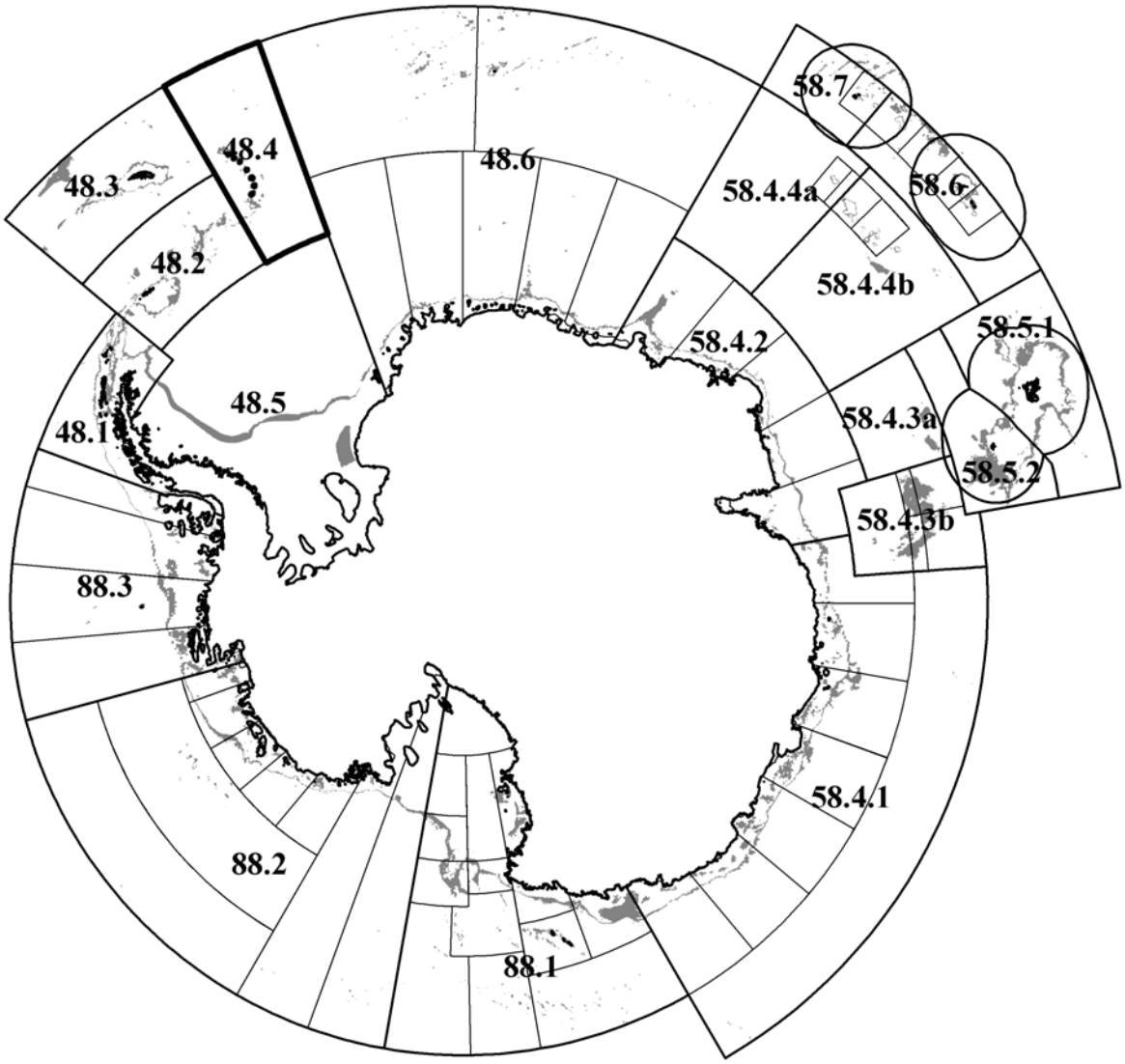
Fishery Report 2013: Exploratory fishery for *Dissostichus* spp. in the South Sandwich Islands (Subarea 48.4)



CONTENTS

The map on the cover page shows the management areas within the CAMLR Convention Area, the specific region related to this report is outlined in bold. Depths between 600 and 1 800 m (the 'fishable depths' for *Dissostichus* spp.) are shaded.

Throughout this report the CCAMLR fishing season is represented by the year in which that season ended, e.g. 2013 represents the 2012/13 CCAMLR fishing season (from 1 December 2012 to 30 November 2013).

