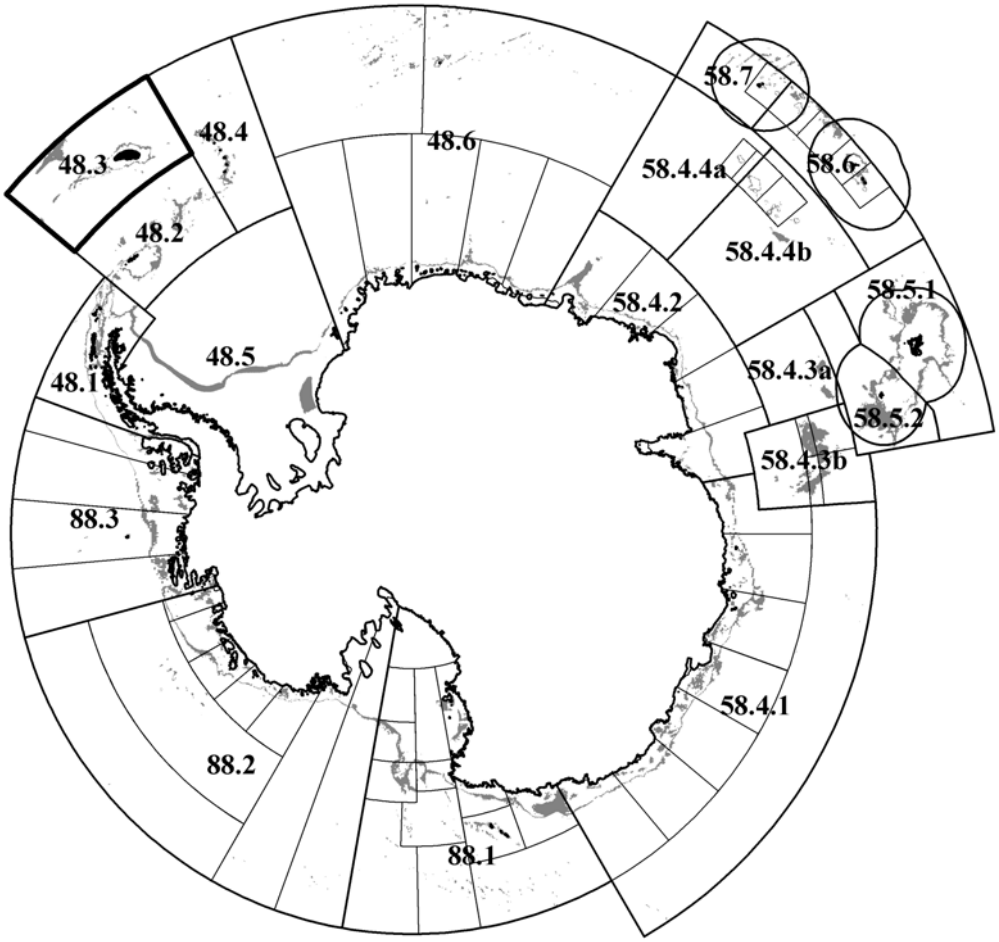
Fishery Report 2013: *Dissostichus eleginoides*
South Georgia (Subarea 48.3)



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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 are shaded.

Throughout this report the CCAMLR fishing season is represented by the year in which that season ended, e.g. 2012 represents the 2011/12 CCAMLR fishing season (from 1 December 2011 to 30 November 2012).

FISHERY REPORT 2013: *DISSOSTICHUS ELEGINOIDES* SOUTH GEORGIA (SUBAREA 48.3)

Introduction to the fishery

1. The fishery for Patagonian toothfish (*D. eleginoides*) in Subarea 48.3 began in the 1980s and expanded rapidly during the early 1990s, when considerable illegal, unregulated and unreported (IUU) catches were also taken (Table 1). The initial fishery also had major problems with seabird by-catch, with relatively large numbers of albatross and petrels, attracted to the baited hooks, being caught and drowned. In response to these issues, CCAMLR introduced strict regulations designed to reduce seabird by-catch. These regulations, including seasonal closures, line-weighting regimes and night-setting requirements, have virtually eliminated the seabird by-catch problem in this fishery.

