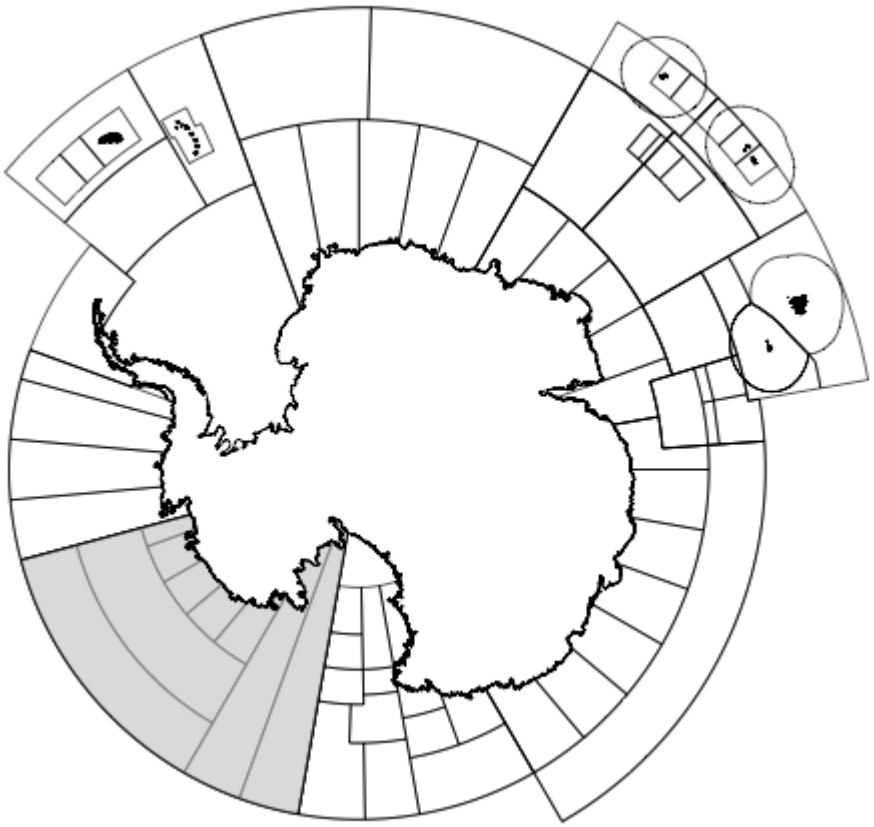
CCAMLR

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

FISHERY REPORT

# Fishery Report 2018: Exploratory fishery for *Dissostichus mawsoni* in Subarea 88.2



The map above shows the management areas within the CAMLR Convention Area, the specific region related to this report is shaded.
Throughout this report the CCAMLR fishing season is represented by the year in which that season ended, e.g. 2015 represents the 2014/15 CCAMLR fishing season (from 1 December 2014 to 30 November 2015).

**Fishery Report 2018: Exploratory fishery for *Dissostichus mawsoni* in Subarea 88.2**

## Introduction to the fishery

1. This report describes the exploratory longline fishery for Antarctic toothfish (*Dissostichus mawsoni*) in Subarea 88.2. Prior to 2017, this fishery was an exploratory fishery for *Dissostichus* spp., however, in order to better align the target species with the assessment process the target species was specified as *D. mawsoni*, with any Patagonian toothfish (*D. eleginoides*) caught counting towards the catch limit for *D. mawsoni.*

2. *D. mawsoni* in small-scale research units (SSRUs) 882A–B (between 150° and 170ºW) are considered to be part of the Ross Sea region stock and are managed within the assessment for Subarea 88.1. In the remainder of this report, Subarea 88.2 is considered to refer to the part of the subarea between 115° and 150ºW (see Figure 1). Within Subarea 88.2, the management of *D. mawsoni* catch limits was developed for the slope/shelf area and for northern seamounts (SSRU 882H). The area north of SSRU 882H has a catch limit of 0 tonnes. The subarea has also been divided into nine small-scale research units (SSRUs) (A–I) (see www.gis.ccamlr.org).