FISHERY REPORT 2013: EXPLORATORY FISHERY FOR *DISSOSTICHUS* SPP. IN THE SOUTH SANDWICH ISLANDS (SUBAREA 48.4)

Introduction to the fishery

1. This report describes the exploratory longline fishery for Patagonian (*Dissostichus mawsoni*) and Antarctic (*D. eleginoides*) toothfish in Subarea 48.4.

2. The fishery for *D. eleginoides* in Subarea 48.4 was initiated as a new fishery in 1993 following notifications from Chile and the USA (SC-CAMLR-XI, Annex 5, paragraph 6.22), and the adoption of Conservation Measure (CM) 44/XI, which set a precautionary catch limit for *D. eleginoides* of 240 tonnes for that season. Subsequently, the USA withdrew from the fishery and the Chilean longline vessel abandoned fishing after one week of poor catches (SC-CAMLR-XII, Annex 5, paragraph 6.2). In addition, a Bulgarian-flagged longliner fished in November and December 1992 and reported a catch of 39 tonnes of *D. eleginoides* (SC-CAMLR-XII, Annex 5, paragraph 6.1).

3. Licensed longline vessels commenced fishing for *D. eleginoides* in Subarea 48.4 in 1992 and 1993; fishing was then abandoned following poor catches. Fishing resumed in Subarea 48.4 in 2005 with the implementation of the mark–recapture experiment.

4. In 2008, the Commission agreed to dividing Subarea 48.4 into a northern area (Subarea 48.4 North) and a southern area (Subarea 48.4 South) with directed longline fisheries of *D. eleginoides* in Subarea 48.4 North and *Dissostichus* spp. in Subarea 48.4 South (Figure 1).

5. In 2013 the catch of *D. eleginoides* was limited to 63 tonnes in Subarea 48.4 North, and the targeting of *D. mawsoni* was prohibited. Any *D. mawsoni* that were retained counted against the catch limit of *Dissostichus* spp. in Subarea 48.4 South. In Subarea 48.4 South, the total catch of *Dissostichus* spp. was limited to 52 tonnes.

6. In 2013 the Commission agreed to change the management regime in the subarea for the coming seasons and agreed to remove the northern and southern area boundaries and instead have separate catch limits for *D. eleginoides* and *D. mawsoni* in the entire subarea.

Reported catch

7. In 2013, one New Zealand-flagged vessel and one UK-flagged vessel fished in this subarea; their combined catches are set out in Table 1. In 2013, the total combined catch was 112 tonnes (72 tonnes of *D. eleginoides* and 40 tonnes of *D. mawsoni*), comprising 62 tonnes in Subarea 48.4 North and 50 tonnes in Subarea 48.4 South. Subarea 48.4 North closed on 4 April when the reported catch reached 98% of the catch limit.

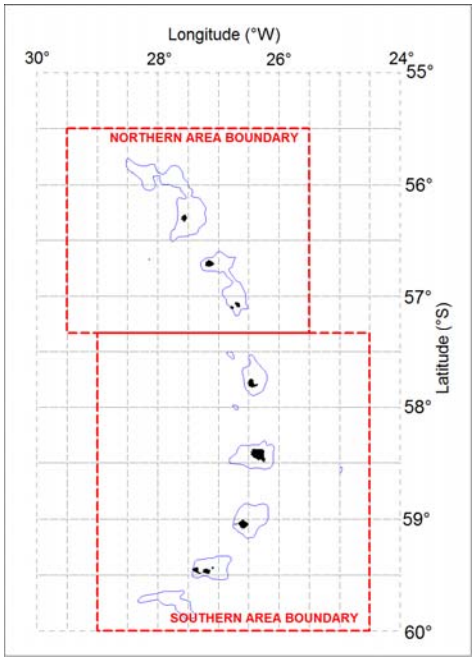


Figure 1: Positions of the boundaries of the northern area (Subarea 48.4 North) and southern area (Subarea 48.4 South) in Subarea 48.4. The 1 000 m depth contour is indicated.

Table 1: Catch history for *Dissostichus* spp. in Subarea 48.4 for the past 10 years (Subarea 48.4 North and Subarea 48.4 South combined). (Source: STATLANT data for past seasons, catch and effort reports for current season and past reports for IUU catch.)