2. The current toothfish fishery employs baited demersal longlines in which lines of baited hooks are deployed close to the sea floor at depths up to 2 000 m. Surface buoys indicate the presence of lines, and vessels typically recover lines after a soak time of 24–48 hours. Bait is usually squid or sardines. The fishery was conditionally certified by the Marine Stewardship Council in 2004. It was recertified without conditions in 2009.

3. In 2004, the Commission agreed to subdivide Subarea 48.3 into three Management Areas (A, B and C) defined in Conservation Measure (CM) 41-02/A. The catch limits for *D. eleginoides* for the past two seasons (2012 and 2013) for Management Areas A, B and C (see Figure 1) were set at 0, 780 and 1 820 tonnes respectively, with an overall catch limit for Subarea 48.3 of 2 600 tonnes.

4. In 1998, the fishery was restricted to the winter months (1 May to 31 August) to minimise interactions with foraging seabirds during their breeding season. Since 2010, CCAMLR has applied a gradual extension to the season, with the season starting five days earlier each year such that the 2013 season opened on 11 April. These extensions were accompanied with a number of additional measures to prevent significant seabird by-catch, as set out in CM 41-02.

5. In 2013, fishing in Management Areas B and C commenced on 12 April and finished on 27 August. The total reported catch of *D. eleginoides* for 2013 in Subarea 48.3 was 2 098 tonnes. Catches in Management Areas B and C were 536 and 1 563 tonnes respectively.

