the right panel, the total effort (hooks) in each cell is shown in a corresponding position on the y-axis. Dotted horizontal lines on both panels reflect the 90 percentile where the accumulated catch from all cells below the line contribute to 90% of the total catch of targeted species in the area over the sample period.

(b) Map showing 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. Relative effort in each cell is archived with the Secretariat. Cells contributing to 90% of the total catch of targeted species in the area are shown with red (dark) shading, with the outlier cells contributing to the remainder of the catch shown with yellow (light) shading.
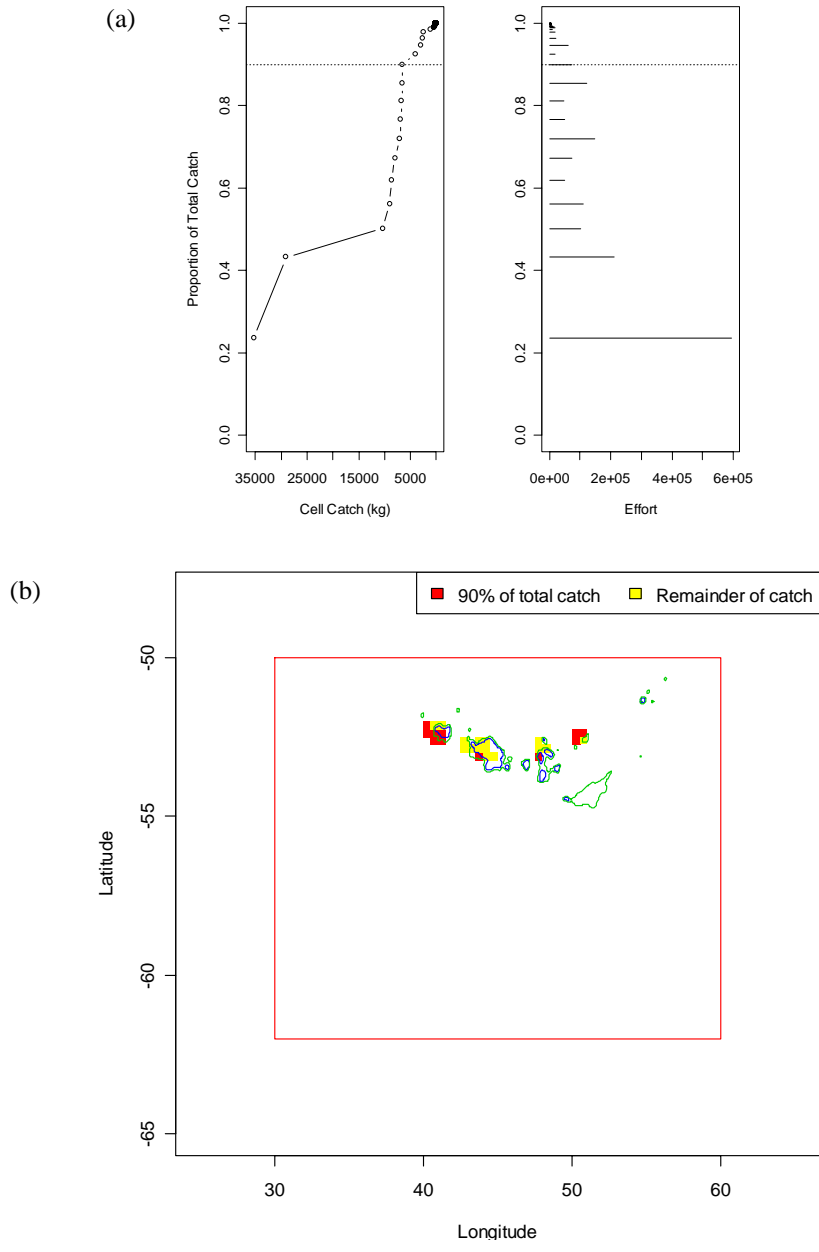

(a)

(b)

Figure 16*: Effective fishing footprint for longline fishing effort (hooks) in Subarea 88.3 (all years).

(a)   Cumulative proportion for successively ranked cells of total catch of targeted species with cells ranked from highest to lowest (left panel). In the right panel, the total effort (hooks) in each cell is shown in a corresponding position on the y-axis. Dotted horizontal lines on both panels reflect the 90 percentile where the accumulated catch from all cells below the line contribute to 90% of the total catch of targeted species in the area over the sample period.

(b)   Map showing 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. Relative effort in each cell is archived with the Secretariat. Cells contributing to 90% of the total catch of targeted species in the area are shown with red (dark) shading, with the outlier cells contributing to the remainder of the catch shown with yellow (light) shading.

Annual proposal to undertake bottom fishing

Evaluate and advise on potential benthic interactions of proposal and ecosystem effects

Open areas (Effective Fishing Footprint)

Areas outside effective fishing footprint

Potentially vulnerable areas

Vulnerable areas (VMEs)

Fisheries Operations Plan

Research and Data Collection Plan

No fishing in current season

Research and Data Collection Plan
Mitigation Development Strategy

Register of Vulnerable Areas
Conservation Management Plan
Mitigation Development Strategy

Season Operations

Move → Fishing area

Research → Shot

Designated Actions in FOP

Observe invertebrate by-catch and other specified data

Report event to Secretariat

higher ← Compare trigger → lower

Update register for interim protection of location across fleet

Designated activities

Figure 17:   Draft annual procedure for managing bottom fisheries in high-seas areas of CCAMLR.

