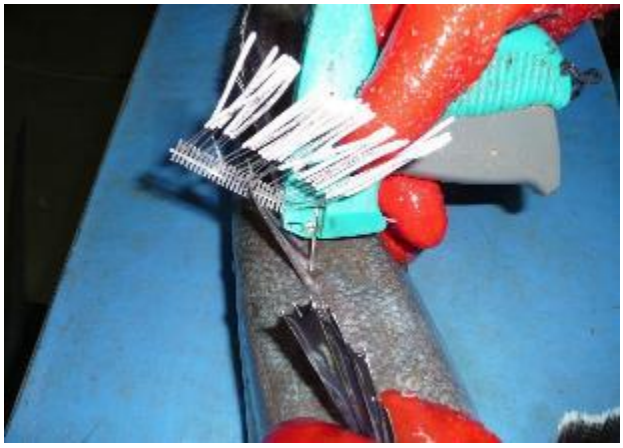
CCAMLR

Commission for the Conservation of Antarctic Marine Living Resources
Commission pour la conservation de la faune et la flore marines de l'Antarctique
Комиссия по сохранению морских живых ресурсов Антарктики
Comisión para la Conservación de los Recursos Vivos Marinos Antárticos

Scheme of International Scientific Observation
Scientific Observer's Manual
Finfish Fisheries
Version 2023



Address 181 Macquarie Street, Hobart, Tasmania 7000, Australia
Post PO Box 213, North Hobart, Tasmania 7002, Australia
Web www.ccamlr.org
Email observer.scheme@ccamlr.org
Telephone +61 3 6210 1110
Fax +61 3 6224 8744

This manual is produced in the official languages of the Commission (English, French, Russian and Spanish) and may be downloaded from the CCAMLR website at the CCAMLR Scheme of International Scientific Observation webpage (www.ccamlr.org/node/73033).

Version	Release date	Observer forms covered	Description
2011	01/12/2010	2011 – 2015 Longline 2011 – 2015 Finfish Trawl 2011 – 2015 Krill Trawl	Original
2019 Draft	01/10/2018	2019 Longline 2019 Finfish Trawl 2019 Krill Trawl	Draft version presented at WG-FSA-18 for review by Members
2020	For release: 01/09/2019	2020 Longline 2019 Finfish Trawl	Presented to WG-EMM-2019 for endorsement
2020a	For release: 01/04/2020	2020 Longline 2019 Finfish Trawl	Additional detail clarifying bird injury conditions added
2023	For release: 01/10/2022	2022 Longline 2022 Finfish Trawl 2023 Longline 2023 Finfish Trawl	Ross Sea Skate tagging programme removed

Table of Contents

1. Introduction

The Commission for the Conservation of Antarctic Marine Living Resources (CCAMLR), at its 1992 Meeting, adopted a Scheme of International Scientific Observation (SISO) as required under Article XXIV of the Convention. The scheme is designed to gather and validate scientific information essential for assessing the status of populations of Antarctic marine living resources and for assessing the impact of fishing on those populations and populations of related and dependent species.

Information from the observer program is a fundamental part of the CCAMLR management approach. The scheme provides independent scientific data that are crucial input data for the assessment of target and by-catch fish species. It also allows the implementation and effective management of measures aimed at reducing incidental mortality associated with fisheries to be monitored. Fisheries in the Convention Area take place in areas where few national research surveys are undertaken and therefore the data from the scheme are also invaluable to understanding the ecosystem of the Southern Ocean.

In order to assist CCAMLR Members and their observers in managing observation programs and recording data, the CCAMLR Secretariat, in consultation with the Scientific Committee and its working groups, have revised and updated the original *Scientific Observers Manual* (2011) to better define best practice and guidance for standard observer tasks. This manual provides guidance on standard tasks and requirements for observers as well as supplementary information to aid data collection requirements. Feedback on the manual, or any queries regarding the SISO program can be addressed to: observer.scheme@ccamlr.org.

2. SISO observer roles and responsibilities

A SISO observer deployed on a vessel engaged in scientific research, or harvesting of marine species within the CAMLR Convention Area is required to observe and report on the operation of vessel activities, and take independent samples of catches from vessels. A comprehensive description of functions and tasks required of SISO observers can be found in Appendix 2, and in Annex 1 of the Text of the Scheme of International Scientific Observation. The requirements for observers, Members who deploy observers and vessels who receive observers are also detailed in the main body of the text (www.ccamlr.org/node/74295). Your employing organisation should discuss these requirements in detail during training and briefing events, particularly the requirements for vessels that you are deployed onto.

A SISO observer is a scientific observer, therefore they are responsible for collecting reliable and accurate data as instructed. The evaluation or interpretation of data by observers is not a requirement by CCAMLR, and observers should be vigilant in ensuring such data or personal opinions are not recorded or reported. Additionally, SISO observers do not have enforcement powers, therefore should not attempt to guide vessels on CCAMLR regulations. Any enquires from the vessel regarding interpretation of CCAMLR regulations should be directed to the vessel's Flag State representatives, or to the Fisheries Monitoring and Compliance section of the CCAMLR Secretariat (email: ccamlr@ccamlr.org).

3. Definition of terms

The following definitions and explanations apply to commonly used terms in the observer logbooks and in this observers manual. Please note that this is not a comprehensive description of each logbook field, rather it is for terms where confusion may arise when comparing the terminology with other fishery operations.

Autoline: Fishing gear type consisting of a single longline with hooks attached and baited mechanically.

Bird scaring device: A bird scaring device or Bird Exclusion Device (BED) is used to discourage birds from accessing baits during hauling of longlines. The guidelines for a BED are described in Conservation Measure (CM) 25-02, Annex 25-02/B (www.ccamlr.org/measure-25-02).

By-catch: By-catch includes all living and non-living material (excluding target species) which is caught whilst fishing. This includes discards and the part of the catch which is not landed but affected by interactions with fishing gear.

Conservation measures: A series of regulations for CCAMLR fisheries.

Conversion factor: The ratio between the total weight of a fish or fishes caught (referred to as green weight) divided by the weight of the same fish or fishes after processing (referred to as processed weight). The conversion factor is used to calculate the total catch taken for a particular species.

Designating Member: The CCAMLR Member providing the observer to the vessel.

Discards: Whole fish or other organisms returned to the sea dead, or with low expectation of survival.

EEZ: Exclusive Economic Zone.

Haul: The act of hauling a fishing line, or the recovery of the fishing gear. Hauling begins when the first anchor attached to the main line is recovered on board the vessel. The haul ends when the final anchor attached to the main line is recovered by the vessel. Where two different sets have been joined for hauling, the haul is considered as one single continuous piece of fishing gear. For trawl fisheries, hauling begins when the vessel starts winching in the net from the assigned fishing depth. The haul ends when net has been recovered on board the vessel.

IMAF: Incidental mortality associated with fishing. Refers to marine mammal and seabird mortalities.

IUU: Illegal, unreported, or unregulated fishing.

Longline: Fishing method using hooks spaced on a long line.

Line segment: A 1 000-hook section of line or a 1 200 m section of line, whichever is the shorter. For pot lines it is defined as a 1 200 m section.

Net monitor cable: A wire commonly suspended from the trawl gantry running to net monitoring equipment attached directly to the net.

Observation: An observation is an independent data record, or description of an event collected or verified by an observer. As such, an observation is not any information that is provided by a third party which cannot be independently confirmed. An example would be recording the integrated line weight details used in an autoline system, which were provided by a vessel without an observer independently weighing a section of line to confirm the supplied figure.

Observation program start date: The date you board the vessel beginning your deployment as an observer on that vessel.

Observation program end date: The date you disembark the vessel ending your deployment as an observer on that vessel.

Offal: Bait and by-products from the processing of catch, including parts or sections of fish or organisms which are by-products of processing.

Receiving Member: The CCAMLR Member receiving the observer and the Flag State of the vessel.

Set: The act of setting a line, or paying out a line with hooks attached. Setting begins when the first anchor attached to the main line is deployed by the vessel. The set ends when the last anchor attached to the main line is deployed by the vessel.

Spanish line or double line: Longline gear type, where a secondary backbone line is attached to the main fishing longline. It is commonly used in areas of rough ground as the backbone line can be used to haul the main fishing line when the main line becomes snagged on the bottom.

Streamer line: A streamer line refers to any bird-scaring device which consists of a pole and long section of line with streamers attached. This may be positioned over the stern outside of the trawl warps. This type of gear has also been described in other publications as 'tori pole', 'bird line' or 'pole and line'. The CCAMLR-configured streamer line is the design adopted by CCAMLR and described in CM 25-02, Annex 25-05/A (www.ccamlr.org/measure-25-02).

Tag: Refers to T-bar style plastic tags, supplied by the CCAMLR Secretariat, which have unique serial numbers. They are used on toothfish and skate species.

Tally period: The observation period where an observer records independent catch and by-catch data from the deck of the vessel during a haul or trawl.

Trawl: A trawl refers to the act of setting, towing and hauling a net on a conventional trawl vessel. The trawl start time is when the net is released into the water from the trawl deck. Fishing start time is when the net reaches the fishing depth, whilst end fishing time is when the vessel begins winching in the net. Trawl end time is when the net is retrieved on board the vessel. For continuous trawl vessels, a single trawl may last many days, therefore for observation and catch reporting purposes, a trawl is defined as a two-hour period of continuous fishing.

Trotline: Longline gear type. Fishing hooks are attached to the main line in clusters of hooks, known as trots or dropper lines.

VME: Vulnerable marine ecosystem. In the context of CCAMLR this refers to seamounts, hydrothermal vents, cold water corals and sponge fields.

VME indicator organism: Any benthic organism listed in the CCAMLR VME Taxa Classification Guide (www.ccamlr.org/node/74322).