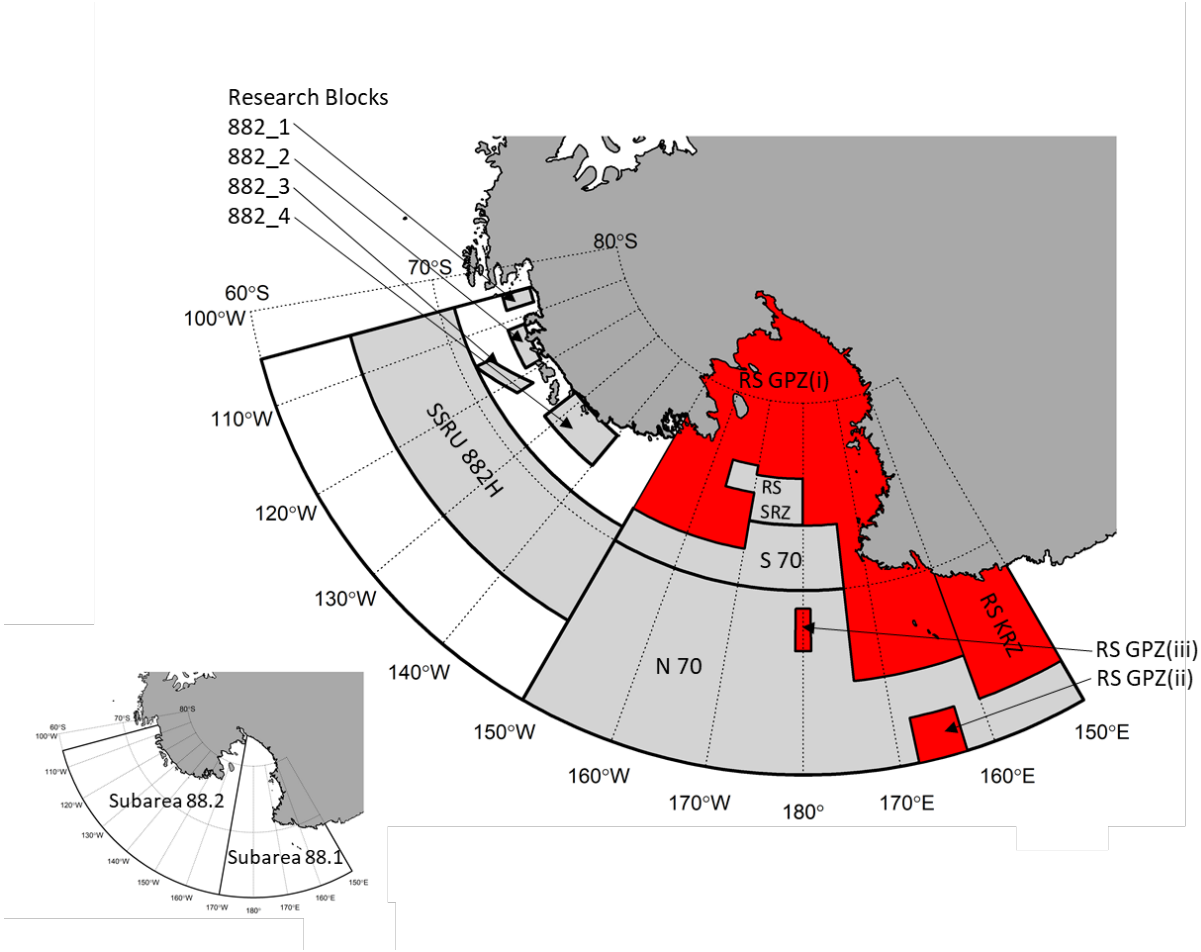



Figure 1: Fishery management areas and the Ross Sea region marine protected area (MPA) (red) in Subareas 88.1 and 88.2.

3. The limits on the exploratory fishery for *D. mawsoni*. in Subarea 88.2 are described in Conservation Measure (CM) 41-10, the catch limits for by-catch species are defined in CMs 33-03 and 41-10.

4. In 2013 the Scientific Committee recognised that an increase in the rate of between-season tag recaptures from SSRU 882H, combined with a high incidence of within-season recaptures, suggested localised depletion in that SSRU. Furthermore, fishing in SSRUs 882C−G had been sporadic, was variable in location and only two tagged fish had been recaptured. Because the abundance index for the stock assessment was not incorporating tag recaptures from the southern area, the Scientific Committee requested the Working Group on Statistics, Assessments and Modelling (WG-SAM) consider how an assessment of stock abundance could be developed for SSRUs 882C–G. The Scientific Committee was unable to provide consensus on advice for the catch limits in this subarea.

5. The catch limit in 2014 for SSRUs 882C–H was set at 390 tonnes and was split into 266 tonnes in SSRU 882H and 124 tonnes in SSRUs 882C–G (CCAMLR-XXXII, paragraphs 5.38 to 5.44).

6. In 2014, the Scientific Committee agreed to a two-year research plan in SSRUs 882C–H (for the 2015 and 2016 seasons) in which the catch limit for SSRU 882H was 200 tonnes, the fishing elsewhere was restricted to four research blocks (see Figure 1) and the combined catch limit for the research blocks was 419 tonnes with no more than 200 tonnes to be taken from any one of the research blocks. This experiment was continued for the 2017 and 2018 seasons.

7. Initially, toothfish were to be tagged at the rate of 3 fish per tonne in the research blocks and 1 fish per tonne in SSRU 882H. Recognising the different sizes of fish in the two areas, the tag-overlap statistic was to be calculated separately for each of SSRU 882H and the research blocks (SC-CAMLR-XXXIII, paragraph 3.173). In 2016, the tagging requirement was revised to be 3 fish per tonne in all areas.

8. In 2018, 11 vessels (from seven Members) fished in Subarea 88.2. For 2019, eight Members with a total of 22 vessels have notified their intention to participate in the exploratory fishery for *D. mawsoni* in Subarea 88.2.

9. In 2018 mark-recapture data were used to calculate biomass estimates for SSRU 882H and research block 882_2, while biomass estimates for 882_1, 882_3, and 882_4 were based on catch-per-unit-effort (CPUE) by seabed area analogy and trend analysis rules. This resulted in catch limits of 200 tonnes in SSRU 882H, 240 tonnes in research blocks 882_1 and 882_2 and 160 tonnes in research blocks 882_3 and 882_4.

10. The timing and duration of fishing activities in Subarea 88.2 have been highly variable over time. Vessels tend to begin fishing in SSRU 882H, where most of the fishing has occurred, before moving south to fish in the research blocks. The fishing season in Subarea 88.2 tends to peak and close a little later than in Subarea 88.1, reflecting the movement of vessels from Subarea 88.1 to Subarea 88.2 after the end of the Subarea 88.1 fishery.

