**REPORT OF THE WORKING GROUP ON
STATISTICS, ASSESSMENTS AND MODELLING**
(Busan, Republic of Korea, 11 to 15 July 2011)

CONTENTS

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INTRODUCTION

Opening of the meeting

1.1   The 2011 meeting of WG-SAM was held in Busan, Republic of Korea, from 11 to 15 July 2011 and concurrently with the meeting of WG-EMM. The meeting was co-convened by Drs A. Constable (Australia) and C. Jones (USA) and local arrangements were coordinated by Mr J. Ahn, Ministry for Food, Agriculture, Forestry and Fisheries (MIFAFF) in association with staff from the National Fisheries Research and Development Institute (NFRDI).

1.2   The meeting was formally opened by Mr Youngman Kim, President of NFRDI. On behalf of the Co-conveners of WG-SAM and WG-EMM, meeting participants and the Secretariat, Mr A. Wright, Executive Secretary, thanked Mr Kim for his warm welcome, and MIFAFF and NFRDI for hosting the meetings. Later, during an initial joint session of WG-EMM and WG-SAM, participants paused in memory of those lost during the tragic sinking of the longliner *Insung No. 1* in the Ross Sea in December 2010.

1.3   Dr Constable welcomed participants (Appendix A) and outlined the work ahead. In 2010, the Scientific Committee had discussed the current exploratory fisheries for *Dissostichus* spp. and had considered further the development of a research framework for data-poor fisheries (SC-CAMLR-XXIX, Annex 8, paragraphs 5.1 to 5.12). The Scientific Committee recommended that some specific elements of the work plan be considered as a high priority focus topic for WG-SAM in 2011. Specifically, WG-SAM was requested to consider (SC-CAMLR-XXIX, paragraph 3.133):

    (i)   methods for evaluating the capability of vessels and gear types to contribute to research outcomes and for calibrating vessels and gears, including specific case studies relevant to current exploratory fisheries such as in tag-recapture programs

    (ii)   proposed research designs and data collection protocols for estimating stock status in data-poor fisheries

    (iii)   methods for assessing stock status in data-poor fisheries.

Adoption of the agenda and organisation of the meeting

1.4   The agenda, as amended, was adopted (Appendix B). Item 2 was the focus topic which considered a work plan for implementing research proposals for data-poor fisheries[1] (SC-CAMLR-XXIX, paragraph 3.126).

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[1]   The term 'data-poor fisheries' refers to fisheries for which a robust stock assessment that provides advice on catch limits according to CCAMLR decision rules has not been developed due to a lack of information. The term includes fisheries which have been closed or had the catch limit set to zero.

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

1.6   In this report, paragraphs that provide advice to the Scientific Committee and its working groups have been highlighted. A list of these paragraphs is provided in Item 7.

1.7   The report was prepared by Drs Constable, S. Hanchet (New Zealand), Jones, Mr T. Peatman (UK), Drs D. Ramm (Data Manager), B. Sharp (New Zealand), D. Welsford (Australia) and P. Ziegler (Australia).

FOCUS TOPIC: WORK PLAN FOR IMPLEMENTING RESEARCH PROPOSALS FOR DATA-POOR FISHERIES[1]

2.1   The Working Group agreed to structure the focus topic on data-poor fisheries (paragraph 1.4) by reviewing a summary of available data, a historical progression of catch limits, current activities in data-poor fisheries, previous examples of methods and approaches to achieve robust assessments for CCAMLR fisheries, general approaches toward advancing assessments for data-poor fisheries and area-specific considerations. It was agreed that general principles could be applied to specific areas in order to provide advice.

Summary of available data types

2.2   To assist Members with developing research proposals, the following section outlines a summary of the current knowledge of the stock structure, the spatial distribution of the various length classes, and the hypothetical life histories of the two *Dissostichus* species within the three ocean sectors.

Dissostichus mawsoni

2.3   The stock structure of *D. mawsoni* was reviewed in WG-FSA-10/24. Three studies using a variety of genetic techniques, including mitochondrial DNA (mtDNA), nuclear DNA introns, and nuclear and mitochondrial single nucleotide polymorphisms (SNPs), have been carried out on samples of muscle tissue from *D. mawsoni* in the Indian, Atlantic and Pacific Ocean sectors in the past 10 years (e.g. Kuhn and Gaffney, 2008). All studies found broadly similar results and that, despite the generally weak genetic diversity in *D. mawsoni*, there was some evidence for significant genetic differentiation between the three ocean sectors but limited evidence for differentiation within ocean sectors. Results of tagging studies have produced results consistent with the genetic studies.

2.4   The spatial distribution of *D. mawsoni* by length was reviewed in WG-FSA-10/24. Sub-adult toothfish (<100 cm TL) are generally found on parts of the Antarctic shelf and upper slope, with known concentrations in the southern Ross Sea, Subareas 88.2 and 88.3 and the west of SSRUs 5842B–D. Maturing toothfish (100–135 cm TL) are typically found on the continental slope all around the Antarctic continent. The largest fish (>135 cm TL) are

typically found in deeper parts of the continental slope and on the banks, ridges and seamounts to the north of the continental slope, with known concentrations in Subareas 48.4, 48.6, 88.1 and 88.2, and Division 58.4.3b.

2.5   A hypothetical life cycle of *D. mawsoni* in the Pacific Ocean sector was developed by Hanchet et al. (2008). Several alternate hypotheses for *D. mawsoni* in the Indian Ocean sector were summarised in 2009 by WG-FSA (SC-CAMLR-XXVIII, Annex 5, Figure 5). No equivalent hypothetical life history has been developed for the Atlantic Ocean sector. However, the adult concentrations found in the north of Subareas 48.4 and 48.6 probably originate from the Antarctic shelf and slope between the Antarctic Peninsula and eastern boundary of Subarea 48.6.

Dissostichus eleginoides

2.6   Genetic analyses (Appleyard et al., 2002; Shaw et al. 2004; Appleyard et al., 2004) and tagging studies (e.g. WG-FSA-03/72) indicate that, similar to *D. mawsoni*, *D. eleginoides* stocks are isolated at the scale of ocean basins. It is likely that the *D. eleginoides* caught in the fisheries in the northern areas of Subarea 88.1, Divisions 58.4.3a and 58.4.3b, and Subarea 48.4, are vagrants from the nearby populations around Macquarie Island, the Kerguelen Plateau and Subarea 48.3 respectively. Recent evidence from Ob and Lena Banks (Divisions 58.4.4a and 58.4.4b) indicate that a self-sustaining population may exist in that area (WG-SAM-11/6).

2.7   The Working Group summarised the historic longline fishing catch and effort (including research fishing) by division/subarea and SSRUs in Tables 1 to 3 on:

- seabed area in fishable depths (600–1800 m)
- total catch
- proportion of species
- depth range and mean
- mean and CV of catch rates (by length of line)
- mean and CV of fish size (catch weighted)
- proportion of fish above 100 cm (*D. mawsoni*) and 80 cm (*D. eleginoides*)
- total tags released
- total tags recaptured.

2.8   In addition, maps were generated that examined the spatial distribution of catch and effort (e.g. Figure 1). The Working Group requested the Secretariat to finalise the following maps for consideration by WG-FSA on:

- fishing locations
- total catch
- proportion of species
- mean of catch rate (by length of line)
- mean of fish size
- proportion of fish above 100 cm (*D. mawsoni*) and 80 cm (*D. eleginoides*).

2.9   WG-SAM-11/4 described the deployment of research hauls in the exploratory fisheries in Subareas 48.6 and 58.4 in 2010/11. The Working Group recalled that the original objective

of requiring research hauls was to assess the distribution and relative abundance of toothfish across fished SSRUs. It requested WG-FSA to evaluate whether research hauls have provided a different perspective of the stock to that provided by commercial hauls, e.g. in terms of fish distribution. It recommended that WG-FSA review the data derived from this method, and assess if other research methods would be more appropriate to achieve the goals of stock assessments in data-poor fisheries.

Summary of historical progression of catch limits in data-poor fisheries

2.10 The Working Group agreed that it would be useful to have a summary of how historical catch limits in data-poor fisheries were derived and the evidence supporting current estimates of stock status where applicable, and recommended that these summaries be incorporated into the Fishery Reports. These historical summaries should include a description of the method by which catch limits were generated, the advice provided to the Scientific Committee, and how this advice was used by the Commission (Table 4). The Working Group requested that the Secretariat complete these summaries and provide the information in the draft Fishery Reports for the next WG-FSA meeting.

Reports of current activities

2.11 WG-SAM-11/5 and 11/6 summarised research fishing activities for the closed *Dissostichus* spp. fisheries on BANZARE Bank (Division 58.4.3a) and Ob and Lena Banks (Divisions 58.4.4a and 58.4.4b) respectively.

2.12 Both papers included a comparison of fish condition between the trotlines and Spanish longlines. The Working Group noted that fish caught on trotline gear were generally in poorer condition than those caught on Spanish longlines, and that the poor condition was especially pronounced for fish smaller than 70 cm in both methods. The Working Group agreed that the difference in fish condition between fish caught at BANZARE Bank and Ob and Lena Banks was likely to be caused by a consequence of these observed differences. It expressed concern that the increased use of trotline gear may decrease the ability to complete tagging programs in many parts of the Convention Area.

2.13 The Working Group thanked Japan for its efforts in implementing and presenting the data collected through these research activities. In 2010/11, the *Shinsei Maru No. 3* used standardised fishing methods, the tag overlap statistic was very high in both regions, the spatial overlap between locations at which previously tagged fish were released and locations at which subsequent catches were taken was high, fish condition was considered at release of tagged fish, and information on depredation rates on research hauls on which fish were tagged was provided.

2.14 The Working Group requested that Japan present information to WG-FSA on the frequency of single or multiple hook wounds sustained by trotline-caught fish as a function of their assessed condition, higher-resolution data indicative of the actual proportion of released fish that were released in the presence of depredating predators, and the average abundance of those predators when tagged fish were released.

2.15   The Working Group discussed the merits of reporting CPUE as a function of length of line rather than as a function of number of hooks, to inform more robust comparisons between methods (e.g. Spanish longlines versus trotlines). It recognised that the 'fished area' is a function of the length of the line, the number of hooks and the attraction distance. WG-SAM requested that in future, CPUE from longline research catches be reported in terms of both number of hooks and length of line.

2.16   The Working Group reviewed analysis for Ob and Lena Banks additional to that provided in WG-SAM-11/7, which included biomass estimates based on a simple Petersen estimator. The method used was the same as that applied when developing the assessment for the *Dissostichus* spp. fishery in Subarea 48.4 (WG-FSA-09/17), including estimation of confidence intervals using the method developed by Chapman (1948). The natural mortality, tag-induced mortality and tag-shedding rates used were also drawn from WG-FSA-09/17. Median estimates of current biomass were similar to those derived from the analyses conducted at WG-FSA in 2010 (SC-CAMLR-XXIX, Annex 8, paragraphs 5.116 and 5.117), however, because the analyses were conducted on two separate years of tag recaptures (each with two recaptures), the confidence intervals were wide.

2.17   The Working Group recommended that a preliminary assessment for Ob and Lena Banks be explored by using standardised CPUE tagging data, length-at-age and -maturity data and commercial and IUU catch history. The Working Group encouraged an assessment that would enable application of CCAMLR decision rules to estimate precautionary catch limits and a presentation of this assessment in the near future.