AGENDA

Working Group on Fish Stock Assessment
(Hobart, Australia, 8 to 19 October 2007)

1. Opening of the meeting

2. Organisation of the meeting and adoption of the agenda

   2.1 Organisation of meeting

3. Review of available information

   3.1 Data requirements specified in 2006
       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 Subgroup on Acoustic Survey and Analysis Methods (SG-ASAM)

   4.2 Report from the Working Group on Statistics, Assessments and Modelling
       (WG-SAM)

   4.3 Review of preliminary stock assessment papers

   4.4 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 2006/07
        5.1.2 New and exploratory fisheries notified for 2007/08
        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

    5.2 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	Interactions with WG-EMM
	10.3	Development of ecosystem models

11.	Scheme of International Scientific Observation

	11.1	Summary of information extracted from observer reports and/or provided by technical coordinators

	11.2	Implementation of observer program
		11.2.1	*Scientific Observers Manual*
		11.2.2	Sampling strategies
		11.2.3	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	Intersessional meetings

14.	Other business
	14.1	Bottom fishing in CCAMLR high-seas areas
	14.2	Bioregionalisation

15.	Adoption of the report

16.	Close of the meeting.

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(Hobart, Australia, 8 to 19 October 2007)

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WG-FSA-07/12	Species profile of mackerel icefish (*Champsocephalus gunnari*) K.-H. Kock (Germany) and I. Everson (UK)

WG-FSA-07/13	Autoliners and seabird by-catch: do line setters increase the sink rate of integrated weight longlines? G. Robertson (Australia), J. Williamson, M. McNeill (New Zealand), S. Candy (Australia) and N. Smith (New Zealand) (*CCAMLR Science*, submitted)
WG-FSA-07/14	A new fishing gear in the Chilean Patagonian toothfish fishery to minimise interactions with toothed whales with associated benefits to seabird conservation C.A. Moreno, R. Castro, L.J. Mujica and P. Reyes (Chile) (*CCAMLR Science*, submitted)
WG-FSA-07/15	Line weights of constant mass (and sink rates) for Spanish-rig Patagonian toothfish longline vessels G. Robertson (Australia), C.A. Moreno, E. Gutiérrez (Chile), S.G. Candy (Australia), E.F. Melvin (USA) and J.P. Seco Pon (Argentina) (*CCAMLR Science*, submitted)
WG-FSA-07/16	Biomass abundance and distribution of fish in the Kerguelen Islands' zone (Division 58.5.1) G. Duhamel and M. Hautecoeur (France) (Available in French and English) (*CCAMLR Science*, submitted)
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WG-FSA-07/55	Spawning periods and locations of *Champsocephalus gunnari* in Subarea 48.3 (South Georgia and Shag Rocks): a review S. Clarke, M. Belchier and M.A. Collins
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WG-FSA-07/58	Stones in toothfish stomachs: an unusual source of geological information from closed regions of Antarctic shelf and slope N.V. Kokorin, D.S. Klucharev and M.A. Sukhoruchenkov (Russia)

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WG-FSA-07/P1	The biology of the spiny icefish (*Chaenodraco wilsoni* Regan, 1914) K.-H. Kock, L.V. Pshenichnov, C.D. Jones, J. Gröger and R. Riehl. (*Polar Biol.*, 31 (3): 381–393 (2007))
WG-FSA-07/P2	CCAMLR process of risk assessment to minimise the effects of longline fishing mortality on seabirds S.M. Waugh, G.B. Baker, R. Gales and J.P. Croxall (*Mar. Pol.,* in press)

WG-FSA-07/P3	Distribution, growth, diet and foraging behaviour of the yellow-fin notothen (*Patagonotothen guntheri*) on the Shag Rocks shelf (Southern Ocean) M.A. Collins, R. Shreeve, S. Fielding and M. Thurston (*J. Fish Biol.*, 72 (1): 271–286 (2008))
WG-FSA-07/P4	Distribution and diet of juvenile Patagonian toothfish on the South Georgia and Shag Rocks shelves (Southern Ocean). M.A. Collins, K.A. Ross, M. Belchier, K. Reid. (*Mar. Biol.*, 152: 135–147 (2007)).
WG-FSA-07/P5	Distribution and ecology of *Chaenocephalus aceratus* (Channichthyidae) around South Georgia and Shag Rocks (Southern Ocean). W.D.K Reid, S. Clarke, M.A. Collins and M. Belchier. (*Polar Biol.*, 30 (12): 1523–1533 (2007))
WG-FSA-07/P6	ACAP Seabird Bycatch Working Group. 2007. *Report of the First Meeting of the Seabird Bycatch Working Group of the Agreement on the Conservation of Albatrosses and Petrels, Valdivia, Chile, 17–18 June 2007.* Available on the ACAP website www.acap.aq/en/index.php?option=com_docman&task=cat_view&gid=50&Itemid=33
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