

**FISHERY REPORT: *CHAMPSOCEPHALUS GUNNARI*  
SOUTH GEORGIA (SUBAREA 48.3)**

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**1. Details of the fishery**

**1.1 Reported catch**

In Subarea 48.3, a pelagic or semi-pelagic trawl fishery targets *Champsoccephalus gunnari* (Table 1). In 2007/08, the fishing season was from 15 November 2007 to 14 November 2008, with a catch limit for *C. gunnari* of 2 462 tonnes (Conservation Measure 42-01). The catch of *C. gunnari* reported to October 2008 was 1 326 tonnes, but fishing is continuing.

Table 1: Catch history for *Champsoccephalus gunnari* in Subarea 48.3 (source: STATLANT data for past seasons, and catch and effort reports for current season).

Season	Reported effort (number of vessels)	Catch limit (tonnes)	Reported catch (tonnes)
1976/77	-	-	93 595
1977/78	-	-	7 472
1978/79	-	-	809
1979/80	-	-	8 795
1980/81	-	-	27 903
1981/82	-	-	54 040
1982/83	-	-	178 824
1983/84	-	-	35 743
1984/85	-	-	628
1985/86	-	-	21 008
1986/87	-	-	80 586
1987/88	1	35 000	36 054
1988/89	-	0	3
1989/90	-	8 000	8 135
1990/91	-	26 000	44
1991/92	-	0	5
1992/93	-	9 200	0
1993/94	-	9 200	13
1994/95	-	0	10
1995/96	-	1 000	0
1996/97	-	1 300	0
1997/98	1	4 520	6
1998/99	1	4 840	265
1999/00	2	4 036	4 114
2000/01	5	6 760	960
2001/02	5	5 557	2 667
2002/03	4	2 181	1 986
2003/04	7	2 887	2 683
2004/05	7	3 574	200
2005/06	5	2 244	2 169
2006/07	5	4 337	4 345
2007/08	4	2 462	1 326

## 1.2 IUU catch

2. There has been no evidence of IUU activity in this fishery.

## 1.3 Size distribution of the catches

3. Catch-weighted length frequencies for *C. gunnari* from 1986/87 to 2007/08 are presented in Figure 1.

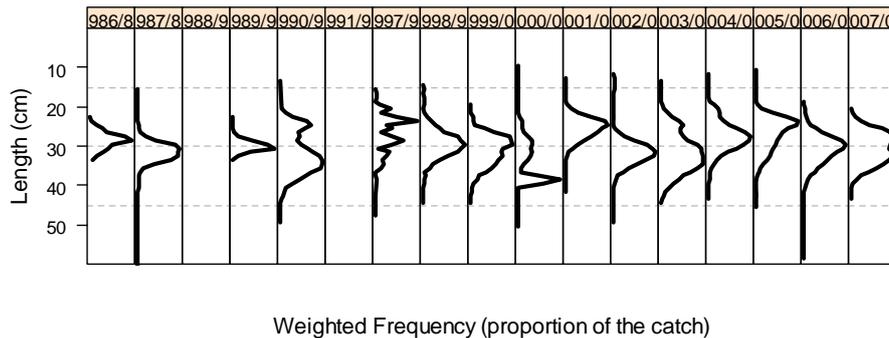


Figure 1: Catch-weighted length frequencies for *Champsocephalus gunnari* in Subarea 48.3 (source: observer, fine-scale and STATLANT data).

## 2. Stocks and areas

4. Within Subarea 48.3, *C. gunnari* is restricted to the shelf area generally shallower than 350 m. Differences in length distribution have been noted between Shag Rocks and South Georgia (WG-FSA-06/51). In the April 2008 survey, 2+ and 3+ fish were abundant at South Georgia and at Shag Rocks, but differences were apparent in the length-frequencies between the two areas (WG-FSA-08/28). These differences are not thought to represent separate stocks. For purposes of stock assessment it is assumed that there is a single stock present. *Champsocephalus gunnari* is considered a semi-pelagic species, young (0+ and 1+) fish are found in the pelagic zone, but with increased age (size) fish become more demersal in habit (WG-FSA-02/7).

