APPENDIX I

FISHERY REPORT: EXPLORATORY FISHERY FOR *DISSOSTICHUS* SPP. IN SUBAREAS 88.1 AND 88.2

CONTENTS

FISHERY REPORT: EXPLORATORY FISHERY FOR *DISSOSTICHUS* SPP. IN SUBAREAS 88.1 AND 88.2

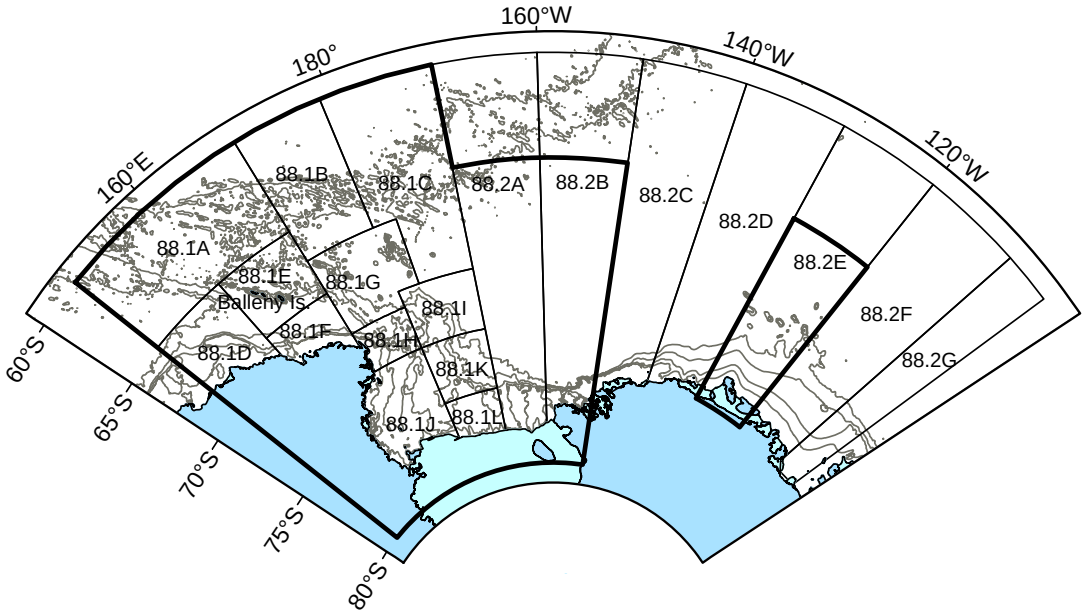

Figure 1: Ross Sea (Subarea 88.1 and SSRUs 882A–B) and SSRU 882E (bounded regions). Depth contours plotted at 500, 1 000, 2 000 and 3 000 m.

1. Details of the fishery

In 2005 the Working Group recommended that Subareas 88.1 and 88.2 be split into two areas for the purposes of stock assessment: (i) the Ross Sea (Subarea 88.1 and SSRUs 882A–B) (WG-FSA-05/4), and (ii) SSRU 882E.

2. The catch limits for the Subarea 88.1 and 88.2 SSRUs in the Ross Sea were changed as part of a three-year experiment starting in 2005/06 (SC-CAMLR-XXIV, paragraphs 4.163 to 4.166). The SSRUs between 150°E and 170°E (881A, D, E, F) and between 170°W and 150°W (882A–B) were closed to fishing to ensure that effort was retained in the area of the experiment. To assist administration of the SSRUs, the catch limits for SSRUs 881B, C and G were amalgamated into a 'north' region and those for SSRUs 881H, I and K were amalgamated into a 'slope' region. Within Subarea 88.2, SSRU 882E was treated as a separate SSRU with its own catch limit, whilst SSRUs 882C, D, F and G were amalgamated with a single catch limit. However, in each of the closed SSRUs, a nominal catch of up to 10 tonnes of *Dissostichus* spp. remained permissible under the research fishing exemption. This nominal catch was not considered as part of the overall catch limit (Conservation Measures 41-09 and 41-10).

3. In 2007/08, the exploratory fishery for *Dissostichus* spp. in Subarea 88.1 was limited to Argentine, Korean, Namibian, New Zealand, Russian, South African, Spanish, UK and Uruguayan vessels using longlines only (Conservation Measure 41-09). The precautionary catch limit for *Dissostichus* spp. was 2 700 tonnes, of which 40 tonnes was set aside for

research fishing and the remaining 2 660 tonnes was applied as follows: 313 tonnes total could be taken in SSRUs B, C and G; 1 698 tonnes total in SSRUs H, I and K; 495 tonnes in SSRU J; and 154 tonnes in SSRU L (Figure 1). Four SSRUs (A, D, E and F) were closed to fishing, but had a research allocation of 10 tonnes each. The catch limits for by-catch species were defined in Conservation Measures 33-03 and 41-09. The fishing season was from 1 December 2007 to 31 August 2008.

4. In Subarea 88.2, the exploratory fishery for *Dissostichus* spp. was limited to Argentine, New Zealand, Russian, South African, Spanish, UK and Uruguayan vessels using longlines only (Conservation Measure 41-10). The precautionary catch limit for *Dissostichus* spp. was 567 tonnes south of 65°S, of which 20 tonnes was set aside for research fishing and the remaining 547 tonnes was applied as follows: 206 tonnes total could be taken in SSRUs C, D and F; and 341 tonnes in SSRU E (Figure 1). Two SSRUs (A and B) were closed to fishing, but had a research allocation of 10 tonnes each. The catch limits for by-catch species were defined in Conservation Measures 33-03 and 41-10. The fishing season was from 1 December 2007 to 31 August 2008.

5. Details of notifications of intentions to fish in 2008/09 are summarised in CCAMLR-XXVII/12. For Subarea 88.1, notifications were submitted by nine Members (Argentina, Chile, New Zealand, Republic of Korea, Russia, South Africa, Spain, UK and Uruguay) with a total of 21 vessels. For Subarea 88.2, notifications were submitted by nine Members (Argentina, Chile, New Zealand, Republic of Korea, Russia, South Africa, Spain, UK and Uruguay) with a total of 19 vessels.