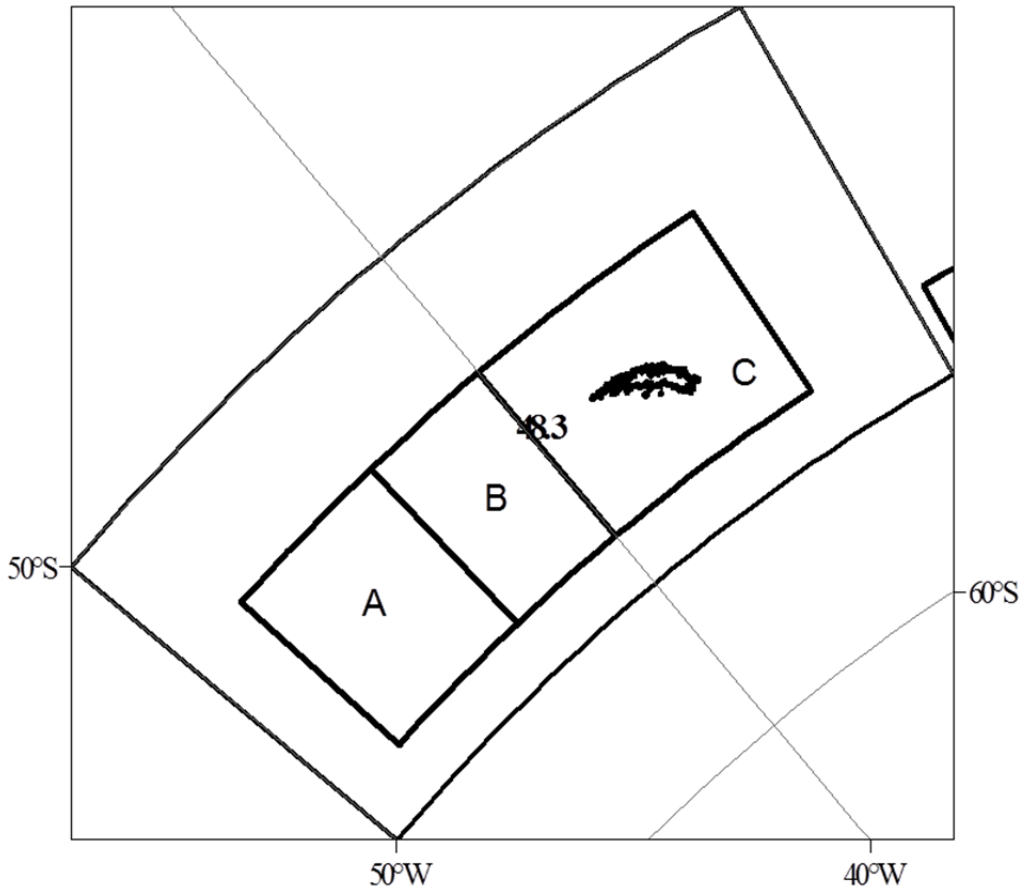

Figure 1: The location of Management Areas A, B and C in Subarea 48.3

Reported catches

6. The catch series is shown in Table 1, and with the exception of 36 tonnes in 2004 and 2 tonnes in 2007, all catches have been from within Management Areas B and C. There has been no evidence of IUU fishing in Subarea 48.3 since 2006.

7. Fishing for *D. eleginoides* in Subarea 48.3 has predominantly used longlines. Occasional potting trials yielded the following catches: 66 tonnes (2001), 24 tonnes (2006) and 55 tonnes (2008). There have been no recent trials using pots. Prior to 1992, fishing focused around Shag Rocks and to the northeast of South Georgia. Since 1992, fishing effort has been distributed more widely over the South Georgia and Shag Rocks shelves and slopes.

Table 1: Catch history for *Dissostichus eleginoides* in Subarea 48.3. (Source: STATLANT data for past seasons, and catch and effort reports for current season, past reports for IUU catch.)

Season	Vessels fishing	Regulated fishery		Estimated IUU catch (tonnes)
		Catch limit (tonnes)	Reported catch (tonnes)	
1985	1	-	521	0
1986	1	-	733	0
1987	1	-	1 954	0
1988	2	-	876	0
1989	3	-	7 060	144
1990	2	-	6 785	437
1991	1	2 500	1 756	1 775
1992	23	3 500	3 809	3 066
1993	18	3 350	3 020	4 019
1994	4	1 300	658	4 780
1995	13	2 800	3 371	1 674
1996	13	4 000	3 602	0
1997	10	5 000	3 812	0
1998	9	3 300	3 201	146
1999	12	3 500	3 627	667
2000	16	5 310	4 904	1 015
2001	18	4 500	4 047	196
2002	17	5 820	5 742	3
2003	19	7 810	7 528	0
2004	17	4 420	4 497	0
2005	8	3 050	3 034	23
2006	11	3 556	3 535	0
2007	11	3 554	3 539	0
2008	12	3 920	3 864	0
2009	11	3 920	3 382	0
2010	9	3 000	2 519	0
2011	6	3 000	1 763	0
2012	6	2 600	1 806	0
2013	6	2 600	2 098	0

Illegal, unreported and unregulated (IUU) fishing

8. There is no evidence of illegal, unreported and unregulated (IUU) fishing since 2006 (Table 1).

Data collection

9. Catch limits for CCAMLR's fisheries for *D. eleginoides* for the 'assessed' fisheries in Subarea 48.3 and Division 58.5.2 are set by CCAMLR using fully integrated assessments; more basic approaches are used for the 'data-poor' fisheries (in Subarea 48.6 and in Area 58 outside the EEZs). The data collection requirements are set out in the relevant conservation measures.

Biological data

10. The collection of biological data under CM 23-05 is conducted as part of the CCAMLR Scheme of International Scientific Observation. In longline fisheries targeting *D. eleginoides*, biological data collection includes representative samples of length (Figure 2), 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-frequency distribution of catches

11. The length frequencies for catches of *D. eleginoides* from 2004 to 2013 are shown in Figure 2. These length-frequency distributions of catches are unweighted. Interannual variability shown in Figure 2 may therefore reflect differences in the fished population and changes in the fishing fleet and its behaviour.