## 3. Parameter estimation

### 3.1 Estimation methods

#### Acoustic surveys

5. No new estimates of standing stock were available from acoustic surveys. Previous acoustic investigations have demonstrated that *C. gunnari* of all sizes/ages spend time in midwater and reinforced the belief that a bottom trawl survey significantly underestimates *C. gunnari* biomass (see WG-FSA-SAM-04/20).

### Trawl surveys

6. In April 2008 the UK undertook a random stratified bottom trawl survey of the South Georgia and Shag Rocks shelves (WG-FSA-08/28). The survey employed the same trawl gear and survey design as previous UK surveys in Subarea 48.3.

### Standing stock

7. Following the procedure agreed at WG-FSA-03, estimates of standing stock were obtained using a bootstrap on calculated icefish densities from the UK survey. Trawl densities were weighted by the correction factor of 1.241, which takes account of the presence of a proportion of the icefish stock above the relatively low headline height of the UK trawl. Trawl densities were then weighted by the proportion of the total survey area in the stratum and inverse weighted by the proportion of the total hauls in the stratum:

$$D_C = D \times \frac{A_S}{A_T} \times \frac{H_T}{H_S}$$

where  $D_C$  = corrected density;  $D$  = trawls density;  $A_S$  = stratum area;  $A_T$  = total area;  $H_T$  = total number of hauls; and  $H_S$  = number of hauls in that stratum.

8. The new sea-floor areas (WG-SAM-08/10 Rev. 2) derived from detailed bathymetric data were used in the analysis for the first time. Ten strata were used (Figure 2; Table 2), with two depth strata (50–200 and 200–300 m, except in NW where 200–350 m used) and five geographic strata (Shag Rock, plus NW, NE, SW and SE South Georgia). The 2008 survey (Figure 3) sampled 70 hauls (compared to 49 in 2007 and 63 in 2006), but two were excluded as they fell outside the depth range used for the assessment. The Working Group noted that four hauls occurred after dusk, but agreed to include these in the assessment.

9. An estimate of the one-sided lower 95% CI of biomass was calculated for the assessment and is tabled below. The estimated mean value of the standing stock decreased from 98 000 tonnes in September 2007 to 76 000 tonnes in April 2008. However, the one-sided lower CI increased from 23 400 to 32000 tonnes. This was a consequence of the increased number of hauls undertaken during the survey.