VME indicator unit: Either one litre of VME indicator organisms that can be placed in a 10-litre container; or one kilogram of those VME indicator organisms that do not fit into a 10-litre container.

4. CCAMLR regulations

CCAMLR implements a comprehensive set of measures in order to support the conservation of Antarctic marine living resources and the management of fisheries in the Southern Ocean. These conservation measures are reviewed and developed at each annual meeting of the Commission, and subsequently implemented by Members during the ensuing intersessional period and fishing season. Conservation measures are published on the CCAMLR website (www.ccamlr.org/node/57043).

SISO observers should be supplied with an electronic copy of the CCAMLR conservation measures, although as noted, a SISO observer is not required to interpret or instruct vessels on the implementation of conservation measures. However, observers must pay particular attention to three conservation measures as data they record will be used to evaluate vessel compliance with these CMs. They are:

(i) CM 25-02. Minimisation of the incidental mortality of seabirds in the course of longline fishing or longline fishing research in the Convention Area. This conservation measure details line weighting requirements for vessels, offal discarding restrictions and the design of streamer lines and BEDs.

(ii) CM 25-03. Minimisation of the incidental mortality of seabirds and marine mammals in the course of trawl fishing in the Convention Area. This conservation measure details trawling practices and offal restrictions for trawl vessels.

(iii) CM 26-01. General environmental protection during fishing. This conservation measure details waste disposal guidelines for all fishing vessels in the Convention Area.

Other conservation measures that may be relevant to observers are as follows:

(i) CMs 22-06 and 22-07 should be studied if an observer is deployed on board a vessel participating in an exploratory fishery where VME taxa data collection is required. See Section 16 of this observer's manual for more detail.

(ii) The appropriate subarea or division conservation measure in the 41 series for toothfish and icefish fisheries should be studied prior to deployment. For example, an observer deployed to Subarea 48.3 in the toothfish fishery should study CM 41-02. See Appendix 1 for a map of CCAMLR subareas.

(iii) Toothfish tagging requirements for vessels are described in CM 41-01, Annex 41-01/C. Tagging is a vessel responsibility (with the exception of some EEZ fisheries), however the observer is required to oversee operations. See section 14 of this observer's manual for more detail.

5. General operational procedures

SISO observers are required to complete two documents during their deployment. Firstly, an electronic logbook, an MS Excel file containing a series of worksheets, is used to record all data collected on a trip. The second document is a cruise report (using an MS Word template), which provides commentary on the trip and can be used to give more detailed descriptions of any unusual events or issues during the deployment. Whilst a captain may request an observer's data during a cruise, the cruise report is a confidential document. Once the Secretariat receives a cruise report it is provided to the Commissioner of the Receiving Member as a documented record of the trip.

The quality of the data is of utmost importance for the work of the Scientific Committee, and therefore relies on the accurate recording of observation periods, the time of events, and precise biological measurements and species identifications. The utility of an observer's work is not related to the quantity of information collected during a cruise.

It is also important to be able to distinguish between data collected by observers and by crew. For this reason, the data collection requirements and reporting fields in the electronic logbooks have mostly been designed to allow independent data collection by the observer. Where data may have been supplied by the crew (e.g. tagging information) there are clear options to indicate this. There are also fields on the relevant forms to indicate which observer collected particular data to allow inter-observer differences to be examined. It is important that these are completed accurately to allow for data validation.

The electronic logbook, cruise report template and detailed instructions on how to complete the logbook can be found on the CCAMLR website for each fishery (www.ccamlr.org/node/74640).

6. Units and formats

The units of reporting for specific fields are specified throughout the observer logbooks. Observers should ensure that the information recorded is in the specified unit and format indicated. General formats that apply throughout the logbooks are as follows:

Field	Format	Description
Date	dd/mm/yyyy	d = day, m = month y = year (e.g. 01/12/2018)
Time	hh:mm	h = hour, m = minute. All times are recorded in 24 hour format (e.g. 21:20, NOT 9:20pm) and are recorded in UTC, **not** local times.
Latitude and longitude degrees	-dd for latitude ± ddd for longitude	d = degrees (e.g. -52 for latitude, 172 for longitude) positive for east longitude, negative for west longitude
Latitude and longitude decimal minutes	MM.mm	M = minute, m = decimal minute (e.g. 26.12)

7. Standard measurements

7.1 Fish

Fish should be measured on a flat, non-slip measuring board or table provided by the vessel as part of the observer's workstation. Ensure that the snout of the fish is butted up to the end of the measuring board, the mouth is closed and the body is straight in a natural position.

For fish with a distinct tail, measure for both standard (SL) and total length (TL) to the nearest cm. SL is measured from the most anterior part of the snout to the end of the vertebral column (Figure 1). An easy way to determine SL is to bend the tail upwards and a crease will form at the point of the last caudal vertebra. TL is defined as the distance from the most anterior part of the snout to the furthest tip of the tail. Lightly 'streamline' the tail before measuring, i.e. the tail should not be spread to its extreme, nor completely compressed.

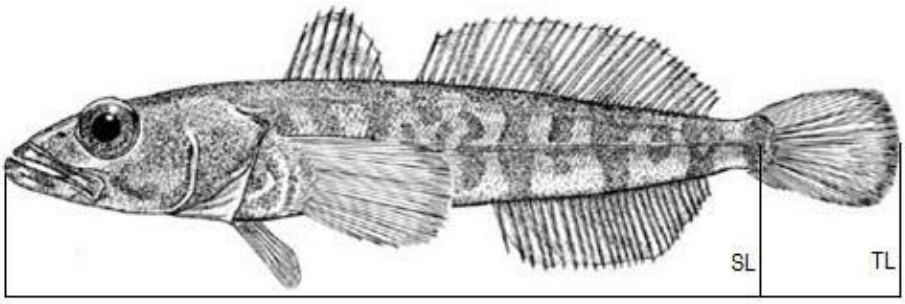


Figure 1: Measurement of toothfish and most other finfish by-catch species.

For *Macrourus* spp. TL and snout to anus (SA) length should be measured to the nearest cm. SA is measured from the tip of the snout to the anus (Figure 2).

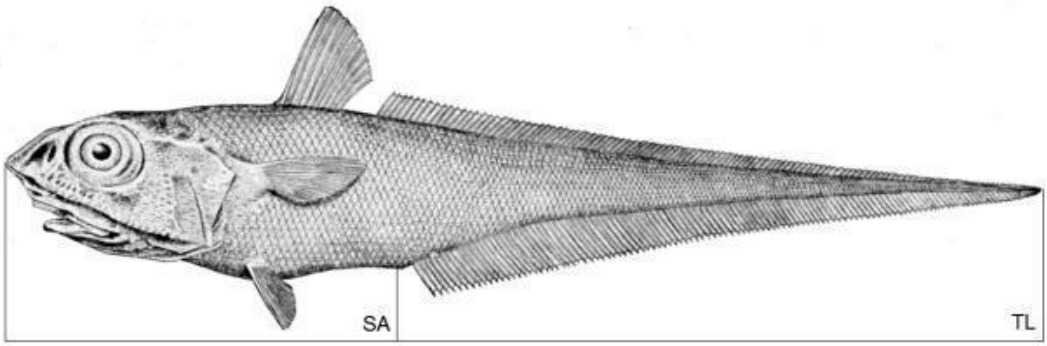


Figure 2: Measurement of *Macrourus* spp.

7.2 Skates and rays

Skates are measured for TL, wing span (WS) and pelvic length (PL) to the nearest cm. WS is measured from wing tip to wing tip (Figure 3). PL is from the tip of the snout to the end of the pelvic fin (Figure 4).

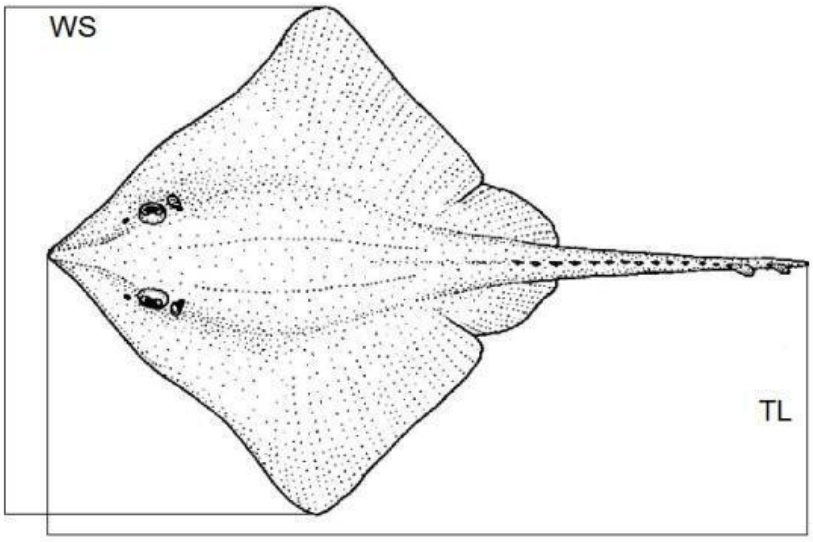
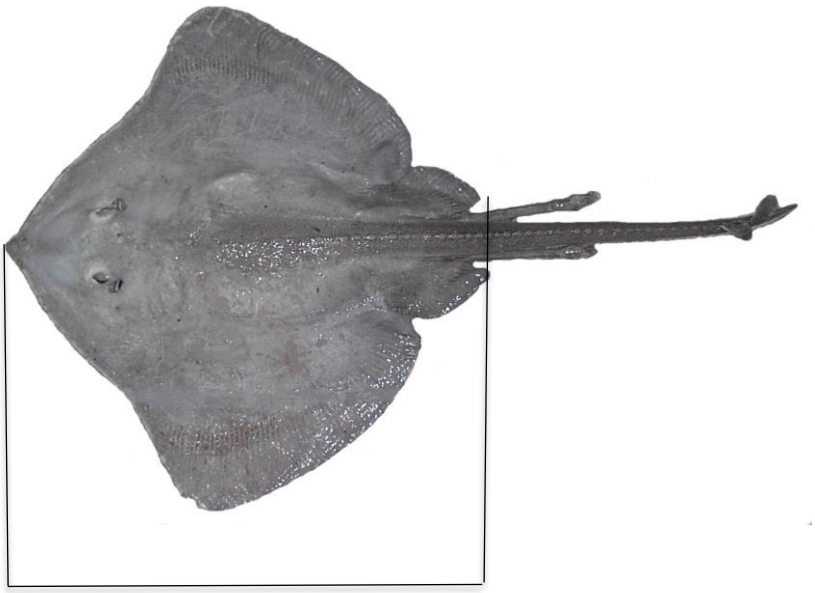


Figure 3: WS and TL measurement for skates and rays.