### Reported catch

11. The historical catches of *D. mawsoni* from Subarea 88.2 are provided in Table 1, there has been no reported catch of *D. eleginoides* in this fishery. In 2018, the total reported catch of

*D. mawsoni* in Subarea 88.2 (SSRUs D–H) was 610 tonnes. This was divided between research block 882_2 (200 tonnes), 882_3 (9 tonnes), 882_4 (184 tonnes) and SSRU 882H (216 tonnes).

Table 1: Catch history for *D. mawsoni*. in Subarea 88.2. (Source: STATLANT data for past seasons, and catch and effort reports for the current season, past reports for IUU catch.) Note that the STATLANT data includes catch occurring in SSRUs 882A–B as part of Subarea 88.2 catch, although the stock assessment includes catch in these SSRUs as part of the Ross Sea Region stock assessment.

| Season | Catch limit (tonnes) | Catch (tonnes) *D. mawsoni* | Total | Estimated IUU catch (tonnes) |
|---|---|---|---|---|
| 2003 | 375 | 106 | 106 | 0 |
| 2004 | 375 | 362 | 362 | 0 |
| 2005 | 375 | 270 | 270 | 0 |
| 2006 | 487 | 425 | 440 | 15 |
| 2007 | 547[1] | 347 | 347 | 0 |
| 2008 | 567 | 416 | 416 | 0 |
| 2009 | 567 | 484 | 484 | 0 |
| 2010 | 575 | 314 | 314 | 0 |
| 2011 | 575[1] | 570 | 570 | * |
| 2012 | 530[1] | 412 | 412 | * |
| 2013 | 530 | 476[q] | 476 | * |
| 2014 | 390[1] | 426[q] | 426 | * |
| 2015 | 819 | 624[q] | 624 | * |
| 2016 | 619 | 617 | 617 | * |
| 2017 | 619 | 624 | 624 | * |
| 2018 | 619 | 610 | 610 | * |

### Illegal, unreported and unregulated (IUU) fishing

12. Illegal, unreported and unregulated (IUU) catch in Subarea 88.2 was estimated at 15 tonnes in 2006 taken from the south of SSRU 882A (Table 1). Following the recognition of methodological issues regarding the estimation of IUU catch levels since 2011, evidence of IUU presence or activity has continued to be recorded but no corresponding estimates of the IUU catch for *D. mawsoni* have been provided (SC-CAMLR-XXIX, paragraph 6.5). One IUU-listed fishing vessel was observed in Subarea 88.2 in 2006 and 2010. Unmarked fishing gear, potentially from an IUU vessel, was reported in this subarea in 2016.

## Data collection

13. SSRUs 882C–H are managed according to CM 41-01 and the data collection plan (Annex 41-01/A), the research plan (Annex 41-01/B) and the tagging program (Annex 41-01/C). The data collected under this conservation measure are described below.

### Biological data

14. The collection of biological data under CM 23-05 is conducted as part of the CCAMLR Scheme of International Scientific Observation. In exploratory longline fisheries targeting *D. mawsoni* or *D. eleginoides*, biological data collection includes representative samples of length, weight, sex and maturity stage, as well as collection of otoliths for age determination of the target and most frequently taken by-catch species and is most recently described in WG-FSA-15/40.

### Length distributions of catches

15. The length-frequency distributions of *D. mawsoni* caught in this fishery from 2009 to 2018 are presented in Figure 2. These length-frequency distributions are unweighted (i.e. they have not been adjusted for factors such as the size of the catches from which they were collected). The interannual variability exhibited in the figure may reflect differences in the fished population but is also likely to reflect changes in the gear used, the number of vessels in the fishery and the spatial and temporal distribution of fishing.

16. The length-frequency distribution of the *D. mawsoni* catch in SSRU 882H appears to be very stable with little evidence of change in length over time (Figure 2). In the research blocks there is distinct bimodality and this is reflected in the overall length-frequency distribution for the subarea.