Life-history parameters

Data collection

12. *Dissostichus eleginoides* is a large long-lived species belonging to the family Notothenidae, or Antarctic cods. Toothfish show distinct depth preferences with age, with juveniles (<50 cm) living on the continental shelf and moving into deeper water (>500 m) as they reach maturity (~90 cm). Toothfish are important predators, primarily feeding on fish, cephalopods and crustaceans, and also scavenge.

(b)

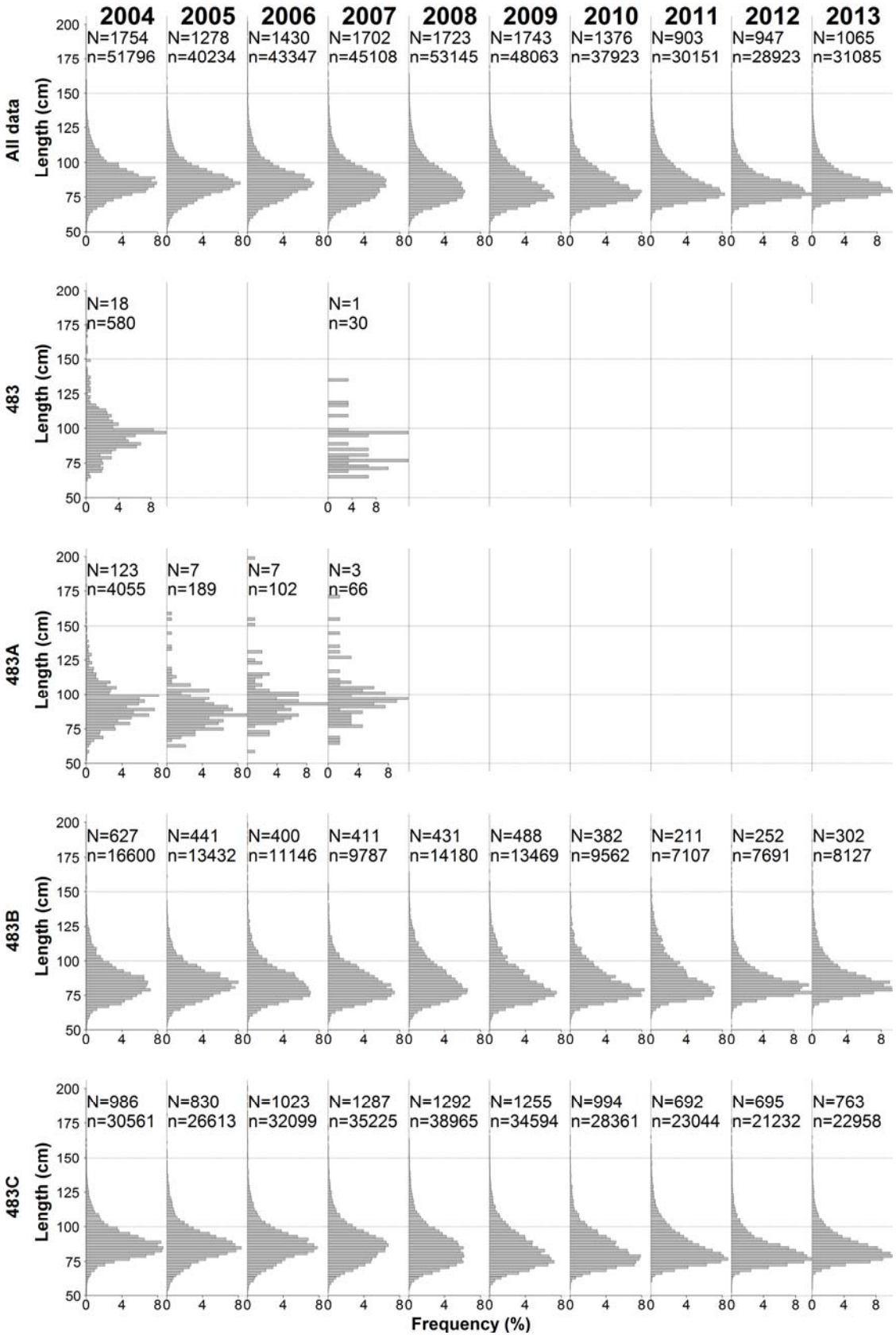

Figure 2: Length-frequencies for *Dissostichus eleginoides* in Subarea 48.3 from 2004 to 2013 using observer data. The number of hauls (N) and the number of fish measured (n) in each year are given at the top of each panel. Areas are those indicated in Figure 1.