2.18   WG-SAM-11/5 confirmed that BANZARE Bank is a spawning ground for *D. mawsoni*, and that fish stocks here are likely linked to those in Division 58.4.1 and potentially other regions within the southern Indian Ocean. Therefore, any fishery is likely to have an impact on other parts of the stock outside BANZARE Bank. The Working Group recommended that the different hypotheses about the stock structure will need to be considered when attempting an assessment or designing new research to collect the necessary data to achieve an assessment. The Working Group also recommended further analyses in regard to interactions between the condition of fish with fish size and gear type.

2.19   WG-SAM-11/9 presented preliminary results of research fishing for the closed *Dissostichus* fishery in Subarea 88.3 undertaken in 2010/11. These results appeared to be broadly consistent with earlier longline surveys conducted by Chilean vessels (SC-CAMLR-XVII/BG/7) and New Zealand (WG-FSA-05/53), indicating that the density of toothfish in this area is likely to be low and that the fish are mostly small. WG-SAM-11/9 reported that 256 *D. mawsoni* were caught, of which 30 were tagged during the course of the survey. The Working Group requested that additional information regarding the spatial distribution of tag releases be presented at WG-FSA-11. The Working Group recommended that information on catch rates by line length and number of hooks, and the size distribution of catch, be provided to WG-FSA-11. It was also recommended that a description of the proposed analysis of otoliths and genetic samples be submitted to WG-FSA-11.

2.20   WG-SAM-11/19 provided a summary of crab research fishing efforts on the Patagonian shelf (Division 41.3.1), South Orkney Islands shelf (Subarea 48.2) and the North Scotia Ridge (Division 41.3.2). The Working Group noted Russia's intention to produce an identification guide for crabs in the southern Atlantic Ocean. It was suggested that crabs

should be tagged in the future and experiments conducted to estimate post-release mortality for crabs that are released. In addition, any further research fishing should be conducted in such a way to achieve an assessment in the future.

General approaches

2.21   Previous Scientific Committee reports (e.g. SC-CAMLR-XXVIII and SC-CAMLR-XXIX) have outlined a range of considerations for the development of proposals for CCAMLR-sponsored research. There have been a few case studies where a consistent well-designed approach has led to a successful outcome in terms of assessment for either *D. mawsoni* or *D. eleginoides*. The key elements that contributed to the success of the low information assessments in SSRU 882E and Subarea 48.4 North were:

(i)   The research was guided by clearly stated research objectives focused on questions of highest priority for the achievement of an assessment, i.e. to achieve: (a) an index of stock abundance; (b) a hypothesis of relationship of fish in the area to the overall stock; (c) estimates of biological parameters relating to productivity (i.e. maturity, growth and recruitment).

(ii)   The research was focused within a relatively small area that was consistent between years.

(iii)   The observational data were collected by vessels that had proven experience in conducting and providing high-quality research fishing within the CCAMLR region.

(iv)   Observational data were collected using a robust experimental design (a pre-designed grid in the case of Subarea 48.4) that was carried out over a sequence of years with a multi-year commitment to the research design.

(v)   The data collected were annually reviewed and the information compared with the objectives of the data collection.

(vi)   The research was robust to a set of expected deviations from the research design (for example, missing years where the area might not be accessible due to ice coverage).

(vii)   Catch removals were able to be estimated accurately because of an absence of IUU activities in the area.

2.22   The Working Group agreed that these successful examples of the progression of data-poor fisheries to fully assessed fisheries provide valuable guidance as to the overall approaches to research in data-poor fisheries. Papers describing these examples are included in Table 5.

2.23   WG-SAM-11/8 developed a set of principles that could be used for evaluating data collection plans in data-poor fisheries. The Working Group agreed that such principles would

greatly assist the Scientific Committee in developing a framework to evaluate research proposals in data-poor fisheries, and would assist Members in designing and implementing proposals that have a high likelihood of achieving the Commission's goals.

2.24   The Working Group recalled similar discussions between 1992 and 1993 (CCAMLR-XI, paragraph 4.28; SC-CAMLR-XII, paragraph 7.4) and from 1997 to 2000 (SC-CAMLR-XIX, paragraphs 7.2 to 7.20) as appropriate approaches to developing assessments in exploratory fisheries.

2.25   It was agreed that to achieve the objectives of Article II of the Convention, research in data-poor fisheries should follow these principles:

(i)   The primary purpose of research in data-poor fisheries is data collection that will lead to a robust estimate of stock status and enable the estimation of precautionary catch limits consistent with CCAMLR decision rules.

(ii)   A detailed plan of proposed fishing operations, data collection and analyses needs to be submitted for review by the Scientific Committee and the Commission. The intention of data collection is to ensure that adequate information is made available to the Scientific Committee to achieve the objectives of the research.

2.26   Any research proposal should provide details on how these principles will be addressed, to enable the Scientific Committee to evaluate, inter alia, the likelihood that the proposal will satisfy CCAMLR-sponsored research as detailed in Table 6.

2.27   The Working Group noted that the first requirement of any new research proposal is that the objectives of the research be clearly stated and that the research be designed appropriately to achieve its stated objectives. The Working Group further noted the three pieces of information required for an assessment of stock status and to apply the CCAMLR decision rules to estimate precautionary yield, i.e.:

(i)   an index of stock abundance
(ii)   a hypothesis of relationship of fish in the research area to the overall stock
(iii)   estimates of biological parameters relating to productivity (i.e. maturity, growth and recruitment).

2.28   The Working Group agreed that the highest priority for data-poor fisheries was to achieve an index of abundance, but that an index of abundance (i) for any particular area is only biologically meaningful in the context of a hypothesis of relationship of fish in the area to the overall stock (ii). Consequently, the requirement to achieve (i) and test (ii) would most strongly drive the design of a research proposal. It was agreed that simulations assuming alternative stock hypotheses would strengthen research proposals, although it was acknowledged that not every country had the experience to conduct simulations.

2.29   Estimates of biological parameters relating to productivity for requirement (iii) can in the first instance be derived from observations in other areas, and then improved over time using location-specific observations. Consequently, the collection of biological samples to address requirement (iii) would not in itself constitute sufficient justification to carry out new

research in the absence of information meeting requirements (i) and (ii), and would not strongly drive the choice of research design. Nevertheless, these biological samples should be collected routinely and analysed in the course of the research.

2.30   WG-SAM-11/13 reported on the development of a generic operating model framework designed to evaluate data collection plans, assessment methods and management strategies. The Working Group encouraged further development of this operating model framework, as it could have a wide variety of applications for both data-poor and assessed fisheries in the CCAMLR area.

2.31   WG-SAM-11/15 compared tagging and other potential sources of stock assessment information between assessed and unassessed SSRUs. It calculated the numbers of additional tagged fish required to match the tag densities of assessed SSRUs for each currently unassessed SSRU and ranked the latter based on this metric in terms of the potential for assessment. The Working Group agreed that the compiled summaries of the current status of exploratory toothfish fisheries were very useful. The tag deficit statistic provided a consistent approach to compare tagging effort in assessed and unassessed areas. The Working Group noted that the likelihood of achieving a tag-based stock assessment was dependent on the number of toothfish that are tagged and available for capture as a proportion of total stock and scanning rate (i.e. catch) of that stock (i.e. see WG-SAM-08/6). When considering tagging effort, the poor performance of previous tagging effort in some areas needs to be accounted for, as there may be actually very few tagged fish available for recapture despite large numbers of tagged fish having been released. The Working Group agreed that the increased statistical power achieved by increasing the number of fish scanned (caught) needs to be balanced against consideration of the likely impact of the catch, given current understanding of stock status, including potentially depleted stocks.

Summary of main methods

2.32   The Working Group identified a list of papers describing methods that have been used by CCAMLR in assessing data-poor fisheries (Table 5). The Working Group identified four assessment approaches that have been attempted: CPUE, depletion experiments, tagging programs and areal survey approaches.

2.33   CPUE alone is not used in assessed fisheries as it is seen to be a poor index of abundance in isolation. The Working Group therefore agreed that catch rates should be de-emphasized as an index of abundance in data-poor fisheries, though it was stressed that there is a distinction between using a CPUE time series of an index of abundance and the use of catch rates with seabed area to provide an initial estimate of biomass in unassessed areas. With respect to depletion approaches, there was agreement that the use of depletion experiments in data-poor fisheries was unlikely to lead to a robust assessment that satisfies the CCAMLR decision rules. It was agreed that these two approaches on their own have shown not to be successful, and further will likely not lead to assessments in the future. However, both tagging programs and areal surveys have led to robust assessments for several stocks of *Dissostichus* in the Convention Area.

2.34   The Working Group recalled that tagging studies have led to stock assessments of toothfish in fisheries in Subareas 48.4 and 88.1 and SSRU 882E. It also recalled that trawl surveys have been important, resulting in precautionary by-catch limits for *Macrourus* spp. in Division 58.4.3b (van Wijk et al., 2000) and Subarea 88.1 (WG-FSA-08/32).

2.35   The Working Group agreed that it would be useful to provide guidance as to general aspects of research designs, standardised methods, performance metrics for a tagging program and areal survey approaches that would have the greatest potential to lead to an assessment in the near future. The Working Group agreed that data-poor areas should be prioritised in such a way that the potential for an assessment of the area within a reasonable timeframe is maximised. For example, areas more likely to have a fishable stock biomass, areas where there are already fish tagged that have a good chance of being recaptured, and areas where some tags have already been recaptured, should be considered higher-priority areas.

2.36   The Working Group compiled a list of recommended performance metrics by which the quality of research efforts could be evaluated, and recommendations for research designs and standardised methods. These are detailed below for both tagging and areal survey approaches. The Working Group noted that methods could be combined, e.g. tagging and areal methods could be conducted in a single research program (fish caught in a trawl survey could also be tagged and released).

Tagging approaches

A. Standards to be met

2.37   The Working Group noted that the success of previous research leading to assessments in exploratory fisheries in Subareas 88.1 and 88.2, and the fishery in Subarea 48.4 North, was in large part due to dedicated efforts by particular Members or vessels to adhere to robust and consistent multi-year experimental designs, and to execute the required tagging program with a high standard of quality. Conversely, the Working Group recognised that the failure to develop assessments in other data-poor fisheries despite several years' research in which tagging was conducted, may be due to problems with research implementation or tagging performance, and not due to any shortcoming with respect to the actual research design, sampling intensity, or analytical methods (SC-CAMLR-XXIX, Annex 8, paragraphs 5.5 and 5.18 to 5.20).

2.38   To ensure that future research in data-poor fisheries is implemented to a high standard, the Working Group recommended development and use of the following performance metrics for tag-based research, to be used in the annual review and evaluation of research programs in progress. Members proposing to conduct new research should also include in their research proposals descriptions of the means by which they will ensure high levels of performance with regard to these metrics, to aid evaluation by WG-FSA and the Scientific Committee of the likelihood that the research will achieve its objectives:

(i)   Tag overlap statistic – this performance metric is already defined and required under Conservation Measure 41-01.

(ii) Spatial overlap statistic – a metric to express the extent to which tagging and subsequent catches to scan for recaptures have occurred in a consistent spatially constrained location.