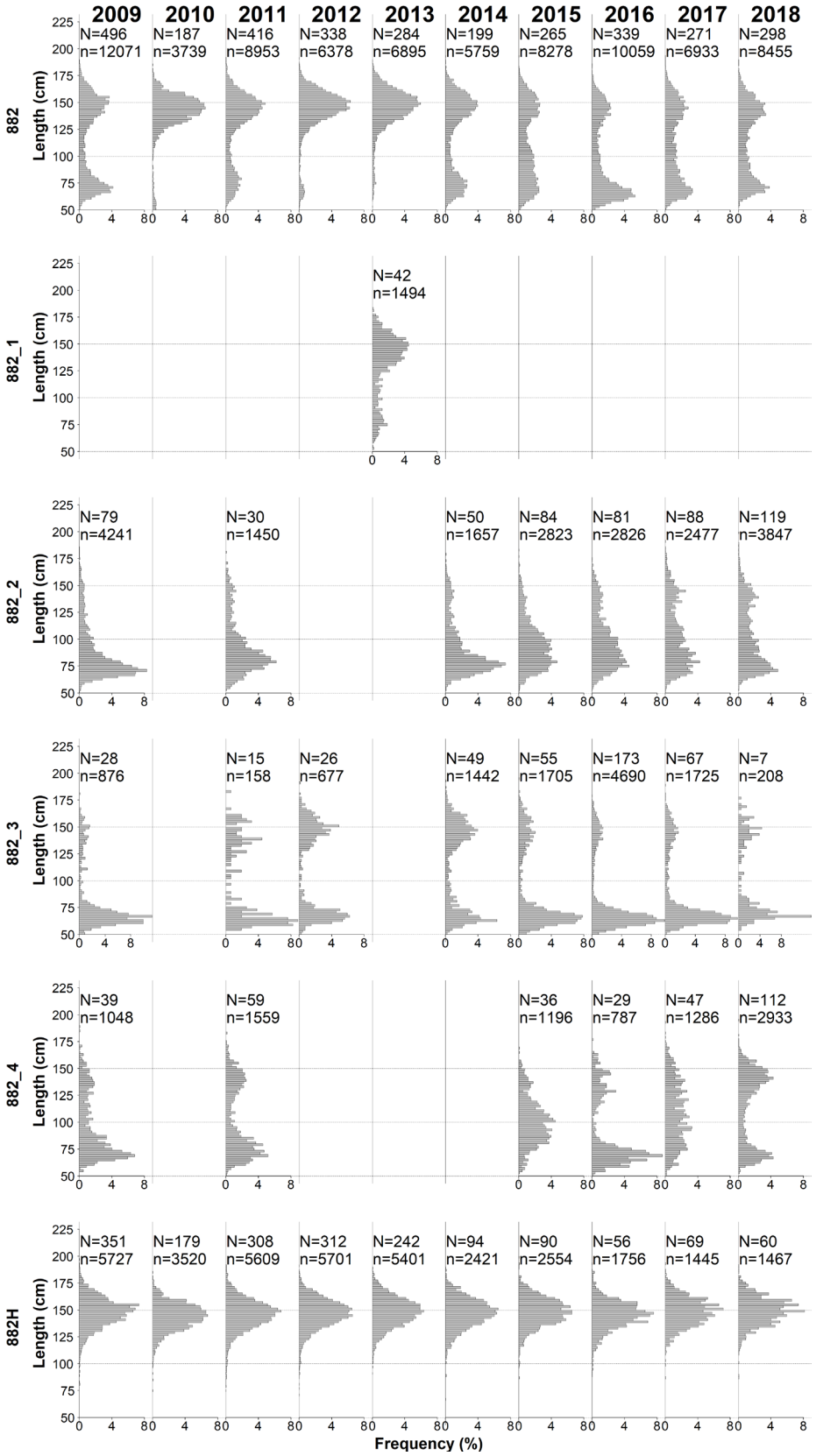



Figure 2: Annual length-frequency distributions of *Dissostichus mawsoni* caught in Subarea 88.2 (top panel) and in the management areas in Figure 1. The number of hauls from which fish were measured (N) and the number of fish measured (n) in each year are provided.

### Tagging

17. Under CM 41-01, each longline vessel fishing in exploratory fisheries for toothfish has been required to tag and release *D. mawsoni* and *D. eleginoides* according to the CCAMLR tagging protocol and the required tagging rate per tonne of green weight caught specified in the fishery-specific conservation measure. In order to ensure that there is sufficient overlap between the length distribution of those fish that are tagged by a vessel and of all the fish that are caught by that vessel, each vessel is required to achieve a minimum tag-overlap statistic of 60% (see Annex 41-01/C, footnote 3). To avoid low sample size artefacts, the requirement for a 60% tag-overlap statistic does not apply to vessels that tag at the required rate but tag less than 30 fish (Table 2).

## Life-history parameters

### Stock structure

18. The current working hypothesis regarding spawning dynamics and early life history of *D. mawsoni* in Subarea 88.2 is described in WG-SAM-14/26. Under this hypothesis, spawning takes place in the northern seamounts of SSRU 882H. As in other regions, spawning appears to take place during winter, and may extend over a period of several months. WG-FSA-12/48 showed via oceanographic drift simulations that eggs and larvae released on seamounts in SSRU 882H would be advected slowly to the east and then recruit to the slope in the eastern part of the subarea and in the western region of Subarea 88.3. As the juveniles grow in size, they move west along the shelf and slope. The fish gradually move deeper as they grow, feeding in the slope region in depths of 1 000–1 500 m, where they gain condition before moving north onto the seamounts in SSRU 882H to start the cycle again. Spawning fish appear to remain in the northern area for only one or two years based on tagging data (WG-SAM-14/27).

Table 2: Annual tagging rate, reported by vessel, operating in the exploratory fishery for *Dissostichus mawsoni* in Subarea 88.2 (a) from 2009 to 2014, and (b) since 2015. The tag-overlap statistics for *D. mawsoni* and *D. eleginoides* respectively are provided in brackets and are not calculated for catches of less than 30 fish (*). - indicates that no fish were tagged.

