

**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 *C. gunnari* (Table 1). The catch limit for the 2005/06 season was 2 244 tonnes (Conservation Measure 42-01). The fishery opened on 15 November 2005 and was closed on advice of the Secretariat on 30 September 2006. During the 2005/06 season the fishery caught 2 171 tonnes.

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

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	1 712
2005/06	5	2 244	2 171

**1.2 IUU catch**

2. There was no evidence of IUU activity in this fishery.

### 1.3 Size distribution of the catches

3. Catch-weighted length frequencies from observer, fine-scale and STATLANT data are presented in Figure 1 for 1986 to 2006.

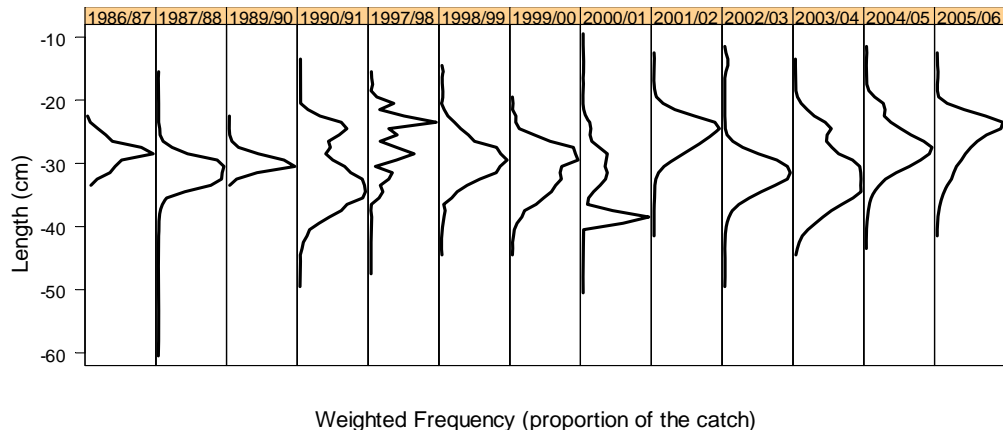


Figure 1: Catch-weighted length frequencies for *Champsocephalus gunnari* in Subarea 48.3 derived from observer, fine-scale and STATLANT data reported by 6 October 2006.

## 2. Stocks and areas

4. Within Subarea 48.3, *C. gunnari* is restricted to the shelf area generally shallower than 500 m deep. Differences in length distribution have again been noted between Shag Rocks and South Georgia (WG-FSA-06/51). These differences are not thought to represent separate stocks. So for purposes of stock assessment it is assumed that there is a single stock present. *C. 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. A limited acoustic/pelagic survey of icefish was conducted in Subarea 48.3 following the completion of the random stratified bottom trawl survey (WG-FSA-06/51). The results again showed 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 (WG-FSA-SAM-04/20), corroborating the results of the Russian trawl acoustic survey in 2002 (WG-FSA-02/44 Rev. 1, WG-FSA-SAM-04/10).

### Trawl surveys

6. In January 2006 the UK undertook a random stratified bottom trawl survey of the South Georgia and Shag Rocks shelves (WG-FSA-06/51). The survey employed the same trawl gear and survey design as previous UK surveys in Subarea 48.3. The raw swept area biomass estimates from the surveys suggest that icefish stock size was between 20 000 and 50 000 tonnes throughout the 1990s (with the exception of the very large stock seen in 1990), and has steadily increased since 2000 to about 117 000 tonnes in 2006 (WG-FSA-06/51).

### 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, divided into 12 strata (Table 2), 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, and adjusted by a correction factor of 1.241. This correction factor takes account of the presence of a proportion of the icefish stock above the relatively low headline height of the UK trawl. An estimate of the lower one-sided 95% CI of biomass was calculated for the assessment and is tabled below.

