APPENDIX M

FISHERY REPORT:
DISSOSTICHUS ELEGINOIDES AND *DISSOSTICHUS MAWSONI*
SOUTH SANDWICH ISLANDS (SUBAREA 48.4)

CONTENTS

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1. Details of the fishery

The fishery for *Dissostichus eleginoides* in Subarea 48.4 was initiated as a new fishery in 1992/93 following notifications from Chile and the USA (SC-CAMLR-XI, Annex 5, paragraph 6.22), and the adoption of Conservation Measure 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).

2. Haul-by-haul data from the Chilean and Bulgarian vessels were submitted to CCAMLR, and WG-FSA used these data to estimate an annual yield of 28 tonnes of *D. eleginoides* for the subarea (SC-CAMLR-XII, Annex 5, paragraph 6.3, Table 1). The Commission adopted a precautionary catch limit for *D. eleginoides* of 28 tonnes per season. In addition, the taking of *D. mawsoni*, other than for scientific research purposes, was prohibited. These limits remained in force until 2004.

3. In 2004/05, the UK conducted a pilot tagging program using a fishing vessel. The vessel caught 27 tonnes of *D. eleginoides* and tagged 42 individuals, and the results of this research fishing were reported to WG-FSA (SC-CAMLR-XXIV, Annex 5, paragraphs 5.140 and 5.141).

4. Following the pilot study, the Commission agreed to an extensive mark–recapture experiment in Subarea 48.4 during the period from 2005/06 to 2007/08, with fishing conducted in accordance with Conservation Measure 24-01 (CCAMLR-XXIV, paragraphs 11.46 and 11.47; SC-CAMLR-XXIV, paragraphs 4.113 to 4.117). The experiment required a revision of the catch limit for *D. eleginoides* to 100 tonnes per season and a revised fishing season (1 April to 30 September) to allow each vessel operating in the fishery to undertake a tagging program in accordance with the CCAMLR tagging protocol (Conservation Measure 41-03). In addition, fishing was limited to the Northern Area of Subarea 48.4 north of a deep-water trench between Candlemas Islands and Saunders Island (Figure 1). The experiment has previously allowed a preliminary assessment of *D. eleginoides* in the Northern Area, and the vulnerable biomass was estimated to be between 1 000 and 2 000 tonnes (WG-FSA-08/46).

5. In 2008 the Commission agreed to a continuation of the tagging experiment initiated in 2004/05 and to dividing Subarea 48.4 into a Northern Area and a Southern Area, with a directed longline fishery on *D. eleginoides* in the Northern Area and *Dissostichus* spp. in the Southern Area. The catch and by-catch limits in 2008/09 were as follows:

Northern Area –

(i) a catch limit of 75 tonnes for *D. eleginoides*;

(ii) the continued prohibition of the taking of *D. mawsoni* other than for scientific research purposes;

(iii) the introduction of catch limits for by-catch species, with a limit for macrourids of 12 tonnes (16% of the catch limit for *D. eleginoides*) and a limit for rajids of 4 tonnes (5% of the catch limit for *D. eleginoides*).

Southern Area –

(i) a catch limit of 75 tonnes for *Dissostichus* spp. (*D. eleginoides* and *D. mawsoni* combined) in the Southern Area;

(ii) the introduction of a move-on rule for by-catch species, with a macrourid trigger set at 16% of the catch of *Dissostichus* spp., and a trigger for rajids set at 5% of the catch of *Dissostichus* spp.

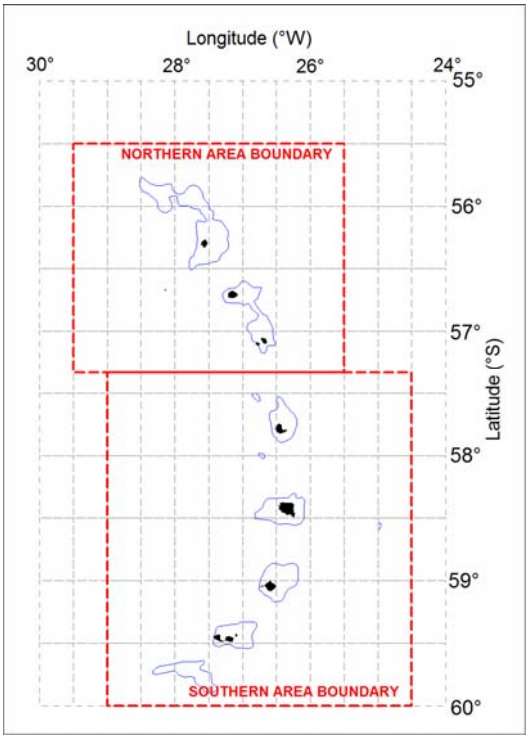

Figure 1: Positions of the boundaries of the Northern Area and Southern Area in Subarea 48.4. The 1 000 m depth contour is indicated.

1.1 Reported catch

6. Licensed longline vessels commenced fishing for *D. eleginoides* in Subarea 48.4 in 1991/92 and 1992/93; fishing was abandoned following poor catches (Table 1). A tagging program was introduced in 2004/05 in the Northern Area, and the program was extended to *D. mawsoni* in the Southern Area in 2008/09. In 2008/09, one New Zealand-flagged vessel and one UK-flagged vessel conducted research fishing and reported a total catch of 133 tonnes of *Dissostichus* spp. from Subarea 48.4 (Table 1(a)).

7. The Southern Area was closed on 11 April 2009 (catch limit for *Dissostichus* spp.: 75 tonnes; final reported catch: 74 tonnes). The Northern Area was closed on 18 May 2009 (catch limit for *D. eleginoides*: 75 tonnes; final reported catch: 59 tonnes). The closure of the Northern Area was triggered by a by-catch limit (catch limit for *Macrourus* spp.: 12 tonnes; final reported catch: 12 tonnes).

1.2 Total removals

8. There is no information to derive an estimate of the level of IUU fishing in Subarea 48.4 (Table 1(a)).

Table 1(a): Catch history for *Dissostichus* spp. in Subarea 48.4 (source: STATLANT data for past seasons, and catch and effort reports for current season, WG-FSA-09/5 Rev. 1 and past reports for IUU catch).