PL

Figure 4: PL measurement for skates and rays.

8. Weights

Weights are measured in either kilograms or grams in the observer logbooks, therefore please ensure you record the data using the correct metric specified in the field title (e.g. fish weight are in kg, gonad weight are in gm). Whilst it is not a specified requirement, the Scientific Committee strongly recommends the use of electronic motion compensating scales for all measurements. There are sections in the logbooks and in the cruise report for you to indicate the weighing equipment used during your deployment.

9. Sexing and maturity stages

9.1 Toothfish

Toothfish that are sampled should be sexed, and the maturity stage determined using the following guide (Figure 5) provided by Gasco et al. (2011). It is important to note that the photos of each gonad development stage are scaled so that they appear the same size. In reality there is a marked size difference between stage 1 and stage 4. The gonad maturity stage guide can also be downloaded separately with larger images from www.ccamlr.org/node/77436.

Females

Maturity stage	Description
F1. Immature	Ovary small, firm, no eggs visible to the naked eye.
F2. Maturing virgin or resting	Ovary more extended, firm, small oocytes visible, giving ovary a grainy appearance.
F3. Developing	Ovary large, starting to swell the body cavity, colour varies according to species, contains oocytes of two sizes.
F4. Gravid	Ovary large, filling or swelling the body cavity, when opened large ova spill out.
F5. Spent	Ovary shrunken, flaccid, contains a few residual eggs and many small ova.

Males

Maturity stage	Description
M1. Immature	Testis small, translucent, whitish, long, thin strips lying close to the vertebral column.
M2. Developing or resting	Testis white, flat, convoluted, easily visible to the naked eye, about $^{1}/_{4}$ length of the body cavity.
M3. Developed	Testis large, white and convoluted, no milt produced when pressed or cut.
M4. Ripe	Testis large, opalescent white, drops of milt produced when pressed or cut.
M5. Spent	Testis shrunk, flabby, dirty white in colour.

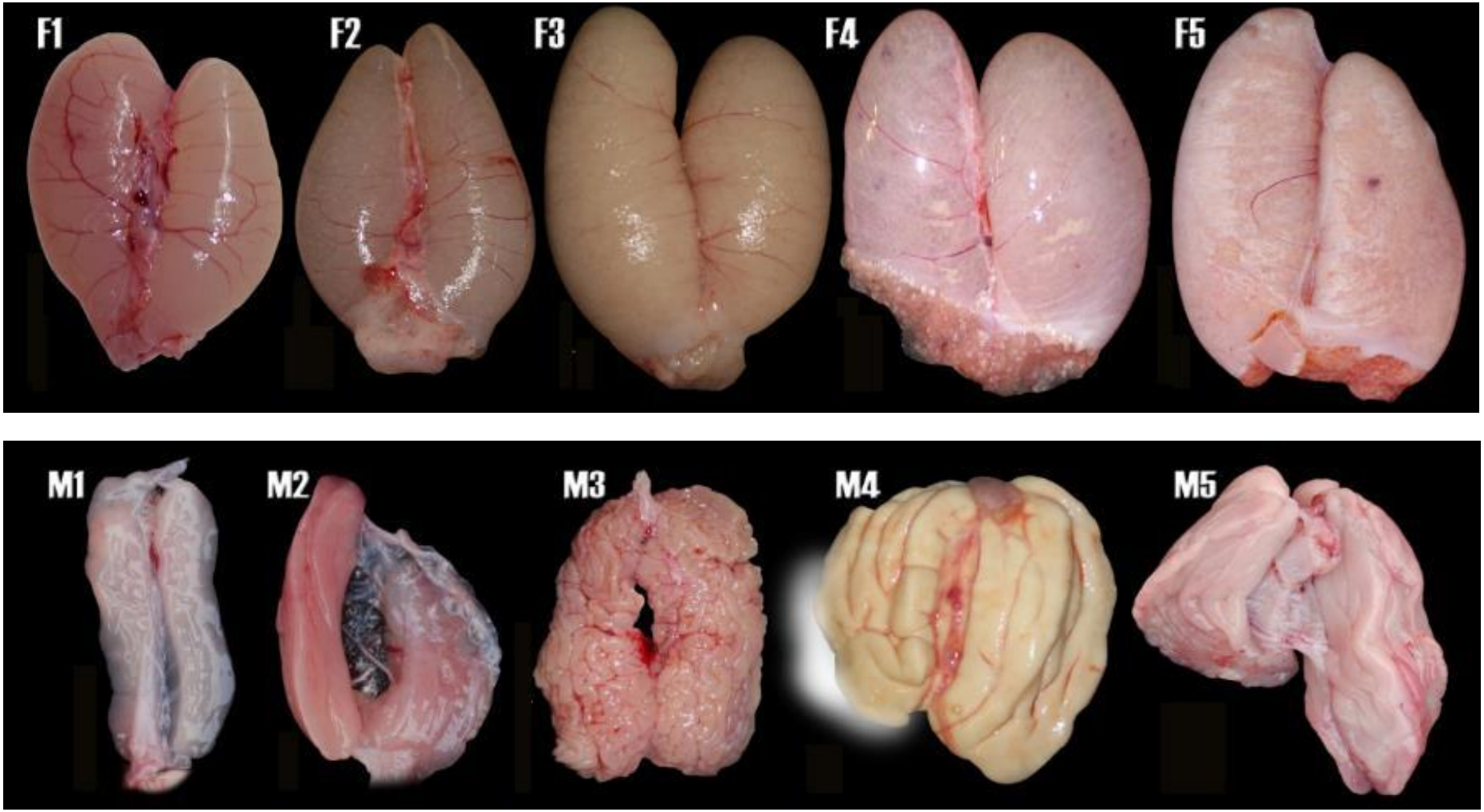


Figure 5: Toothfish maturity staging guide.

9.2 Skates and rays

Maturity data for skates and rays are required to determine the *length*-at-maturity. Although not a current SISO requirement, if skates are sampled for vertebrae and thorns, the maturity stage is helpful to determine the age-at-maturity. Males can be staged externally, without dissection (Figure 6). For females (Figure 7) internal examination is required to determine their maturity stage. It should be noted that this maturity scale was originally developed for New Zealand skates, and has been used for *Raja georgiana* and *Bathyraja eatonii* with good results, but has not been specifically tested on all Antarctic skate species (Francis, 2003).

Males

Maturity stage	Description
M1. Immature	Claspers short (not extending beyond pelvic fins) and uncalcified.
M2. Maturing	Claspers extend beyond pelvic fins but are soft and uncalcified (rarely, some calcification may have begun).
M3. Mature	Claspers extend well beyond pelvic fins and are hard, rigid and calcified.

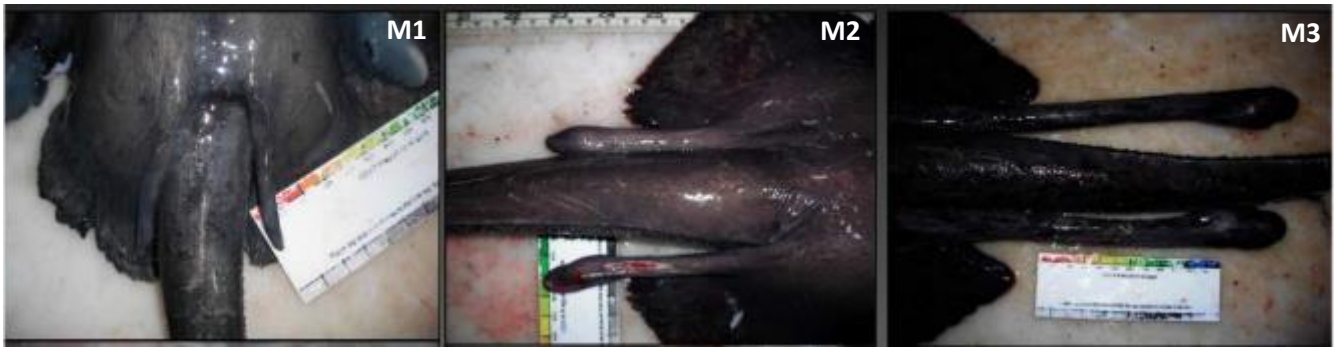


Figure 6: Maturity stages of male *Bathyraja meridionalis* (Benedit, 2009).

Females

In small immature females, the ovary may be completely embedded in the epigonal organ and therefore invisible. The epigonal organ is a white to pink, soft and easily torn organ (similar in consistency to the liver, but softer). It runs much of the length of the body cavity, appearing as a strap on each side of the backbone.