1.1 Reported catch

6. In 2007/08, eight Members (Argentina, Republic of Korea, New Zealand, Russia, South Africa, Spain, UK and Uruguay) and 15 vessels fished in the exploratory fishery in Subarea 88.1. Fishing was restricted due to sea-ice and vessels fished between December 2007 and early March 2008; no research fishing was conducted. The fishery was closed on 31 August 2008 and the total reported catch of *Dissostichus* spp. was 2 259 tonnes (84% of the limit) (CCAMLR-XXVII/BG/15, Table 2). The following SSRUs were closed during the course of fishing:

- SSRUs B, C and G closed on 19 December 2007, triggered by the catch of *Dissostichus* spp. (total catch 259 tonnes; 83% of the catch limit).

7. Four Members (New Zealand, Russia, UK and Uruguay) and four vessels fished in the exploratory fishery in Subarea 88.2. Fishing was restricted due to sea-ice and vessels fished in February and March 2008; no research fishing was conducted. The fishery closed on 31 August 2008 and the total reported catch of *Dissostichus* spp. was 416 tonnes (73% of the limit) (CCAMLR-XXVII/BG/15). SSRU E was closed on 1 February 2008, triggered by the catch of *Dissostichus* spp. (total catch 333 tonnes; 98% of the catch limit).

8. The number of active fishing vessels and the catch of *Dissostichus* spp. in Subareas 88.1 and 88.2 in 2007/08 are shown in Tables 1 and 2 respectively.

Table 1: Number of vessels authorised in Conservation Measure 41-09, number of vessels that fished, and the catch of *Dissostichus* spp. in Subarea 88.1 in 2007/08; no research fishing was conducted (source: catch and effort reports).

Flag State	Vessels authorised in CM 41-09	Number of vessels that fished	Reported catch (tonnes)		
			D. mawsoni	*D. eleginoides*	Total
Argentina	2	1	<1	<1	<1
Korea, Republic of	5	3	423	3	426
Namibia	1	0			
New Zealand	4	4	717	<1	718
Russia	2	1	250	<1	250
South Africa	1	1	121	<1	121
Spain	1	1	44	2	46
UK	3	3	637	0	637
Uruguay	2	1	61	<1	61
Total	21	15	2253	6	2259

Table 2: Number of vessels authorised in Conservation Measure 41-10, number of vessels that fished, and the catch of *Dissostichus* spp. in Subarea 88.2 in 2007/08; no research fishing was conducted (source: catch and effort reports).

Flag State	Vessels authorised in CM 41-10	Number of vessels that fished	Reported catch (tonnes)		
			D. mawsoni	*D. eleginoides*	Total
Argentina	2	0			
New Zealand	4	1	345	0	345
Russia	2	1	26	<1	26
South Africa	1	0			
Spain	1	0			
UK	3	1	35	0	35
Uruguay	2	1	10	0	10
Total	15	4	416	<1	416

9. The Ross Sea fishery saw a steady expansion of effort (number of sets) from 1997/98 to 2000/01, a slight drop in 2001/02, followed by an increase in 2002/03, and an almost three-fold increase in 2003/04. In 2004/05 and 2005/06, overall effort in the Ross Sea dropped, but increased in 2006/07. In 2006/07, ice conditions resulted in some restrictions on fishing in some of the southern SSRUs in January and early February. Thus, in contrast to recent years, no fishing was carried out in SSRUs 881G, K and L. However, vessels fished most of the other available SSRUs in Subareas 88.1 and 88.2 in 2007. Fishing in 2006/07 saw the highest level of effort in SSRUs 881B and 882E, and the second-highest level of effort in SSRU 881H. For the second year, a small amount of fishing was carried out in SSRUs 882D and F.

10. The catch of *D. mawsoni* has shown a steadier increasing trend over the same period, peaking at 3 079 tonnes in Subarea 88.1 for the 2004/05 season, declining to 2 952 tonnes in 2005/06, and increasing to 3 096 in 2006/07, reflecting the annual changes in catch limits.

11. Catches and catch limits for *Dissostichus* spp. and by-catch species by SSRU and SSRU groups reported from Subareas 88.1 and 88.2 in 2007/08 are summarised in Table 3 (see CCAMLR-XXVII/BG/15).

Table 3: Catches and catch limits for *Dissostichus* spp. and by-catch species (macrourids, rajids and other species) by SSRU and SSRU groups reported from Subareas 88.1 and 88.2 in 2007/08 (source: catch and effort reports).

SSRU Groups	*Dissostichus* spp. catch (tonnes)		Macrourids catch (tonnes)		Rajids catch (tonnes)		Other species catch (tonnes)	
	Limit	Catch	Limit	Catch	Limit	Catch	Limit	Catch
881A	0	0	0	0	0	0	0	0
881BCG	313	259	50	2	50	0	60	2
881D	0	0	0	0	0	0	0	0
881E	0	0	0	0	0	0	0	0
881F	0	3	0	0	0	0	0	0
881HIK	1698	1553	271	107	84	4	60	15
881J	495	410	79	0	50	0	20	3
881L	154	38	24	1	50	0	20	0
882A	0	0	0	0	0	0	0	0
882B	0	0	0	0	0	0	0	0
882CDFG	206	83	33	5	50	0	80	1
882E	341	333	55	13	50	0	20	4

12. The historical catches of *Dissostichus* spp. caught in Subareas 88.1 and 88.2 are given in Tables 4 and 5 respectively.

Table 4: Catch history for *Dissostichus* spp. in Subarea 88.1. Reported catch includes catch from research fishing. (Source: STATLANT data for past seasons, and catch and effort reports for current season, WG-FSA-08/10 Rev. 2 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		
1996/97	-	1	1980	0	0	0	0	0
1997/98	-	1	1510	1	41	42	0	42
1998/99	2	2	2281	1	296	297	0	297
1999/00	-	3	2090	0	751	751	0	751
2000/01	6	10	2064	34	626	660	0	660
2001/02	10	3	2508	12	1313	1325	92	1417
2002/03	13	10	3760	26	1805	1831	0	1831
2003/04	26	21	3250	13	2184	2197	240	2437
2004/05	21	10	3250	7	3098	3105	23	3128
2005/06	21	13	2964	1	2968	2969	0	2969
2006/07	21	15	3072*	12	3079	3091	0	3091
2007/08	21	15	2700	6	2253	2259	187	2446

* Includes 40 tonnes for research fishing (CCAMLR-XXV, paragraph 12.56).