(a)

| Flag State | Vessel name | Season | | | | | |
|---|---|---|---|---|---|---|---|
| | | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 |
| Argentina | *Argenova XXI* | | 1.0 (*, -) | | | | |
| Chile | *Isla Eden* | 1.2 (*, -) | | | | | |
| Korea, Republic of | *Hong Jin No. 701* | | | | | 1.3 (*, -) | 1.1 (84, -) |
| | *Hong Jin No. 707* | 1.3 (36, -) | | 0.9 (73, -) | 1.5 (62, -) | | 1.4 (78, -) |
| | *Jung Woo No. 3* | | 1.1 (*, -) | 1.1 (84, -) | | | |
| | *Kostar* | | | | | 1.1 (82, -) | 1.0 (*, -) |
| | *Sunstar* | | | | | 1.1 (*, -) | 1.0 (65, -) |
| New Zealand | *Antarctic Chieftain* | 1.8 (61, -) | | 1.0 (92, -) | 1.0 (96, -) | 1.1 (86, -) | 1.0 (80, -) |
| | *Janas* | 1.2 (73, -) | | 1.1 (81, -) | 1.0 (83, -) | 1.1 (82, -) | 1.4 (76, -) |
| | *San Aspiring* | | | 1.1 (77, -) | | | |
| Norway | *Seljevaer* | | | | | 1.2 (*, -) | 1.1 (86, -) |
| Russia | *Chio Maru No. 3* | | | 2.2 (*, -) | | | |
| | *Gold Gate* | | | 1.1 (76, -) | | | |
| | *Palmer* | | | | | 1.0 (75, -) | 1.0 (58, -) |
| | *Sparta* | | | 1.2 (79, -) | 1.1 (62, -) | 1.2 (75, -) | 1.0 (70, -) |
| | *Yantar 31* | | | | | 2.1 (*, -) | 1.0 (57, -) |
| South Africa | *Ross Mar* | 1.0 (60, -) | | | | | |
| Spain | *Tronio* | 1.2 (17, -) | 1.2 (49, -) | | | | |
| UK | *Argos Froyanes* | 2.2 (55, -) | 1.0 (55, -) | 1.0 (77, -) | 1.0 (66, -) | 1.1 (68, -) | 1.2 (73, -) |
| | *Argos Georgia* | 1.1 (56, -) | 1.1 (*, -) | 1.1 (50, -) | | | 1.2 (52, -) |
| | *Argos Helena* | 1.9 (61, -) | | | | | |
| Ukraine | *Simeiz* | | | | | 1.7 (*, -) | 1.2 (77, -) |
| Uruguay | *Ross Star* | 1.4 (64, -) | | 1.2 (68, -) | | | |
| Required tagging rate | | 1 | 1 | 1 | 1 | 1 | 1 |

(b)

| SSRU | Flag State | Vessel name | Season | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | 2015 | | 2016 | | 2017 | | 2018 | |
| A, B | New Zealand | *Janas* | 3.3 | (72, -) | | | | | | |
| | Norway | *Seljevaer* | 3.1 | (61, -) | | | | | | |
| | UK | *Argos Froyanes* | 3.1 | (85, *) | | | | | | |
| C, D, E, F, G | Australia | *Antarctic Chieftain* | 3.2 | (85, -) | | | | | | |
| | Australia | *AntarcticDiscovery* | | | | | 3.6 | (88, -) | | |
| | Korea, Republic of | *Hong Jin 701* | | | | | 3.2 | (84, -) | | |
| | Korea, Republic of | *Kostar* | 3.2 | ( *, -) | | | | | | |
| | Korea, Republic of | *Sunstar* | 3.2 | (77, -) | 3.2 | (83, -) | | | | |
| | Norway | *Seljevaer* | 3.1 | (74, -) | | | | | | |
| | Russia | *Oladon 1* | | | 3.1 | (83, -) | | | | |
| | Russia | *Pro Pioneer* | | | | | 3.3 | (87, -) | | |
| | Russia | *Sparta* | | | | | 3.3 | (83, -) | | |
| | Russia | *Ugulan* | | | | | 3.3 | (69, -) | | |
| | Russia | *Yantar 31* | 3.0 | ( *, -) | 3.1 | (78, -) | | | | |
| | Spain | *Yanque* | | | 3.4 | (87, -) | | | | |
| | Ukraine | *Calipso* | | | | | | | 3.6 | (77, -) |
| | Ukraine | *Koreiz* | | | 3.1 | (83, -) | 3.0 | (82, -) | 3.0 | (69, -) |
| | Ukraine | *Marigolds* | | | | | 3.5 | ( *, -) | | |
| | Ukraine | *Simeiz* | 3.1 | (83, -) | | | 3.3 | (90, -) | 3.0 | (64, -) |
| | UK | *Argos Froyanes* | | | 3.0 | (93, -) | | | 3.3 | (75, -) |
| | UK | *Argos Georgia* | | | 3.9 | (83, -) | | | | |
| | Uruguay | *Badaro* | | | | | | | 3.2 | (60, -) |
| | New Zealand | *Janas* | | | 4.3 | (94, *) | 10 | (*, -) | | |
| H | Australia | *Antarctic Chieftain* | 1.1 | (84, -) | | | | | | |
| | Australia | *AntarcticDiscovery* | | | | | 3.1 | (82, -) | | |
| | Norway | *Seljevaer* | 1.0 | (60, -) | | | | | | |
| | Russia | *Palmer* | | | 1.1 | (61, -) | | | | |
| | Russia | *Pro Pioneer* | | | | | 3.1 | (84, -) | 3.0 | (72, -) |
| | Ukraine | *Koreiz* | | | | | | | | |
| | Ukraine | *Simeiz* | 1.0 | (69, -) | | | | | | |
| | UK | *Argos Froyanes* | | | 1.0 | (91, -) | | | 3.3 | (86, -) |
| | UK | *Argos Georgia* | | | 1.4 | ( *, -) | | | | |

Table 3: The number of individuals of *Dissostichus mawsoni* tagged in Subarea 88.2 (a) from 2009 to 2014, and (b) since 2015. The number of fish recaptured by each vessel is provided in brackets.