Maturity stage	Description
F1. Immature	Ovary invisible or contains only small (pinhead-sized) ova that have no trace of yellow or orange yolk. Uteri thread-like. No uterine egg cases.
F2. Maturing	Ovary contains small to medium (up to marble-sized) white to orange ova. Uteri may have visible swellings at anterior or posterior ends. No uterine egg cases.
F3. Mature	Ovary contains some large (greater than marble-sized) yellow or orange ova, in addition to small and medium ova. Uteri enlarged (>1 cm wide) and *may* contain egg cases. The presence of uterine egg cases guarantees that the female is mature, but females without uterine egg cases are still mature if they have some large ovarian eggs.

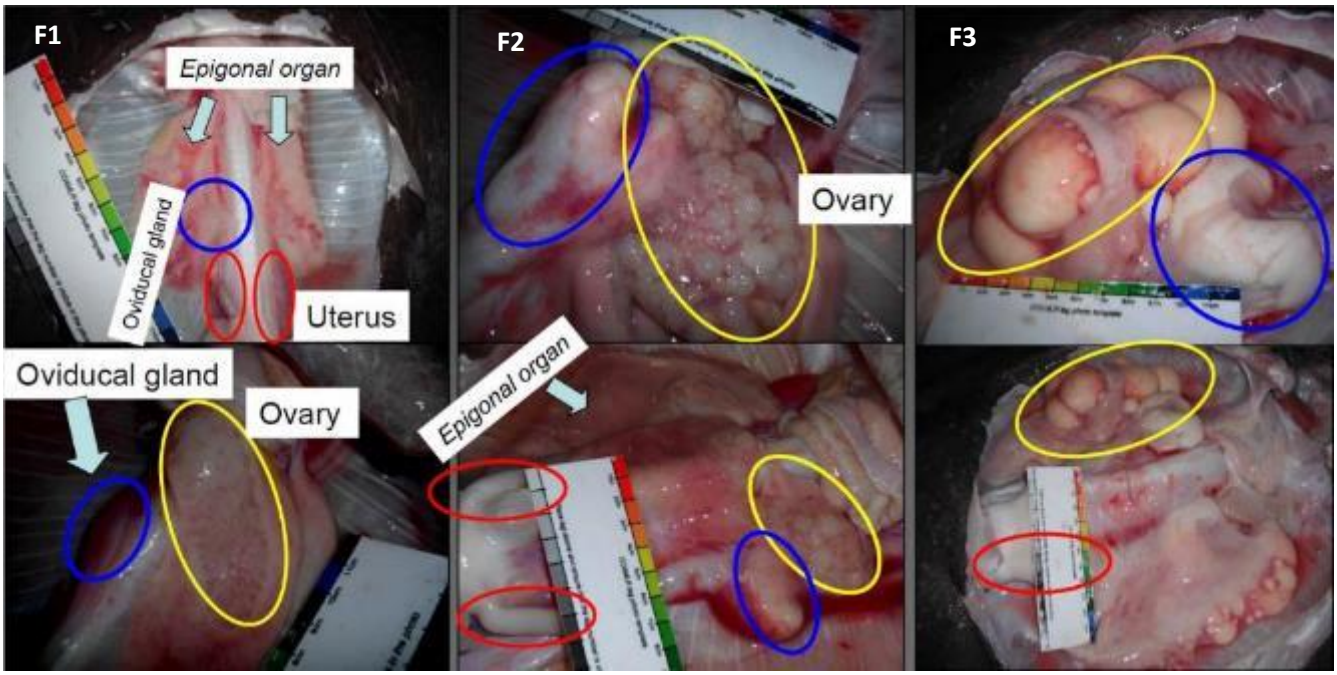


Figure 7: Maturity stages of female *Bathyraja meridionalis* (Benedit, 2009).

10. Otolith collection and storage

Otoliths are small calcareous concretions in the inner ear of fish, which are involved in maintaining the fish's balance and orientation in the water and in sound detection. The use of otoliths for ageing is especially important when scales, the other important hard part used for ageing, are either absent (as in Channichthyids) or lost from the fish by the time it is brought on deck (e.g. *Electrona carlsbergi*). The structure and shape of otoliths varies greatly between species and can be used to confirm species identification.

10.1 Removing otoliths

The inner ear on each side has three otoliths, but two of these are usually very small and only one of each set (the sagitta) is usually useful or even visible. The inner ear apparatus is found usually nestling in a pouch-like extension of the cranium (the otic bulla) in the postero-ventral part of the skull. The best technique for speedy and reliable otolith removal depends on the size of the fish.

Equipment: Use a large knife with a rigid blade to make incisions, and fine pointed forceps for collecting the otoliths.

Technique one: This method requires the removal of the roof of the cranium to look for the otoliths below the brain, (Figures 8 and 9) and is useful for inexperienced people to help them learn the precise position of the otic bulla. Place the fish belly-down on a firm table and make a shallow vertical cut with the knife at the posterior extremity of the head (Figure 10), but sufficiently deep to reach the brain cavity. Then continue this cut forward so as to slice off the top of the cranium and expose the brain. The otoliths can be found in the very bottom of the brain case below the hind part of the brain (Figure 9a). They are easily recognisable by their bright white opaque colour, in contrast to the creamy colour of the brain tissue and the translucent bone (Figures 9 and 11).

Technique two: This technique can be faster on large fish, but is only recommended once experience is gained in learning the position of the otic bulla. For this technique, make a vertical cut through the head (at a right angle to the spine) at the position indicated in Figure 10. The exact position has to be learnt by trial and error, as each species is slightly different. The aim is to make the cut either just in front of, or just behind, the otoliths, so that these can be picked out. An error of a few millimetres can mean that the otoliths themselves are sliced in half. Cut at least half-way down through the head, so that the front of the head can be bent forward and down to expose the cranium. The vertical section of the head that is exposed should resemble Figure 8b (assuming you

have cut behind the otoliths and are looking towards the fish's snout). They are usually still encased in the inner ear membranes, and can be picked out with the forceps. If you cannot find them, try making another cut a little in front of, or behind, the first one.

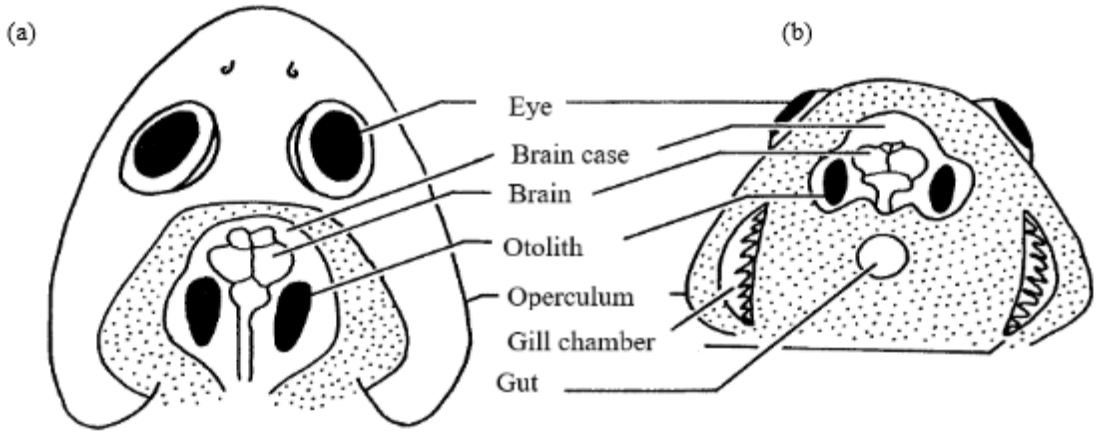


Figure 8: Positions of the otoliths in a fish head. (a) Dorsal view, (b) Vertical section through head.

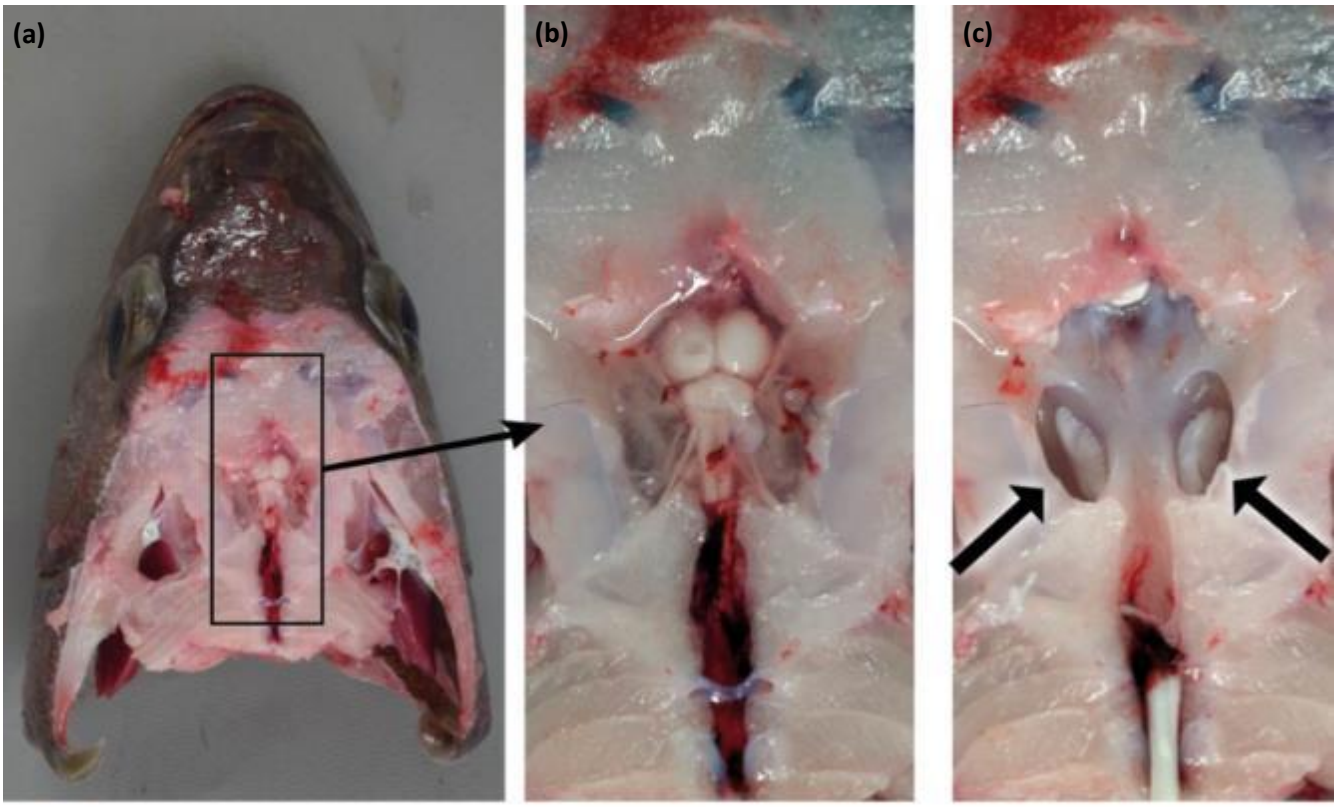


Figure 9: Photo showing dissection of fish head and otolith location (Gasco, 2017).