(iii) Temporal overlap statistic – a metric to express the extent to which the research is carried out at the same time each year.

(iv) Trauma index – a measure of the injuries to the fish associated with the capture and tagging process, and their vitality prior to release.

(v) Depredation index – a metric of the risk or extent to which depredation of tagged and released fish by predators (i.e. sperm whales and killer whales) may be affecting the survival of tagged and released fish. Such a metric could represent the proportion of tagged fish that were released at times and locations at which predators were observed, and the abundance of those predators and/or the observed level of depredation on hauls in the proximity of releases (e.g. proportion of caught fish that were damaged).

2.39 The Working Group encouraged Members to develop and propose these metrics for use in the evaluation of proposals by WG-FSA.

B. Research design and standardised methods

2.40 The Working Group recommended applying the following research design for data-poor fisheries:

(i) Choose an SSRU or some other spatially constrained area:

(a) the area should be chosen with a reference to the stated objective of the research

(b) priority areas include those where catch rates indicate that a viable toothfish fishery may be present depending on catch rates, catch history and size of fishable seabed areas

(c) consideration should also be given to the likely role of a particular SSRU in the plausible stock hypothesis (i.e. is it only juveniles in the area?).

(ii) Develop an initial estimate of the plausible biomass for the unassessed area:

(a) the ratio of CPUE and seabed areas for a reference area (where an assessment exists) might be considered to estimate the biomass that might be present in the unassessed area

(b) CPUE between the reference and experimental area should be standardised for gear type, vessel, time of year, target species and size distribution of fish present

(c)   the effects from catch history (i.e. depletion prior to the experiment) needs to be considered

(d)   appropriate reference areas may include SSRUs in Subarea 88.1 and SSRU 882E (*D. mawsoni*) or Subarea 48.4 North (*D. eleginoides*) for which current biomass estimates are available.

(iii)   Use an appropriate method (e.g. WG-SAM-08/6) to:

(a)   determine an appropriate combination of catches, tag releases and research duration (years) to achieve a target CV for a tag-based biomass estimate, given the preliminary biomass estimate (e.g. scenarios see Figures 2 and 3).

(iv)   Apply a discount factor to the estimate of biomass to account for uncertainty and evaluate the likely impact of the research catch on the stocks (see e.g. SC-CAMLR-XXIX, Annex 8, paragraphs 5.116 and 5.117).

2.41   The Working Group noted that the number of fish tagged and released will increase throughout the course of a multi-year tag-release program, but that not all released fish will be available for recapture due to the effects of tagging mortality, natural mortality and tag loss.

2.42   Dr Sharp noted that the number of tagged fish available for recapture in year t can be approximated by:

$$
\begin{aligned}
T_t = \ & X_{t-1}\, C_{t-1}\, (1 - M_x)\, (e^{-\lambda})\, (e^{-M}) \\
& + X_{t-2}\, C_{t-2}\, (1 - M_x)\, (e^{-2\lambda})\, (e^{-2M}) \\
& + X_{t-3}\, C_{t-3}\, (1 - M_x)\, (e^{-3\lambda})\, (e^{-3M}) \\
& \ldots\ \text{etc.}
\end{aligned}
$$

where T_t = tagged fish available for recapture in year t
       X_t = tagging rate (fish per tonne) in year t
       C_t = (catch) in year t
       M_x = tagging mortality
       λ = annual tag loss rate approximation
       M = natural mortality.

2.43   Dr Sharp noted that by applying this formula, it is possible to estimate the number of tags available for recapture (Figure 2) as a function of the tagging rate used in the survey. By superimposing the tagging rate in Figure 2 it is possible to examine the incremental improvement in the CV of the biomass estimate across multiple years of a tag-recapture experiment, as a function of tagging rate and annual catch. Alternately it is possible to set a target CV and derive multiple options for different combinations of tagging rate, annual catch and experiment length (number of years) to achieve that target CV under an assumed initial biomass. Figure 3 illustrates this relationship for a range of tagging rates in a four-year experiment, assuming constant annual catches and constant tagging rates in all years.

2.44   The Working Group noted that the number of tags available for recapture is contingent on high standards of tagging performance with respect to the performance metrics identified in paragraph 2.38. For areas in which tagging performance has been of consistently low

quality (e.g. SC-CAMLR-XXIX, Annex 8, paragraphs 5.5 and 5.18 to 5.20), it may be necessary to assume very low numbers of available tagged fish despite a high number of historical releases. The Working Group recommended that WG-FSA examine this in further detail.

Areal survey approaches

2.45   The Working Group identified several potential means by which areal surveys can be undertaken, including trawl, longline and pot surveys. It was agreed to focus on trawl and longline surveys for the purposes of providing guidance on research designs and standardised methods.

Trawl surveys

A. Standards to be met

2.46   To ensure that future research in data-poor fisheries is implemented to a high standard, the Working Group recommended development and use of the following performance metrics for trawl surveys, to be used in the annual review and evaluation of research programs in progress:

(i)   Spatial overlap statistic: a metric to express the extent to which hauls and survey strata have occurred in a consistent spatially constrained location.

(ii)   Temporal overlap statistic: a metric to express the extent to which the research is carried out at the same time each year.

(iii)   If tagging is carried out, see tagging metrics (paragraph 2.38).

B. Research design, standardised methods and assessments

2.47   The Working Group recommended following the guidelines detailed in the Draft Manual for Bottom Trawl Surveys in the Convention Area (SC-CAMLR-XI, Annex 5, Appendix H, Attachment E, paragraph 4) for research trawl surveys in data-poor fisheries.

Longline surveys

A. Standards to be met

2.48   To ensure that future research in data-poor fisheries is implemented to a high standard, the Working Group recommended development and use of the following performance metrics for longline surveys, to be used in the annual review and evaluation of research programs in progress:

(i)   Spatial overlap statistic: a metric to express the extent to which hauls and survey strata have occurred in a consistent, spatially constrained location.

(ii)   Temporal overlap statistic: a metric to express the extent to which the research is carried out at the same time each year.

(iii)   If tagging is carried out, see tagging metrics (paragraph 2.38).

(iv)   Depredation index: a metric of the risk or extent to which depredation may have influenced estimates of catch rates or catch.

B. Research design and standardised methods

2.49   The Working Group recommended applying the following research design for data-poor fisheries:

(i)   Choose an SSRU or some other spatially constrained area:

    (a)   the area should be chosen with a reference to the stated objective of the research

    (b)   consideration should also be given to the likely role of a particular SSRU in the plausible stock hypothesis (i.e. is it only juveniles in the area?).

(ii)   Develop an initial estimate of the plausible biomass for the unassessed area:

    (a)   the ratio of CPUE and seabed areas for a reference area (where an assessment exists) might be considered to estimate the biomass that might be present in the unassessed area

    (b)   CPUE between the reference and experimental area are needed to be standardised for gear type, vessel, time of year, target species and size distribution of fish present

    (c)   the effects from catch history (i.e. depletion prior to the experiment) needs to be considered

    (d)   appropriate reference areas may include SSRUs in Subarea 88.1 and SSRU 882E (*D. mawsoni*) or Subarea 48.4 North (*D. eleginoides*) for which current biomass estimates are available.

(iii)   Develop a survey design:

    (a)   determine what component of the population will be surveyed

    (b)   determine survey area and strata (taking into account bathymetry) and generate set locations. The set locations should be random and stratified by depth with a specified minimum distance between lines

    (c)   determine the number of longlines based on a power analysis and a target CV

    (d)   calculate nominal catch limit based on number of longlines and appropriate catch rates from historical data.

(iv) Survey standardisation:

(a) all aspects of the survey should be consistent within and between surveys, including:

- vessel

- gear type and configurations (e.g. Spanish longline or trotline, line specifications)

- number of hooks per survey line (at least 3 500 hooks and no more than 5 000 hooks)

- hook type and size

- bait type

- distance between hooks and length of leaders

- soak time

- location of survey strata

- time of year that the survey is conducted.

(v) Evaluate the likely impact of the catch on the fish stocks.

Area-specific considerations

2.50 The Working Group agreed that general principles could be applied to different areas, but that each area has its own specific attributes that may have an important influence on how these principles would be applied. However, the Working Group considered that the issues covered in paragraphs 2.32 to 2.49 were sufficiently comprehensive to cover area-specific considerations.

METHODS FOR ASSESSING FINFISH STOCKS IN ESTABLISHED FISHERIES, NOTABLY *DISSOSTICHUS* SPP.

Tagging

3.1 WG-SAM-11/14 reported on work undertaken by the Secretariat to coordinate data arising from CCAMLR toothfish tagging programs, as endorsed by CCAMLR-XXV (CCAMLR-XXV, paragraph 4.50). Typical problems that may arise in the data when attempting to correctly match and code tag-recapture events are described and categorised. The Working Group thanked the Secretariat for this work, and recommended that:

(i) a record in the database be kept for tracking how tag categorisations have changed over time

(ii)   the Secretariat identify a consistent schedule on which the status of tags in category 7 'no link' are reviewed and potentially updated in light of new information. Additional minor technical recommendations to improve the definition of the categories were conveyed from Mr A. Dunn (New Zealand) to the Secretariat in his absence.

3.2   WG-SAM-11/12 and 11/18 were initiated in response to comments by Dr S. Candy (Australia) at the 2010 meeting of WG-FSA. Dr Candy commented that using the methods of WG-FSA-SAM-05/10 and Hillary et al. (2006) to approximate loss rates of double-tagged fish in CASAL's tag-loss model for single tagged fish (Kirkwood and Walker, 1984) could introduce significant bias in estimates of stock status.

3.3   WG-SAM-11/12 and 11/18 provided different approaches to improve the approximation of loss rates of double-tagged fish in CASAL. WG-SAM-11/12 presented an explicit calculation of CASAL's parameter for annual tag-loss rate, l', to approximate loss of double tagged-fish for a specified range of time at liberty, derived from the estimate of the observed annual tag-loss rate, l, and the mid-point of the range of time at liberty specified.

3.4   The approach of WG-SAM-11/18 was first to estimate instantaneous and annual tag-loss rates for *Dissostichus* spp. tagged in the Ross Sea using recaptures of double-tagged *Dissostichus* spp. with one or two tags remaining. The parameter of annual tag-loss rate for CASAL's single-tag model was then set to approximate the loss rate of double-tagged fish, given the estimated instantaneous and annual tag-loss rates referred to above, for a maximum time at liberty. The report noted that the combination of the previous incorrect double-tag model and tag-loss rate parameter had very little impact on the estimates of biomass in the assessment models.

3.5   The Working Group noted that both papers provided methods that can be used to ensure the CASAL tag-loss model can be parameterised to approximate annual loss rates of double-tagged fish, although for both approaches the approximation is only appropriate for a specified time at liberty.

3.6   The Working Group recommended that tag-loss rates used in CASAL assessments conducted at the forthcoming meeting of WG-FSA should be adjusted in order to best approximate true tag-loss rates over the range of times at liberty of the mark-recapture data.