Trawl surveys

13. In January 2013, the UK undertook a random stratified bottom trawl survey of South Georgia and the Shag Rocks (see WG-FSA-13/17). The survey is the 16th of its type (the trawl series starting in 1986) and employed the same trawl gear and survey design as previous UK surveys in Subarea 48.3 (see WG-FSA-10/38). The 2013 survey covered the whole shelf area, covering depths of 100–320 m. The primary aim of the survey was to estimate stocks of mackerel icefish (*Champsocephalus gunnari*) but juvenile *D. eleginoides* are also captured. Numbers and lengths of *D. eleginoides* provide an index of recruitment for stock assessments.

14. *Dissostichus eleginoides* were caught in 20 out of the 70 hauls in the 2013 survey and were present in the greatest numbers around the eastern end of Shag Rocks. The total catch of toothfish was low when compared to the 2011 catch, totalling 322 kg (201 individuals). Toothfish ranged in length from 17 to 74 cm, and the majority were 40–60 cm. There was evidence of a cohort of 3+ fish (modal length of 44 cm), which were seen as 2+ fish during the 2012 survey. There was little evidence of strong cohorts of 1+ or 2+ fish present over the South Georgia shelf, although 4+ fish were caught (modal length 51cm).

15. Biological and ecological data of fish in Subarea 48.3 were also collected by an Argentinean research survey in 2013 (see WG-FSA-13/61 and 13/62).

Observer data

16. All toothfish vessels in Subarea 48.3 carry a CCAMLR scientific observer who collects a range of data, including conversion factors, length frequencies, weights and maturity. Otoliths are collected by observers for an ageing program that provides length-at-age data for assessments. Observers also record whale depredation rates which are included in stock assessments. Observers work with vessels to tag toothfish and skates and collate recapture data. These data underpin the stock assessments for *D. eleginoides* in Subarea 48.3. Tagging of *D. eleginoides* continued at a rate of 1.3 fish per tonne in 2013, with a total of 3 351 fish tagged and 607 recaptures (including within season recaptures).

Parameter estimates

17. The biological parameters assumed in the stock assessment (Table 2) 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. 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 2: Biological parameters assumed for *Dissostichus eleginoides* in Subarea 48.3.

Component	Parameter	Value	Component	Parameter	Value
Natural mortality	M	0.13	Tag-related growth retardation		0.75
VBGF	K	0.08	CASAL tag loss rate		0.006377
VBGF	t_0	–0.7	Immediate tagging survivorship		See below
VBGF	L_∞	126	Tag probability of detection		1
Length to mass (cm to t)	a	2.54E-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		Estimated

18. Immediate tagging survivorship is applied as a length-specific tag mortality ogive in which larger fish are assumed to experience a higher rate of mortality as a consequence of the tagging procedure than smaller fish (Table 3). Since CASAL can only apply a single tag mortality across all sizes, the correction to the tagged fish proportions at length and numbers of tagged fish must be applied externally.

Table 3: Length-specific tagging survival rates used in the assessment for *Dissostichus eleginoides* in Subarea 48.3.

	Length class (cm)						
	40	50	60	70	80	90	100 +
Proportion surviving	1.0	0.96	0.95	0.95	0.94	0.83	0.8

19. Since the length-specific tag-mortality rates are calculated externally to the assessment, the tagging mortality parameters in the CASAL input files are set to zero in all instances.