Season	Regulated fishery						Estimated IUU catch (tonnes)	Total removals (tonnes)
	Effort (number of vessels)		*Dissostichus* spp.					
			Catch limit (tonnes)*	Reported catch (tonnes)				
	Limit	Reported		*D. eleginoides*	*D. mawsoni*	Total		
1991/92	-	1	-	30	0	30	-	30
1992/93	-	1	240[a]	10	0	10	-	10
1993/94	-	0	28[a]	0	0	0	-	0
1994/95	-	0	28[a]	0	0	0	-	0
1995/96	-	0	28[a]	0	0	0	-	0
1996/97	-	0	28[a]	0	0	0	-	0
1997/98	-	0	28[a]	0	0	0	-	0
1998/99	-	0	28[a]	0	0	0	-	0
1999/00	-	0	28[a]	0	0	0	-	0
2000/01	-	0	28[a]	0	0	0	-	0
2001/02	-	0	28[a]	0	0	0	-	0
2002/03	-	0	28[a]	0	0	0	-	0
2003/04	-	0	28[a]	0	0	0	-	0
2004/05	-	1	100[b]	27	<1	27	-	27
2005/06	-	2	100[b]	18	<1	19	-	19
2006/07	-	2	100[b]	54	<1	54	-	54
2007/08	-	2	100[b]	98	<1	98	-	98
2008/09	-	2	150[c]	74	59	133	-	133

[a] Applies to *D. eleginoides* in the subarea
[b] Applies to *D. eleginoides* in the Northern Area only
[c] 75 tonnes for *D. eleginoides* in the Northern Area and 75 tonnes for *Dissostichus* spp. in the Southern Area

Table 1(b): Catch of *Dissostichus* spp. in the Northern Area (N) and Southern Area (S) in Subarea 48.4 (source: fine-scale data pro-rated by total reported catch in Table 1(a)). The Southern Area was closed to fishing between 2004/05 and 2007/08.

Season	*D. eleginoides*		*D. mawsoni*	
	N	S	N	S
2004/05	27			
2005/06	18		<1	
2006/07	54		<1	
2007/08	98		<1	
2008/09	59	15	<1	59

1.3 Size distribution of catches

9. Most *D. eleginoides* caught in the fishery ranged from 80 to 140 cm in length, with a broad mode at approximately 90–115 cm (Figure 2). *Dissostichus mawsoni* caught in the Southern Area in 2008/09 had a mode at approximately 140–170 cm.

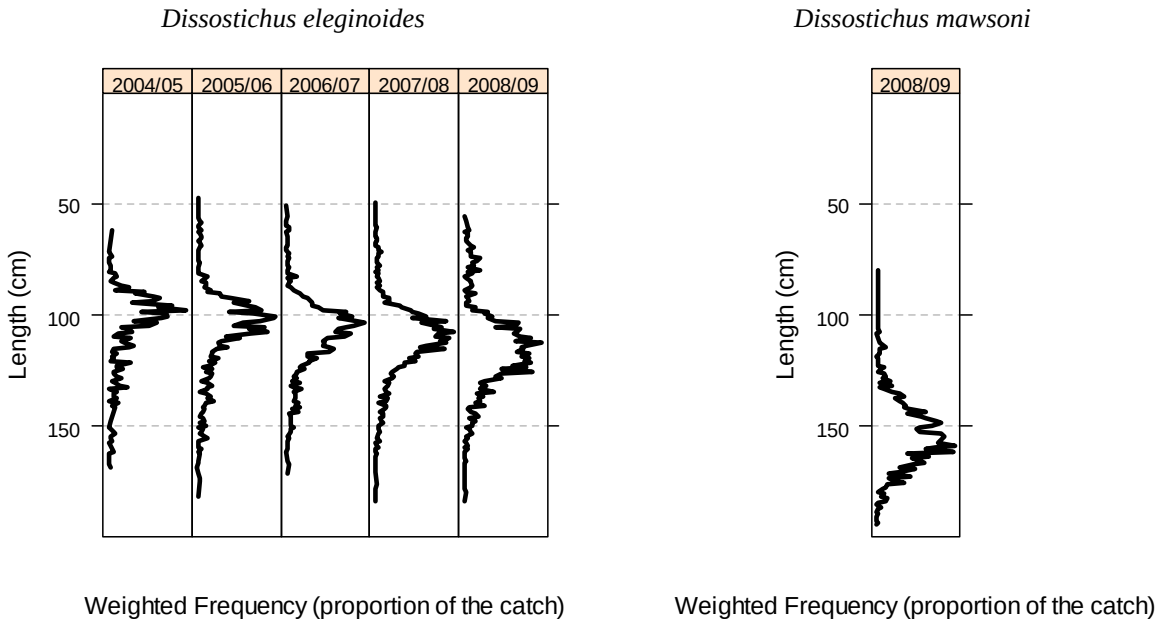

Figure 2: Catch-weighted length frequencies for *Dissostichus eleginoides* and *Dissostichus mawsoni* in Subarea 48.4 (source: observer, fine-scale and STATLANT data, and the length–weight relationships were taken from observations on *D. eleginoides* in Subarea 48.3 and *D. mawsoni* in Subarea 88.1).

2. Stocks and areas

10. WG-FSA-09/17 and 09/18 provided a comprehensive analysis of the distribution of the two species in Subarea 48.4 (Figure 3).

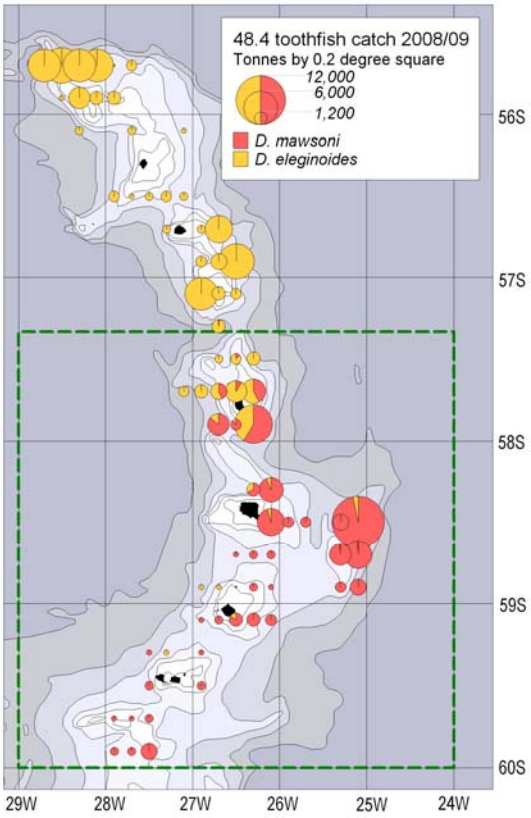

Figure 3: Distribution of the two *Dissostichus* species in Subarea 48.4.