Table 5: Catch history for *Dissostichus* spp. in Subarea 88.2. Reported catch includes catch from research fishing. (Source: STATLANT data for past seasons, and catch and effort reports for current season, WG-FSA-08/10 Rev. 2 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		
1996/97	-	0	1 980	0	0	0	-	0
1997/98	-	0	63	0	0	0	-	0
1998/99	-	0	0	0	0	0	-	0
1999/00	-	0	250	0	0	0	-	0
2000/01	2	0	250	0	0	0	-	0
2001/02	7	1	250	0	41	41	0	41
2002/03	9	2	375	0	106	106	0	106
2003/04	18	3	375	0	374	375	0	375
2004/05	10	4	375	0	411	411	0	411
2005/06	17	7	487	0	514	514	15	529
2006/07	16	7	567*	0	347	347	0	347
2007/08	15	4	567	<1	416	416	0	416

* Includes 20 tonnes for research fishing (CCAMLR-XXV, paragraph 12.60).

1.2 IUU catch

13. The estimated IUU catch in Subarea 88.1 was 92 tonnes in 2001/02, 240 tonnes in 2003/04, 23 tonnes in 2004/05 and 187 tonnes in 2007/08 (Table 4).

14. There was an estimated 15 tonnes of IUU catch in Subarea 88.2 (SSRU 882A) in 2005/06 (Table 5). This was the first observed occurrence of IUU fishing in Subarea 88.2. There was no estimated IUU catch in Subarea 88.2 in 2007/08 (WG-FSA-08/10 Rev. 2).

1.3 Size distribution of the catches

15. *Dissostichus mawsoni* ranged from 50 to 180 cm (Figures 2 and 3). In all seasons, there was a broad mode of adult fish at about 120–170 cm. In 2005/06, there was a strong mode at about 60 cm in Subarea 88.2. These fish were predominantly caught at the edge of the continental shelf in SSRUs 882F and G. This mode was not apparent in 2006/07, probably as there was no fishing on the shelf in these SSRUs in 2006/07.

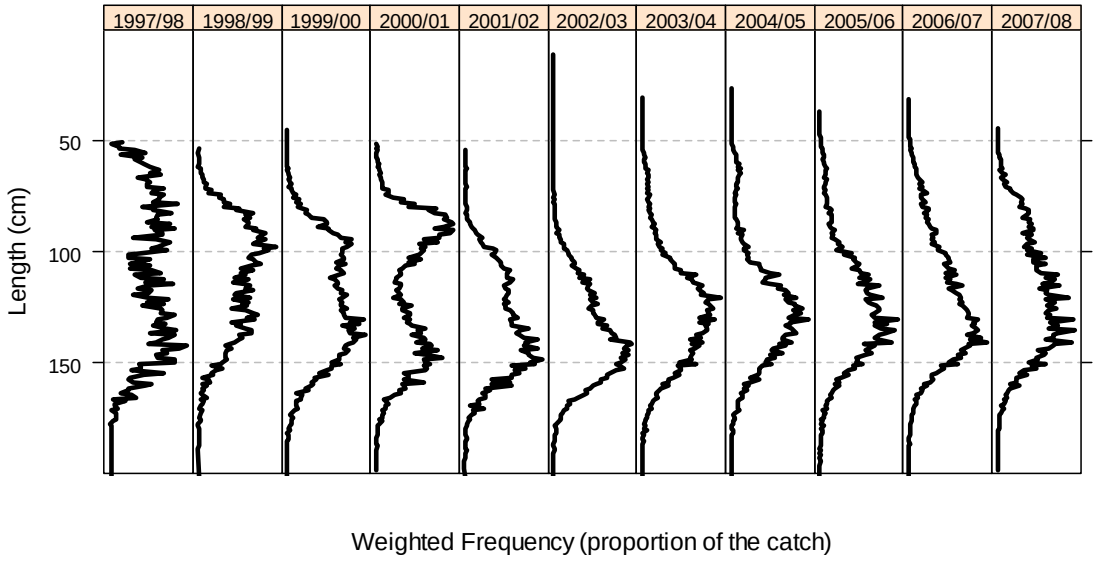

Figure 2: Catch-weighted length frequencies for *Dissostichus mawsoni* in Subarea 88.1 (source: observer, fine-scale and STATLANT data).

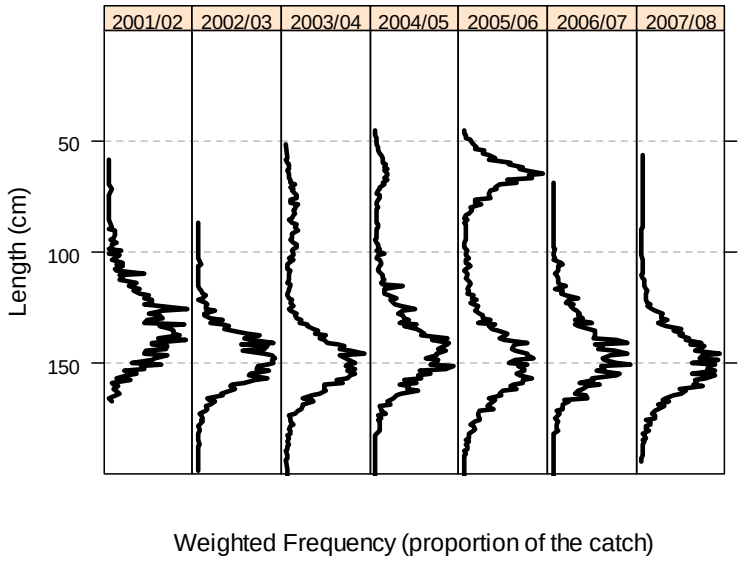

Figure 3: Catch-weighted length frequencies for *Dissostichus mawsoni* in Subarea 88.2 (source: observer, fine-scale and STATLANT data, and the length–weight relationship was taken from observations on *D. mawsoni* in Subarea 88.1).