Stock assessment status

20. *Dissostichus eleginoides* in Subarea 48.3 are genetically distinct from those found on the Patagonian shelf (FAO Area 41). The stock, occurring within Management Areas A, B and C, is genetically separate from fish taken in the extreme north and west of Subarea 48.3. All assessments consider only the stock within Management Areas A, B and C.

21. The stock of *D. eleginoides* in Subarea 48.3 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 models were run from 1985 to 2013 and were initialised assuming an equilibrium age structure at an unfished equilibrium biomass.

22. The assessment model assumes a single-area and single-fleet fishery with separate selection patterns estimated for two distinct time periods, the first from 1985 to 1997, the second from 1988 to 2013. A fishery-independent index of abundance, derived from a first

quarter bottom trawl survey, is available for most years between the period 1987 to 2013 and an index of CPUE, determined from the commercial fishery, is also available for use in the assessment for the period 1998 to 2013. The CPUE index is corrected for cetacean depredation (i.e. CPUE is increased to account for removal of catch by killer whales) for the period that cetacean observations are available (2004 onwards), using a generalised linear model analysis. A similar correction is also applied to the total catch. The correction for cetacean depredation varies annually but is typically in the range of a 3% to 5% increase.

23. Double-normal selection patterns were fitted in all instances to allow for any potential reduction in selection at older ages, although, in all instances, the model estimated sigmoid selection patterns.

24. The assessment model includes tag-release and tag-recapture events for which data are available from 2003. 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 modelled population. In addition, tagged fish were assumed to suffer a growth retardation equal to 0.75 years of zero growth following tagging. All fish are double tagged with tag shedding estimated at 0.006377 years^{-1}.

25. 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 MCMCs. 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.

26. Likelihood profiles for B_0 from the 2013 assessment (Figure 3) showed 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.

27. 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 4) show that the stock remains at around 53% of B_0 in 2013.

28. Stochastic long-term projections conducted in accordance with the CCAMLR procedures for yield calculations (Figure 4) indicate that a constant yield of 2 400 tonnes will maintain SSB above 50% of B_0 over the next 35 years with 50% probability.

Table 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 2007, 2009, 2011 and 2013 assessments.

Assessment year	B_0 (000 tonnes)		$B_{current}$ (000 tonnes)		$B_{current}/B_0$	
2007	112	(98.7–125.0)	67.1	(52.9–79.9)	0.59	(0.54–0.64)
2009	98.5	(93.6–103.8)	60.2	(55.0–65.7)	0.61	(058–0.64)
2011	85.1	(78.9–92.1)	44.9	(38.9–51.9)	0.53	(0.49–0.56)
2013	85.9	(81.6–90.8)	45.4	(41.3–49.7)	0.53	(0.50, 0.55)

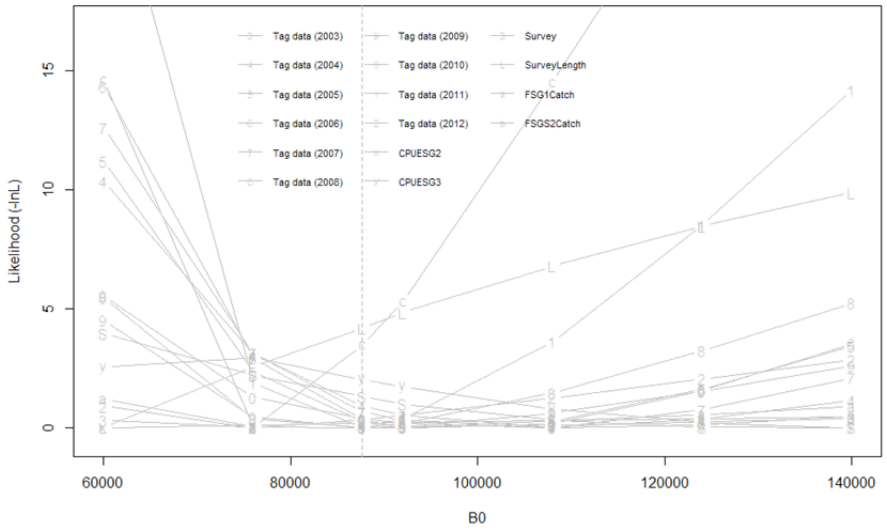

Figure 3: Likelihood profiles for values of B_0. Negative log likelihood values have been rescaled to have minimum 0 for each dataset. Vertical line indicates the overall MPD estimate of B_0.