3. Assessment of the northern stock of *D. eleginoides*

3.1 Mark–recapture data

11. Since 2005/06, vessels operating in this fishery have been required to tag and release *Dissostichus* spp. at a rate of five fish per tonne of green weight caught. A total of 1 529 *D. eleginoides* and 204 *D. mawsoni* (total 1 733 fish) have been tagged and released, and 54 *D. eleginoides* and 2 *D. mawsoni* (total 56 fish) have been recaptured in that subarea (Tables 2 and 3). In addition, one *D. eleginoides* tagged in Subarea 48.4 was recaptured in Subarea 48.3.

Table 2: Number of individuals of *Dissostichus* spp. tagged and released and the tagging rate (fish per tonne of green weight caught) reported by vessels operating in the exploratory fishery for *D. eleginoides* in Subarea 48.4. The number of *D. eleginoides* is indicated in brackets. The total number of tagged fish recaptured to date in Subarea 48.4 is also included. (Source: observer data and catch and effort reports)

Season	Flag State	Vessel name	*Dissostichus* spp. tagged and released	
			Number of fish	Tagging rate
2004/05	UK	*Argos Helena*	42 (42)	1.56
2005/06	New Zealand	*San Aspiring*	98 (88)	7.93
	UK	*Argos Helena*	46 (46)	7.16
2006/07	New Zealand	*San Aspiring*	252 (251)	5.25
	UK	*Argos Helena*	40 (40)	6.44
2007/08	New Zealand	*San Aspiring*	252 (252)	5.12
	UK	*Argos Froyanes*	252 (252)	5.17
2008/09	New Zealand	*San Aspiring*	432 (309)	5.84
	UK	*Argos Georgia*	319 (249)	5.36
Total number of fish tagged and released			1733 (1529)	
Total number of tagged fish recaptured in Subarea 48.4			56 (54)	

Table 3: Release and recapture data from Subarea 48.4.

Release season	Number of releases (tag rate)	Recaptures by season (catches (tonnes) in parentheses)					
		2004/05 (26.8)	2005/06 (18.3)	2006/07 (54.0)	2007/08 (97.5)	2008/09 (58.9)	All seasons
2004/05	42 (1.6)	0	0	0	2	2	4
2005/06	134 (7.1)	-	0	2	9*	4	15*
2006/07	291 (5.4)	-	-	0	12	12	24
2007/08	504 (5.2)	-	-	-	0	8	8
2008/09	344 (5.8)	-	-	-	-	3	3
All seasons	1 315 (5.1)	0	0	2	22	29	54*

3.2 Length frequency

12. Length-frequency data from the fishery suggests the presence of a single modal length class progressing each year (Figure 4). Another strong year-class appears to have recruited to the fishery over the duration of the mark–recapture experiment and comprised a significant proportion of the vulnerable biomass in 2008/09 (70–80 cm modal length class).

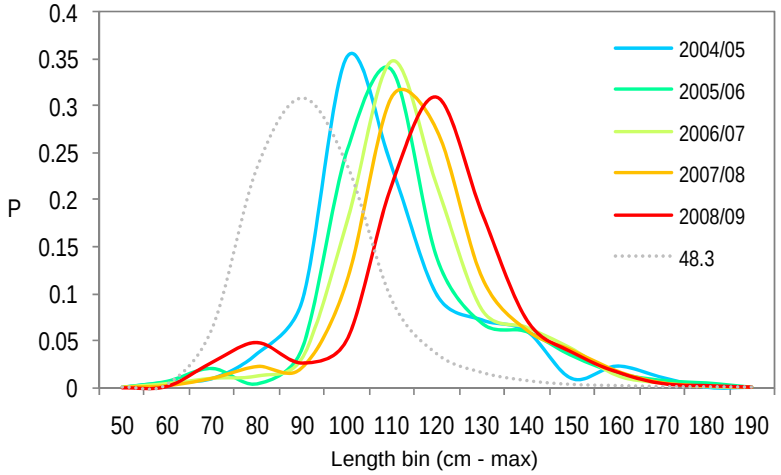

Figure 4: Catch-length frequencies in Subarea 48.4 by season, with the catch-length frequency from Subarea 48.3 in 2006/07 included for comparison.

3.3 Stock assessment

13. WG-FSA-09/17 presented a Subarea 48.4 *D. eleginoides* assessment model, using CASAL software. The assessment model is for the Northern Area of Subarea 48.4 only. The model was based on the catch-at-length-based Subarea 48.3 CASAL model (Hillary et al., 2006) though with two important differences:

- CPUE data were not included in the model. Fishing masters were initially unfamiliar with the fishing grounds, hence the CPUE series was not deemed to be a useful estimate of population abundance.
- A single-fleet structure was used, covering the period of the experiment only (earlier catches in 1991 and 1992 were not included in the model).

14. Data from the fishery in Subarea 48.4 were used to estimate biological parameters for the stock, though some parameter values were taken from the Subarea 48.3 model if insufficient data were available to estimate the parameter values for the Subarea 48.4 stock. These were:

- Natural mortality – 0.13.
- Stock recruitment parameters – steepness 0.75.
- Maturation parameters – maturation proportion-at-length.
- The L_{inf} used in the 2007 Subarea 48.3 assessment appeared, from an analysis of tag-return data, to be more appropriate for this stock than the smaller L_{inf} recently estimated for the Subarea 48.3 stock, so the following growth parameters were used initially: t_0 –1.49, L_{inf} 152.8, k 0.067. Investigations showed that when t_0 was fixed at –1.49, the model estimated L_{inf} and k to be very close to the initial values.

- Tag loss rate – 0.0036.
- Tagging mortality rate – 0.1, at the upper end of estimates of those available for Subarea 48.3 to reflect the large size of animals in Subarea 48.4.
- Tag detection probability – 1.

15. The Working Group agreed that this model should be used to assess the *D. eleginoides* stock in the Northern Area of Subarea 48.4.