16. The length-frequency data from the Ross Sea fishery have been very consistent over the past three to four seasons. There was no evidence of any truncation of the overall length-frequency distribution, and no evidence for a reduction in fish length in any SSRU over time (WG-FSA-07/28). Although moderate numbers of small fish are caught in some years (e.g. on the shelf in 1999 and 2001), these year classes are not seen in large numbers in later years in the fishery, and there was no evidence for recent strong variation in year-class strength in the fishery (WG-FSA-07/28). It should be noted that the scaled length frequencies only represent the landed part of the *D. mawsoni* catch, and do not include the (often smaller) fish that were selected for tagging before the catch was sampled by observers (WG-FSA-06/34).

2. Stocks and areas

17. 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 adult tagged fish.

18. Previous research has found that length modal distribution, sex ratio, fish body condition factor and reproductive development of *D. mawsoni* differ between the northern and southern SSRUs in Subarea 88.1, with sampling from the northern SSRUs suggesting that there was a significant higher ratio of males to females that were in poorer condition, and were more advanced in reproductive development (Fenaughty, 2006). Spawning is suspected to occur on isolated geographic features north of the main Antarctic shelf areas, north of 70°S (WG-FSA-06/26).

19. However, considerable uncertainty remains over spawning dynamics and early life history of *D. mawsoni*. The present hypothesis is that *D. mawsoni* in Subareas 88.1 and 88.2 spawn to the north of the Antarctic continental slope, mainly on the ridges and banks of the Pacific-Antarctic Ridge (Hanchet et al., 2008). The spawning appears to take place during winter and spring, and may extend over a period of several months. Depending on the exact location of spawning, eggs and larvae become entrained by the Ross Sea gyres (a small clockwise rotating western gyre located around the Balleny Islands and a larger clockwise rotating eastern gyre covering the rest of Subareas 88.1 and 88.2), and may either move west settling out around the Balleny Islands and adjacent Antarctic continental shelf, south onto the Ross Sea shelf, or eastwards with the eastern Ross Sea gyre settling out along the continental slope and shelf to the east of the Ross Sea in Subarea 88.2. As the juveniles grow in size, they move west back towards the Ross Sea shelf and then move out into deeper water (>600 m). The fish gradually move northwards as they mature, feeding in the slope region in depths of 1 000–1 500 m, where they gain condition before moving north onto the Pacific-Antarctic ridge to start the cycle again. Spawning fish may remain in the northern area for up to two or three years. They then move southwards back onto the shelf and slope where productivity is higher and food is more plentiful and where they regain condition before spawning.

3. Parameter estimation

20. No assessment was undertaken in 2008. The assessment undertaken in 2007 is reported in SC-CAMLR-XXVI, Annex 5, Appendix I.

3.1 Observations

Tag release and recapture

21. Under Conservation Measure 41-01, each longline vessel fishing in exploratory fisheries for *Dissostichus* spp. is required to tag and release *Dissostichus* spp. at the rate of one toothfish per tonne of green-weight catch throughout the season. Vessels may discontinue tagging once 500 fish have been tagged.

22. Tagging rates, by vessel and Flag State since 2004/05, are given in Table 6 for Subarea 88.1 and Table 7 for Subarea 88.2. The tagging rates were determined from tagging data and catch and effort reports submitted to the Secretariat. In 2006/07, four vessels did not achieve a tagging rate of at least one toothfish per tonne of green-weight catch: *Antartic II* (Argentina), *Froyanes* (Norway), *Argos Georgia* (UK) and *Argos Helena* (UK) in Subarea 88.2.

Table 6: 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 *Dissostichus* spp. in Subarea 88.1 since 2004/05. The number of *D. eleginoides* is indicated in brackets. (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	Argentina	*Antartic III*	291 (1)	1.15
	New Zealand	*Janas*	456 (6)	1.05
		San Aotea II	500 (12)	1.00
		San Aspiring	580 (0)	(>500 fish)
	Norway	*Froyanes*	317 (1)	1.53
	Russia	*Volna*	174 (0)	0.74
		Yantar	111 (0)	0.43
	UK	*Argos Helena*	381 (0)	1.46
	Uruguay	*Paloma V*	188 (1)	1.19
		Punta Ballena	223 (1)	1.06
2005/06	Argentina	*Antartic II*	122 (0)	0.83
	New Zealand	*Avro Chieftain*	266 (0)	1.05
		Janas	283 (1)	1.05
		San Aotea II	512 (2)	(>500 fish)
		San Aspiring	437 (0)	1.03
	Norway	*Froyanes*	121 (0)	1.23
	Russia	*Volna*	250 (0)	0.76
		Yantar	246 (0)	0.71
	UK	*Argos Georgia*	50 (0)	1.14
		Argos Helena	275 (4)	1.02
	Uruguay	*Paloma V*	142 (16)	1.33
		Punta Ballena	211 (0)	1.04
		Viking Sur	62 (0)	0.94
2006/07	Argentina	*Antartic II*	228 (0)	1.45
	Korea, Republic of	*Insung No. 22*	352 (20)	1.16
		Jung Woo No. 2	198 (19)	1.24
	New Zealand	*Avro Chieftain*	289 (0)	1.06
		Janas	184 (0)	1.13
		San Aotea II	385 (10)	1.25
		San Aspiring	463 (1)	1.11
	Norway	*Froyanes*	168 (0)	1.11
	Russia	*Volna*	103 (0)	1.04
		Yantar	375 (0)	1.12
	South Africa	*Ross Mar*	51 (0)	1.00
	UK	*Argos Georgia*	249 (20)	1.03
		Argos Helena	270 (3)	1.36
	Uruguay	*Ross Star*	152 (2)	1.14
		Viking Sur	141 (0)	1.34

(continued)

Table 6 (continued)