Season	Catch limit (tonnes)	Reported catch (tonnes)			Estimated IUU catch (tonnes)
		D. eleginoides	*D. mawsoni*	Total	
2004	28[a]	0	0	0	-
2005	100	27	0	27	-
2006	100	18	0	19	-
2007	100	54	0	54	-
2008	100	98	0	98	-
2009	150	74	59	133	-
2010	116	57	56	114	-
2011	70	39	15	54	-
2012	81	55	22	78	-
2013	115	72	40	112	-

Illegal, unreported and unregulated (IUU) fishing

8. Data on potential IUU fishing in this subarea is limited to sightings from licenced vessels, which are only present for short periods annually. These vessels have not detected IUU activity in the subarea (Table 1).

Data collection

9. Catch limits for CCAMLR's fisheries for *D. mawsoni* and *D. eleginoides* for the 'assessed' fisheries in Subareas 48.3, 88.1 and 88.2 and Division 58.5.2 are set using fully integrated assessments; more basic approaches are used for the 'data-poor' fisheries (in Subarea 48.6 and in Area 58 outside the exclusive economic zones (EEZs)). The management of these data-poor fisheries has been a major focus of attention in CCAMLR in recent years after the acknowledgement that commercial fishing by itself had resulted in too few data to develop a full assessment of the targeted stocks in these areas. CCAMLR has developed a framework for designing and undertaking research fishing designed to lead to an assessment of these toothfish stocks in the short to medium term, established under the provisions of CM 41-01. This research planning framework has three phases: prospecting phase, biomass estimation phase and assessment development phase, with a set of decisions and review for the progression between stages.

Biological data

10. The collection of biological data is conducted as part of the CCAMLR Scheme of International Scientific Observation; for fisheries targeting *D. mawsoni* and *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.

Length distributions of catches

11. The length-frequency distributions of *D. mawsoni* and *D. eleginoides* caught in this fishery are presented in Figure 2 for all years in which the number of that species measured was more than 150 fish. 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.

12. The length-frequency distribution of *D. eleginoides* caught in Subarea 48.4 shows a shifting mode from 80–100 cm at the beginning of the time series to 125–140 cm in the most recent season (Figure 2a). A second mode of smaller fish (60–80 cm) becomes evident in 2009 and persists throughout the remainder of the time series, indicating a recruitment pulse.

13. The length-frequency distribution of *D. mawsoni* shows a single strong mode at 140–160 cm and does not show a clear progression between years, and small fish (<100 cm) are only evident in the most recent season (Figure 2b).

Tagging

14. Since 2012, vessels have been required to tag and release *Dissostichus* spp. at a rate of five fish per tonne of green weight caught (Table 2). The tag-overlap statistic estimates the representative similarity between the size distributions of those fish that are tagged by a vessel and of all the fish that are caught by that vessel. Each vessel catching more than 10 tonnes of each species of *Dissostichus*, is required to achieve a minimum tag-overlap statistic[1] of 60% (Annex 41-01/C).

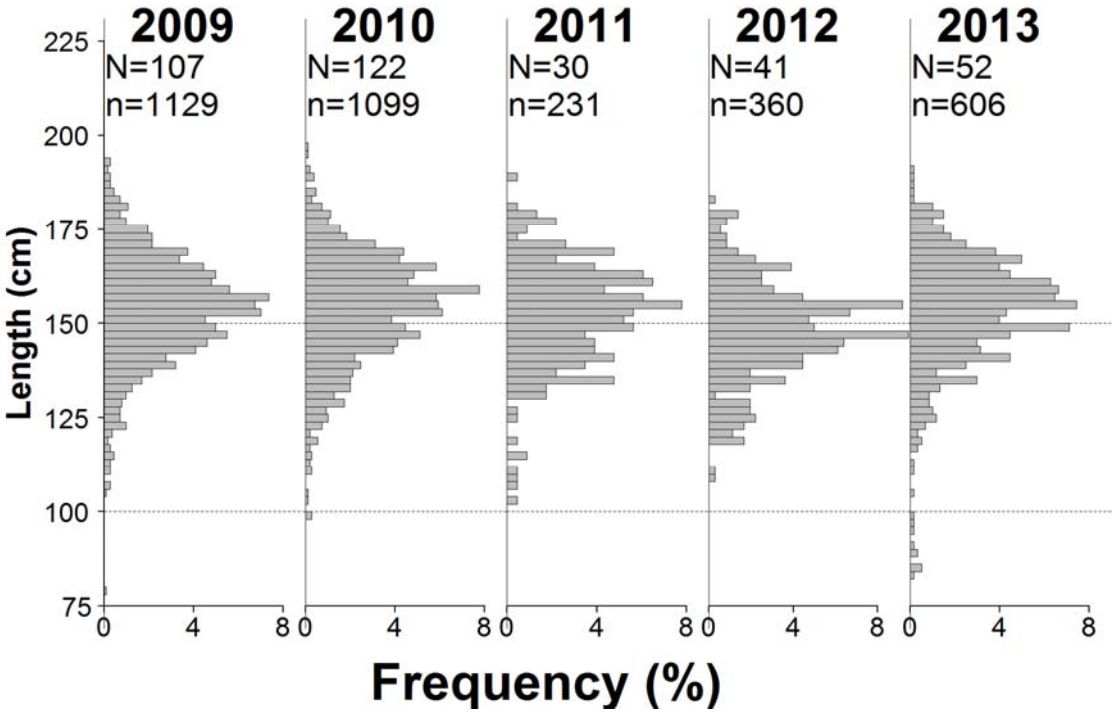
15. In 2005, the UK conducted a pilot tagging program using a longline fishing vessel. All vessels which have fished in Subarea 48.4 have exceeded the minimum tagging rate.