3.4 CASAL model structure and assumptions

Population dynamics

16. The CASAL population model used in the assessment of toothfish in Subarea 48.4 was a combined-sex, single-area, three-season model. The annual cycle was defined as follows: the first season (December to April) is where only recruitment (at the start) and natural mortality occurs; the second season, ranging from the beginning of May to the end of August, includes both natural mortality and fishing and contains the spawning period – half the mortality in that particular season being accounted for before spawning occurs; the final season runs from the beginning of September to the end of November, thus completing the annual cycle, with only natural mortality occurring. It was assumed throughout that the proportions of natural mortality and growth that occurred within each season were equal to that season's length as a proportion of a year. The models were run over the years 1990 to 2009, with an initial unexploited equilibrium age structure, and with a Beverton-Holt stock-recruit relationship with fixed steepness.

Model estimation

17. The catch proportions-at-length data were fitted to the model-expected proportions-at-length composition, using a multinomial likelihood.

18. Tag-release events for 2005, 2006, 2007 and 2008 were incorporated into the model with recaptures used from 2006, 2007, 2008 and 2009. Within year/season recaptures were omitted from the observations to allow for possible incomplete mixing in the first few months after release. Tag-release and recapture events occurred during the fishing season (season 2), with a probability of detection of recaptured tags of 1. The estimated numbers of scanned fish for each length class relevant to those in the recapture data were calculated using the total catch biomass, the catch-at-length proportions and the mean weight of the fish.

19. In each year, the length frequencies of releases and recaptures ranged from 20 to 220 cm in 10 cm length bins.

Data weighting

20. The appropriate effective sample sizes to be used to weight the length-frequency data, and the levels of possible over-dispersion apparent in the estimated tagged populations, were investigated. For both sets of observations, standard formulae were used to estimate these quantities after an initial MPD run of the model with the original sample sizes/dispersion values. The actual effective sample sizes/dispersion values predicted by the model's fit to the relevant dataset were then adopted, and a secondary MPD run was performed.

Penalties

21. Two types of penalties were included within the model. First, a penalty on the catch constrained the estimated harvest rate in any year from exceeding a specified maximum, set at 1.0 (see the *U_max* parameter in the fishery definition in the population.csl file) in the CASAL assessment models. Second, a tagging penalty discouraged population estimates that were too low to allow the correct number of fish to be tagged.

Priors

22. Table 4 shows the free parameters estimated in the CASAL model, along with their respective bounds and prior parameterisations.

Table 4: Free parameters, and their priors and bounds in the CASAL assessment models.

Parameter	Prior	Lower bound	Upper bound
B_0 (virgin SSB)	Uniform-log	500	5000
k (von Bertalanffy)	Uniform	0.05	0.15
L_{inf} (von Bertalanffy)	Uniform	110	250
l_{50} and l_{to95} (logistic selectivity parameters)	Uniform	1	50
YCS	Log-normal	0.001	20

3.5 Selectivity and growth

23. A logistic selectivity was assumed because of the potential interaction between growth and selectivity, particularly in a model with such a short data series as this. Furthermore, the fleet fishing in Subarea 48.3 has an approximately flat-topped selectivity, despite being estimated as a double-normal. Since the same vessels are fishing in Subareas 48.3 and 48.4, a logistic selectivity-at-age was assumed for the Subarea 48.4 assessment, of the form:

$$s(l) = 1/\left(1+19^{(l_{50}-l)/l_{to95}}\right) \quad (1)$$

where $s(l)$ is the selectivity at length l, l_{50} is the length at 50% selectivity and l_{to95} the length for which 95% selectivity is obtained at length $l_{50} + l_{to95}$.

3.6 Point-estimate (MPD) results

24. A single assessment model was run for WG-FSA. Table 5 summarises the estimated parameter values.

Table 5: Review of parameter estimates for the four CASAL models, using the MPD estimation results, given to four significant figures.

B_0 (tonnes)	Selectivity parameters (see equation 1)	Growth parameters
1127	a_{50} 11.54, a_{to95} 4.151	k 0.06628, L_{inf} 153.7

25. Model-fit diagnostics and goodness-of-fit achieved by the reference model are shown in Figures 5 to 10.

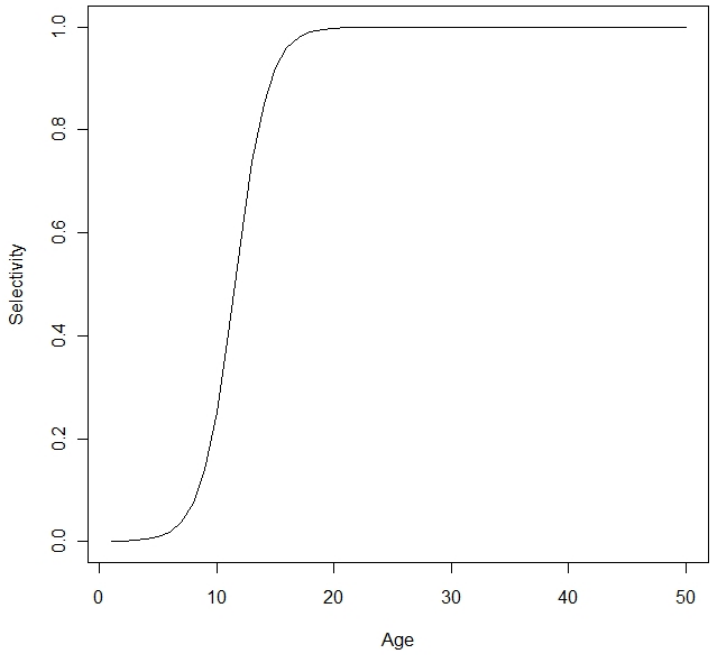

Figure 5: Estimated logistic selectivity curve in the assessment model.