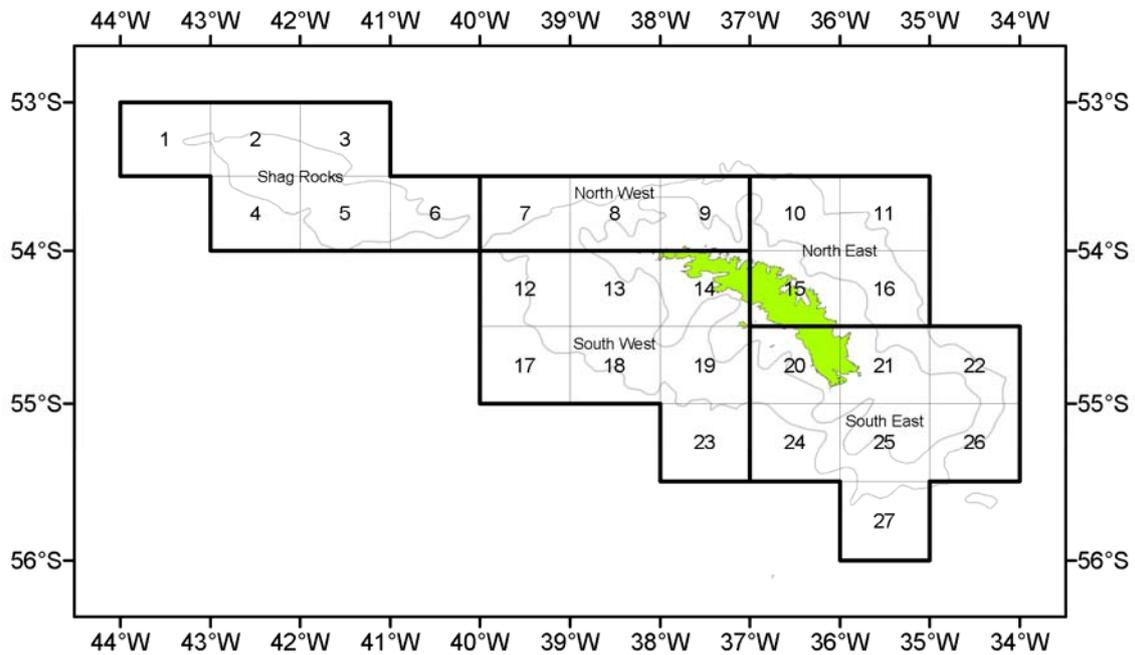


Figure 2: Strata and grid squares used in the 2008 UK survey of Subarea 48.3.

Table 2: Seabed areas of survey strata used to estimate biomass within the bootstrap procedure and results of bootstrap.

Component	Description	Value
Nominal date of survey	Mid-point	25 Apr 2008
Survey timing (days since start of year)		116
Seabed area of survey strata	Strata (m)	km <sup>2</sup>
	1. SR 50–200	2 553
	2. SR 200–300	1 438
	3. NW 50–200	3 371
	4. NW 200–350	2 059
	5. NE 50–200	2 766
	6. NE 200–300	3 576
	7. SW 50–200	4 276
	8. SW 200–300	6 637
	9. SE 50–200	6 617
	10. SE 200–300	3 838
Bottom trawl survey	Bottom to 6 m	tonnes
Biomass estimates from bootstrap procedure	Mean	76 384
	SE	30 183
	Lower CI	27 630
	Upper CI	142 835
	One-sided lower 95% CI	32 767

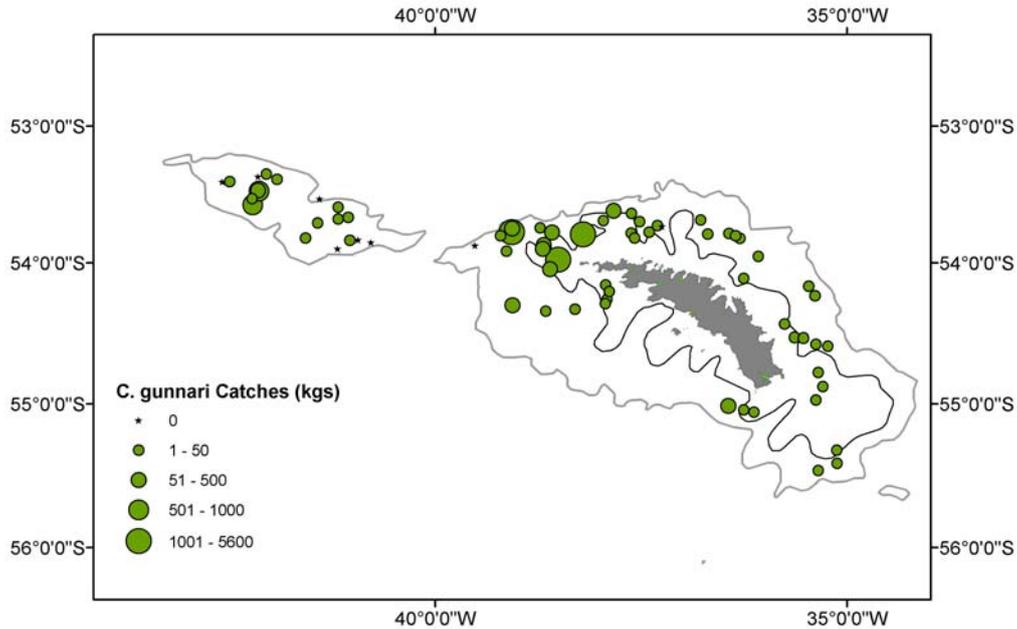


Figure 3: *Champtocephalus gunnari* catches from the survey in Subarea 48.3 in April 2008.