16. Following the pilot study, the Commission agreed to a mark–recapture experiment in Subarea 48.4 between 2006 and 2008, with fishing conducted in accordance with CM 24-01 (CCAMLR-XXIV, paragraphs 11.46 and 11.47; SC-CAMLR-XXIV, paragraphs 4.113 to 4.117). The experiment resulted in a CASAL assessment of toothfish in Subarea 48.4 North in 2009 and subsequent annual updates (2010–2013).

17. To date a total of 815 *D. mawsoni* have been tagged with 37 recaptured (Table 3a) and 2 945 *D. eleginoides* have been tagged with 212 recaptured (Table 3b).

[1] The tag-overlap statistic estimates the similarity in size distributions of fish that are tagged and all fish caught by a vessel (Annex 41-01/C, footnote 3).

(a)



(b)

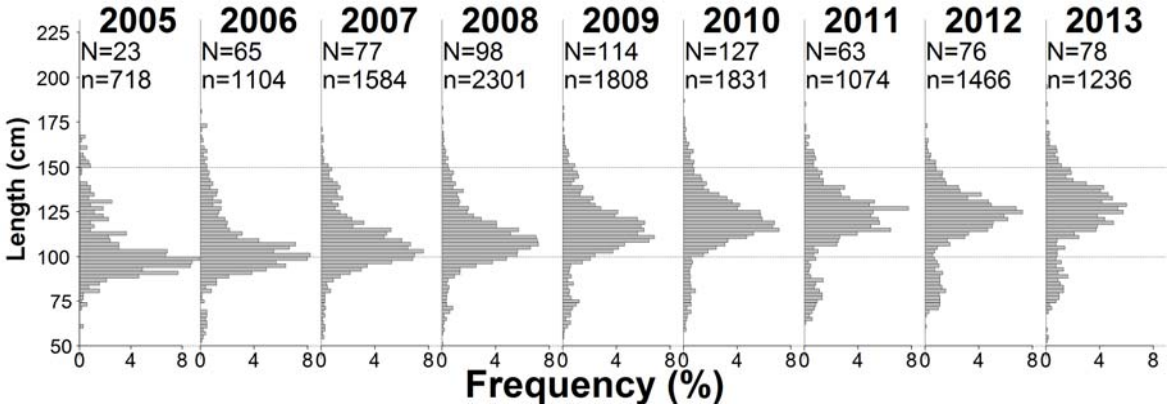


Figure 2: Annual length-frequency distributions for (a) *Dissostichus mawsoni* and (b) *D. eleginoides* in Subarea 48.4. The number of hauls from which fish were measured (N) and the number of fish measured (n) in each year are provided. Note: length-frequency distributions are only presented for those years/SSRUs in which the number of fish measured was >150.

Table 2: Annual tagging rate, reported by vessel, operating in the exploratory fishery for *Dissostichus* spp. in Subarea 48.4.

Flag State	Vessel name	Season								
		2005	2006	2007	2008	2009	2010	2011	2012	2013
New Zealand	*San Aspiring*		7.9	5.2	5.1	5.8	5.4	5.8	6.5	6.5
UK	*Argos Froyanes*				5.2		5.5			5.1
UK	*Argos Georgia*					5.4		5.7	5.2	
UK	*Argos Helena*	1.6	7.2	6.4						
Required tagging rate		1	3	3	3	3	3	3	5	5

Table 3: Number of individuals of (a) *Dissostichus mawsoni* and (b) *D. eleginoides* tagged in each year. The number of fish recaptured by each vessel/year is provided in brackets.