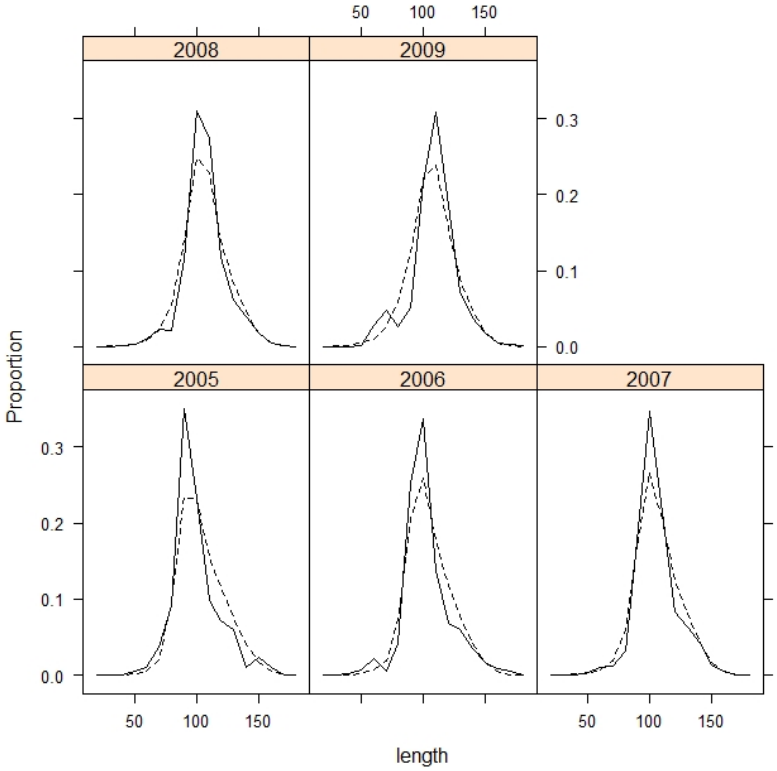

Figure 6: Fit to fleet catch-length frequencies for the assessment model. The full and dotted lines represent the observed and predicted length frequencies respectively.

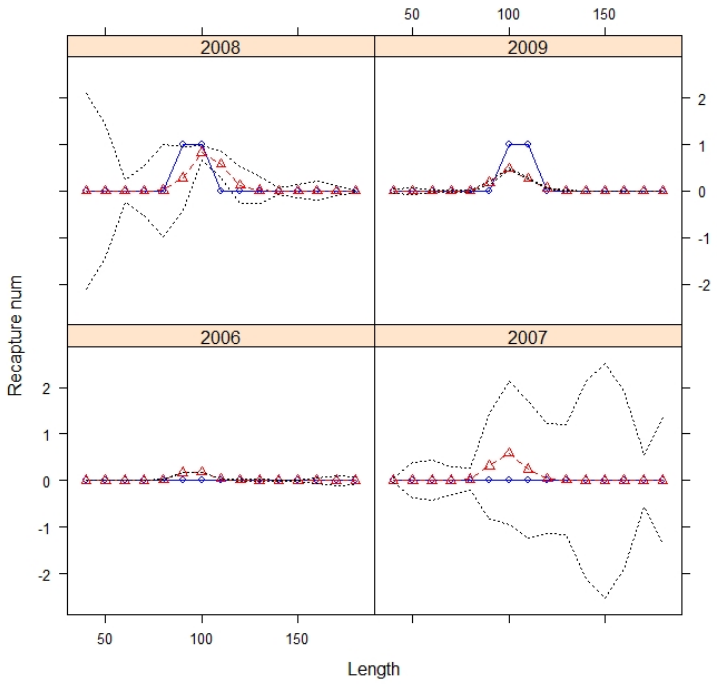

Figure 7: Fits to the 2005 tag-release data – observed recapture probabilities are the circles, expected recaptures are the broken red lines with triangles (s.e's also shown by dotted lines).

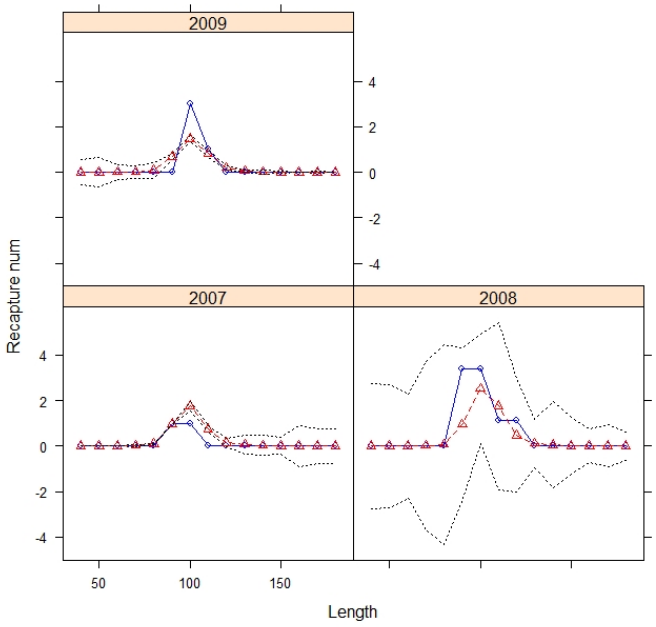

Figure 8: Fits to the 2006 tag-release data – observed recapture probabilities are the circles, expected recaptures are the broken red lines with triangles (s.e's also shown by dotted lines).

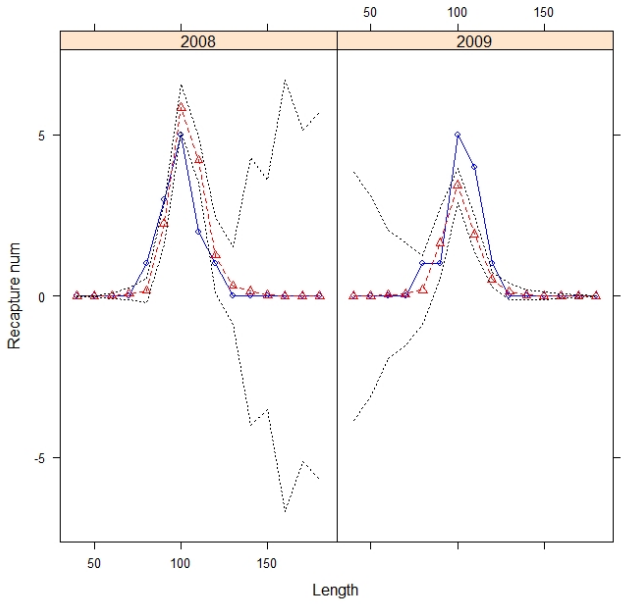

Figure 9: Fits to the 2007 tag-release data – observed recapture probabilities are the circles, expected recaptures are the broken red lines with triangles (s.e's also shown by dotted lines).