### Population structure

10. The distribution of densities-at-age was derived using the CMIX program. The length classes were constrained from 130–400 mm. Initial runs with the bounds for means estimated from von Bertalanffy growth parameters (Table 3) did not fit the observed data particularly well. For subsequent CMIX runs bounds on the cohorts were estimated from the length-density plot, with the standard deviations constrained to be linearly related to the mean. The 1+ fish were included, but were not well estimated by the CMIX procedure, probably a consequence of them not being fully selected (gear and behaviour) by the trawl.

Table 3: Initial input parameters for the CMIX analysis of *Champtocephalus gunnari* length density in Subarea 48.3.

Parameter	Value
Size range included	130–400 mm
Initial bounds:	Age 1: 160–190 Age 3: 250–390 Age 4: 300–400
Survey date	116
No. function calls	1 000
Reporting frequency	100
Stopping criteria	1E-6
Freq. for convergence testing	5
Simplex expansion coefficient	1

Table 4: Results generated from CMIX for the truncated length-density distribution.

	Component 1	Component 2	Component 3
Means of mixture components (mm)	175	270	348
Standard deviations of mixture components	15.1	22.8	29.0
Total density of each mixture component	1 499	1 5385	4 007
SD of each mixture component density	1 267	4 906	1 411
Density %	7.2	73.6	19.2
Sum of the observed densities = 22 577.1			
Sum of the expected densities = 20 888.0			

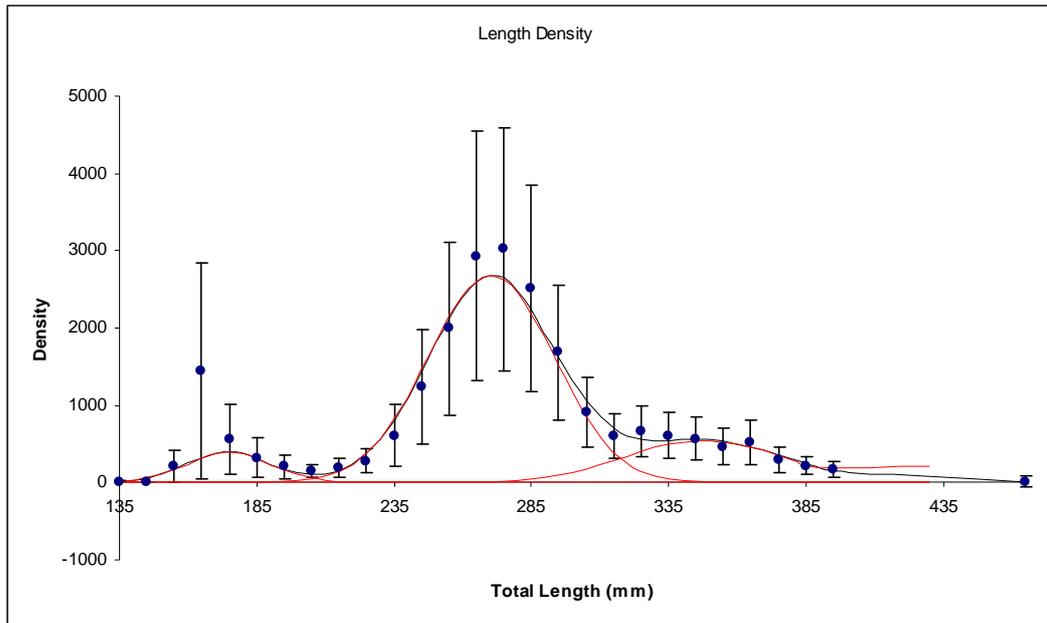


Figure 4: CMIX analysis of truncated length-density distribution from the 2008 bottom trawl survey in Subarea 48.3, with error bars representing standard errors.