(a)

Flag State	Vessel name	Season							
		2006	2007	2008	2009	2010	2011	2012	2013
New Zealand	*San Aspiring*	10 (0)	1 (0)		123 (2)	148 (7)	25 (3)	28 (5)	124 (0)
UK	*Argos Froyanes*					54 (15)			55 (0)
UK	*Argos Georgia*				70 (0)		58 (4)	119 (1)	
UK	*Argos Helena*								
Total		10 (0)	1 (0)		193 (2)	202 (22)	83 (7)	147 (6)	179 (0)

(b)

Flag State	Vessel name	Season								
		2005	2006	2007	2008	2009	2010	2011	2012	2013
New Zealand	*San Aspiring*		88 (0)	251 (2)	252 (11)	309 (15)	162 (17)	110 (22)	218 (24)	239 (21)
UK	*Argos Froyanes*				252 (12)		256 (16)			231 (32)
UK	*Argos Georgia*					249 (14)		115 (17)	85 (9)	
UK	*Argos Helena*	42 (0)	4 (0)	40 (0)						
Total		42 (0)	134 (0)	291 (2)	504 (23)	558 (29)	418 (33)	225 (39)	303 (33)	470 (53)

18. WG-FSA-09/17 and 09/18 provided a comprehensive analysis of the distribution of the two species in Subarea 48.4 (Figure 3). More recent tagging data has shown that small numbers of *D. eleginoides* move between Subareas 48.3 and 48.4. For example, of 2 943 *D. eleginoides* tagged in Subarea 48.4 between 2005 and 2013, 169 fish were recaptured in Subarea 48.4 and eight in Subarea 48.3.

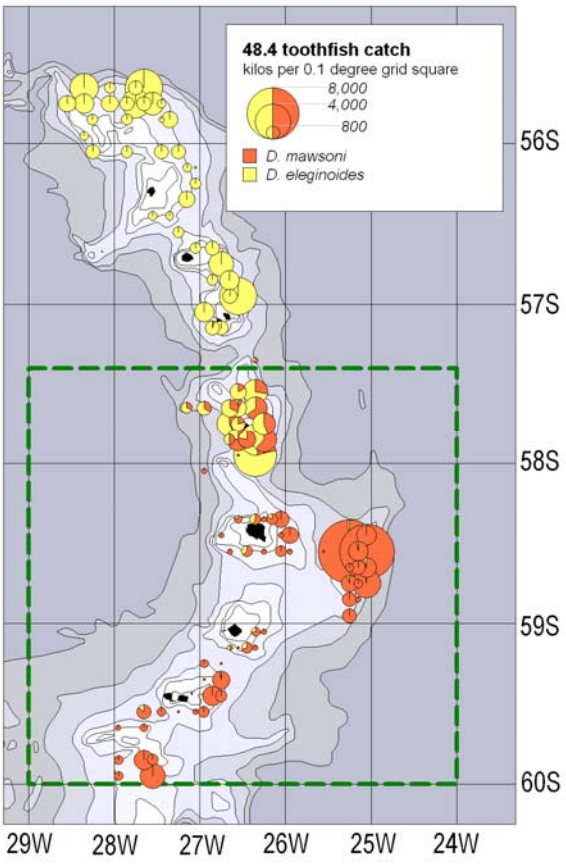


Figure 3: Catch distribution of the two *Dissostichus* species in Subarea 48.4.

Life-history parameters

Data collection

19. *Dissostichus* spp. are large long-lived species, belonging to the family Nototheniidae, or 'Antarctic cods'. Toothfish show distinct depth preferences with age, with juveniles living on the continental shelf and moving into deeper water as they reach maturity. Toothfish are predators, primarily feeding on fish, cephalopods and crustaceans, and they may also scavenge. Two species of toothfish occur in Subarea 48.4 and have a similar biology, however, *D. mawsoni* grows larger than *D. eleginoides* and tends to inhabit cooler, more southerly waters.

Parameter estimates

20. The biological parameters assumed in the stock assessment (Table 4) are taken from the scientific literature, where available. These values are derived from analyses of the biological data collected by scientific observers on board fishing vessels (see below). Where

derived values are not available (e.g. natural mortality and the steepness of the stock and recruit relationship), values have been assumed that are consistent with the assumed values for other toothfish assessments conducted by CCAMLR.