Assessments

3.7   WG-SAM-11/17 presented the results of simulations in which data was withheld from the existing (2009) stock assessment models for Subarea 88.1 and SSRU 882E (WG-FSA-09/40 and 09/41). The Working Group noted that the simulations were a good illustration of the stability of these models and the rate at which data collected in data-poor exploratory fisheries may accumulate to yield plausible estimates of biomass. WG-SAM further noted that in order to illustrate the true accumulation of knowledge as a fishery progressed from data-poor to assessed (i.e. incorporating structural as well as statistical uncertainty), it would

be useful to plot B_0 and current B (with associated uncertainty) as they were estimated in every year of the exploratory fishery, noting changes arising from different assessment methods, new model inputs and/or altered structural assumptions over time.

3.8   The following WG-SAM participants notified their intention to submit updated stock assessments to WG-FSA in 2011:

(i)   Dr Welsford indicated that an update of the Division 58.5.2 toothfish assessment (WG-FSA-09/20) will be presented using updated survey data from 2010/11 and a new estimate of *M* as in WG-FSA-10/41, and incorporating uncertainty in *M*. He also indicated plans to update the preliminary assessment for *Champsocephalus gunnari* in Division 58.5.2.

(ii)   Dr Hanchet indicated that there are plans to update the Ross Sea region toothfish assessment (WG-FSA-09/40 Rev. 1) in Subarea 88.1 and SSRUs 882A and 882B using two additional years' tag-recapture and catch-at-age data, and an updated tag-loss estimate as in WG-SAM-11/18. There are also plans for a similar update of the toothfish assessment in SSRU 882E (WG-FSA-09/41), including a new sensitivity in which SSRUs 882C–G are assessed in combination.

(iii)   Mr Peatman indicated that there are plans to update the toothfish assessment in Subarea 48.3 (WG-FSA-09/28 Rev. 1), including two seasons of additional survey data, tag-recapture data and catch-at-age data, and updated tag-loss parameters estimated as in WG-SAM-11/18. There are also plans for a similar update of the toothfish assessment in Subarea 48.4 North (WG-FSA-09/17). He also indicated that there are plans to update the preliminary assessment of *C. gunnari* in Subarea 48.3 (WG-FSA-09/27).

3.9   The Working Group noted that WG-SAM-11/15 identified several SSRUs in which some tag recaptures have occurred and recommended that WG-FSA consider undertaking preliminary estimates of biomass for these areas during the forthcoming WG-FSA meeting, using methods endorsed by WG-SAM or following successful examples of research in data-poor fisheries as listed in Table 5.

3.10   The Working Group encouraged Members to collaborate during the intersessional period to progress preliminary assessment work, especially during years in which WG-FSA will not be updating assessments for the assessed fisheries.

3.11   A preliminary population status model for *D. eleginoides* on the Kerguelen Plateau, Divisions 58.5.1 and 58.5.2, was presented to the Working Group (WG-SAM-11/20). The model was an age-structured, multi-fishery, single-area and -sex model.

3.12   The Working Group thanked Australia and France for their collaboration in producing this study. It noted that continued ageing of fish from the POKER survey and development of methods to incorporate tagging data that take account of the spatial distribution of tags, fishing effort and the movement of toothfish, would be beneficial. The Working Group requested that the report be submitted to the forthcoming meeting of WG-FSA, along with provision of the CASAL input files. The Working Group also noted the different signals in the commercial CPUE data from the Kerguelen Island fishery and the Heard and McDonald

Islands fishery. The Working Group noted the importance of understanding the spatial distribution of biomass and age classes in the Kerguelen Plateau. Dr Welsford commented that this would be an aim for future work.

Scientific research to inform assessments

3.13 WG-SAM-11/16 described a proposal to carry out CCAMLR-sponsored research to provide a fishery-independent index of relative abundance for pre-recruit *D. mawsoni* in the stock in Subareas 88.1 and 88.2, as requested by the Scientific Committee in 2010 (SC-CAMLR-XXIX, paragraph 3.185). The proposed research would use a standardised longline survey within defined survey strata in the southern Ross Sea shelf (SSRUs 881J and L) which collectively are thought to contain the bulk of the toothfish population of the target size classes.

3.14 The Working Group welcomed the research proposal and agreed that it had a high likelihood of achieving its objectives and fulfilling the request of the Scientific Committee. It endorsed the choice of main survey strata locations, but suggested extending the exploratory survey strata to depths shallower than the currently proposed 500 m. It further suggested that full sampling, ageing and biological analysis be extended to fish smaller than the target 80–100 cm size range. The Working Group noted that in the short term, tagging is not a necessary component to estimate relative abundance and that the proposed high tagging rate could possibly be relaxed; however, tagging can provide valuable additional information pertaining to fish life-cycle movement, and over time may inform estimates of absolute, rather than relative abundance for the survey strata in question.

STRATEGIES FOR ACQUIRING DATA AND SETTING CATCH LIMITS
IN DATA-POOR FISHERIES

4.1 The Working Group noted that the substance of this agenda item had been covered in the focus topic under Item 2, and in particular its advice on:

    (i) principles for data collection in data-poor fisheries and research fishing in closed areas (paragraph 2.25)

    (ii) guidelines for developing research proposals consistent with these principles (paragraphs 2.26 to 2.29 and Table 6)

    (iii) standardised research design, analysis and assessment methods, including estimating the minimum catch required to complete a research plan for tagging studies (paragraphs 2.37 to 2.44) and areal surveys using trawls (paragraphs 2.46 and 2.47) or longlines (paragraphs 2.48 and 2.49).

DESIGNS FOR SCIENTIFIC RESEARCH ON COMMERCIAL FISH STOCKS
IN CLOSED AREAS WITH ZERO CATCH LIMITS

Review of research proposals

5.1   Three proposals to continue research fishing were considered under this agenda item (WG-SAM-11/5, 11/7 and 11/10). The Working Group reflected on the general principles and guidelines developed under Item 2 when reviewing the proposals and agreed that all three proposals need to be developed further to take into account the advice contained under Item 2 and summarised under Item 4.

5.2   The Working Group also made some specific recommendations for each of the separate proposals.

5.3   WG-SAM-11/7 provided the details of a proposal to continue research fishing in two SSRUs in Divisions 58.4.4a and 58.4.4b. The Working Group recommended the proposal be revised taking into account the main principles and guidelines discussed above (paragraph 5.1). The proposal should focus, in particular, on the following three points:

    (i)   A stock assessment should be attempted based on the tag-recapture, biological and fishery data to enable an evaluation of the impact of the proposed research catch on stock status.

    (ii)   A higher proportion of Spanish longlines should be considered because this will assist in achieving higher survival rates of tagged fish and will provide more comparisons in standardised CPUE between Spanish longlines and trotlines.

    (iii)   The proposal should consider explicitly ways to address potential problems with depredation of tagged toothfish by toothed whales.

5.4   Dr K. Taki (Japan) noted that the vessel carrying out the research had some operational difficulties in repeatedly switching between trotlines and Spanish longlines and that Japan would explore the possibility of just using Spanish longlines for the duration of the research fishing. However, the Working Group agreed that the data arising from the comparative fishing trials between trotlines and Spanish longlines made by Japan had been very informative and encouraged further trials if possible.

5.5   WG-SAM-11/5 provided the details of a proposal to continue research fishing in Division 58.4.3b. The Working Group recommended the proposal be revised taking into account the main principles and guidelines discussed above (paragraph 5.1). The proposal should focus, in particular, on the following points:

    (i)   An assessment of stock biomass for this area should be made using the seabed area × CPUE calculation and/or tag-recapture data to enable an evaluation of the impact of the proposed research catch on stock status.

    (ii)   A higher proportion of Spanish longlines should be considered because this is likely to assist in achieving higher survival rates of tagged fish and will provide more comparisons in standardised CPUE between Spanish longlines and trotlines.

(iii) A power analysis should be conducted to determine the ability of the current survey design to detect changes in CPUE.

(iv) A sensitivity analysis should be conducted to determine the impact of recapturing a small number of tags on the assessment of stock size in the survey area.

5.6 WG-SAM-11/10 provided the details of a proposal to continue research fishing in Subarea 88.3. The Working Group recommended the proposal be revised taking into account the main principles and guidelines discussed above (paragraph 5.1). The proposal should focus, in particular, on the following points:

(i) The research program should focus on the western SSRUs and in particular SSRU 883B where catch rates were generally higher and most tagged fish had been released.

(ii) An assessment of stock biomass for SSRU 883B should be made based on seabed area × CPUE, as this will help the Scientific Committee understand the effect of the proposed catch on stock status. The proposed catch limits greatly exceed the catch achieved in 2010/11, even when adjusted for increased numbers of longline sets.

(iii) Additional data should be provided in the revised proposal including the spatial distribution of tag releases in 2010/11 so that the effectiveness of the proposed research fishing in the second season to recapture tagged fish can be evaluated.

(iv) Some consideration also needs to be given to the likely condition of the fish on release, because studies in other areas have shown that a large proportion of small (<70 cm TL) *D. eleginoides* caught by Spanish longline and trotline are in poor condition, and it is believed that most of the fish in this subarea are small fish.

(v) The Working Group endorsed the proposal to increase the tagging level to 10 tags per tonne.

5.7 The Working Group noted that some locations in the Convention Area are unlikely to support a viable toothfish fishery and that even research fishing in closed areas or exploratory fishing in these locations may not be sustainable. It requested that WG-FSA consider developing guidelines to assist with deciding when an area could not support a viable fishery and when research or exploratory fishing should cease.

OTHER BUSINESS

Review of the Secretariat's Strategic Plan and Data Management Systems

6.1 The Working Group noted the outcomes of the independent review of the Secretariat's data management systems (CCAMLR-XXX/5) and the Secretariat's progress in reviewing its strategic plan (WG-EMM-11/9).

6.2   The independent review recommended changes to the Secretariat's organisational structure, the development of IT and data strategies, the further development of procedures for data processing and quality assurance, improvements to application systems, including the CCAMLR website, and upgrades to the Secretariat's IT infrastructure and services. The reviewers proposed that these recommendations be implemented as part of the Secretariat's review of its Strategic Plan and through the phased implementation of 10 specific projects. Three of these projects were initiated in 2011 – redevelopment of the Secretariat's document archive, development of an Enterprise Data Model and redevelopment of the CCAMLR website. The remaining projects are scheduled for implementation in 2012 and 2013, funding permitting.

6.3   The Secretariat's revised Strategic Plan has addressed the review recommendations dealing with improvements to the organisational structure. In addition, the revised Strategic Plan includes a staffing and salary strategy for consideration by the Commission in 2011 (CCAMLR-XXIX, paragraphs 3.5 and 3.10). The revised Strategic Plan covers the period from 2012 to 2014 and makes recommendations related to the Secretariat's support to the Scientific Committee and its working groups, including:

   (i)   re-titling of the Science Officer post to Science Manager, and re-titling of the Scientific Observer Data Analyst post to Scientific Observer Program Coordinator

   (ii)   establishing an Analytical Support Officer post to strengthen the Secretariat's scientific analytical capacity (see SC-CAMLR-XXVIII, Annex 5, paragraphs 15.2 to 15.8)

   (iii) strengthening the role of the Data Centre through restructuring, revised administrative processes and improved coordination of existing personnel resources

   (iv)   establishing a Data Assistant post within the Data Centre to mitigate the risk of a single-point failure related to the current concentration of the Secretariat's data processing capacity in a single staff position.