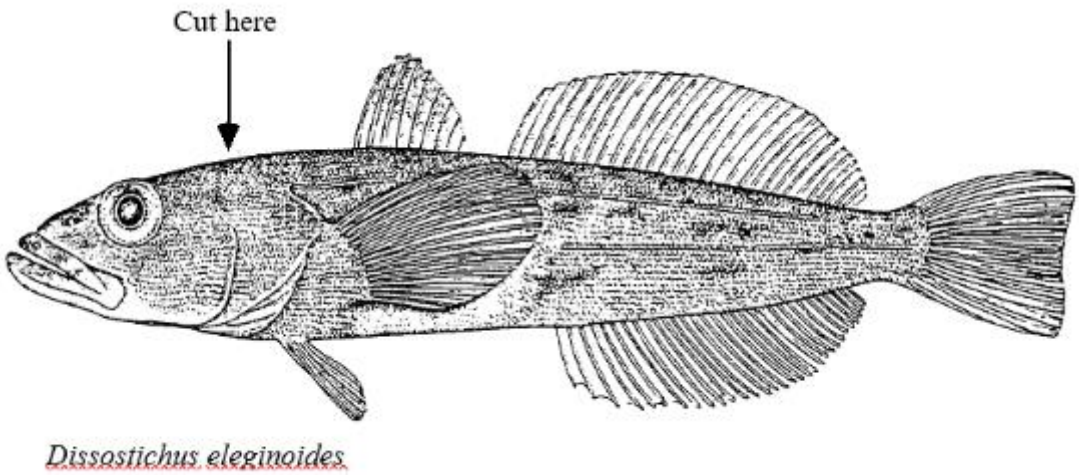


Figure 10: Cut position for extracting toothfish otoliths.

Figure 11: Dissection of icefish showing otoliths in situ. Photo: Dale Maschette (Australian Antarctic Division).

10.2 Otolith storage

The responsibility of the storage, cataloguing and ageing of otoliths is agreed upon in the bilateral arrangement between Designating and Receiving Members, therefore the exact storage technique may differ from the methods described here. The Scientific Committee recommends that otoliths are best stored in dry, small manilla envelopes, about 50 x 75 mm, with a glued flap. Plastic or other non-porous bags are not recommended, as they do not allow the contents to dry out. If any tissue remains on the otolith, it will rot and tend to damage the otolith if it cannot dry out. In any case, rub the otoliths between the fingers to remove as much tissue as possible before placing in the envelopes. Small otoliths should first be put in a small capsule (empty gelatine capsules, as used in the pharmaceutical industry, are best) to prevent them being lost in the cracks of the envelope or getting damaged.

On the outside of the envelope record the information as shown below, before the otoliths are added to the envelope to avoid them being damaged. A rubber stamp for printing the headings is very useful to avoid excessive writing, and batches of envelopes should be prepared beforehand. An example envelope label for otoliths is in Figure 12.

Fish serial number:	
Haul number:	
Species:	
TL:	SL:
Weight:	Sex:
Otolith number:	Date:

Figure 12: Example otolith envelope label.

Keep the otoliths in their packets in a dry place, in a suitable container where they are safe from having heavy weights being put on them to prevent damage.

11. Conversion factor tests – finfish fisheries

A conversion factor is used to determine the live weight of a target species (or green weight) from the processed or landed weight. In CCAMLR finfish fisheries, observers are requested to conduct conversion factor tests for all commercially landed species. This test is an essential part of an observer's role because a fundamental part of fisheries management is the ability to determine the quantity of fish extracted from a fishery. Whilst the conversion factors reported in CCAMLR fisheries management are provided from vessel data, the observer tests and descriptions provide an important verification of the vessel practices.

The size of the conversion factor depends on the method of cutting the fish, and the retained product type. Therefore, for all reported species and processing types, the minimum number of fish to be sampled are 25 individuals.

The process for completing a conversion factor test is very simple. Fish that are to be tested must be weighed and measured prior to processing. Use a sharp knife or a tube to drain the stomach of water prior to weighing (see Figure 13 as an example). Then allow the vessel crew to process the fish in the manner used by the vessel. The processed weight is then recorded.

It is important to select fish across a representative weight range of the catch as larger fish produce a lower conversion factor. The best way to achieve this is to conduct smaller, more frequent tests, rather than fewer larger tests. Different crew members will also produce different conversion factors from their cuts, therefore it is important to try and collect data from multiple cutters during your trip. Pay attention to the cutting methods

used by the crew when conducting the test as opposed to during normal processing times, as they may unconsciously alter their procedures to perform the best cut they can.

Figure 13: Steel tube for draining the stomach of water prior to weighing. Photo: Andy Smith (CAPFISH).

12. Target Species Identification Guide

12.1 Toothfish

The Patagonian toothfish (*Dissostichus eleginoides* – CCAMLR code TOP, Figure 14) supports fisheries by CCAMLR Members off the coasts of South America and around most of the sub-Antarctic islands and banks of the Atlantic and Indian Oceans. The closely related and superficially very similar Antarctic toothfish (*D. mawsoni* – CCAMLR code TOA, Figure 15) is the target of exploratory fisheries in more southern latitudes, close to the continental shelf of Antarctica.

Data on the specific identity of fish taken in these fisheries, especially from those that operate on the boundary between the distributions of the two species, is clearly important in order to know which species is being exploited in which area. Therefore, scientific observers are requested to take special care to identify the species correctly.

The following information has been developed using standard reference material (Gon and Heemstra, 1990) and information based on the experience of fishers that described the best way to separate the two species during fishing operations in the region of overlap between the species.

12.2 Patagonian toothfish

Patagonian toothfish are widespread and common in sub-Antarctic waters over shelves and banks from South Georgia in the west to Macquarie Island in the east. They are also found off the coasts of Chile and Argentina and on the Campbell Plateau south of New Zealand. The southern limit is not precisely known, but it probably does not occur in water at temperatures less than 1°C; this is equivalent to about 57°S in most areas, but probably further south in the area south of New Zealand, where the Polar Front tends to be in a more southerly position. It grows to over 2 m in length and 100 kg in weight, but specimens over 1.5 m are uncommon. It is a bentho-pelagic species which feeds mainly on mesopelagic fish and squid, but also on some benthic prawns and crabs. Larval and young juvenile stages are pelagic, but older juveniles and adults are mostly caught on the bottom. Depth range is 300 to >2 000 m, with younger fish generally in shallower water.

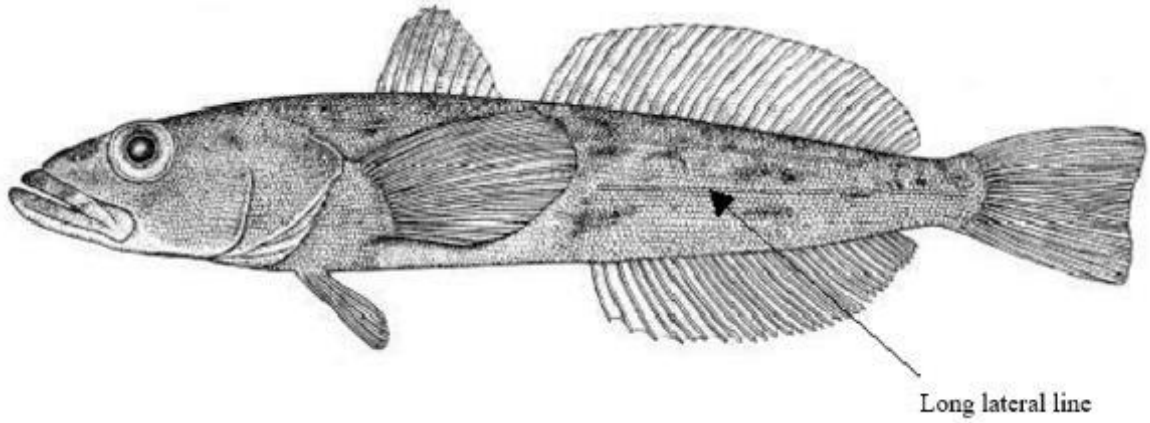


Figure 14: Patagonian toothfish (Fischer and Hureau, 1985).

12.3 Antarctic Toothfish

Antarctic toothfish are very similar externally to Patagonian toothfish, but inhabit the higher latitudes of the Southern Ocean, over the Antarctic continental shelf, including the Antarctic Peninsula, and the deeper ocean to the north. Its northern distribution limit is not precisely known.