Table 4: Biological parameters assumed for *Dissostichus eleginoides* in Subarea 48.4.

Component	Parameter	Value	Component	Parameter	Value
Natural mortality	M	0.13	Tag-related growth retardation		0.5
VBGF	K	0.09	CASAL tag loss rate		0.0064
VBGF	t_0	0.0	Immediate tagging survivorship		0.1
VBGF	L_∞	153	Tag probability of detection		1
Length to mass (cm to t)	a	2.71E-08			
Length to mass	b	2.8	Stock-recruit relationship steepness	h	0.75
Maturity range: 0 to full maturity		1–23	Lognormal recruitment SD		1.0

By-catch of fish

21. Catch limits for by-catch species groups (macrourids, rajids and other species) are defined in CM 41-03. The macrourid by-catch limit is 11 tonnes, whilst the rajid by-catch limit is 3.5 tonnes.

22. If the by-catch of skates and rays exceeds 5% of the catch of *Dissostichus* spp. in any one haul or set, or if the catch of *Macrourus* spp. reaches 150 kg and exceeds 16% of the catch of *Dissostichus* spp. 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.

23. In addition to the mitigation measures in CM 41-03, rajids are handled and released following ‘Year-of-the-Skate’ protocols to maximise their survival.

24. The by-catch in Subarea 48.4 consists predominantly of macrourids, with a maximum of 26 tonnes being recorded in 2009.

25. In 2013 by-catch of skates and rays and *Macrourus* spp. were within the limits set out in CM 41-03 and the move-on rule was not triggered.

26. Catches of by-catch species groups (macrourids, rajids and other species), their respective catch limits, and number of rajids released alive, are summarised in Table 5.

Table 5: Catch history for by-catch species (macrourids, rajids and other species), including catch limits and number of rajids released alive, in Subarea 48.4. 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 (tonnes)	Number released	Catch limit (tonnes)	Reported catch (tonnes)
2005	-	3	-	0	-	-	0
2006	-	5	-	1	4359	-	0
2007	-	14	-	2	6515	-	0
2008	-	16	-	4	8276	-	0
2009	-	26	-	2	9767	1	1
2010	-	16	-	2	6183	1	1
2011		5		1	4680		0
2012	-	7	-	1	5582	-	0
2013	-	6	-	1	3115	-	0

Assessments of impacts on affected populations

27. The distribution of rajids and macrourids in Subarea 48.4 has been investigated and initial results of their distributions were provided in WG-FSA-09/17 and 09/18. Two-hundred skate were tagged in Subarea 48.4 in 2013 so that a total of 7 036 skate have now been tagged in this subarea, although to date only 261 tagged skate have been recaptured from this subarea.

28. Although catch rates for macrourids in Subarea 48.4 North were high at the start of the fishery, vessels have altered their fishing techniques and areas and rates have subsequently dropped; both macrourid and rajid catches were within the catch limits in 2013.

29. Macrourid catches were previously thought to almost entirely comprise *Macrourus whitsoni.* Recent taxonomic studies (including genetic analyses) now indicate that the *Macrourus* population comprises two species, including *M. whitsoni* and the recently described species *M. caml* (WG-FSA-10/33; McMillan et al., 2012).

Invertebrate by-catch including VME taxa

30. There are no registered VMEs or VME Risk Areas in Subarea 48.4.

Incidental mortality of birds and mammals

Incidental mortality

31. In 2009 one chinstrap penguin (*Pygoscelis antarctica*) was injured in the fishery in Subarea 48.4. There have been no other observed seabird or marine mammal mortalities in this fishery.

Mitigation measures

32. CM 25-02 on minimisation of the incidental mortality of seabirds in longline fishing applies to this subarea except paragraph 5 (that longlines shall be set at night only), if requirements of CM 24-02 are met. This exception means that longlines can be set in the daytime if vessels follow protocols to ensure that longlines sink quickly. CM 24-02 also stipulates a limit of three (3) seabirds per vessel during daytime setting.

33. The level of risk of incidental mortality of seabirds in Subarea 48.4 is category 3 (medium) (SC-CAMLR-XXX, Annex 8, paragraph 8.1).

Ecosystem implications and effects

34. There is no formal evaluation available for this fishery.

Current management advice and conservation measures

35. The limits on the exploratory fishery for *Dissostichus* spp. in Subarea 48.4 are defined in CM 41-03. The limits in force and the advice of WG-FSA to the Scientific Committee for the forthcoming season are summarised in Table 6.