(a)

| Flag State | Vessel name | Season | | | | | |
|---|---|---|---|---|---|---|---|
| | | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 |
| Argentina | *Argenova XXI* | | 8 (0) | | | | |
| Chile | *Isla Eden* | 5 (0) | | | | | |
| Korea, Republic of | *Hong Jin No. 701* | | | | | 7 (0) | 20 (0) |
| | *Hong Jin No. 707* | 17 (3) | | 40 (3) | 38 (1) | | 22 (1) |
| | *Jung Woo No. 3* | | 6 (0) | 35 (0) | | | |
| | *Kostar* | | | | | 11 (0) | 10 (0) |
| | *Sunstar* | | | | | 8 (1) | 33 (1) |
| New Zealand | *Antarctic Chieftain* | 78 (0) | | 46 (1) | 59 (9) | 321 (42) | 171 (19) |
| | *Janas* | 58 (2) | | 30 (3) | 99 (17) | 62 (0) | 21 (0) |
| | *San Aspiring* | | | 190 (17) | | | |
| Norway | *Seljevaer* | | | | | 9 (1) | 30 (0) |
| Russia | *Chio Maru No. 3* | | | 90 (2) | 101 (1) | | |
| | *Gold Gate* | | | 44 (16) | | | |
| | *Palmer* | | | | | 55 (3) | 24 (0) |
| | *Sparta* | | | 50 (3) | 36 (10) | 12 (3) | 27 (0) |
| | *Yantar 31* | | | | | 2 (0) | 13 (0) |
| South Africa | *Ross Mar* | 120 (27) | | | | | |
| Spain | *Tronio* | 15 (2) | 52 (4) | | | | |
| UK | *Argos Froyanes* | 51 (0) | 250 (38) | 68 (2) | 210 (49) | 15 (4) | 67 (3) |
| | *Argos Georgia* | 182 (21) | 9 (1) | 58 (13) | | | 13 (5) |
| | *Argos Helena* | 24 (0) | | | | | |
| Ukraine | *Simeiz* | | | | | 4 (0) | 12 (0) |
| Uruguay | *Ross Star* | 53 (0) | | 16 (0) | | | |
| Total | | 603 (55) | 325 (43) | 667 (60) | 543 (87) | 508 (54) | 463 (29) |

(b)

| SSRU | Flag State | Vessel name | Season | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | 2015 | | 2016 | | 2017 | | 2018 | |
| A, B | New Zealand | *Janas* | 165 | (0) | | | | | | |
| | Norway | *Seljevaer* | 33 | (0) | | | | | | |
| | UK | *Argos Froyanes* | 150 | (0) | | | | | | |
| Total | | | 348 | (0) | | | | | | |
| C, D, E, F, G | Australia | *Antarctic Chieftain* | 240 | (1) | | | | | | |
| | Australia | *AntarcticDiscovery* | | | | | 52 | (0) | | |
| | Korea, Republic of | *Hong Jin No. 701* | | | | | 545 | (0) | | |
| | Korea, Republic of | *Kostar* | 5 | (0) | 73 | (0) | | | | |
| | Korea, Republic of | *Sunstar* | 76 | (0) | 323 | (0) | | | | |
| | Norway | *Seljevaer* | 438 | (19) | | | | | | |
| | Russia | *Oladon 1* | | | 101 | (0) | | | | |
| | Russia | *Pro Pioneer* | | | | | 85 | (0) | | |
| | Russia | *Sparta* | | | | | 178 | (0) | | |
| | Russia | *Ugulan* | | | | | 61 | (0) | | |
| | Russia | *Yantar 31* | 18 | (0) | 86 | (0) | | | | |
| | Spain | *Yanque* | | | 57 | (1) | | | | |
| | Ukraine | *Calipso* | | | | | | | 33 | (0) |
| | Ukraine | *Koreiz* | | | 575 | (7) | 311 | (11) | 378 | (17) |
| | Ukraine | *Marigolds* | | | | | 13 | (0) | | |
| | Ukraine | *Simeiz* | 351 | (2) | | | 187 | (3) | 222 | (1) |
| | UK | *Argos Froyanes* | | | 118 | (0) | | | 51 | (5) |
| | UK | *Argos Georgia* | | | 51 | (1) | | | | |
| | Uruguay | *Badaro* | | | | | | | 208 | (9) |
| | New Zealand | *Janas* | | | 323 | (0) | 1 | (0) | | |
| Total | | | 1128 | (22) | 1384 | (9) | 1433 | (14) | 892 | (32) |
| H | Australia | *Antarctic Chieftain* | 145 | (25) | | | | | | |
| | Australia | *AntarcticDiscovery* | | | | | 424 | (4) | | |
| | Norway | *Seljevaer* | 11 | (1) | | | | | | |
| | Russia | *Palmer* | | | 44 | (2) | | | | |
| | Russia | *Pro Pioneer* | | | | | 131 | (5) | 408 | (18) |
| | Ukraine | *Simeiz* | 64 | (2) | | | | | | |
| | UK | *Argos Froyanes* | | | 144 | (8) | | | 270 | (6) |
| | UK | *Argos Georgia* | | | 27 | (1) | | | | |
| Total | | | 220 | (28) | 215 | (11) | 555 | (9) | 678 | (24) |

19. Analysis of the genetic diversity for *D. mawsoni* from Subareas 48.1 and 88.1 and Division 58.4.2 found weak genetic variation between the three areas (Smith and Gaffney, 2005). This differentiation is supported by oceanic gyres, which may act as juvenile retention systems, and by limited movement of tagged fish. Kuhn and Gaffney (2008) expanded the work of Smith and Gaffney (2005) by examining nuclear and mitochondrial single nucleotide polymorphisms on tissue samples collected from Subareas 48.1, 88.1 and 88.2 and Division 58.4.1. They found broadly similar results to those of the earlier studies, with some evidence for significant genetic differentiation between the three ocean sectors but limited evidence for differentiation within ocean sectors. A lack of genetic differentiation between stocks in different ocean sectors was reported by Mugue et al. (2014).