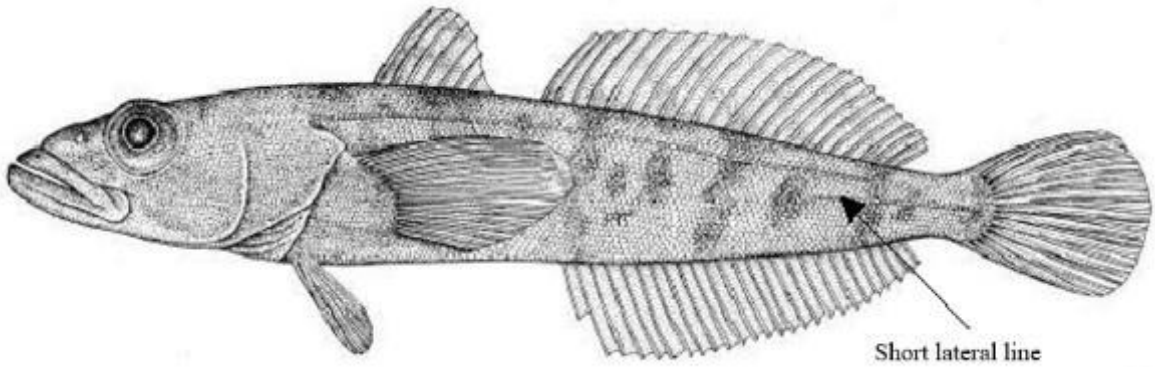


Figure 15: Antarctic toothfish (Fischer and Hureau, 1985).

12.4 Toothfish species differences

Determining the difference between the species is based on two primary features.

1. Dorsal fin colouration – the colour and pattern of the dorsal fins appear to be quite distinctive between the two species. Those of Patagonian toothfish are generally uniform with well-defined white tips of the dorsal and often the pectoral fins. Antarctic toothfish, in contrast, have a pattern of alternating dark and light bands across the dorsal fin which are visible when the fin is erect (Figure 16).
2. Tooth structure – the teeth of Patagonian toothfish are relatively large, long and pointed compared to those of Antarctic toothfish which have much smaller teeth relative to their body size (Figure 17).

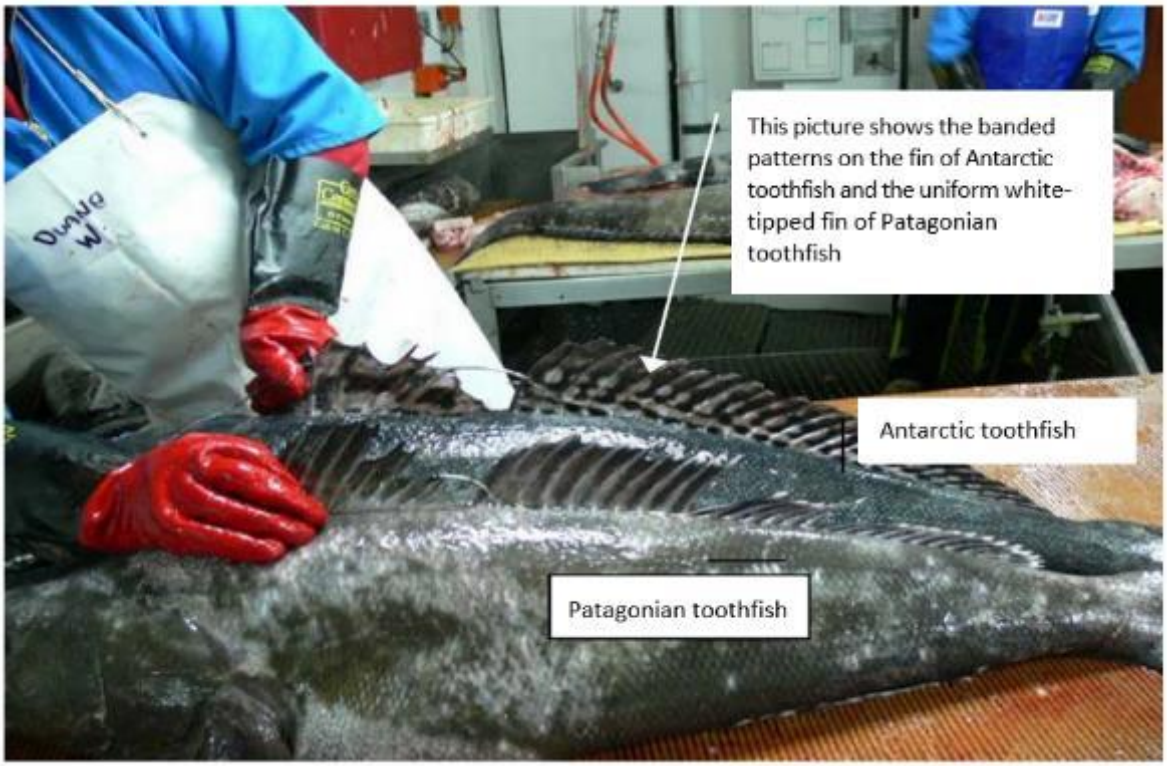


Figure 16: Dorsal fin colouration of Antarctic and Patagonian toothfish. Photo: J. Fenaughty and the Ross Sea MSC Client Group (New Zealand).

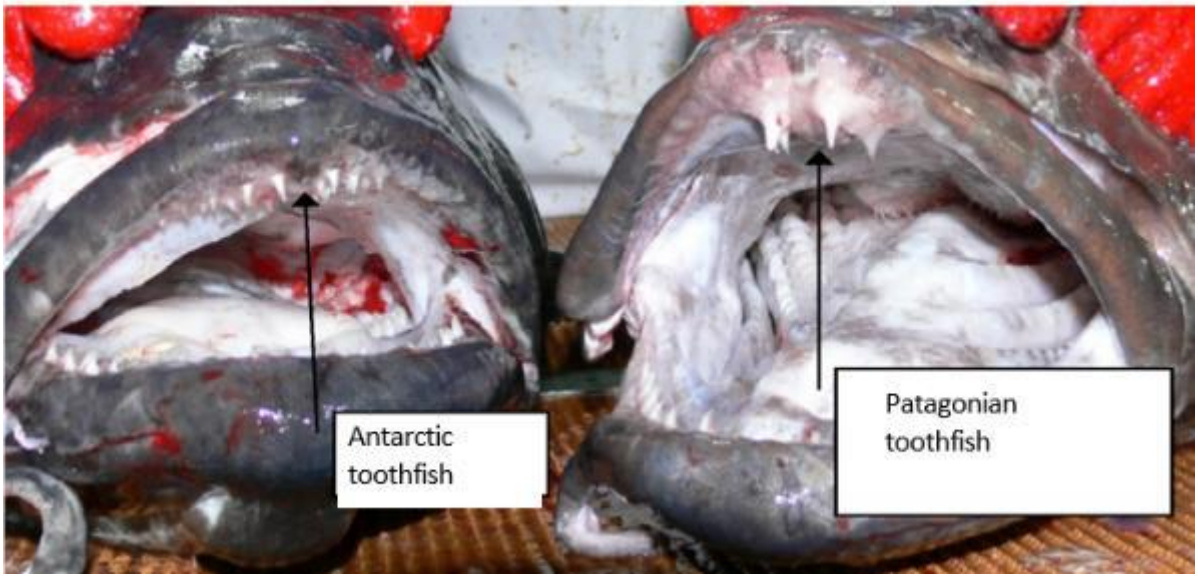


Figure 17: Tooth structure of Antarctic and Patagonian toothfish. Photo: J. Fenaughty and the Ross Sea MSC Client Group (New Zealand).

Secondary features can be used to confirm identification. These include the length of the lateral line (see Figures 14 and 15) and the structure of the otoliths which are much bigger in proportion to the body size and more elongated in Patagonian toothfish than those of Antarctic toothfish (Figures 18 and 19). Retained otoliths can also be used for subsequent identification, verification and confirmation.

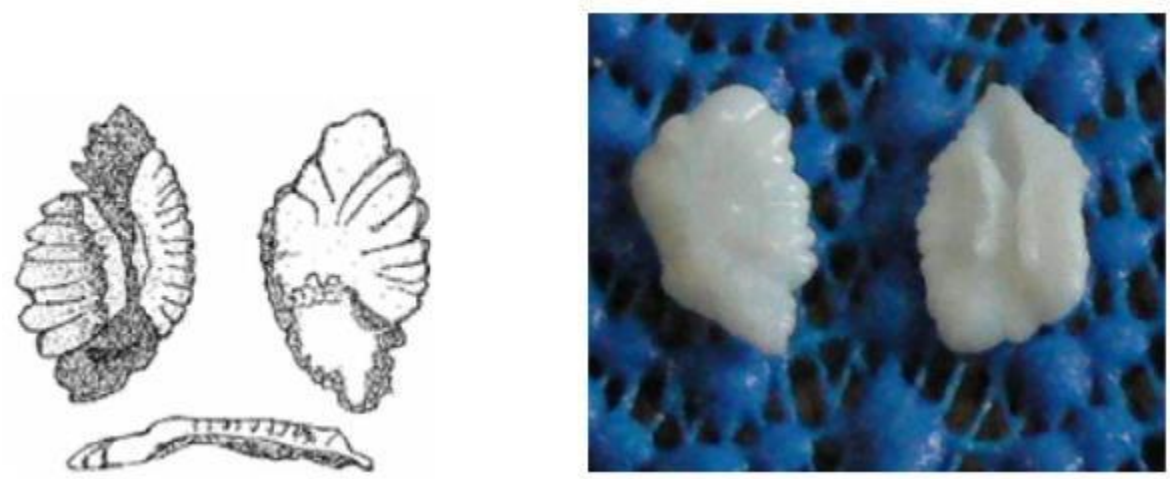


Figure 18: Patagonian toothfish otoliths. Photo and drawing: J. Fenaughty and the Ross Sea MSC Client Group (New Zealand).