Season	Flag State	Vessel name	*Dissostichus* spp. tagged and released	
			Number of fish	Tagging rate
2007/08	Argentina	*Antartic III*	None reported	0
	Korea, Republic of	*Hong Jin No. 707*	255 (0)	1.20
		Insung No. 2	13 (8)	1.24
		Jung Woo No. 2	212 (11)	1.05
	New Zealand	*Avro Chieftain*	50 (0)	1.20
		Janas	179 (0)	1.03
		San Aotea II	196 (3)	1.22
		San Aspiring	370 (0)	1.08
	Russia	*Yantar*	283 (0)	1.13
	South Africa	*Ross Mar*	128 (3)	1.06
	Spain	*Tronio*	46 (38)	1.00
	UK	*Argos Froyanes*	370 (0)	1.06
		Argos Georgia	196 (14)	1.32
		Argos Helena	181 (1)	1.30
	Uruguay	*Ross Star*	95 (1)	1.56

Table 7: 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 *Dissostichus* spp. in Subarea 88.2 since 2004/05. The number of *D. eleginoides* is indicated in brackets. (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	New Zealand	*Avro Chieftain*	269 (0)	1.01
	Norway	*Froyanes*	0	0
	Russia	*Volna*	0	0
		Yantar	72 (0)	0.85
2005/06	Argentina	*Antartic II*	16 (0)	0.24
	New Zealand	*Janas*	64 (0)	1.13
	Norway	*Froyanes*	196 (2)	0.91
	Russia	*Volna*	0	0
		Yantar	0	0
	UK	*Argos Georgia*	76 (0)	1.86
		Argos Helena	92 (1)	1.72
2006/07	Argentina	*Antartic II*	2 (0)	0.05
	Norway	*Froyanes*	97 (0)	0.89
	Russia	*Volna*	55 (0)	1.03
		Yantar	100 (0)	1.01
	UK	*Argos Georgia*	0	0
		Argos Helena	14 (0)	0.46
	Uruguay	*Viking Sur*	10 (0)	1.07
2007/08	New Zealand	*Avro Chieftain*	349 (0)	1.01
	Russia	*Yantar*	None reported	0
	UK	*Argos Frøyanes*	38 (0)	1.09
	Uruguay	*Ross Star*	2 (0)	0.21

4. Stock assessment

23. No assessment was undertaken in 2008. The assessment undertaken in 2007 is reported in SC-CAMLR-XXVI, Annex 5, Appendix I.

5. By-catch of fish and invertebrates

5.1 By-catch removals

24. Catches of by-catch species groups (macrourids, rajids and other species) reported in fine-scale data, their respective catch limits, and number of rajids cut from lines and released alive are summarised for Subareas 88.1 and 88.2 in Tables 8 and 9 respectively.

Table 8: Catch history for by-catch species (macrourids, rajids and other species), catch limits and number of rajids released alive in Subarea 88.1. Catch limits are for the whole fishery (see Conservation Measure 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)
1996/97	-	0	-	0	-	-	0
1997/98	-	9	-	5	-	50	1
1998/99	-	22	-	39	-	50	5
1999/00	-	74	-	41	-	50	7
2000/01	-	61	-	9	-	50	14
2001/02	100	154	-	25	-	50	10
2002/03	610	66	250	11	966	100	12
2003/04	520	319	163	23	1 744	180	23
2004/05	520	462	163	69	4 996	180	24
2005/06	474	258	148	5	14 640	160	18
2006/07	485	153	152	38	7 352	160	43
2007/08	426	112	133	4	7190	160	20

Table 9: Catch history for by-catch species (macrourids, rajids and other species), catch limits and number of rajids released alive in Subarea 88.2. Catch limits are for the whole fishery (see Conservation Measure 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)
1996/97	-	0	-	0	-	-	0
1997/98	-	0	-	0	-	-	0
1998/99	-	0	-	0	-	-	0
1999/00	-	0	-	0	-	-	0
2000/01	-	0	-	0	-	-	0
2001/02	40	4	-	0	-	20	0
2002/03	60	18	-	0	-	140	8
2003/04	60	37	50	0	107	140	8
2004/05	60	21	50	0	-	140	3
2005/06	78	92	50	0	923	100	12
2006/07	88	54	50	0	-	100	13
2007/08	88	17	50	0	-	100	4

25. The Working Group noted that the three-year experiment for managing by-catch in Subareas 88.1 and 88.2 had resulted in improved management. The macrourid by-catch limit was exceeded in Subarea 88.2 in 2005/06, but no catch limits were exceeded in either area in 2006/07 and 2007/08.

26. Current catch limits for macrourids and rajids in the Ross Sea are proportional to the catch limit of *Dissostichus* spp. in each SSRU based on the following rules from Conservation Measure 33-03:

- the limit for rajids is 5% of the catch limit of *Dissostichus* spp. or 50 tonnes whichever is greater;
- the limit for macrourids is 16% of the catch limit of *Dissostichus* spp. or 20 tonnes whichever is greater.

27. The 16% ratio of the catch limit of macrourids to the catch limit of *Dissostichus* spp. was based on the ratio of the by-catch limit for macrourids to the catch limit for *Dissostichus* spp. in Division 58.5.2 in 2002/03 (CCAMLR-XXI, paragraph 11.53).

28. There were no new assessments of by-catch species or recommendations for revised catch limits by SSRU in 2006/07.

5.2 Assessments of impacts on affected populations

Macrourids

29. The estimate of γ for *M. whitsoni* in Subarea 88.1 in 2003 was 0.01439 for a CV of 0.2 (SC-CAMLR-XXII, paragraph 4.132) or 0.01814 for a CV of 0.5 (SC-CAMLR-XXII, Annex 5, paragraph 5.242). This indicates that *M. whitsoni* has relatively low productivity and thus may be vulnerable to overexploitation.

30. WG-FSA-05/24 updated the standardised CPUE for *M. whitsoni* in Subareas 88.1 and 88.2 based on an analysis of fine-scale data from all vessels in the exploratory fishery from 1997/98 to 2004/05. Standardised CPUE increased to a peak in 2002 and 2003, dropped in 2004, before increasing again in 2005.