## Parameter estimates

### Standardised CPUE

20. Standardised CPUE analyses of *D. mawsoni* were updated for 2015 in WG-FSA-15/36. In SSRU 882H, standardised CPUE indices declined from 2003 to around 2011, then increased slightly to 2014 followed by a sharp increase in 2015 to the highest level since 2003. In SSRUs 882C–G, standardised CPUE indices show a strong increase from 2007 to 2013, before decreasing slightly in 2014 and 2015, although the uncertainty in the trend is high.

### Catch at age

21. For the purposes of estimating fishery selectivity for the SSRUs 882C–H fishery, three strata are defined using *D. mawsoni* length- and age-frequency data: SSRU 882H, 882G and 882C–F (WG-FSA-14/56, 14/57 and 16/45).

22. The numbers of otoliths collected by New Zealand vessels and subsequently aged are insufficient to represent the age frequency of the catch in each of the strata in every year. Where available, the otolith ages were used to construct annual area-specific age–length keys (ALKs), which were applied to the scaled length-frequency distributions for those years to produce annual catch-at-age distributions (WG-FSA-18/36).

### Tag-recapture data

23. The tagging program in Subarea 88.2 has resulted in more than 11 500 tagged fish released and 590 recaptured fish; within the four research blocks more than 4 828 fish have been tagged fish with 47 recaptures of fish tagged in the same research block.

### Parameter values

24. Estimates of natural mortality, length–mass, growth and maturity parameters for *D. mawsoni* in SSRUs 882C–H are as used in the Ross Sea assessment.

## Stock assessment status

25. Two-area population models for *D. mawsoni* in Subarea 88.2 have been developed as current single-area models did not fully explain the patterns in the observed data on tag recaptures and age composition (WG-SAM-15/49 and WG-FSA-16/44). Although the hypothesised stock structure spans SSRUs 882C–H, these models were restricted to the data available in SSRU 882H given the very limited data available to inform estimation of biomass in SSRUs 882C–G. Additional data resulting from a two-year research plan initiated in 2017 and extended to 2019 are expected to better inform the assessment of the entire stock in the future. Modelling results suggested that a two-area model with sex- and age-specific migrations from the shelf region to SSRU 882H and back provided the best fits to the age and tag data collected in SSRU 882H (WG-FSA-18/37). Furthermore, a resident population in SSRU 882H was not required to explain the patterns observed in the data, nor was annually varying or density-dependent migration (WG-FSA 18/44). Simulation modelling suggests that the current rates of tag returns in both the north and the south of the area may provide adequate data for a stock assessment in future years. Current models (e.g. WG-FSA-18/37) are considered to be indicative at this stage and should not be used for management advice.

## By-catch of fish and invertebrates

### Fish by-catch

26. Catch limits for by-catch species groups (macrourids, rajids and other species) are defined in CM 41-01 and CM 33-03 and provided in Table 4. The total by-catch in SSRU 882H and in each of the research blocks defined in Annex 41-10/A in Subarea 88.2 in 2019 shall not exceed a precautionary catch limit of 10 tonnes of skates and rays, and 32 tonnes of *Macrourus* spp. and 32 tonnes of other species in each area for which a catch limit for *D. mawsoni* is defined.

27. If the by-catch of any one species is equal to, or greater than, 1 tonne in any one haul or set, then the fishing vessel must move at least 5 n miles away for a period of at least five days.

28. If the catch of *Macrourus* spp. taken by a single vessel in any two 10-day periods in a single SSRU exceeds 1 500 kg in a 10-day period and exceeds 16% of the catch of *D. mawsoni* in that period, the vessel shall cease fishing in that SSRU for the remainder of the season.

Table 4: Catch history for by-catch species (macrourids, rajids and other species), catch limits and number of rajids released alive in Subarea 88.2 (SSRUs 882C–H). Catch limits are for the whole fishery (see CM 33-03 for details). (Source: fine-scale data.)

| Season | Macrourids | | Rajids | | | Other species | |
|---|---|---|---|---|---|---|---|
| | Catch limit (tonnes) | Reported catch (tonnes) | Catch limit (tonnes) | Reported catch landed dead (tonnes) | Number released | Catch limit (tonnes) | Reported catch (tonnes) |
| 2004 | 60 | 37 | 50 | <1 | 107 | 140 | 8 |
| 2005 | 60 | 20 | 50 | <1 | - | 140 | 3 |
| 2006 | 78 | 84 | 50 | <1 | 865 | 100 | 12 |
| 2007 | 88 | 54 | 50 | <1 | - | 100 | 13 |
| 2008 | 88 | 17 | 50 | 0 | - | 100 | 4 |
| 2009 | 90 | 58 | 50 | <1 | 265 | 100 | 14 |
| 2010 | 92 | 49 | 50 | 0 | - | 100 | 15 |
| 2011 | 92 | 51 | 50 | <1 | 168 | 100 | 13 |
| 2012 | 84 | 29 | 50 | <1 | - | 120 | 11 |
| 2013 | 84 | 25 | 50 | <1 | - | 120 | 8 |
| 2014 | 62 | 7 | 50 | <1 | 28 | 120 | 3 |
| 2015 | 99 | 19 | 50 | 1 | 192 | 120 | 7 |
| 2016 | 99 | 52 | 50 | <1 | 861 | 120 | 3 |
| 2017 | 99 | 22 | 31 | 1 | 314 | 99 | 2 |
| 2018 | 99 | 22 | 31 | <1 | 104 | 99 | 2 |