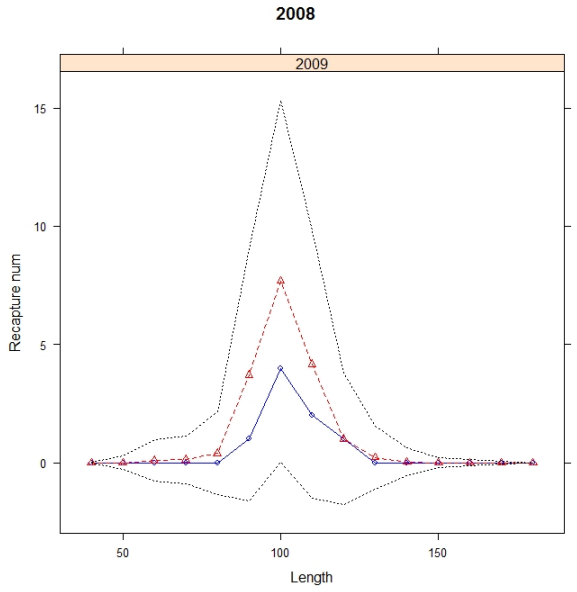

Figure 10: Fits to the 2007 tag-release data – observed recapture probabilities are the circles, expected recaptures are the broken red lines with triangles (s.e's also shown by dotted lines).

26. Stock trajectories and key indices are shown in Figure 11.

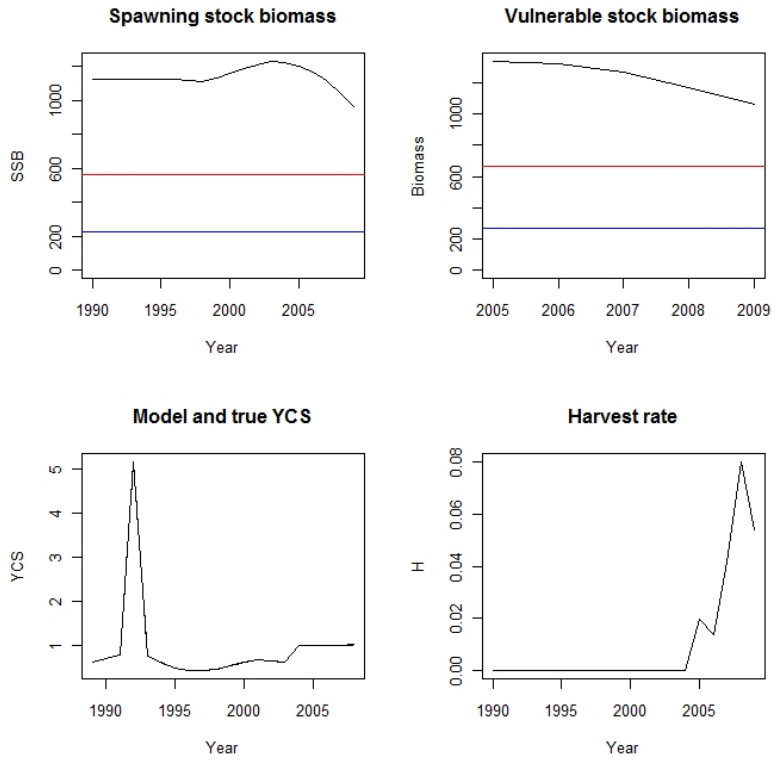

Figure 11: Stock trajectories for the assessment model.

27. As can be seen, good fits were achieved to both the tag-recapture and catch-at-length datasets. The fits are particularly good considering the short time series available for the datasets.

28. Figure 12 shows the likelihood profile for the current assessment model for the virgin biomass parameter. Overall likelihood levels are low (for instance compared with the Subarea 48.3 assessment), reflecting the low quantities of data currently available from this fishery. Nevertheless, the tag data from the early years (2005–2007) suggest B_0 in the range 800–1 400 tonnes. The tag data from 2008 suggest a higher biomass, and the catch-at-length data suggest a lower biomass, mostly driven by the lognormal prior.

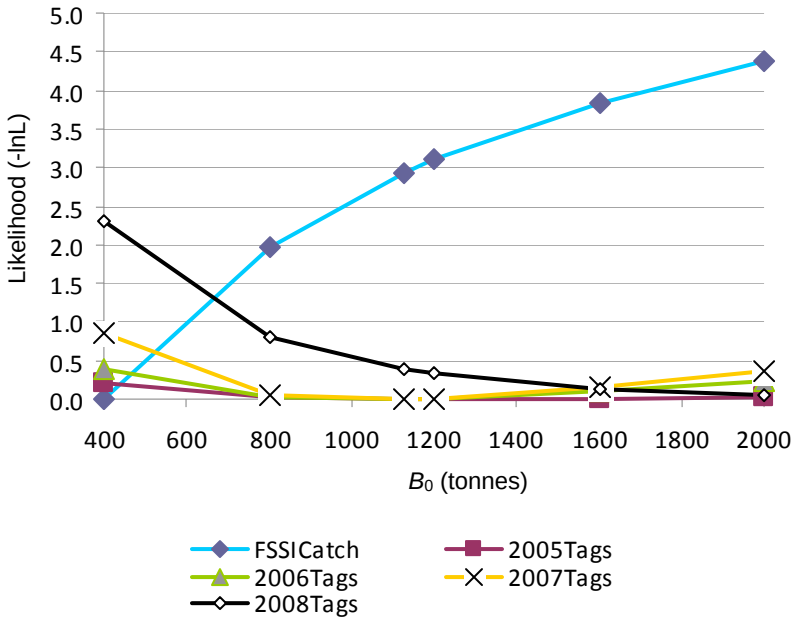

Figure 12: Likelihood profiles for the reference model for Subarea 48.4. The legend refers the particular curve in the figure to the relevant dataset etc. used in the assessment.

3.7 MCMC results

29. As can be seen from Table 6, the uncertainty in the MCMC samples about the posterior median is large, primarily due to the low levels of data available. The convergence of the MCMC chains was assessed using the methods already outlined in WG-FSA-05 (SC-CAMLR-XXIV, Annex 5).

Table 6: Median biomass and 95% CIs for the initial equilibrium SSB (B_0), the current SSB (B_{2009}) and the ratio of current to initial SSB (B_{2009}/B_0).

Model	B_0 (tonnes)	B_{2009} (tonnes)	B_{2009}/B_0
Reference	997 (547.4–2487.1)	1103 (546.6–2777.3)	1.09 (0.82–1.41)

3.8 Sensitivity runs

30. No sensitivity runs were suggested by the Working Group.

3.9 Yield calculations

31. CASAL allows the historic stock dynamics to be projected into the future, for a variety of future scenarios. A constant catch projection allows calculation of the long-term yield that satisfies the CCAMLR decision rules:

(i) Choose a yield γ_1, so that the probability of the spawning biomass dropping below 20% of its median pre-exploitation level, over a 35-year harvesting period, is 10% (depletion probability).