31. WG-FSA-05/22 considered approaches to monitoring and assessing macrourids and rajids in Subarea 88.1 and recommended that a random bottom trawl survey would be the best approach towards obtaining abundance estimates. Tag–recapture experiments for rajids and experimental manipulation of fishing effort are alternative methods which show some promise for monitoring abundance.

32. WG-FSA-08/32 provided biomass and yield estimates of *M. whitsoni* for the Ross Sea fishery (Subareas 88.1 and SSRUs 882A–B) based on extrapolations under three different density assumptions from a trawl survey (Table 10). The resulting biomass estimates had a CV of about 0.3. WG-FSA welcomed the concept of decoupling by-catch limits from those of target species and agreed to use estimates of biomass for Subarea 88.1, noting that SSRUs 882A–B are currently closed (WG-FSA main report, section 4.2).

Table 10: Biomass estimates from the trawl surveys for the BioRoss 400–600 and 600–800 m and IPY-CAML 600–1 200 and 1 200–2 000 m strata (bold numbers) and extrapolated biomass estimates (with CVs) for the remaining strata based on three methods of extrapolation.

Survey	Depth range (m)	Biomass (tonnes)	Extrapolated biomass (tonnes)		
			Constant density	CPUE (all vessels)	CPUE (NZ vessels)
BioRoss – 881H	400–600	**230**	**230 (49)**	**230 (49)**	**230 (49)**
BioRoss – 881H	600–800	**3 531**	**3 531 (38)**	**3 531 (38)**	**3 531 (49)**
SSRU 881H west	800–1 200		92 (50)	83 (54)	103 (55)
SSRU 881H west	1200–2000		713 (40)	1 114 (49)	1 038 (47)
IPY – 881H	600–1200	**975**	**975 (50)**	**975 (50)**	**975 (50)**
IPY – 881H	1200–2000	**3 356**	**3 356 (40)**	**3 356 (40)**	**3 356 (49)**
SSRU 881 I	600–1200		3 297 (50)	7 883 (51)	5 992 (50)
SSRU 881 I	1200–2000		4 670 (40)	11 168 (42)	8 576 (41)
SSRU 881 K	600–1200		1 539 (50)	5 027 (51)	2 774 (51)
SSRU 881 K	1200–2000		2 998 (40)	5 995 (45)	9 111 (43)
SSRU 882 A–B	600–1200		1 404 (50)	1 396 (58)	857 (60)
SSRU 882 A–B	1200–2000		4 087 (40)	525 (70)	-
Total			26 892 (29)	41 823 (28)	36 542 (30)

33. Yield estimates were calculated using the constant density assumption when extrapolating the biomass estimate across the slope region, noting that this would provide a more precautionary estimate of yield than one based on extrapolations using longline CPUE data. The resulting biomass estimate for SSRUs 881H, I and K and small portions of SSRUs 881J–L was 21 401 tonnes which gave a yield estimate of 388.2 tonnes. This yield

estimate was then apportioned across the five SSRUs taking into account maximum historical catches. Yields per SSRU are detailed in Table 11. Existing move-on rules are retained, and macrourid by-catch limits and catches are expected to be reviewed on an annual basis.

Table 11: Proposed catch limits of grenadiers in Subarea 88.1 assuming a CV of 0.5 for the estimate of B_0 and that the grenadier density was constant across the entire slope (WG-FSA-08/32).

SSRU	Current catch limit		Estimated yield	Maximum historic catch	Proposed catch limit
881B, C, G	50	}	-	34	40
881H, I, K	271			390	320
881J	79		388	46	50
881L	24			6	20
882A–B	0		100	8	0
Total	424		488		430

Rajids

34. WG-FSA-06/31 reviewed the biological parameters of skates, whilst WG-FSA-06/32 characterised the results of the skate tagging program. Neither can currently be used to estimate total abundance.

35. WG-SAM-07/4 presented data and a preliminary developmental model for Antarctic skates in SSRUs 881H, I, J and K of the Ross Sea. The developmental model attempted to create a catch history of all skates and rays in the Ross Sea, and integrate these data with the available observational data (including tag–recapture data) into a single integrated stock assessment model.

36. The paper concluded that aspects of the catch history were very uncertain, including the species composition, the weight and number of skates caught, the proportion discarded, and the survival of those tagged or discarded. The size composition of the commercial catch was also very uncertain because of the low numbers sampled each year. Most aspects of the tagging data were also uncertain, including the actual numbers of skates released, the initial mortality of tagged skates, the tag-loss rate and the numbers of skates scanned for tags. While updated summaries of the numbers of skate tag releases and recaptures have been reported, these data are still preliminary and further work is required. Lastly, there is great uncertainty over the biological parameters, including age and growth, natural mortality, steepness and size and age at maturity. However, the paper noted that whilst many aspects of this uncertainty remain, changes to the C2 dataform since 2005 have led to substantial improvements in the landings and release data.

37. The Working Group noted several areas where better data are required, including improving species identification, increasing the detection rate of tagged skates, increasing the number of skates measured and sexed, validating estimates of age and growth, revising the skate tagging protocols and undertaking more extensive skate survivorship experiments, and these were taken up under the appropriate agenda items.

5.3 Identification of levels of risk

38. WG-FSA-05/21 presented risk categorisation tables for *M. whitsoni* and *Amblyraja georgiana*, which are the major by-catch species in Subareas 88.1 and 88.2 (SC-CAMLR-XXIV, Annex 5, Appendix N, Tables 5 and 6).

5.4 Mitigation measures

39. WG-FSA-05/24 used a standardised CPUE analysis to determine factors affecting by-catch rates of macrourids and rajids in the exploratory fishery for toothfish in Subareas 88.1 and 88.2. The analysis was based on fine-scale haul-by-haul data and observer data from all vessels in the fishery from 1997/98 to 2004/05.

40. The major factors influencing macrourids by-catch were vessel, area and depth (SC-CAMLR-XXIV, Annex 5, Appendix N, Figures 1 and 2). Catch rates of *M. whitsoni* were highest along the shelf edge (SSRUs 881E, I, K and 882E) in depths from 600 to 1 000 m, and there was an order of magnitude difference in macrourids catch rates between different vessels. Examination of vessel characteristics showed that catch rates of macrourids were lower with the Spanish line system than with the autoline system. This effect was confounded by the bait type, as Spanish line vessels tended to use the South American pilchard as bait, whereas autoline vessels used varying species of squid and/or mackerel. However, the difference in macrourids catch rates between the few Spanish line vessels that used squid and mackerel for bait, and the majority that used pilchards, was much less than the overall difference between Spanish line and autoline vessels. Russian and Korean vessels had extremely low catch rates compared to other vessels fishing in the same location.