### 3.2 Parameter values

#### Fixed parameters

11. The fixed parameters used in the assessment remained unchanged from previous years (SC-CAMLR-XXVI, Annex 5, Appendix O, Table 5).

#### Removals

##### *Fishing mortality (catches since survey)*

12. Catches taken after the assessment of biomass from the bottom trawl survey (i.e. 25 April 2008) must be included within the assessment. Following the survey, 1 616 tonnes of catch limit remain to be taken in Subarea 48.3.

### Initial age structure

13. The proportion of density-at-age was derived from the CMIX program for ages 1+ to 3+ (Table 4).

### Selectivity

14. A knife-edge selectivity vector was used for *C. gunnari*, starting at 2.5 years and fully selected at age 2.5.

## 4. Stock assessment

### 4.1 Model structure and assumptions

15. The GYM was used to perform the short-term projection of the *C. gunnari* biomass. Estimates of yield were derived by determining the maximum catch level (fishing mortality) that had a less than 5% chance of reducing the spawning stock biomass to below 75% of the level that would occur in the absence of fishing in the two years following a survey biomass estimate.

### 4.2 Model configuration

Table 5: GYM configuration for the assessment of *Champsoccephalus gunnari* in Subarea 48.3.

Category	Parameter	Value
Age structure	First age class in stock	1
	Last age class in stock	10
	Oldest age in last class	11
Natural mortality	$M$	0.71
Length-at-age	$K$	$0.17 \text{ y}^{-1}$
	$t_0$	-0.58 y
	$L_\infty$	557 mm
	Date '0'	245 d
	Growth period (start and end dates)	1 Dec–30 Nov
	Reference date	1 Dec
Weight-at-age (kg, mm) ( $W = aL^b$ )	'a'	5.47E-10
	'b'	3.42
Maturity (age based)	$L_{m50}$	0 mm*
	Range over which maturity occurs	0 mm
	Age 0	Maturity 1
Spawning season	Start–End date	30 Nov–30Nov
Fishery information	Upper bound to annual $F$	5

(continued)

Table 5 (continued)

Category	Parameter	Value
Future projections	Tolerance for finding $F$ in each year	1E-08
	Tolerance for resolving catches	0.01
	Age first selected	2.5
	Age fully selected	2.5
	Relative fishing effort	Date: 1 Dec, Effort: 1
2007	Selectivity varied from last	✓
	Catch (mass)	1 616 000**
	Age first selected	2.5
	Age fully selected	2.5
	Relative fishing effort	Date: 1 Dec, Effort: 0 Date: 25 Apr, Effort: 1
Initial population structure	Age class	Density (%)
	1+1	7.2
	2+2	73.6
	3+3	19.2
	Date of survey	25 Apr 08
	Biomass to scale	3.2 E07
Simulation specifications	Number of runs in simulation	1
	Depletion level for test	0.2
Characteristics of a trial	Years to remove initial age structure	0***
	Estimate median $SB_0$	Deterministic
	Observations to use in median $SB_0$	2
	Year 0 of projection	2007
	Reference start date	01/12
	Increments in year	365
	Years to project stock	2
Evaluation of yield	Type	Fishing mortality
	Vector of $F$	0, 0.1, 0.144, 0.2

\* Maturity is not used in the short-term projection. It is set to 0 to allow the GYM to monitor the whole population.

\*\* Catch taken or potentially taken after the survey, but before the end of the year (31 November 2008).

\*\*\* Set to 0 since catches were made after the survey, else set to 1.