(ii) Choose a yield γ_2, so that the median escapement in the SSB over a 35-year period is 50% of the median pre-exploitation level, at the end of the projection period.

(iii) Select the lower of γ_1 and γ_2 as the yield.

32. The depletion probability was calculated as the proportion of samples from the Bayesian posterior, where the predicted future spawning biomass (SSB) was below 20% of B_0 in the respective sample of any one year, for each year in the 35-year projection period.

33. The level of escapement was calculated as the proportion of samples from the Bayesian posterior, where the projected future status of the SSB was below 50% of B_0 in the respective sample, at the end of the 35-year projection period.

34. Lognormal recruitment was used for the projection, calculated from the MCMC results to have a CV of 1.07. The reason for this very high variability is the identification in the current assessment of a single dominating cohort. Because of this very high recruitment variability, the future catch limit was constrained by the first (γ_1) decision rule. Figure 13 shows the historic and future SSB dynamics for a constant yield of 41 tonnes projected from 2010 to 2043.

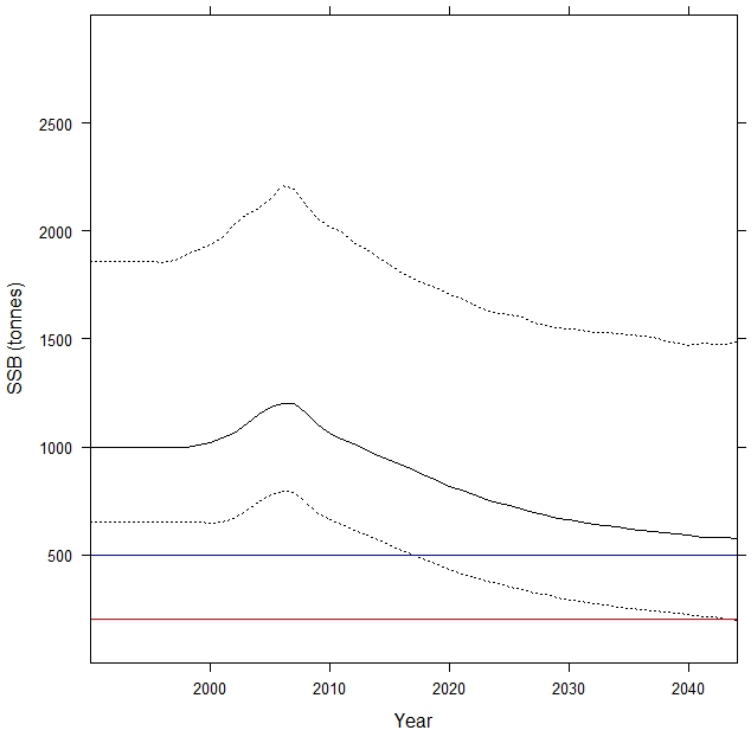

Figure 13: Historic and projected SSB dynamics for a constant future (2010–2043) yield of 41 tonnes. The solid line represents the median with the dotted lines representing the 80% credible interval. The blue and red lines are the medians of 50% and 20% of virgin biomass respectively. The yield associated with γ_1 was 41 tonnes, and with γ_2 was 47 tonnes.

3.10 Future work

35. The assessment is currently rather uncertain, because of the low levels of data available. This may be expected to change as more tags are released and recaptured. The most important future work will be to move from proportions-at-length to proportions-at-age in the model.

4. Assessment of toothfish in the Southern Area

36. The southern area is in the first year of a three-year experiment. No assessment is currently available.

37. A comparison of the catch rates and fishable area, recalculated from information presented in WG-FSA-09/18, is given in Table 7. This suggests that the biomass of toothfish in the Southern Area of Subarea 48.4 may be at least as large, and possibly twice as large, as the population of *D. eleginoides* in the Northern Area. Given that this population is probably

a virgin stock, the Working Group concluded that the proposed catch limit of 75 tonnes applied over a three-year experiment would be unlikely to deplete the stock in the Southern Area to the point where it would require recovery.

Table 7: Simple CPUE comparison of Subarea 48.4 Northern and Southern Areas.

	CPUE all years (kg/hook)	Area (km^2)	Stock biomass index
48.4 North	0.121	10 134	1 103[1]
48.4 South	0.126	17 970	2 037[2]

[1] MCMC median northern area stock size in 2009; see Table 6.
[2] Calculated by comparison of CPUE, stock size and northern area stock size.

38. WG-FSA-09/18 proposed a continuation of the tagging experiment initiated in the Southern Area in 2008/09. The Working Group agreed that this was a useful approach, and should follow the successful approach which had provided an assessment of the Northern Area after four experimental years. An extension of the experiment for a further two years was recommended.

5. By-catch of fish and invertebrates

5.1 By-catch removals

39. Catches of by-catch species groups (macrourids, rajids and other species) reported in fine-scale data, and number of rajids cut from lines and released alive are summarised in Tables 8 and 9. The by-catch in this fishery consists predominantly of macrourids (up to 26 tonnes per season) and rajids (up to 9 767 released alive). Catch limits for by-catch species were introduced in the Northern Area in 2008/09.

Table 8: Catch history for by-catch species in the Northern Area (macrourids, rajids and other species) and number of rajids released alive in Subarea 48.4 (source: fine-scale data).

Season	Catch limit		Catches taken		Rajids – number released	Other species reported catch (tonnes)
	Macrourids	Rajids	Macrourids (tonnes)	Rajids (tonnes)		
2004/05	-	-	3	0	0	<1
2005/06	-	-	5	1	4359	<1
2006/07	-	-	14	2	6515	<1
2007/08	-	-	16	4	8276	<1
2008/09	12	4	12	1	8493	<1

Table 9: Catch history for by-catch species in the Southern Area (macrourids, rajids and other species) and number of rajids released alive in Subarea 48.4 (source: fine-scale data).

Season	Catches taken		Rajids – number released	Other species reported catch (tonnes)
	Macrourids	Rajids		
2008/09	14	0.6	1274	<1

5.2 Assessment of impacts on affected populations

40. 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. To date, 269 skates have been tagged in the Northern Area, and rajids are generally distributed to the east, compared to toothfish being generally distributed to the north and west. In the Southern Area, rajids are rare, although 197 were tagged in 2008/09. The potential for significant impacts on rajids may therefore be limited.