41. It was not possible to reliably determine factors influencing catch rates of rajids in Subareas 88.1 and 88.2 from either fine-scale or observer data because a proportion of skates are cut free and released at the surface and these are not accurately recorded or reported in either dataset (SC-CAMLR-XXIV, Annex 5, Appendix N, paragraphs 42 to 53).

42. This analysis suggested that it might be possible to reduce by-catch of macrourids in Subareas 88.1 and 88.2 by avoiding fishing in the depth ranges and areas where by-catch rates are highest. However, the Working Group noted that there is a considerable overlap with the spatial and depth distribution of *Dissostichus* spp. and area and/or depth restrictions would also impact on the ability of the fleet to catch *Dissostichus* spp.

43. The Working Group recommended that further work should be carried out in the intersessional period to compare by-catch levels arising from different gear configurations and to determine whether this information could be used to develop mitigation and avoidance measures for by-catch (SC-CAMLR-XXIV, Annex 5, paragraph 6.22).

44. The current by-catch limits and move-on rules are given in Conservation Measure 33-03.

45. The Working Group recommended that, where possible, all rajids should be cut from the line while still in the water, except on the request of the scientific observer (SC-CAMLR-XXIV, Annex 5, paragraph 6.25). The Commission has been requested to review this mitigation practice (see SC-CAMLR-XXVI, Annex 5, paragraph 5.53).

6. By-catch of birds and mammals

6.1 By-catch removals

46. Details of seabird by-catches are summarised in Table 12.

Table 12: Seabird by-catch limit, observed mortality rate and total estimated mortality of seabird by-catch in Subareas 88.1 and 88.2 (from SC-CAMLR-XXVII, Annex 6, Table 3).

Season	By-catch limit (number of birds)	Mortality rate (birds/thousand hooks)	Total estimated mortality (number of birds)
1997/98		0	0
1998/99		0	0
1999/00		0	0
2000/01		0	0
2001/02	3*	0	0
2002/03	3*	0	0
2003/04	3*	0.0001	1
2004/05	3*	0	0
2005/06	3*	0	0
2006/07	3*	0	0
2007/08	3*	0	0

* Per vessel during daytime setting.

47. Ad hoc WG-IMAF assessed the risk levels of seabirds in this fishery in Subarea 88.1 as category 1 (low) south of 65°S, category 3 (average) north of 65°S and overall as category 3 (SC-CAMLR-XXVII, Annex 6, Figure 1) and recommended (SC-CAMLR-XXVII, Annex 6, Table 15):

- strict compliance with Conservation Measure 25-02 (but with the possibility of exemption to paragraph 4 to allow for daytime setting);
- south of 65°S, no need to restrict longline fishing season;
- north of 65°S, restrict longline fishing to the period outside at-risk species' breeding season where known/relevant unless line sink rate requirement is met at all times;
- daytime setting permitted subject to line sink rate requirements and seabird by-catch limits;
- no offal dumping.

48. Ad hoc WG-IMAF assessed the risk level of seabirds in this fishery in Subarea 88.2 as category 1 (low) (SC-CAMLR-XXVII, Annex 6, Table 3) and recommended:

- strict compliance with Conservation Measure 25-02 (but with exemption to paragraph 4 to allow for daytime setting);
- no need to restrict longline fishing season;

- daytime setting permitted subject to line sink rate requirement;
- no offal dumping.

49. There was one report of incidental mortality of a seal (likely to be a crabeater seal) in the longline fishery of Subarea 88.1 in 2007/08.

6.2 Mitigation measures

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

7. Ecosystem implications/effects

51. Developments in evaluating ecosystem effects of the Antarctic toothfish fishery were discussed at the FEMA workshop (SC-CAMLR-XXVI/BG/6, paragraphs 45 to 48) and are summarised below.

52. Two key trophic interactions were identified as being important for Antarctic toothfish. The first concerned the nature of the interaction between toothfish predators (e.g. Type C killer whales, sperm whales and Weddell seals) and toothfish. Results from the ECOPATH model suggest that toothfish only forms about 2% of the diet of its predators (WG-EMM-07/18). However, it was noted that the consumption of toothfish in particular locations, at particular times of the year, or by particular parts of the population may be especially important to predators, even though the total consumption of toothfish by all individuals of a species is relatively low. This may be more important if there are small sub-populations of predators.

53. The second key trophic interaction was between toothfish and its prey – in particular demersal fish species. Results from the ECOPATH model suggest that toothfish consumes 70% of the annual production of demersal species (WG-EMM-07/18), and so a reduction of the toothfish population could have a large impact on the natural mortality of these species. The workshop also recognised the additional complex interaction with the fishery, whereby demersal fish are taken as by-catch, so that a reduction in natural mortality may be partially offset by an increase in fishing mortality.

54. The workshop considered that it was important to further develop the ecosystem modelling work in the Ross Sea to specifically address these interactions. It recommended that a scoping exercise be undertaken to determine the complexity of the model. It noted that models would need to be spatially and temporally explicit to take into account the spatio-temporal effects of the predation. It considered that a Minimum Realistic Model approach would be most appropriate. Given the paucity of data, it agreed that the model should be as simple as possible, yet complex enough to test the key functional relationships, and that modelling results in the first instance would by necessity need to be used in a strategic rather than tactical sense.

55. The workshop also noted that the modelling was likely to identify a number of areas requiring extra data collection. These included understanding the 3-D foraging area of toothfish, its predators and its prey and how it may change seasonally and spatially, as well as a better understanding of toothfish movements, spawning dynamics and early life history.

8. Harvest controls and management advice

8.1 Conservation measures

Table 13: Limits on the exploratory fishery for *Dissostichus* spp. in Subarea 88.1 in force in 2007/08 (Conservation Measure 41-09) and advice to the Scientific Committee for 2008/09.