### 4.3 Model results

16. A single short-term projection of yield in 2008/09 (Year 1) and 2009/10 (Year 2), was computed:

	Catch limit
Year 1	3834
Year 2	2631

#### 4.4 Discussion of model results

17. The catch limits have increased since the 2007/08 season, which is due to the increase in the one-sided lower 95% CI of the biomass estimate. Although the mean biomass estimate declined slightly from September 2007, the increased number of trawls undertaken during the April survey resulted in greater confidence in the results. There were also differences in the stratification and the sea-floor areas.

#### 4.5 Future research requirements

18. The Working Group identified a number of future research requirements for the intersessional period:

- (i) Investigate the applicability of the 1.241 correction factor. This could be investigated by comparing the acoustic backscatter attributable to icefish in the 0–6 m zone with that more than 6 m off the sea-floor. However, there are still uncertainties regarding discrimination of *C. gunnari* from other acoustic scatterers, which will need to be addressed.
- (ii) Investigate the utility of diet, feeding rates, fish condition and predation in informing natural mortality rates in projections.
- (iii) The Working Group also suggested that on future surveys pelagic trawls be used to assess density in the area to the south that is considered unsuitable for bottom trawling.

### 5. By-catch of fish and invertebrates

#### 5.1 By-catch removals

19. Catches of by-catch species (*Gobionotothen gibberifrons*, *Notothenia rossii*, *Lepidonotothen squamifrons*, *Pseudochaenichthys georgianus* and *Chaenocephalus aceratus*) reported in fine-scale data, and their respective catch limits, are summarised in Table 6. Fish by-catch was negligible.

Table 6: Catch history for by-catch species (*Gobionotothen gibberifrons*, *Notothenia rossii*, *Lepidonotothen squamifrons*, *Pseudochaenichthys georgianus* and *Chaenocephalus aceratus*) and catch limits in the fishery for *Champscephalus gunnari* in Subarea 48.3 (see Conservation Measure 33-01 for details). (Source: fine-scale data.)

Season	<i>Gobionotothen gibberifrons</i> (tonnes)		<i>Notothenia rossii</i> (tonnes)		<i>Lepidonotothen squamifrons</i> (tonnes)		<i>Pseudochaenichthys georgianus</i> (tonnes)		<i>Chaenocephalus aceratus</i> (tonnes)	
	Limit	Reported	Limit	Reported	Limit	Reported	Limit	Reported	Limit	Reported
1998/99	1470	0	300	0	300	0	300	0	2200	0
1999/00	1470	0	300	0	300	0	300	0	2200	0
2000/01	1470	0	300	0	300	0	300	6	2200	0
2001/02	1470	0	300	0	300	0	300	5	2200	5
2002/03	1470	0	300	0	300	0	300	5	2200	1
2003/04	1470	0	300	0	300	0	300	3	2200	0
2004/05	1470	0	300	0	300	0	300	25	2200	1
2005/06	1470	0	300	1	300	0	300	6	2200	0
2006/07	1470	0	300	0	300	0	300	1	2200	0
2007/08	1470	0	300	0	300	0	300	1	2200	0

## 5.2 Mitigation measures

20. The by-catch limits are set out in Conservation Measure 33-01. Move-on rules are included in the annual conservation measure set for this fishery, e.g. Conservation Measure 42-01.

## 6. By-catch of birds and mammals

21. Seabird mortality in this trawl fishery is summarised in Table 7. The number of seabirds caught (5) was the same as 2006/07, which was the lowest since recording began in the 2000/01 season. The birds caught were three white-chinned petrels and two king penguins. Note that as of 1 October a further 1 136 tonnes of catch remain to be taken and further seabird mortality may occur.

Table 7: Number of seabirds killed in the trawl fishery in Subarea 48.3. DIC – *Thalassarche chrysostoma*, DIM – *Thalassarche melanophrys*, PRO – *Procellaria aequinoctialis*.