41. Although catch rates for macrourids were initially high, vessels have altered their fishing techniques and rates subsequently dropped to 16% of the catch weight for *D. eleginoides*. In 2009/10 the macrourid catch limited the northern fishery (the catch limit for macrourids was reached before the catch limit of toothfish). In the Southern Area, a move-on rule (at 16% of the toothfish catch) operated.

42. Macrourid catches are almost entirely composed of *M. whitsoni.*

5.3 Identification of levels of risk

43. None available for this fishery.

5.4 Mitigation measures

44. By-catch limits and move-on rules are included in the annual conservation measure established for this fishery (Conservation Measure 41-03). In addition, mitigation measures for rajids include using Year-of-the-Skate protocols for releasing skates caught alive.

45. The move-on rule for macrourids was triggered frequently, and resulted in 14 tonnes of macrourids being caught in the Southern Area, 19% of the toothfish catch. The rajid by-catch was 0.6 tonnes, 0.8% of the toothfish catch, and the move-on rule was not triggered.

6. By-catch of birds and mammals

6.1 By-catch removals

46. There have been no observed seabird mortalities in the Subarea 48.4 fishery (Table 10).

Table 10: Seabird by-catch limit, observed mortality rate and total estimated mortality in Subarea 48.4 (from SC-CAMLR-XXVIII, Annex 7, Table 4).

Season	Mortality rate (birds per thousand hooks)	Total estimated mortality (number of birds)
2004/05	0	0
2005/06	0	0
2006/07	0	0
2007/08	0	0
2008/09	0	0

47. There have been no observed marine mammal mortalities in the Subarea 48.4 fishery.

48. WG-IMAF assessed the risk level of seabirds in this fishery in Subarea 48.4 at category 3 (average) (SC-CAMLR-XXVIII, Annex 7, Table 14 and Figure 2).

6.2 Mitigation measures

49. Conservation Measure 25-02 applies to this fishery, except paragraph 5 if requirements of Conservation Measure 24-02 are met. There is a limit of three (3) seabirds per vessel during daytime setting. Fishing in December, January, February, March, October and November shall be in accordance with Conservation Measure 24-02.

7. Ecosystem implications/effects

50. No evaluation available for this fishery.

8. Harvest controls and management advice

8.1 Conservation measures

51. The limits on the fishery for *D. eleginoides* and *D. mawsoni* in Subarea 48.4 are defined in Conservation Measure 41-03. The limits in force and the Working Group's advice to the Scientific Committee for the forthcoming season are summarised in Table 11.

Table 11: Limits on the fishery for *Dissostichus eleginoides* and *D. mawsoni* in Subarea 48.4 in 2008/09 (Conservation Measure 41-03) and advice to the Scientific Committee for 2009/10.

Element	Limit in force	Advice for 2009/10
Access	Northern Area: directed longline fishery on *Dissostichus eleginoides*	Carry forward
	Southern Area: directed longline fishery on *Dissostichus* spp.	Carry forward
Catch limit	Northern Area: Precautionary catch limit for *D. eleginoides* was 75 tonnes and the taking of *D. mawsoni*, other than for scientific research purposes, is prohibited.	Revise to 41 tonnes
	Southern Area: Precautionary catch limit for *Dissostichus* spp. was 75 tonnes	Carry forward
Season	1 December to 30 November	Carry forward
By-catch	Northern Area: Precautionary catch limits for *Macrourus* spp. (12 tonnes) and rajids (4 tonnes).	Revise to 6.6 tonnes (macrourids in the north) and 2.1 tonnes (rays in the north)
	Southern Area: By-catch move-on rules for *Macrourus* spp. (16% of toothfish catch in one haul) and rajids (5%).	Review
Mitigation	In accordance with CM 25-02, except paragraph 5 if requirements of CM 24-02 are met.	Carry forward
	Fishing in December, January, February, March, October and November shall be in accordance with CM24-02.	
	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.	Carry forward
Data	Five-day catch and effort reporting Haul-by-haul catch and effort data Biological data reported by the CCAMLR scientific observer.	Carry forward Carry forward Carry forward
Research	Each vessel taking part in the fishery for *D. eleginoides* shall undertake a tagging program in accordance with the CCAMLR tagging protocol.	Carry forward
	Toothfish tagged at a rate of at least five fish per tonne green weight caught.	Amend to require preferential tagging of *D. mawsoni* when both species are taken on one haul.
Environmental protection	Regulated by CM 26-01.	Carry forward

8.2 Management advice

52. The Working Group recommended continuation of the tagging experiment in the Southern Area of Subarea 48.4 for a further two years.

53. The Working Group agreed that the experiment in the Northern Area had been completed. It agreed that an appropriate catch limit for toothfish in the Northern Area, consistent with CCAMLR decision rules, would be 41 tonnes.

54. The Working Group recommended the following limits for toothfish and by-catch in Subarea 48.4:

Northern Area –

(i) a catch limit of 41 tonnes for *D. eleginoides*;

(ii) the continued prohibition of the taking of *D. mawsoni* other than for scientific research purposes;

(iii) maintenance of catch limits for by-catch species, with a limit for macrourids of 6.6 tonnes (16% of the catch limit for *D. eleginoides*) and a limit for rajids of 2.1 tonnes (5% of the catch limit for *D. eleginoides*).

Southern Area –

(i) a catch limit of 75 tonnes for *Dissostichus* spp. (*D. eleginoides* and *D. mawsoni* combined);

(ii) maintenance of a move-on rule for by-catch species, with a macrourid trigger of 150 kg and 16% of the catch of *Dissostichus* spp., and a trigger for rajids set at 5% of the catch of *Dissostichus* spp.

55. WG-FSA-09/18 suggested that in order to maximise tagging on the predominant species in the Southern Area, *D. mawsoni*, only this species should be tagged. The Working Group recommended that where *D. mawsoni* and *D. eleginoides* are caught on the same line in the Southern Area, the majority of the tags released within the required tagging rate should be on *D. mawsoni*. The Working Group also recommended that tagging of *D. eleginoides* should take place on any line where *D. mawsoni* is not caught.

Reference

Hillary, R.M., G.P. Kirkwood and D.J. Agnew. 2006. An assessment of toothfish in Subarea 48.3 using CASAL. *CCAMLR Science*, 13: 65–95.