6.4   The Secretariat's cost projections to the end of 2014 indicate that these recommendations can be implemented within the Commission's existing policy of a zero-real growth budget and through the restructuring of the Secretariat's organisational structure.

6.5   The Working Group endorsed the recommendations related to the Secretariat's support to the Scientific Committee and its working groups, including the establishment of the new posts (paragraphs 6.3(ii) and (iv)).

ADVICE TO THE SCIENTIFIC COMMITTEE

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

7.2	WG-SAM provided advice to the Scientific Committee and WG-FSA on the following items:

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

7.3	WG-SAM requested that the Secretariat summarise the spatial distribution of fishery characteristics (paragraph 2.8) and the historical progression of catch limits in data-poor fisheries (paragraph 2.10 and Table 4).

ADOPTION OF THE REPORT AND CLOSE OF THE MEETING

8.1	The report of the meeting of WG-SAM was adopted.

8.2	In closing the meeting, Dr Jones, on behalf of both Co-conveners, thanked the participants for their contributions to the meeting and their work during the intersessional period, and the rapporteurs for bringing together a focused report. Dr Jones also thanked Mr Ahn, his local organising team and the Korean fishing industry for their kind hospitality and assistance during the meeting, and the Secretariat for its support.

8.3	Dr Welsford, on behalf of the Working Group, thanked Drs Constable and Jones for facilitating discussions which led to a successful meeting. This was Dr Constable's last year as Convener of WG-SAM and the Working Group thanked him for his leadership in developing methods in statistics and assessments, and for guiding the group from its beginning as a subgroup of WG-FSA. The Working Group hoped that a new convener would be appointed by the Scientific Committee at its next meeting.

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Table 1: Overall characteristics in fisheries for *Dissostichus* spp. in Subareas 48.4, 48.6, 88.1, 88.2 and 88.3 and Divisions 58.4.1, 58.4.2, 58.4.3a, 58.4.3b, 58.4.4a and 58.4.4b in all seasons. TOP – *D. eleginoides*, TOA – *D. mawsoni*, TOT – *Dissostichus* spp.

Subarea/ division	No. of sets	Catch (tonnes)			Proportion in catch		CPUE (tonnes/km of line)						Fishing depth (m)		
		TOP	TOA	TOT	TOP	TOA	TOP			TOA			Mean	Min.	Max.
							Mean	SD	CV (%)	Mean	SD	CV (%)			
48.4	798	403	130	533	0.76	0.24	0.058	0.064	112	0.022	0.064	290	1 335	355	1 931
48.6	1 361	343	1 070	1 413	0.24	0.76	0.026	0.032	119	0.076	0.145	190	1 333	383	2 902
58.4.1	1 900	97	2 464	2 562	0.04	0.96	0.003	0.016	475	0.095	0.131	138	1 476	554	3 773
58.4.2	806	2	1 050	1 052	0.00	1.00	0.000	0.001	608	0.131	0.191	146	1 353	563	2 245
58.4.3a	418	231	10	242	0.96	0.04	0.028	0.031	108	0.002	0.008	478	1 347	941	1 895
58.4.3b	948	133	1 044	1 177	0.11	0.89	0.013	0.031	241	0.072	0.084	117	1 495	643	2 293
58.4.4a	277	80	0	80	1.00	0.00	0.039	0.027	69	0.000	-	-	414	250	1 645
58.4.4b	98	69	0	69	1.00	0.00	0.049	0.030	61	0.000	-	-	819	345	1 920
88.1	12 759	131	26 384	26 515	0.00	1.00	0.001	0.010	797	0.237	0.284	120	1 155	232	2 450
88.2	2 296	0	3 538	3 539	0.00	1.00	0.000	0.000	2 664	0.189	0.252	133	1 370	513	2 260
88.3	21	0	0	0	0.05	0.95	0.000	0.001	458	0.002	0.004	170	1 039	622	1 700

Table 2: SSRU characteristics in fisheries for *Dissostichus* spp. in Subareas 48.4, 48.6, 88.1, 88.2 and 88.3 and Divisions 58.4.1, 58.4.2, 58.4.3a, 58.4.3b, 58.4.4a and 58.4.4b in all seasons. TOP – *D. eleginoides*; TOA – *D. mawsoni*; TOT – *Dissostichus* spp.

SSRU	No. sets	Catch (tonnes)			Proportion in catch		CPUE (tonnes/km of line)						Fishing depth (m)			No. fish tagged and released			No. tagged fish recaptured			Seabed area (km^2) fishable depth range 600–1800 m
		TOP	TOA	TOT	TOP	TOA	TOP			TOA			Mean	Min.	Max.	TOP	TOA	TOT	TOP	TOA	TOT	
							Mean	SD	CV (%)	Mean	SD	CV (%)										
484N	519	368	2	370	0.99	0.01	0.080	0.067	83	0.001	0.002	365	1308	355	1931	1522	12	1534	72	0	72	7 710
484S	279	35	128	163	0.22	0.78	0.017	0.031	184	0.061	0.096	156	1384	895	1812	425	394	819	14	24	38	11 033
486A	336	128	41	169	0.76	0.24	0.038	0.030	77	0.013	0.027	212	1210	525	2043	274	55	329	3	0	3	10 582
486B	32	0	104	104	0.00	1.00	0.000	0.001	411	0.362	0.208	57	1424	1177	1579	0	312	312	0	1	1	6 242
486C	52	0	92	92	0.00	1.00	0.000	-	-	0.198	0.097	49	1426	922	1933	0	275	275				12 527
486D	50	0	100	100	0.00	1.00	0.000	-	-	0.224	0.163	73	1557	1248	1970	0	298	298				11 630
486E	85	0	299	299	0.00	1.00	0.000	-	-	0.250	0.263	105	1676	859	2902	1	862	863				14 544
486F	a																					10 169
486G	806	215	434	649	0.33	0.67	0.029	0.033	114	0.056	0.115	206	1325	383	1985	558	700	1258	9	5	14	10 727
5841A	a																					47
5841B	a																					16 544
5841C	795	71	1067	1138	0.06	0.94	0.006	0.022	395	0.092	0.132	143	1549	575	2939	193	1964	2157	0	11	11	33 107
5841D	13	0	10	10	0.00	1.00	0.000	-	-	0.057	0.033	58	1287	1192	1414	0	33	33	0	1	1	43 805
5841E	316	7	532	539	0.01	0.99	0.002	0.007	403	0.120	0.203	169	1551	740	2618	28	1319	1347	0	1	1	39 249
5841F	10	0	7	7	0.00	1.00	0.000	-	-	0.033	0.018	54	1330	830	1961	2	7	9				34 589
5841G	759	20	838	858	0.02	0.98	0.002	0.009	513	0.089	0.087	98	1374	554	3773	88	2186	2274	1	11	12	29 397
5841H	7	0	10	10	0.03	0.97	0.003	0.005	180	0.091	0.026	29	1318	1000	1572	3	70	73				18 255
5842A	221	0	236	236	0.00	1.00	0.000	0.000	1487	0.106	0.244	230	1345	599	1910	5	735	740				34 947
5842B	a																					12 598
5842C	75	1	72	73	0.01	0.99	0.001	0.002	300	0.109	0.097	89	1152	579	2245	5	180	185				11 188
5842D	38	0	21	21	0.00	1.00	0.000	-	-	0.108	0.100	92	1207	661	1931							11 044
5842E	472	1	721	722	0.00	1.00	0.000	0.001	587	0.149	0.178	120	1400	563	2000	23	1427	1450	0	2	2	38 962
5843aA	418	231	10	242	0.96	0.04	0.028	0.031	108	0.002	0.008	478	1347	941	1895	466	0	466	10	0	10	18 605
5843bA	314	91	151	242	0.38	0.62	0.032	0.046	142	0.053	0.070	130	1202	643	1814	249	286	578				33 476
5843bB	334	27	644	671	0.04	0.96	0.004	0.012	321	0.101	0.112	110	1733	1133	2293	30	432	462	0	8	8	19 549
5843bC	84	0	46	47	0.01	0.99	0.001	0.003	481	0.052	0.029	57	1519	1159	1887	2	79	81	0	1	1	25 724
5843bD	108	6	119	125	0.05	0.95	0.006	0.018	309	0.061	0.045	73	1580	1125	2019	27	162	189				20 831
5843bE	108	9	84	92	0.10	0.90	0.003	0.007	246	0.056	0.041	73	1506	1076	1738	46	172	218	1	1	2	31 388
5844aA	277	80	0	80	1.00	0.00	0.039	0.027	69	0.000	-	-	414	250	1645	104	0	104				2 090
5844bB	53	9	0	9	1.00	0.00	0.033	0.018	55	0.000	-	-	542	345	1040	188	0	188				7 533
5844bC	10	13	0	13	1.00	0.00	0.067	0.029	43	0.000	-	-	1414	1002	1920	148	0	148	1	0	1	5 070
5844bD	35	48	0	48	1.00	0.00	0.070	0.031	44	0.000	-	-	1068	910	1265	140	0	140				8 031

(continued)

Table 2 continued

SSRU	No. sets	Catch (tonnes)			Proportion in catch		CPUE (tonnes/km of line)						Fishing depth (m)			No. fish tagged and released			No. tagged fish recaptured			Seabed area (km²) fishable depth range 600–1800 m
							TOP			TOA												
		TOP	TOA	TOT	TOP	TOA	Mean	SD	CV (%)	Mean	SD	CV (%)	Mean	Min.	Max.	TOP	TOA	TOT	TOP	TOA	TOT	
881A	37	15	1	16	0.97	0.03	0.058	0.064	110	0.004	0.016	362	1484	1000	2276	27	8	35				4 158
881B	731	90	799	889	0.10	0.90	0.016	0.035	220	0.136	0.227	167	1538	597	2450	819	439	1258	43	6	49	2 905
881C	1268	12	3802	3814	0.00	1.00	0.001	0.004	387	0.402	0.553	138	1519	863	2210	222	2906	3137	16	106	122	245
881D	[a]																					47 404
881E	197	7	104	112	0.07	0.93	0.003	0.011	315	0.046	0.059	128	1135	279	2389	25	35	60	1	4	5	12 392
881F	6	0	2	2	0.00	1.00	0.000	-	-	0.063	0.069	109	868	444	1336	0	15	15				14 782
881G	452	3	261	264	0.01	0.99	0.001	0.003	330	0.087	0.116	133	1117	391	1917	28	96	124	2	4	6	4 417
881H	3672	1	9021	9023	0.00	1.00	0.000	0.001	1612	0.264	0.275	104	1222	343	2096	33	8496	8529	1	636	639	21 825
881I	3478	1	6065	6067	0.00	1.00	0.000	0.001	1186	0.221	0.190	86	1085	480	2156	11	5449	5460	1	226	229	26 637
881J	674	0	1268	1268	0.00	1.00	0.000	0.000	997	0.145	0.119	82	799	309	1404	1	1463	1465	0	13	13	22 330
881K	1417	1	3490	3491	0.00	1.00	0.000	0.001	1102	0.274	0.248	90	1010	257	1755	4	4059	4064	0	33	33	28 215
881L	423	0	597	597	0.00	1.00	0.000	0.000	1568	0.094	0.062	65	645	473	1058	0	575	575	0	2	2	6 914
881M	404	0	972	972	0.00	1.00	0.000	0.000	2010	0.261	0.199	76	975	232	1262	1	1090	1091	0	70	70	32 511
882A	89	0	229	229	0.00	1.00	0.000	0.001	943	0.233	0.221	95	1134	608	1843	1	205	206				19 907[c]
882B	4	0	1	1	0.00	1.00	0.000	-	-	0.040	0.032	81	635	609	671	0	1	1				15 928[c]
882C	4	0	5	5	0.00	1.00	0.000	-	-	0.100	0.060	59	1074	646	1521	0	11	11				8 702
882D	189	0	245	245	0.00	1.00	0.000	0.000	1029	0.154	0.169	110	1369	721	1854	0	206	206	0	8	8	26 438
882E	1698	0	2671	2671	0.00	1.00	0.000	0.000	2447	0.202	0.273	135	1392	680	2004	5	2625	2630	3	268	274	28 392
882F	283	0	365	365	0.00	1.00	0.000	-	-	0.143	0.154	108	1386	748	2260	0	441	441	0	8	8	58 485
882G	13	0	7	7	0.00	1.00	0.000	-	-	0.028	0.013	48	869	513	1160	0	15	15				30 392
883A	[b]															0	7	7				25 441
883B	11	0	0	0	0.00	1.00	0.000	-	-	0.004	0.005	117	1004	622	1700	0	11	11				33 773
883C	6	0	0	0	0.00	1.00	0.000	-	-	0.000	0.001	125	992	719	1622	0	20	20				36 110
883D	4	0	0	0	0.70	0.30	0.001	0.001	200	0.000	0.001	200	1205	837	1541							8 816