Fishing season	Trawls observed	DIC	DIM	PRO	Other
2000/01	315	5	46	41	
2001/02	431		18	49	1
2002/03	182	1	7	28	
2003/04	221	1	26	59	1
2004/05	253		9	1	1
2005/06	457	1	11	20	1
2006/07	111	1	2	3	
2007/08	206			3	2

22. Ad hoc WG-IMAF assessed the level of risk of incidental mortality of seabirds in Subarea 48.3 as a category 5 (high) (SC-CAMLR-XXVI/BG/31).

### **6.1 Mitigation measures**

23. Conservation Measure 25-03 applies to this fishery.

## **7. Ecosystem implications/effects**

24. The current pelagic trawl fishery for *C. gunnari* in Subarea 48.3 has minimal impact on the benthic ecosystem. There is a small by-catch of other icefish species, but this is typically much smaller than the catch limits for these species. *Champtocephalus gunnari* play an important role in the ecosystem of the South Georgia shelf as predators of krill, *Themisto* and other euphausiids, and as prey of fur seals and gentoo penguins (WG-FSA-08/30). Icefish may also be consumed by juvenile toothfish in years of high icefish abundance at Shag Rocks. Estimates of icefish standing stock have been shown to vary with variability in krill abundance at South Georgia, and in years of poor krill availability, icefish condition is poorer and larger quantities are likely to be consumed by both fur seals and gentoo penguins, which are normally krill dependent.

## **8. Harvest controls and management advice**

### **8.1 Conservation measures**

25. The limits on the fishery for *C. gunnari* in Subarea 48.3 are defined in Conservation Measure 42-01. The limits in force and the Working Group's advice to the Scientific Committee for the forthcoming season are summarised in Table 8.

26. In 2007 the Scientific Committee recognised that the spawning of *C. gunnari* has little spatial overlap with the fishery and removed the requirement of vessels fishing between 1 March and 31 May to undertake 20 research trawls, but asked that this be reviewed by WG-FSA-08.

27. The Working Group noted that in 2008 the survey took place during this period (April). During the survey, all icefish of size <23 cm were immature (Stages I or II). At Shag Rocks, 37.9% of the larger (>22 cm) female fish were in spawning or post-spawning condition, whilst at South Georgia the majority (53%) of larger female fish were in pre-spawning (Stage III) condition. There was only one spent fish found at South Georgia and none in spawning condition. The Working Group agreed that there is little spatial overlap between the main fishing grounds and spawning areas, which are mostly inshore and in the fjords.

Table 8: Limits on the fishery for *Chamsocephalus gunnari* in Subarea 48.3 in 2007/08 (Conservation Measure 42-01) and advice to the Scientific Committee for 2008/09.

Element	Limits in force	Advice for 2008/09
Access (gear)	Trawling only Bottom trawl prohibited	Carry forward
Access (area)	Fishing prohibited within 12 n miles of South Georgia from 1 March to 31 May.	Carry forward
Catch limit	2 462 tonnes	Revise to 3 834 tonnes
Move-on rule	Move on if >100 kg caught of which >10% by number are <240 mm TL.	Carry forward
Season	15 November to 14 November	Carry forward
By-catch	By-catch rates as in CM 33-01 to apply, plus move-on rule.	Carry forward
Mitigation	In accordance with CM 25-03.	Carry forward
Seabirds	Any vessel catching 20 seabirds to cease fishing.	Carry forward
Observers	Each vessel to carry at least one CCAMLR scientific observer and may include one additional scientific observer.	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
Target species	<i>Chamsocephalus gunnari</i> By-catch is any species other than <i>C. gunnari</i> .	Carry forward
Research	No requirement	Carry forward
Environmental protection	Regulated by CM 26-01. No offal discharge.	Carry forward

## 8.2 Management advice

28. The Working Group recommended that the catch limit for *C. gunnari* should be set at 3 834 tonnes in 2008/09 and 2 631 tonnes in 2009/10 based on the outcome of the short-term assessment.