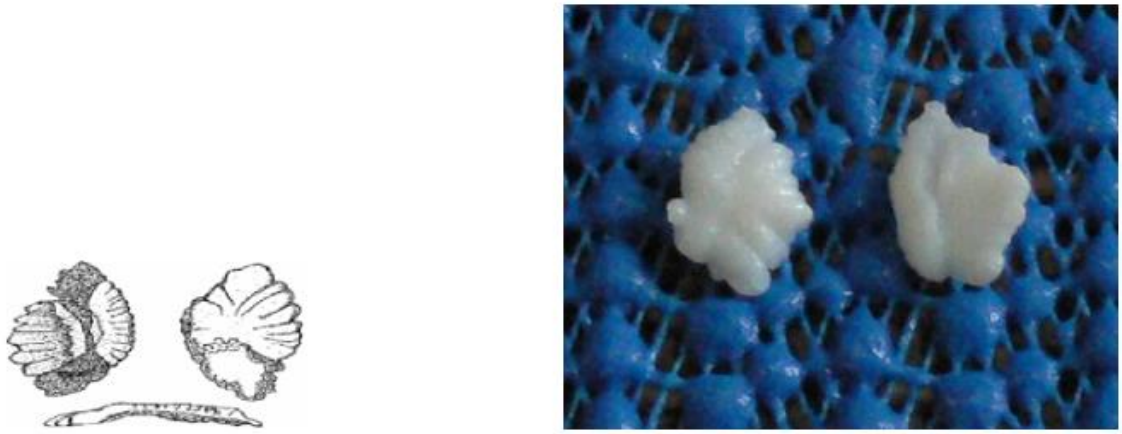


Figure 19: Antarctic toothfish otoliths. Photo and drawing: J. Fenaughty and the Ross Sea MSC Client Group (New Zealand).

12.5 Mackerel icefish

Mackerel icefish (*Champsocephalus gunnari*) are currently only targeted in the EEZ fisheries of Subarea 48.3 and Division 58.5.2 using either midwater or demersal trawls (Figure 20). They belong to the Channichthyidae (crocodile icefishes) family. Identifying features of this family include two separate dorsal fins, a large fan-like pectoral fin, 2–3 lateral lines and a scaleless body. Mackerel icefish can grow up to 44 cm in length.

Figure 20: Mackerel icefish showing the large pectoral fin and lateral lines. Photograph: Australian Fisheries Management Authority.

13. Sampling and identifying target catch and by-catch species

13.1 Toothfish

Toothfish sampling requirements in CCAMLR fisheries vary depending on the fishery type. The default toothfish sampling requirements can be found in Appendix 3 and on the CCAMLR website (www.ccamlr.org/node/81589).

It is important to note that these sampling requirements may change in an exploratory or research fishery, as a research plan that applies to your vessel may stipulate increased sampling requirements, or extra types of sampling to be undertaken. These requirements should be communicated to you prior to deployment, through your employing organisation.

13.2 Icefish

Icefish sampling requirements for Subarea 48.3 are stipulated in CM 23-05, and for Division 58.5.2 in CM 42-02, Annex 42-02/B. In both cases the requirement is to record a representative sample of length composition from each fine-scale grid rectangle (0.5° latitude by 1° longitude) fished in each calendar month. A suggested practical method of achieving this is to sample 10 individuals per haul.

13.3 By-catch species

The sampling and identifying of by-catch species is a critical part of an observer's workload, as it allows the assessment and quantification of fishery ecosystem impacts. By-catch sampling protocols are described in the logbook instructions for each fishery, and should be consulted before any sampling takes place. As with the toothfish sampling requirements, where a research plan is being undertaken by your vessel, there may be increased numbers of types of sampling requested for by-catch species. These must be discussed and agreed with you prior to deployment, through your employing organisation.

Observers are requested to identify by-catch species to the lowest taxonomic level possible, and because of their expertise, it is beneficial to assist vessels with their species identification for their by-catch reporting requirements. However, observers should only provide identification assistance. The separation and

quantification of by-catch is a vessel responsibility. Any queries relating to species identification should be directed to the observer deployment organisation or company as appropriate.

Because of the size and number, an extensive list of materials for identifying by-catch species are housed separately on the CCAMLR website: www.ccamlr.org/node/77322.

Observers should be provided with these materials before deployment by their employing organisation. In particular the CCAMLR by-catch guides and the *Fishes of the Ross Sea Region* guide provide extensive photos and descriptions of many common by-catch species, and keys for determining differences between *Macrourus* species, and larval fish by-catch.

14. Toothfish and skate tagging

The CCAMLR tagging program is administered by the Secretariat which provides standardised tagging protocols and tagging equipment to fishing vessels engaged in the program. This standardisation is an essential component of the tagging program as CCAMLR uses the fisheries-based tag and recapture rates as the basis of abundance estimation for toothfish.

The Secretariat receives and stores data on all fish that are tagged and the subsequent recapture of those fish. Each recapture is linked to the tagging event in order to verify the data for use in population estimates as well as to examine movement rates and growth of fish.

The tagging of skates and rays is only mandatory as part of CCAMLR fisheries in the Ross Sea (Subarea 88.1 and small-scale research units (SSRUs) 882A–B), with a focussed tagging program beginning in the 2020 season and scheduled to run for two years (see section 14.1). Tagging of these species does also still occur in some domestic EEZ fisheries within the Convention Area, and any skate tagging should follow CCAMLR protocols.

A SISO observer or appropriately trained crew member on each longline vessel should tag and release toothfish. As the vessel is responsible for ensuring tagging and tag recovery protocols are correctly followed, several crew will most likely be trained in tagging procedures, however, the vessel is expected to cooperate with the observer if you feel the procedures are not being undertaken correctly. Any tagging procedures should follow the CCAMLR toothfish and skate tagging guide which can be found at www.ccamlr.org/node/85702.

The guide should be provided to observers before deployment and contains extensive descriptions and pictures of correct tagging procedures. Pay particular attention to the handling recommendations for large fish. Videos of tagging processes can also be requested from the Secretariat to aid with training.

15. Observations of marine mammals and seabirds

15.1 Marine mammal observations – longline fisheries

Marine mammal interactions with fisheries are a growing major world-wide issue with both substantial ecological and economic consequences. Most longline fisheries operating around the world, including many toothfish fisheries in the Southern Ocean, are seriously affected by these interactions.

Depredation can also have negative impacts on the conservation of recovering marine mammal populations as a result of incidental by-catch, lethal responses from illegal fishers and increased dependence through artificial food provisioning. Finally, depredation can affect the management of fisheries and the fish stock assessment if depredated fish are disregarded when defining quotas. Stocks that have also been under pressure from illegal fishing activity are especially sensitive to the effects of depredation. Most depredation activity in the Southern Ocean is due to interactions with odontocetes (toothed whales), specifically sperm whales and killer whales.

Due to these issues, the Scientific Committee requested more detailed data on marine mammal interactions be collected, and consequently data collection fields were added to the longline observer logbook in 2019. Protocols for data collection have been adapted from marine mammal observation programs undertaken by national observers in the French EEZ fisheries, and around South Georgia, and are detailed in the longline logbook instructions. More information on data collection guidelines are also available from the CCAMLR website (www.ccamlr.org/node/92575).

15.2 Interactions with fishing gear

Observers are required to monitoring marine mammal and seabird interactions with fishing gear in all fisheries. It is vitally important that an observer differentiates between observations that are recorded during the observer's dedicated observation periods, with those that an observer is alerted to by the vessel as this affects mortality calculations. For example, if an observer is given a dead bird by the vessel crew and told that it was found during hauling, this must be clearly stated in the logbook.

Observations are conducted with the following objectives:

(i) to document and quantify seabird and marine mammal catch rates and determine the specific identity, age and sex of all seabirds caught

(ii) assess the relative vulnerability of different seabird and marine mammal species

(iii) monitor the mortality of seabirds and marine mammals per unit of fishing effort

(iv) document all aspects of a vessel's fishing strategy, methods and equipment which have an impact on seabirds and marine mammals

(v) assess the effectiveness of CCAMLR measures aimed at reducing the incidental mortality of seabirds and marine mammals

(vi) ascertain what, in terms of a vessel's fishing operations, contributes to the seabird and marine mammal by-catch rates observed, and to collect data relevant to factors that influence seabird by-catch rates

(vii) to collect and retain biological samples.

For collection of seabirds and marine mammal data, the highest priorities for a single scientific observer are as follows:

(i) Record mortality, injury and entanglement of seabirds and marine mammals. The level of observation will vary between fisheries, and on the tasking of the observer. In all situations, observers should attempt to maximise the level of coverage of trawl hauls and longline hooks hauled. It is essential that the proportion of fishing effort observed is recorded to allow estimation of total incidental mortality.

(ii) Trawl warp strikes. Conduct at least one warp-strike observation per 24-hour period.

(iii) Record interaction of marine mammals with fishing vessels and gear. During each haul or trawl observation period, record any interactions with the vessel that do not result in mortality, injury or entanglement.

(iv) Verify that mitigation measures used by vessels comply with CCAMLR requirements, and describe any additional measures, or measures that differ from CCAMLR requirements.