[a]   No fishing reported
[b]   Research fishing (data not yet processed)
[c]   Seabed areas for sector north of 80°S

Table 3: Catch-weighted mean length of *Dissostichus* spp. (with weighted std dev and CV) and proportion of large individuals caught in SSRUs in fisheries for *Dissostichus* spp. in Subareas 48.4, 48.6, 88.1, 88.2 and 88.3 and Divisions 58.4.1, 58.4.2, 58.4.3a, 58.4.3b, 58.4.4a and 58.4.4b in all seasons. Large individuals: *D. eleginoides* > 80 cm; *D. mawsoni* > 100 cm.

Subarea/ division	SSRU	*D. eleginoides*				*D. mawsoni*			
		Weighted mean length (cm)	Weighted SD	CV (%)	Proportion large individuals	Weighted mean length (cm)	Weighted SD	CV (%)	Proportion large individuals
48.4	484N	112	17	15	0.96	148	21	14	1.00
	484S	122	17	14	0.98	155	14	9	1.00
48.6	486A	102	23	22	0.83	146	17	12	0.99
	486B	149	23	16	1.00	147	19	13	0.96
	486C	-	-	-	-	141	25	18	0.91
	486D	-	-	-	-	154	11	7	1.00
	486E	-	-	-	-	152	16	11	0.99
	486G	108	24	22	0.89	143	18	12	0.99
58.4.1	5841C	139	21	15	0.99	138	18	13	0.96
	5841D	-	-	-	-	141	14	10	0.99
	5841E	143	15	10	1.00	142	17	12	0.98
	5841F	-	-	-	-	135	20	14	0.94
	5841G	133	25	18	0.99	136	20	15	0.94
	5841H	105	10	10	1.00	142	16	12	0.98
58.4.2	5842A	116	-	-	1.00	142	25	17	0.91
	5842C	90	18	20	0.65	106	37	34	0.50
	5842D	-	-	-	-	107	34	31	0.55
	5842E	96	25	27	0.70	127	24	19	0.85
58.4.3a	5843aA	92	28	31	0.60	147	8	5	1.00
58.4.3b	5843bA	108	23	21	0.89	140	15	11	0.99
	5843bB	143	17	12	1.00	141	14	10	0.99
	5843bC	114	26	23	0.82	140	14	10	1.00
	5843bD	105	21	20	0.88	139	15	11	0.99
	5843bE	108	34	32	0.74	140	14	10	1.00
58.4.4a	5844aA	87	19	22	0.56	-	-	-	-
58.4.4b	5844bB	75	13	18	0.39	-	-	-	-
	5844bC	97	22	23	0.76	-	-	-	-
	5844bD	93	17	18	0.76	-	-	-	-
88.1	881A	97	19	19	0.81	144	14	10	1.00
	881B	98	23	23	0.80	142	18	12	0.97
	881C	108	25	24	0.85	146	13	9	1.00
	881E	99	21	21	0.83	119	29	24	0.73
	881F	-	-	-	-	114	15	13	0.84
	881G	105	24	22	0.87	144	16	11	0.99
	881H	115	21	18	0.96	123	22	18	0.83
	881I	114	21	19	1.00	130	23	17	0.89
	881J	115	16	14	1.00	108	22	20	0.62
	881K	120	27	22	0.91	120	24	20	0.80
	881L	113	4	4	1.00	102	22	21	0.49
	881M	-	-	-	-	106	18	17	0.68
88.2	882A	123	14	11	1.00	120	30	25	0.74
	882B	-	-	-	-	96	19	20	0.34
	882C	-	-	-	-	99	34	35	0.38
	882D	142	20	14	1.00	114	35	31	0.57
	882E	115	2	2	1.00	145	19	13	0.97
	882F	-	-	-	-	96	33	35	0.34
	882G	-	-	-	-	87	42	49	0.30
88.3	883C	-	-	-	-	42	-	-	0.00
	883D	82	13	16	0.50	79	-	-	0.00

Table 4: A summary of catches, catch limits and the methods for setting catch limits (1997/98 season onwards) in Subareas 48.4 and 48.6.

Subarea 48.4

Season	Target species	Method	Catch limit (tonnes)	Total reported catch (tonnes)	IUU catch (tonnes)	Total removals (tonnes)	Catch limit by SSRU	Other catch limitations	Method for setting catch limit	Research requirements
1997/98	*D. eleginoides*	Longline	28	0		0			Leslie method to estimate local density, YPR analysis from 48.3 to estimate precautionary catch (SC-CAMLR-XII, Annex 5, paragraph 6.3)	
1998/99	*D. eleginoides*	Longline	28	0		0				
1999/00	*D. eleginoides*	Longline	28	0		0				
2000/01	*D. eleginoides*	Longline	28	0		0				
2001/02	*D. eleginoides*	Longline	28	0		0				
2002/03	*D. eleginoides*	Longline	28	0		0				
2003/04	*D. eleginoides*	Longline	28	0		0				
2004/05	*D. eleginoides*	Longline	28	27		27				
2005/06	*D. eleginoides*	Longline	100	19		19			100 tonnes to allow establishment of mark-recapture program in 48.4 N (SC-CAMLR-XXIV, paragraph 4.118)	
2006/07	*D. eleginoides*	Longline	100	54		54				
2007/08	*D. eleginoides*	Longline	100	98		98				
2008/09	*Dissostichus* spp.	Longline	150	133		133		75 tonnes of *D. eleginoides* in 48.4 N, 75 tonnes of *Dissostichus* spp. in 48.4 S	75 tonnes in N and S to allow establishment of tag-recapture program in 48.4 (SC-CAMLR-XXVII, paragraph 4.97)	
2009/10	*Dissostichus* spp.		116	114		114		Finfish by-catch move-on rules (CM 41-03). 41 tonnes of *D. eleginoides* in 48.4 N, 75 tonnes of *Dissostichus* spp. in 48.4 S	41 tonnes in 48.4 N using CASAL assessment of stock using tag data, 75 tonnes in 48.4 S carried forward (SC-CAMLR-XXVIII, paragraphs 4.93 and 4.94)	

(continued)

Table 4 (continued)

Subarea 48.6

Season	Target species	Method	Catch limit (tonnes)	Total reported catch (tonnes)	IUU catch (tonnes)	Total removals (tonnes)	Catch limit by SSRU	Other catch limitations	Method for setting catch limit	Research requirements
1997/98	*Dissostichus* spp.	Longline	1536	0		0		888 tonnes north of 60°S, 648 tonnes south of 60°S	Based on GYM precautionary catch estimates using parameters from 48.3 and seabed area under consideration relative to 48.3 (SC-CAMLR-XVI, paragraph 9.60)	
1998/99	*Dissostichus* spp.	Longline	1202	0		0		707 tonnes north of 60°S, 495 tonnes south of 60°S	Unknown	
1999/00	*Dissostichus* spp.	Longline	910	0		0		455 tonnes north of 60°S, 455 tonnes south of 60°S	Maximum catch of 100 tonnes per fine-scale rectangle and discounted by 50% (SC-CAMLR-XVIII, paragraph 9.49)	
2000/01	*Dissostichus* spp.	Longline	910	0		0		As above		
2001/02	*Dissostichus* spp.	Longline	910	0		0		As above		
2002/03	*Dissostichus* spp.	Longline	910	0		0		As above		
2003/04	*Dissostichus* spp.	Longline	910	7		7		As above		
2004/05	*Dissostichus* spp.	Longline	910	51		51		As above		
2005/06	*Dissostichus* spp.	Longline	910	163		163		As above		
2006/07	*Dissostichus* spp.	Longline	910	112		112		As above		
2007/08	*Dissostichus* spp.	Longline	400	24		24		200 tonnes north of 60°S, 200 tonnes south of 60°S	Commission. SC-CAMLR noted previous catch limit calculations no longer valid (SC-CAMLR-XXVI, paragraph 4.127)	
2008/09	*Dissostichus* spp.	Longline	400	282		282		As above		
2009/10	*Dissostichus* spp.	Longline	400	295		295		As above	Recommendation that existing CMs remain in force (SC-CAMLR-XXVIII, paragraph 4.174)	

Table 5:   List of papers with assessment methods that have been applied in data-poor fisheries to be considered for WG-FSA.

Working Group papers:

Agnew, D.J., C. Edwards, R. Hillary, R. Mitchell and L.J. López Abellán. 2008. Analysis of the potential for an assessment of toothfish stocks in Divisions 58.4.1, 58.4.2. Document *WG-SAM-08/4*. CCAMLR, Hobart. Australia.

Delegation of the United Kingdom. 2005. Proposal for a mark-recapture experiment to estimate toothfish population size in Subarea 48.4. Document *WG-FSA-05/57*. CCAMLR, Hobart. Australia.

Hillary, R.M. 2008. Exploratory assessment methods for exploratory fisheries: an example case using catch, IUU catch and tagging data for Subarea 58.4.3a. Document *WG-SAM-08/5*. CCAMLR, Hobart. Australia.

Hillary, R.M. 2008. Defining tag rates and TACs to obtain suitably precise abundance estimates for new and exploratory fisheries in the CCAMLR Convention Area. Document *WG-SAM-08/6*. CCAMLR, Hobart. Australia.

McKinlay, J.P. and D.C. Welsford. 2008. Expected tag-recapture rates from new and exploratory fisheries for *Dissostichus* spp. Document *WG-FSA-08/63*. CCAMLR, Hobart. Australia.

Welsford, D.C. 2010. Evaluating the impact of multi-year research catch limits on overfished toothfish populations. Document *WG-FSA-10/42 Rev. 1*. CCAMLR, Hobart. Australia.