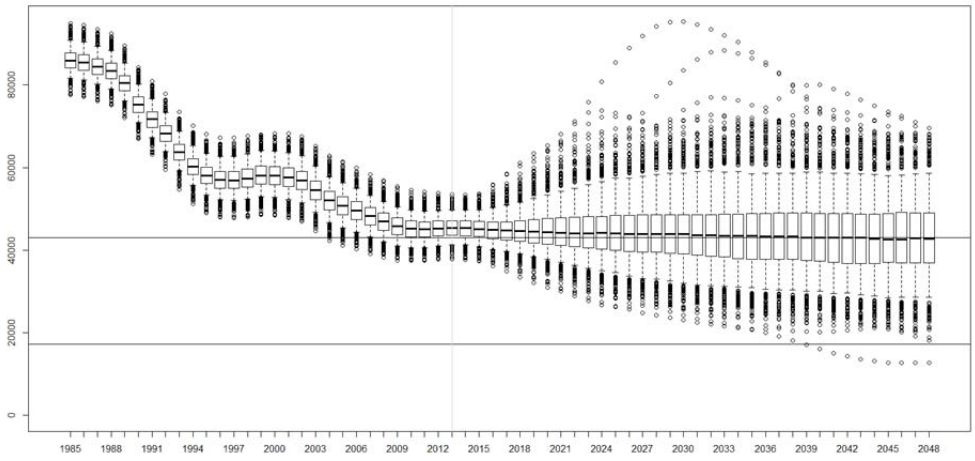

Figure 4: Estimated spawning stock biomass based on a 35-year projection at a constant yield of 2 400 tonnes. Boxes show median and 25th and 75th percentiles. Whiskers extend to the 5th and 95th percentiles.

By-catch of fish and invertebrates

Fish by-catch

29. Catch limits for by-catch species groups (macrourids, rajids and other species) are defined in CM 41-02. The macrourid by-catch limit is 120 tonnes, and the rajid by-catch limit is also 120 tonnes.

30. If the by-catch of skates and rays or macrourids exceeds 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.

31. 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. Both macrourid and rajid catches were well within the catch limits.

Table 5: Catch history for by-catch species (macrourids, rajids and other species), catch limits and number of rajids released alive in Subarea 48.3. Catch limits are for the whole fishery (see CM 41-02 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)
2004	221	82	221	38	-	-	10
2005	152	121	152	9	-	-	19
2006	177	137	177	7	21 056	-	35
2007	177	130	177	4	9 265	-	26
2008	196	162	196	12	19 558	-	36
2009	196	110	196	22	23 709	-	33
2010	150	70	150	7	15 810	-	16
2011	150	74	150	4	12 832	-	9
2012	130	54	130	2	13 503	-	9
2013	130	59	130	2	14 005	-	11

32. A preliminary assessment of rajid populations in Subarea 48.3 using a surplus production model implemented in a Bayesian framework was presented in 2007 (WG-SAM-07/11), at which time it was considered that there were insufficient data to inform the assessment. Nevertheless, these preliminary results suggested that the catch limit in Subarea 48.3 for rajids would be sustainable.

33. A rajid tagging program has been under way since 2006 in Subarea 48.3, the possibility of undertaking a skate assessment will be considered as more data become available.

Incidental mortality of birds and mammals

Incidental mortality

34. A single mortality of a white-chinned petrel (*Procellaria aequinoctialis*) was observed in May 2013 (Table 6). The seabird mortality rate was calculated as 0.001 birds/thousand hooks (this figure is calculated from the number of birds killed divided by number of hooks observed) and is extrapolated to give an estimated total of four seabirds for the season.