Table 6: Limits on the fishery for *Dissostichus eleginoides* and *D. mawsoni* in Subarea 48.4 in force (CM 41-03).

Element	Limit in force for 2014
Access	Subarea 48.4 is open to a fishery for *Dissostichus* spp.
Catch limit	The precautionary catch limit for *D. eleginoides* is 45 tonnes. The precautionary catch limit for *D. mawsoni* is 24 tonnes.
Season	1 December to 30 November
By-catch	Precautionary catch limit for *Macrourus* spp. is 16% of the combined *Dissostichus* spp. catch limit (11tonnes). Precautionary catch limit for rajids is 5% of the combined *Dissostichus* spp. catch limit (3.5 tonnes). By-catch move-on rules for *Macrourus* spp. (more than 150 kg and 16% of toothfish catch in one haul) and rajids (5%).
Seabird mitigation	In accordance with CM 25-02, except paragraph 5, if requirements of CM 24-02 are met. Fishing in December, January, February, March, October and November shall be in accordance with CM 24-02. Limit of three (3) seabirds per vessel during daytime setting
Observers	At least one (1) scientific observer appointed in accordance with the CCAMLR Scheme of International Scientific Observation
Data	Five-day catch and effort reporting Haul-by-haul catch and effort data Biological data reported by the CCAMLR scientific observer

(continued)

Table 6 (continued)

Element	Limit in force for 2014
Research	Each vessel taking part in the fishery for *D. eleginoides* shall undertake a tagging program in accordance with the CCAMLR tagging protocol. Toothfish tagged at a rate of at least five fish per tonne of green weight caught Fish should be tagged in proportion to the species composition and length-frequency distribution of the catch.
Environmental protection	Regulated by CM 26-01

Reference

McMillan, P., T. Iwamoto, A. Stewart and P.J. Smith. 2012. A new species of grenadier, genus *Macrourus* (Teleostei, Gadiformes, Macrouridae) from the southern hemisphere and a revision of the genus. *Zootaxa*, 3165: 1–24.

Appendix 1

STOCK ASSESSMENT

D. mawsoni

A1. The fishery for *D. mawsoni* in Subarea 48.4 has been in operation for only a few years. Catches are generally small and there is little or no ageing information at present. Consequently, the stock is assessed using a simple Petersen biomass estimate to which a harvest rate is applied to determine appropriate catch limits. The biomass estimates are quite variable ranging from around 500 tonnes to 1 000 tonnes.

D. eleginoides

A2. The stock of *D. eleginoides* in Subarea 48.4 was assessed using an age-structured CASAL integrated stock assessment model for both sexes combined with ages from 1 to 50, the last age being a plus group. The model was run from 1990 to 2013 and was initialised assuming an equilibrium age structure at an unfished equilibrium biomass.

A3. The assessment model assumes a single area and single fleet fishery with a single sigmoid selection pattern estimated for the full time series. The use of a double normal selection pattern, to allow for potential dome-shaped selection in the fishery, was investigated in 2012, however, it was concluded that a sigmoid selection pattern provided a more robust model fit and gave more precautionary estimates of stock abundance.

A4. The assessment model includes tag-release and tag-recapture events for which data are available from 2005. The model assumes that tagging was applied to a cohort of fish simultaneously and that tagging from each year was applied as a single tagging event. The model applies the same population processes to both the tagged and untagged components of the modeled population. In addition, tagged fish were assumed to suffer a growth retardation equal to 0.5 years of zero growth following tagging. All fish are double-tagged with tag shedding estimated at 0.0064 $year^{-1}$ and an additional post-tagging mortality rate of 0.1.

A5. Model parameters are initially estimated by maximising the composite likelihood of the data, priors and penalties (the MPD estimates) and subsequently by estimating the Bayesian posterior distributions using Monte Carlo Markov Chains (MCMC). Model fits were evaluated at the initial MPD by investigating fits to observations and likelihood profiles of key parameters estimated by the model, specifically B_0.

A6. Likelihood profiles for B_0 from the 2013 assessment (Figure A1) show generally consistent estimates of B_0 from each of the datasets used in the assessment, particularly from the tag-release and recapture information which is included in the assessment primarily to provide an estimate of total abundance.