The classification of bird condition after interaction(s) with fishing gear were developed by the ad-hoc Working Group on IMAF in 2004 (Ad Hoc WG-IMAF-04 paragraphs 6.214-6.216) and are defined as follows:

(i) Alive landed on board and released uninjured
(ii) Alive, landed injured on board. a bird should be recorded as injured if it has any of the following pathologies: fracture of a wing bone, a leg bone or beak, more than two primary feathers on either wing that have broken feather shafts, substantial damage to the patagial tendon (indicated by a drooping wing or the inability to fly upon release), an open wound (other than superficial injuries in which there is no subcutaneous muscle damage), waterlogged or hydrocarbon soiled plumage, or any bird released with a hook in situ.
(iii) Dead not landed on board – those birds observed to be killed by direct interaction with fishing gear but not landed on the fishing vessel.
(iv) Dead landed on board – those birds landed on the vessel that are dead (i.e. show no muscle movement or corneal reflex)

The CCAMLR website has extensive resources on seabird identification, a self-training tool to assist observers to identify seabirds and marine mammals, and several posters in multiple languages for educating crew and vessels on reducing impacts on marine species (www.ccamlr.org/node/77322).

16. Vulnerable marine ecosystems

The recording of VME taxa is only required for longline fishing in areas where CM 22-06 applies. The VME Taxa Guide can be found on the CCAMLR website (www.ccamlr.org/node/74322).

CM 22-07 details how VME indicator organisms should be recorded to determine when a VME has been encountered. In the process of recording encounters with VMEs, there are important roles for the vessel and the observer and these are described below.

16.1 Vessel requirements

Vessels are required to retain all VME indicator organisms for each line segment in the 10-litre container and report the number of units (CM 22-07).

16.2 Observer requirements

The observer should sample the following:

(i) random sampling – a pre-selected random sample of about 30% of the line segments

(ii) required sampling – every line segment that collects ≥5 VME indicator units.

In order to separate the requirements of random sampling from required regular sampling, observers should, prior to line hauling, inform the crew of the individual line segments for which a bucket of VME indicator organisms should be retained. The master should also be informed of the random sample list so that the mid-points of the requested line segments are recorded. All of these buckets examined by the observer as part of the random sample should be entered as Random Sample for the 'sample type' field on the Haul VME logbook form.

In addition, buckets from which ≥5 VME indicator units are recovered need to be examined by the observer and entered as sample type 'Trigger' in the Haul VME logbook form. If a random sample happens to be ≥5 VME indicator units, it should still be recorded as a random sample.

17. References

Benedit, R. 2009. Electronic Photo Guide. Maturity Stages for *Bathyraja meridionalis* (1 up to 3), South Georgia. MRAG, London.

Fischer, W. and J.-C. Hureau (Eds). 1985. *FAO Species Identification Sheets for Fishery Purposes. Southern Ocean (CCAMLR Convention Area Fishing Areas 48, 58 and 88)*, Vols I and II. Prepared and published with the support of the Commission for the Conservation of Antarctic Marine Living Resources. FAO, Rome.

Francis, M.P. 2003. Length at maturity of the Antarctic skates *Amblyraja georgiana* and *Bathyraja eatonii* in the Ross Sea. Document *WG-FSA-03/42*. CCAMLR, Hobart, Australia.

Gasco, N. 2017. MANUAL COPEC. Muséum national d'histoire naturelle, Paris, France.

Gasco, N., J. Brown, S. Parker and G. Duhamel. 2011. Gonad Stages Identification *Dissostichus eleginoides*. Muséum national d'histoire naturelle, Paris, France.

Gon, O. and P.C. Heemstra (Eds). 1990. *Fishes of the Southern Ocean*. J.L.B. Smith Institute of Ichthyology, Grahamstown, South Africa: 462 pp.

18. CCAMLR observer resources

CCAMLR data forms and instructions:

www.ccamlr.org/node/74640

By-catch guides, sampling protocol and training materials:

www.ccamlr.org/node/77322

Tagging program ordering information:

www.ccamlr.org/node/76310

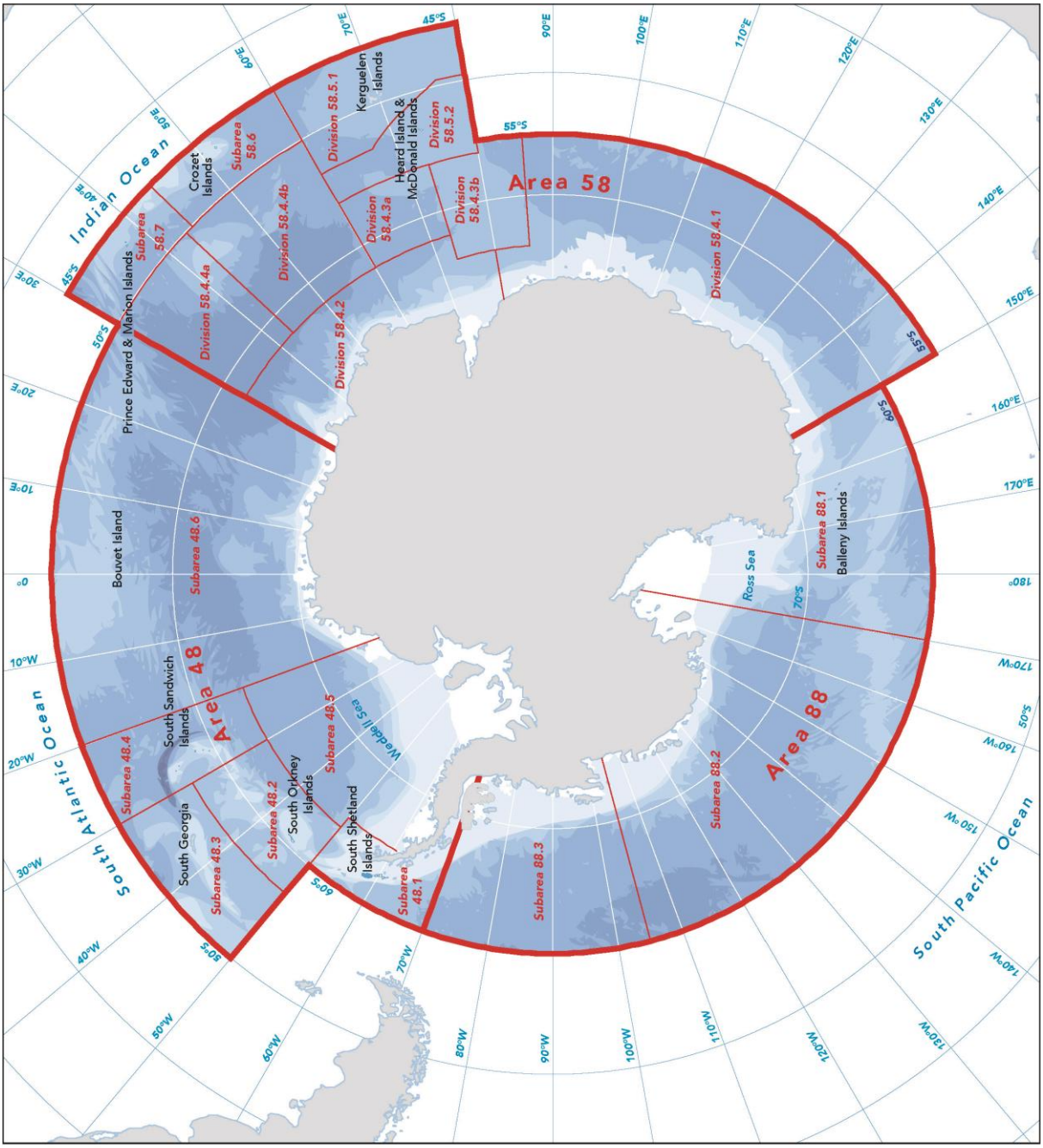
CCAMLR conservation measures:

www.ccamlr.org/node/57043

Text of the Scheme of International Scientific Observation:

www.ccamlr.org/node/74295

19. Appendix 1 – Map of the CAMLR Convention Area



CCAMLR

Commission for the Conservation of Antarctic Marine Living Resources

Convention Area
Statistical Areas

0 500 1000 1500 2000 km

1:45 000 000

South Pole Lambert Azimuthal Equal Area projection

http://gis.ccamlr.org

20. Appendix 2 – Functions and tasks of Scientific Observers appointed in accordance with the Scheme of International Scientific Observation

The function of scientific observers on board vessels engaged in scientific research or harvesting of marine living resources is to observe and report on the operation of fishing activities in the Convention Area with the objectives and principles of the Convention for the Conservation of Antarctic Marine Living Resources in mind.

2. In fulfilling this function, scientific observers will undertake the following tasks, using the observation formats approved by the Scientific Committee:

(i) take samples of catches to determine biological characteristics

(ii) record biological data by species caught

(iii) record by-catches, their quantity and other biological data in accordance with relevant conservation measures

(iv) record entanglement and incidental mortality of seabirds and marine mammals

(v) report on the measures taken to avoid incidental mortality

(vi) record the procedure and parameters by which declared catch weight is measured

(vii) prepare reports of their observations using the observation formats approved by the Scientific Committee and submit them to CCAMLR through the Designating Member

(viii) assist, by mutual agreement of the Designating Member and Receiving Member, the vessel in the catch recording and reporting procedures

(ix) undertake other tasks as may be decided by mutual agreement of the Designating Member and Receiving Member

(x) collect and report data on sightings of unauthorised or unidentifiable fishing vessels, unmarked fishing gear, and recovery of fishing gear in the Convention Area, including vessel type identification, vessel position and activity and gear type

(xi) collect information on fishing gear loss and garbage disposal by fishing vessels at sea.

21. Appendix 3 – Observer sampling requirements for *Dissostichus* spp.

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

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

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

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

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

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

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

To help ensure that the work of observers is not unduly impacted by such operational changes, the sampling rate should be up to 7 fish per 1 000 hooks.

As a practical procedure to achieve the desired samples, observers should sample up to 10 fish per line for type III (which includes all type II data plus 10 otoliths), then up to 25 fish per line for type II, to an overall total of 35 fish per line (assuming an average line of 5 000 hooks).