Ziegler, P.E., D.C. Welsford and A.J. Constable. 2010. Evaluating length-frequency data and length-based performance indicators in new and exploratory fisheries. Document *WG-FSA-10/43*. CCAMLR, Hobart. Australia.

CCAMLR Science **papers:**

Agnew, D.J., C. Edwards, R. Hillary, R. Mitchell and L.J. López Abellán. 2009. Status of the coastal stocks of *Dissostichus* spp. in East Antarctica (Divisions 58.4.1 and 58.4.2). *CCAMLR Science*, 16: 71.

de la Mare, W.K. 1994. Estimating confidence intervals for fish stock abundance estimates from trawl surveys. *CCAMLR Science,* 1: 203–207.

Hillary, R.M. 2009. Assessment and tag program adaption methods for exploratory fisheries in the CAMLR Convention Area: an example application for Division 58.4.3a. *CCAMLR Science*, 16: 101–113.

McKinlay, J.P., D.C. Welsford, A.J. Constable and G.B. Nowara. 2008. An assessment of the exploratory fishery for *Dissostichus* spp. on BANZARE Bank (CCAMLR Division 58.4.3b) based on fine-scale catch and effort data. *CCAMLR Science*, 15: 55–78.

Parkes, G., C.A. Moreno, G. Pilling and Z. Young. 1996. Use of the Leslie stock depletion model for the assessment of local abundance of Patagonian toothfish (*Dissostichus eleginoides*). *CCAMLR Science*, 3: 55–77.

Table 6:   Any research proposal in data-poor fisheries should provide details on each point to enable the Scientific Committee to evaluate the likelihood the proposal will, inter alia, satisfy the requirements of Conservation Measure 21-02, paragraphs 1(ii)(a–c).

Category	Information
1. Main objective	(a) Objectives for the research and why it is a priority for CCAMLR. (b) Description how performance measures will be accounted for. (c) Relevant existing information on the target species from this region, and information from other fisheries in the region or similar fisheries elsewhere.
2. Fishery operations	(a) Fishing nation (b) Fishing vessels (c) Target species (d) Fishing methods (e) Fishing regions and locations (f) Timing and duration.
3. Data collection	(a) Objectives of the data collection. (b) Types and quantities of catch, effort and related biological, ecological and environmental data (e.g. sample size by location) that will be collected and how sampling/fishing gear has been calibrated. (c) Methods for data collection (how and where these data types will be collected). (d) Methods for data analysis (description of methods by data type). (e) How and when will the data lead to a robust estimate of stock status and precautionary catch limits. Include evidence that the proposed methods are highly likely to be successful. (f) Nominated research provider for data analysis and evaluations of stock status and precautionary catch limits.
4. Proposed catch limits	(a) Proposed catch limits and justification. (Note that the catch limits should be at a level not substantially above that necessary to obtain the information specified in the plans for data collection and required to undertake the evaluations of stock status and precautionary catch limits.) (b) Evaluation of the impact of the proposed catch on stock status: • rationale that proposed catch limits are consistent with Article II of the Convention • evaluation of time scales involved in determining the responses of harvested, dependent and related populations to fishing activities. • Information on estimated removals, including IUU activities. (c) Details of dependent and related species and the likelihood of their being affected by the proposed fishery.
5. Research capability	(a) Evidence that the proposed fishing vessels and nominated research providers have the resources and capability to fulfil all obligations of the proposed data collection plan.
6. Reporting for evaluation and review	(a) List dates by which specific actions leading to the design and implementation of the data collection plan, and the provision of a robust assessment and precautionary catch limits, will be concluded and reported to CCAMLR. (b) Where the research is for more than one year, undertake an annual review of the research, including a review of the performance of the research program, preliminary analyses to evaluate how well the research will meet the research objectives, and determine if adjustments are required or whether the program should cease. (c) Description of performance measurers to allow SC-CAMLR to evaluate whether the research has been successful in achieving its objectives.
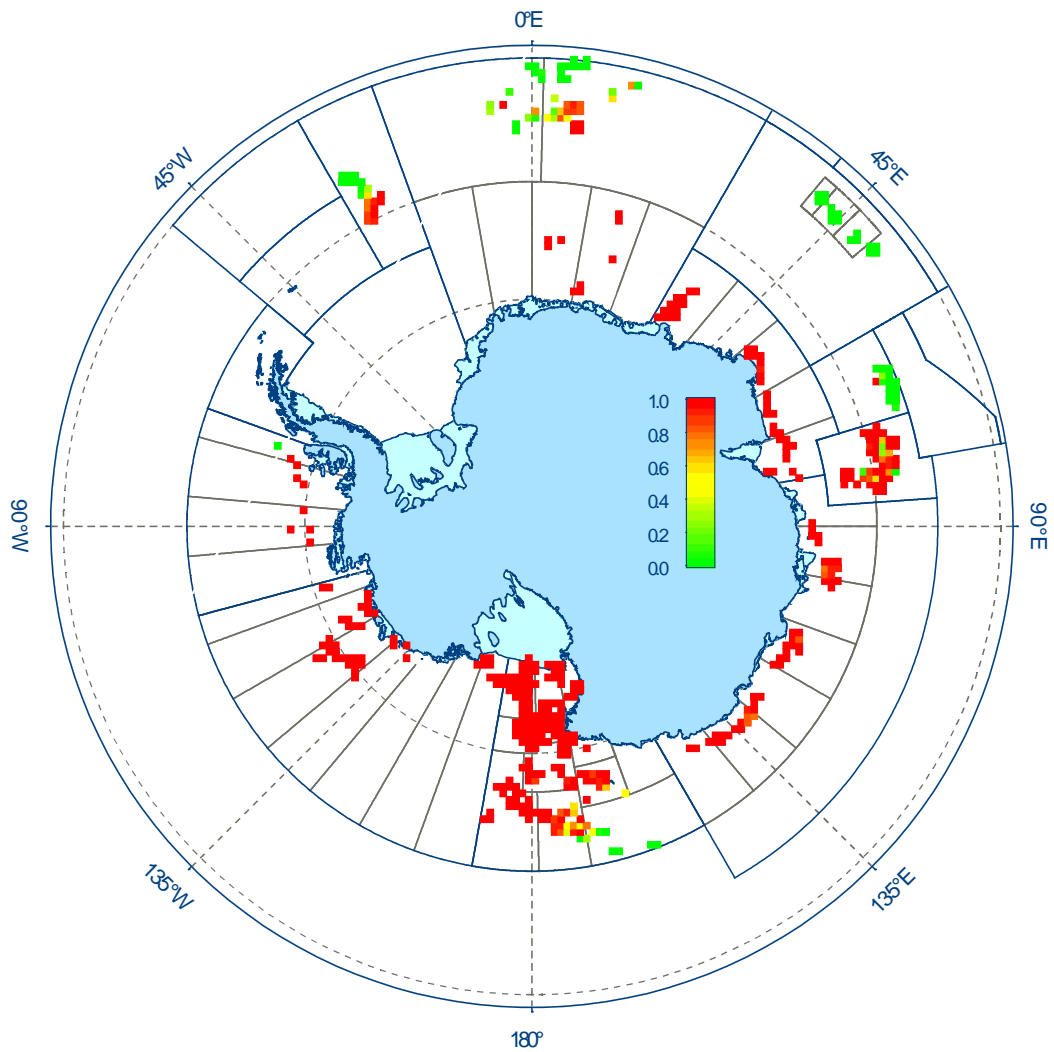
Figure 1[*]: Proportion of *Dissostichus mawsoni* in the total *Dissostichus* spp. catch by number in longline catches by fine-scale rectangles for all sets up to and including 2009/10.

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[*]   This figure is available in colour on the CCAMLR website.

Estimated biomass: 3 000 tonnes   **ⁱs: 3000 tonnes**

Estimated biomass: 10 000 tonnes   **ⁱs: 10000 tonnes**

Figure 2:   Estimated CVs to be achieved for an estimate of biomass as determined by the Petersen estimator (WG-SAM-08/6) applied to a multi-year tag-recapture survey. The estimated CV is a function of the number of tagged fish in the population available for recapture and the amount of fish scanned for tags per year (i.e. tonnes of catch), for a given initial biomass estimate (in this case 3 000 tonnes and 10 000 tonnes) derived by other means (e.g. relative CPUE with an analogous assessed SSRU, modified by an estimate of fishable seabed area).

(a)

Estimated biomass: 3 000 tonnes   s: **3000 tonnes**

(b)

Estimated biomass: 3 000 tonnes   : **3000 tonnes**

(c)