29. Skates thought to have a reasonable chance of survival are released at the surface in accordance with CM 33-03. The current by-catch limits and move-on rules for rajids are given in CM 33-03.

### Invertebrate by-catch including VME taxa

30. All Members are required to submit, within their general new (CM 21-01) and exploratory (CM 21-02) fisheries notifications, information on the known and anticipated impacts of their gear on vulnerable marine ecosystems (VMEs), including benthos and benthic communities such as seamounts, hydrothermal vents and cold-water corals. All of the VMEs in CCAMLR's VME Register are currently afforded protection through specific area closures. There have been 16 VME Risk Areas identified in SSRUs 882C–H. The locations and other details can be found at www.ccamlr.org/node/85695.

## Incidental mortality of seabirds and marine mammals

### Incidental mortality

31. The risk levels of birds in the fishery in Subarea 88.2 is category 1 (low) south of 65°S, category 3 (average) north of 65°S and overall is category 3 (SC-CAMLR-XXX, Annex 8, paragraph 8.1). There have been no reports of incidental mammal or bird mortalities in Subarea 88.2.

### Mitigation measures

32. CM 25-02 applies to these areas and in recent years has been linked to an exemption for night setting in CM 24-02 and subject to a bird by-catch limit. Offal and other discharges are regulated under annual conservation measures (e.g. CMs 41-09 and 41-10).

## Ecosystem implications and effects

33. Developments in evaluating ecosystem effects of the *D. mawsoni* fishery were discussed at the Fisheries Ecosystem Models in the Antarctic (FEMA) and FEMA2 Workshops (SC-CAMLR-XXVI/BG/06, paragraphs 45 to 48 and SC-CAMLR-XXVIII, Annex 4); much of the emphasis of those discussions was on the Ross Sea fishery and a summary of the outcomes can be found in the Fishery Report for Subarea 88.1.

## Current management advice and conservation measures

34. The limits on the exploratory fishery for *D. mawsoni* in Subarea 88.2 are defined in CM 41-10. The limits in force for the forthcoming season are summarised in Table 5.

Table 5: Limits on the exploratory fishery for *Dissostichus mawsoni* in Subarea 88.2 in force (CM 41-10).

| Element | Limit in force |
|---|---|
| Access (gear) | Limited to notified vessels using longlines |
| Catch limit | Precautionary catch limit for *Dissostichus* spp. for Subarea 88.2, applied as follows:<br>Research Block 882_1 – 240 tonnes<br>Research Block 882_2 – 240 tonnes<br>Research Block 882_3 – 160 tonnes<br>Research Block 882_4 – 160 tonnes<br>SSRU H – 200 tonnes |
| Season | 1 December to 31 August |
| Fishing operations | In accordance with CM 41-01, the setting of research hauls is not required (Annex 41-01/B, paragraphs 3 and 4) |
| By-catch | Regulated by CMs 33-03 and 41-10 |
| Mitigation | In accordance with CM 25-02, except paragraph 4 if requirements of CM 24-02 are met<br>Daylight setting allowed under CM 24-02 |
| Observers | Each vessel to carry at least two scientific observers, one of whom shall be appointed in accordance with the CCAMLR Scheme of International Scientific Observation |
| VMS | To be operational in accordance with CM 10-04 |
| CDS | In accordance with CM 10-05 |
| Research | Undertake research plan and tagging program as set out in Annexes 41-01/B and 41-01/C<br>Toothfish tagged at a rate of at least 3 fish per tonne green weight caught |

(continued)

Table 5 (continued)

| Element | Limit in force |
|---|---|
| Data | Daily and five-day catch and effort reporting under CMs 23-01 and 23-07<br>Haul-by-haul catch and effort data under CM 23-04<br>Biological data reported by the CCAMLR scientific observer |
| Target species | For the purposes of CMs 23-01 and 23-04, the target species is *Dissostichus mawsoni* and the by-catch is any species other than *D. mawsoni* |
| Environmental protection | Regulated by CMs 22-06, 22-07, 22-08 and 26-01 |

## References


Kuhn, K.L. and P.M. Gaffney. 2008. Population subdivision in the Antarctic toothfish (*Dissostichus mawsoni*) revealed by mitochondrial and nuclear single nucleotide polymorphisms (SNPs). *Ant. Sci.*, 20: 327–338.

Mugue, N.S., A.F. Petrov, D.A. Zelenina, I.I. Gordeev and A.A. Sergeev. 2014. Low genetic diversity and temporal stability in the Antarctic toothfish (*Dissostichus mawsoni*) from near-continental seas of Antarctica. *CCAMLR Science*, 21: 1–9.

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