A7. Parameter uncertainty was estimated using MCMC analyses. The posterior distribution was sampled from 1 000 000 iterations, following an initial burn-in of 100 000 iterations, and

thinned by a factor of 1 000, to achieve a final sample length of 1 000. Estimates of initial biomass levels and current biomass levels (Table A1) show the stock to be around 84% of B_0 in 2013.

A8. Stochastic long-term projections conducted in accordance with the CCAMLR procedures for yield calculations (Figure A2) indicate that a constant yield of 45 tonnes will maintain SSB above 50% of B_0 over the next 35 years with 50% probability.

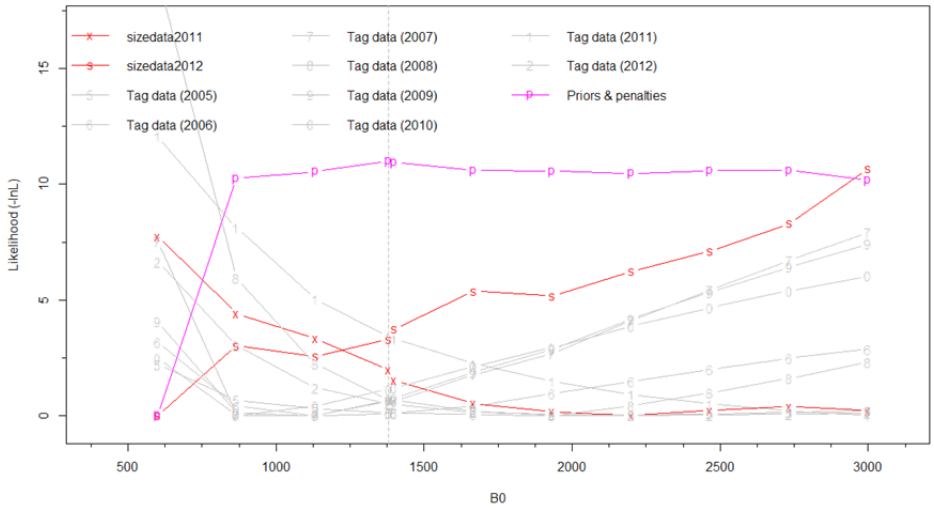


Figure A1: *Dissostichus eleginoides* in Subarea 48.4: Likelihood profiles for values of B_0. Negative log likelihood values have been rescaled to have minimum 0 for each dataset. Vertical line indicates the overall MPD estimate of B_0.

Table A1: *Dissostichus eleginoides* in Subarea 48.4: median spawning biomass and 95% CIs for the initial equilibrium SSB (B_0), the current SSB ($B_{current}$) and the ratio of current to initial SSB for the 2013 assessment.

Assessment year	B_0 (thousand tonnes)	$B_{current}$ (thousand tonnes)	$B_{current}/B_0$
2013	1 384 (1 043–1 948)	1 158 (780–1 775)	0.84 (0.75–0.91)

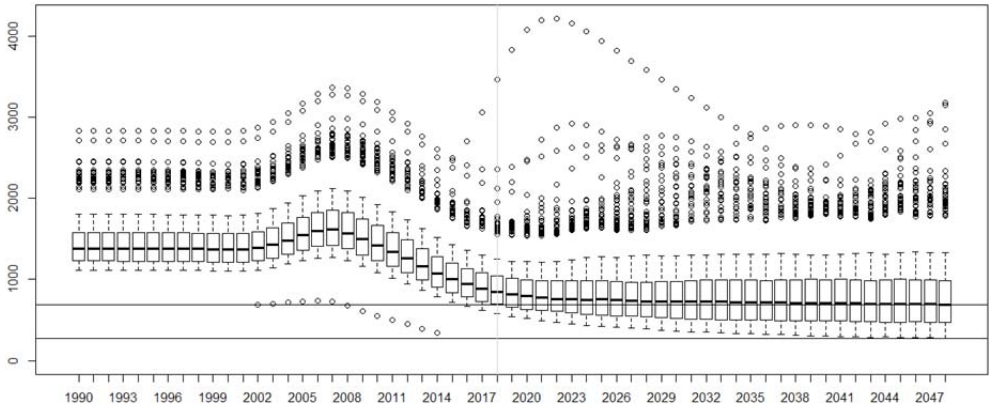


Figure A2: *Dissostichus eleginoides* in Subarea 48.4: Estimated spawning stock biomass based on a 35-year projection at a constant yield of 45 tonnes. Boxes show median and 25th and 75th percentiles. Whiskers extend to the 5th and 95th percentiles.