Estimated biomass: 3 000 tonnes   s: **3000 tonnes**
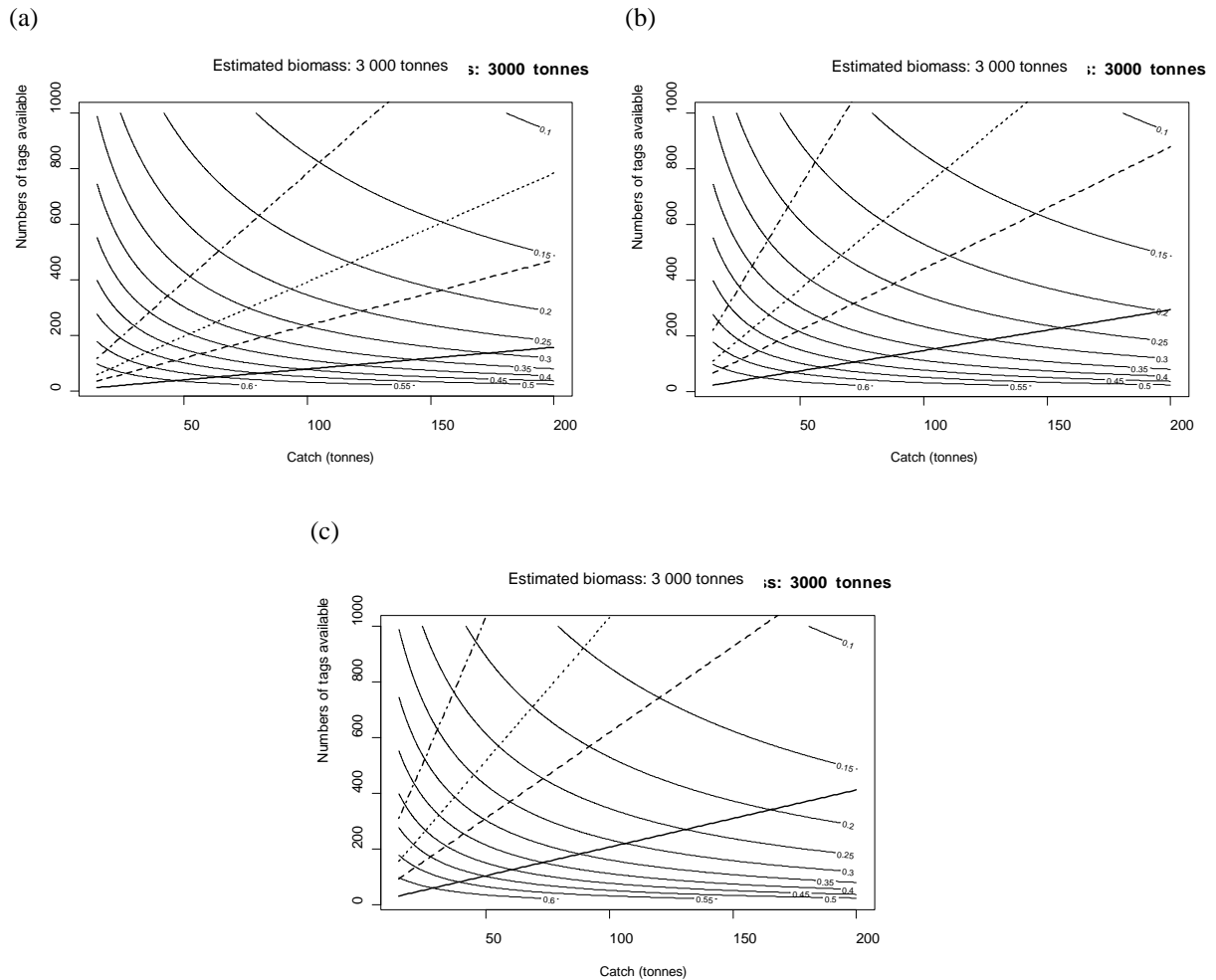
Figure 3:   Estimated CVs to be achieved for an estimate of biomass as determined by the Petersen estimator (WG-SAM-08/6) applied to a multi-year tag-recapture survey. The estimated CV is a function of the number of tagged fish in th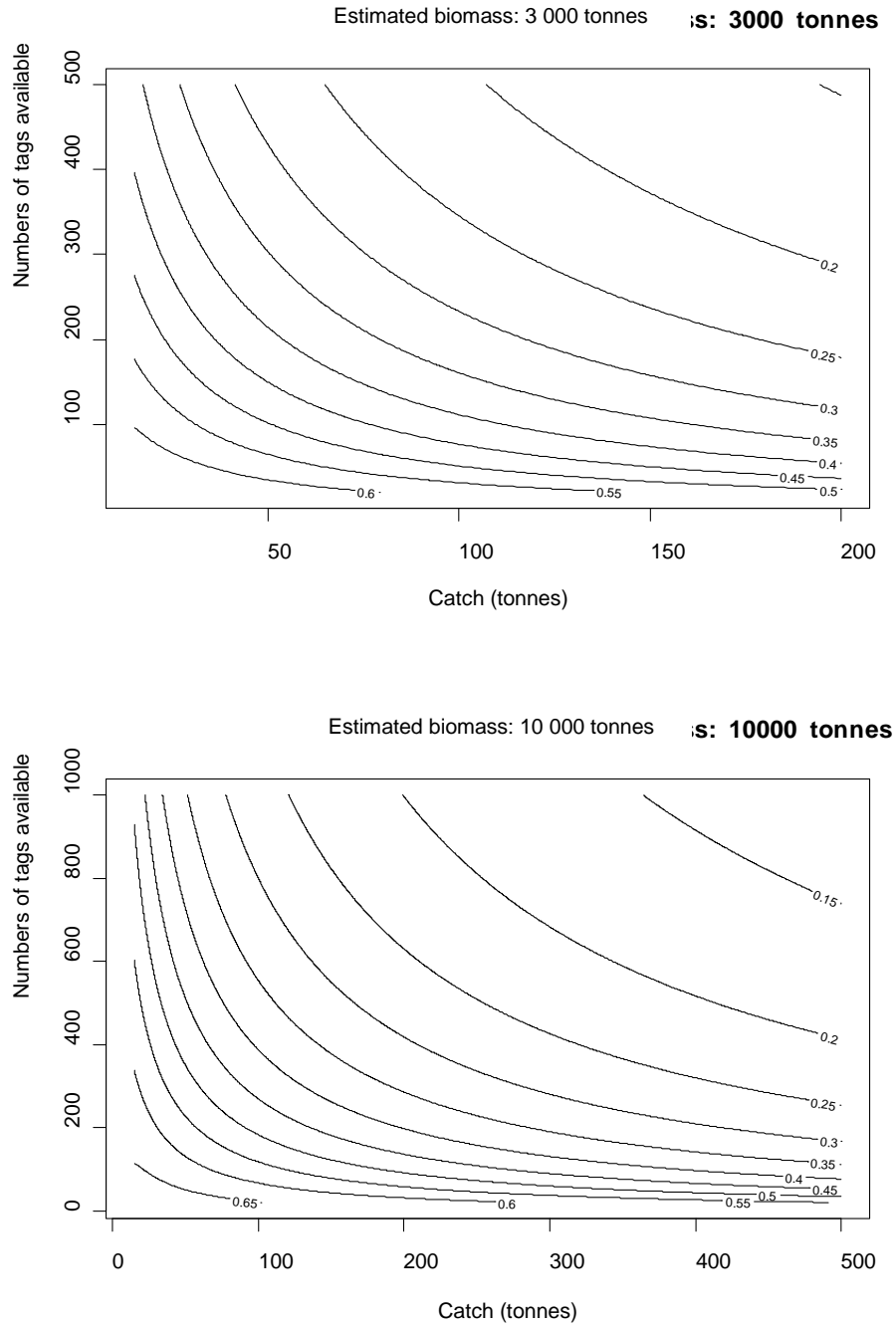e population available for recapture and the amount of fish scanned for tags per year (i.e. annual catch in tonnes), for a given initial biomass estimate (in this case 3 000 tonnes) derived by other means. Heavy lines are based on the formula developed by Dr Sharp (paragraphs 2.42 and 2.43) and indicate the estimated number of tags available for recapture in (a) year 2, (b) year 3 and (c) year 4, as a function of the tagging rate in fish per tonne, assuming constant catches and tagging rates in all years of the survey. Heavy lines correspond to tagging rates of 1 (solid), 3 (dashed), 5 (dotted) and 10 (alternating) fish per tonne, under the following asumptions: tagging mortality = 0.1 (WG-FSA-05/19); annual tag-loss rate approximation = 0.0084 (WG-FSA-11/18); natural mortality = 0.13 (WG-FSA-09/40 Rev. 1).

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AGENDA

Working Group on Statistics, Assessments and Modelling
(Busan, Republic of Korea, 11 to 15 July 2011)

1. Introduction
    1.1 Opening of the meeting
    1.2 Adoption of the agenda and organisation of the meeting

2. Focus topic: work plan for implementing research proposals for data-poor fisheries

3. Methods for assessing finfish stocks in established fisheries, notably *Dissostichus* spp.
    3.1 Tagging
    3.2 Assessments
    3.3 Scientific research in support of assessments

4. Strategies for acquiring data and setting catch limits in data-poor fisheries

5. Designs for scientific research on commercial fish stocks in closed areas and areas with zero catch limits

6. Other business

7. Advice to the Scientific Committee
    7.1 WG-FSA
    7.2 General

8. Adoption of report and close of meeting.

LIST OF DOCUMENTS

Working Group on Statistics, Assessments and Modelling
(Busan, Republic of Korea, 11 to 15 July 2011)

WG-SAM-11/1	Draft Agenda for the 2011 Meeting of the Working Group on Statistics, Assessments and Modelling (WG-SAM)
WG-SAM-11/2	List of participants
WG-SAM-11/3	List of documents
WG-SAM-11/4	Deployment of research hauls in the exploratory fisheries for *Dissostichus* spp. in Subareas 48.6 and 58.4 in 2010/11 Secretariat
WG-SAM-11/5	Reports on abundance and biological information of toothfish in Division 58.4.3b by *Shinsei Maru No.3* in the 2010/11 and proposal of the consecutive survey in the 2011/12 seasons K. Taki, T. Iwami and M. Kiyota (Japan)
WG-SAM-11/6	Reports on abundance and biological information on toothfish in Divisions 58.4.4a and b by *Shinsei Maru No. 3* in the 2010/11 season K.Taki, T. Iwami and M. Kiyota (Japan)
WG-SAM-11/7	Research plan for toothfish in Divisions 58.4.4a and b by *Shinsei Maru No. 3* in 2011/12 Delegation of Japan
WG-SAM-11/8	Principles for evaluating data collection plans in data-poor exploratory fisheries P.E. Ziegler, D.C. Welsford and A.J. Constable (Australia)
WG-SAM-11/9	Brief results of research fishing in Subarea 88.3 in the 2010/11 season Delegation of the Russian Federation
WG-SAM-11/10	Plan of research fishing in Subarea 88.3 in the 2011/12 season Delegation of the Russian Federation
WG-SAM-11/11	See WG-EMM-11/44
WG-SAM-11/12	Models of tag shedding for double tagging as a function of time at liberty and approximate solutions for the single tagging model in CASAL S.G. Candy (Australia)

WG-SAM-11/13   Development of a generic operating model framework for data collection, assessment method and management strategy evaluations
P.E. Ziegler (Australia)

WG-SAM-11/14   Developments in the CCAMR tagging program relating to tag linking
Secretariat

WG-SAM-11/15 Rev. 1   Research standards for exploratory fisheries
D. Kinzey (USA)

WG-SAM-11/16   Proposal for a CCAMLR sponsored research survey to monitor abundance of pre-recruit Antarctic toothfish in the southern Ross Sea
S.M. Hanchet, S. Mormede, S.J. Parker and A. Dunn (New Zealand)

WG-SAM-11/17   Investigation of the sensitivity of the Ross Sea toothfish assessment to withholding subsets of the available data
S. Mormede (New Zealand)

WG-SAM-11/18   Estimates of the tag loss rates for single and double tagged toothfish (*Dissostichus mawsoni*) fishery in the Ross Sea
A. Dunn, M.H. Smith (New Zealand), D.J. Agnew (UK) and S. Mormede (New Zealand)

WG-SAM-11/19   Report on the results of exploratory research fishing for crabs in Subarea 48.2 on board FV *Tamango* in the 2009/10 season
V.A. Bizikov and S.E. Anosov (Russia)

WG-SAM-11/20   A preliminary population status model for the Patagonian toothfish, *Dissostichus eleginoides*, on the Kerguelen Plateau (Divisions 58.5.1 and 58.5.2) using CASAL
S.G. Candy (Australia), A. Relot, G. Duhamel (France), D.C. Welsford, A.J. Constable, T.D. Lamb (Australia), P. Pruvost and N. Gasco (France)

Other documents

WG-SAM-11/P1   Estimates of sustainable yield for 50 data-poor stocks in the Pacific coast groundfish fishery management plan
E.J. Dick and A.D. McCall
(*NOAA-TM-NMFS-SWFSC-460* (2010))

WG-SAM-11/P2   Depletion-based stock reduction analysis: a catch-based method for determining sustainable yields for data-poor fish stocks
E.J. Dick and A.D. McCall
(*Fish. Res.* (2011), in press, doi:10.1016/j.fishres.2011.05.007)

WG-SAM-11/P3	Depletion-corrected average catch: a simple formula for estimating sustainable yields in data-poor situations A.D. McCall (*ICES J. Mar. Sci.* (2009), 66: 2267–2271)
WG-EMM-11/9	The Secretariat review of the Strategic Plan, associated activities and outcomes Secretariat
WG-EMM-11/44	Some properties of diagnostics of GLMM model tuning for standardising CPUE indices in the Area 48 using the CCAMLR fishery statistics database P. Gasyukov and S. Kasatkina (Russia)
CCAMLR-XXX/5	Report on the independent review of CCAMLR's data management systems Secretariat