35. The efficacy of the early-season extension in the *D. eleginoides* fishery in Subarea 48.3 was reviewed in 2013 (WG-FSA-13/32) and found to be successful, in that the

extension was not associated with increased seabird mortality. A proposal for two further season extensions and a change to the start date of the main season (to 16 April) was therefore agreed for 2014 and 2015.

36. A summary of the historic seabird mortality by longline in Subarea 48.3 over the past 10 seasons is presented in Table 6. The three most common species injured or killed in the fishery were the southern giant petrel (*Macronectes giganteus*), the black-browed albatross (*Thalassarche melanophrys*) and unidentified *Procellaria* sp. (probably mostly white-chinned petrel).

Table 6: Number of seabirds killed in the longline fishery in Subarea 48.3.

Season	*Macronectes giganteus*	*Procellaria* spp.	*Thalassarche melanophris*	Other
2004	3		1	1
2005	4			2
2006				
2007				
2008				
2009			1	1
2010			1	1
2011				1
2012	1		1	
2013		1		

37. There have been no reports of incidental mortalities of marine mammals in 2013. Over the last 10 years, three marine mammal mortalities associated with fishing have occurred in Subarea 48.3.

Mitigation measures

38. The requirements of CM 25-02 ‘Minimisation of the incidental mortality of seabirds in the course of longline fishing or longline fishing research in the Convention Area’ apply to this fishery. There is an exemption to the requirement for night setting by achieving the sink rates described in CM 24-02 and subject to a seabird by-catch limit.

39. Additional measures, including a vessel catch limit of three seabirds and the requirement for 100% prior compliance with CM 25-02, apply to vessels fishing in season-extension periods and these are set out in CM 41-02.

40. The risk level of seabirds in this fishery in Subarea 48.3 is category 5 (high) (SC-CAMLR-XXX, Annex 8, paragraph 8.1)

Ecosystem implications and effects

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

Current management advice and conservation measures

42. The limits on the exploratory fishery for *D. eleginoides* in Subarea 48.3 are defined in CM 41-02. The limits in force and the advice of WG-FSA to the Scientific Committee for the forthcoming season are summarised in Table 7.

Table 7: Limits on the fishery for *Dissostichus eleginoides* in Subarea 48.3 in force (CM 41-02).

Element	Limits in force 2015 and 2016
Access (gear)	Longlines or pots only
Subdivision of Subarea 48.3	See Figure 1
Catch limit	Catch limit for *Dissostichus eleginoides* of 2 400 tonnes for the subarea, applied as follows: Management Area A: 0 tonnes Management Area B: 720 tonnes Management Area C: 1 680 tonnes
Season:	16 April to 31 August
longline	In 2014, extensions start on 6 April and end on 14 September for vessels complying fully with CM 25-02 in the previous season
pots	1 December to 30 November
seabirds	During extension period and in each season, any vessel catching three (3) seabirds to cease fishing
By-catch:	Any by-catch of crab shall, as far as possible, be released alive.
crabs	
finfish	Total combined catch of skates and rays 120 tonnes Total catch of *Macrourus* spp. 120 tonnes
any species	Move-on rule
Mitigation	In accordance with CM 25-02
Observers	Each vessel to carry at least one CCAMLR scientific observer and may include one additional scientific observer
Data	Five-day catch and effort reporting under CM 23-01 Haul-by-haul catch and effort data under CM 23-03 Biological data reported by the CCAMLR scientific observer
Target species	For the purposes of CMs 23-01 and 23-04, *D. eleginoides* is the target species and the by-catch is any species other than *D. eleginoides*.
Jellymeat	Number and weight of *D. eleginoides* discarded, including those with jellymeat condition, to be reported. These catches count towards the catch limit.
Research fishing	Catches of *D. eleginoides* taken under CM 24-01 in the area of the fishery shall be considered as part of the catch limit.
Environmental protection	Regulated by CM 26-01