Element	Limit in force	Advice for 2008/09
Access (gear)	Limited to vessels from Argentina, Republic of Korea, Namibia, New Zealand, Russia, South Africa, Spain, UK and Uruguay using longlines.	Review
Catch limit	Precautionary catch limit for *Dissostichus* spp. was 2 700 tonnes for Subarea 88.1, of which 40 tonnes was set aside for research fishing and the remaining 2 660 tonnes was applied as follows: SSRUs A, D, E and F – 0 tonnes SSRUs B, C and G – 313 tonnes total SSRUs H, I, K – 1 698 tonnes total SSRU J – 495 tonnes SSRU L – 154 tonnes.	Review
Season	1 December to 31 August	Same period
Fishing operations	In accordance with CM 41-01 and the setting of research hauls is not required (Annex B, paragraphs 3 and 4).	Carry forward
By-catch	Regulated by CMs 33-03 and 41-09.	Review
Mitigation	In accordance with CM 25-02, except paragraph 4 if requirements of CM 24-02 are met. Daylight setting allowed under CM 24-02.	Carry forward Carry forward
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.	Carry forward
VMS	To be operational in accordance with CM 10-04.	Carry forward
CDS	In accordance with CM 10-05.	Carry forward
Research	Undertake research plan and tagging program as set out in CM 41-01, Annexes B and C.	Carry forward
	Research fishing under CM 24-01 limited to 10 tonnes of *Dissostichus* spp. green weight and a single vessel in each of SSRUs A, D, E and F. Catches shall not be considered part of the catch limit for the fishery.	Carry forward
	Toothfish tagged at a rate of at least one fish per tonne green weight caught, except in SSRUs A, D, E and F where the rate is three fish per tonne green weight caught (research fishing).	Carry forward

(continued)

Table 13 (continued)

Element	Limit in force	Advice for 2008/09
Data	Five-day catch and effort reporting under CM 23-01. Haul-by-haul catch and effort data under CM 23-04. Biological data reported by the CCAMLR scientific observer.	Carry forward Carry forward Carry forward
Target species	For the purposes of CMs 23-01 and 23-04, the target species is *Dissostichus* spp. and the by-catch is any species other than *Dissostichus* spp.	Carry forward
Environmental protection	Regulated by CM 26-01. No offal discharge.	Carry forward
Additional element	Fishing within 10 n miles of Balleny Islands is prohibited.	Carry forward

Table 14: Limits on the exploratory fishery for *Dissostichus* spp. in Subarea 88.2 in force in 2007/08 (Conservation Measure 41-10) and advice to the Scientific Committee for 2008/09.

Element	Limit in force	Advice for 2008/09
Access (gear)	Limited to vessels from Argentina, New Zealand, Russia, South Africa, Spain, UK and Uruguay using longlines.	Review
Catch limit	Precautionary catch limit for *Dissostichus* spp. was 567 tonnes for Subarea 88.2 south of 65°S, of which 20 tonnes was set aside for research fishing and the remaining 547 tonnes was applied as follows: SSRUs A and B – 0 tonnes SSRUs C, D, F and G – 206 tonnes total SSRU E – 341 tonnes.	Carry forward
Season	1 December to 31 August	Same period
Fishing operations	In accordance with CM 41-01 and the setting of research hauls is not required (Annex B, paragraphs 3 and 4).	Carry forward
By-catch	Regulated by CMs 33-03 and 41-10.	Review
Mitigation	In accordance with CM 25-02, except paragraph 4 if requirements of CM 24-02 are met. Daylight setting allowed under CM 24-02.	Carry forward Carry forward
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.	Carry forward
VMS	To be operational in accordance with CM 10-04.	Carry forward
CDS	In accordance with CM 10-05.	Carry forward
Research	Undertake research plan and tagging program as set out in CM 41-01, Annexes B and C.	Carry forward
	Research fishing under CM 24-01 limited to 10 tonnes of *Dissostichus* spp. green weight and a single vessel in each of SSRUs A and B. Catches shall not be considered part of the catch limit for the fishery.	Carry forward
	Toothfish tagged at a rate of at least one fish per tonne green weight caught, except in SSRUs A and B where the rate is three fish per tonne green weight caught (research fishing).	Carry forward

(continued)

Table 14 (continued)

Element	Limit in force	Advice for 2008/09
Data	Five-day catch and effort reporting under CM 23-01. Haul-by-haul catch and effort data under CM 23-04. Biological data reported by the CCAMLR scientific observer.	Carry forward Carry forward Carry forward
Target species	For the purposes of CMs 23-01 and 23-04, the target species is *Dissostichus* spp. and the by-catch is any species other than *Dissostichus* spp.	Carry forward
Environmental protection	Regulated by CM 26-01. No offal discharge.	Carry forward

8.2 Management advice

56. The Working Group agreed that the management advice on catch limits for *Dissostichus* spp. in Subareas 88.1 and 88.2 could be carried forward from last year. However, it noted that it would be expected that the assessment be updated next year.

57. The Working Group recommended new catch limits for *Macrourus* spp. in Subarea 88.1 based on the advice given in SC-CAMLR-XXVII, Annex 5, paragraphs 6.16 to 6.22.

58. The Working Group considered the New Zealand proposal on the future management of the *Dissostichus* spp. fishery in Subareas 88.1 and 88.2 but was unable to provide consensus advice on the issue of maintaining the network of open and closed SSRUs in these subareas.

59. However, the Working Group recommended an additional SSRU in the region to the west of 170°E in the western Ross Sea, including Terra Nova Bay and McMurdo Sound (i.e. SSRU 881J west) be created. It further recommended that this SSRU should be closed to fishing because of its importance as a corridor for sub-adult toothfish moving between the shelf and the northern area to spawn.

60. The Working Group also recommended that the catch limits for SSRUs 881J (east of 170°E) and 881L be combined, and noted that the combined catch limits be revised based on the reduced seabed areas and CPUE estimates for this region (SC-CAMLR-XXVII, Annex 5, paragraph 5.74).

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