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

Component	Description	Value
Nominal date of survey	Mid-point	16 Jan 2006
Survey timing (days since start of year)		15
Seabed area of survey strata		km <sup>2</sup>
1. Shag Rocks	1. 50–150 m	1 473.5
	2. 150–250 m	1 870.5
	3. 250–500 m	1 610
2. Northwest South Georgia	4. 50–150 m	1 816
	5. 150–250 m	2 189
	6. 250–500 m	2 068
3. Northeast South Georgia	7. 50–150 m	1 037
	8. 150–250 m	4 113
	9. 250–500 m	994
4. South South Georgia	10. 50–150 m	6 008
	11. 150–250 m	12 902
	12. 250–500 m	5 141
Bottom trawl survey	Bottom to 6 m	tonnes
Biomass estimates from bootstrap procedure	Mean	104924.9
	SE	46374.55
	Lower CI	31668.42
	Upper CI	207970.02
	One-sided lower 95% interval	37502.78

### Population structure

8. The distribution of densities-at-age was derived using the CMIX program, with bounds for means estimated from von Bertalanffy growth parameters (Table 3) and the standard deviations linearly related to the means. Initial CMIX runs did not converge using data from the entire length-density distribution, so the CMIX analysis was re-run excluding fish greater than 400 mm (5+) and less than 190 mm (1+) from the analysis which contributed only a tiny fraction to the overall fish density. CMIX was run using the input parameters detailed in Table 3. The results (Table 4 and Figure 2) indicate a high density of fast-growing 2+ fish.

Table 3: Input parameters for the CMIX analysis of *Champscephalus gunnari* length density in Subarea 48.3.

Parameter	Value
Size range included	190–400 mm
Survey date	15
Birthday	245
$t_0$	–0.58
$k$	0.17
$L_\infty$	557 mm
Proportion between cohorts	0.5
Number of cohorts	3
Bounds on intercept (start, step)	1, 50 (15, 1.0)
Bounds on slope (start, step)	0.0, 0.4 (0.07, 0.01)
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)	236	287	336
Standard deviations of mixture components	20.4	24.6	28.5
Total density of each mixture component	12 601	1 963	1 298
SD of each mixture component density	5 124	2 123	856
Density %	79.4	12.4	8.2
Sum of the observed densities =	16 162		
Sum of the expected densities =	15 700		

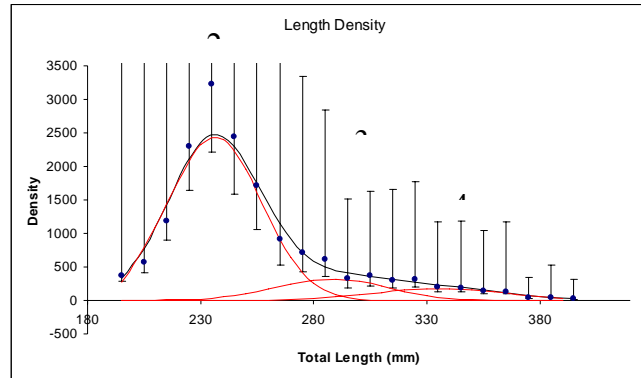


Figure 2: CMIX analysis of truncated length-density distribution from the 2006 bottom trawl survey in Subarea 48.3.

### 3.2 Parameter values

#### Fixed parameters

9. The majority of fixed parameters used in the assessment remained unchanged from 2004 and 2005 although new ‘length-to-mass’ parameters were used that were derived from the latest (2006) survey data (Table 5).

Table 5: Fixed parameters used in the 2006 assessment of *Champscephalus gunnari* in Subarea 48.3.

Component	Parameter	Value	Units
Natural mortality	$M$	0.71	$y^{-1}$
VBGF	$K$	0.17	$y^{-1}$
VBGF	$t_0$	-0.58	y
VBGF	$L_\infty$	557	mm
	Date ‘0’	245	d
Length to mass	‘a’	6E-10	kg, mm
Length to mass	‘b’	3.4	

#### Removals

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

10. Catches taken after the assessment of biomass from the bottom trawl survey (i.e. 24 January 2006) must be included within the assessment. These are detailed below.

Season	Catch (tonnes)
2005/06	1607

### Initial age structure

#### *Total density of each mixture component*

11. The proportion of density-at-age was derived from the CMIX program for ages 2+ to 4+ (Table 4).

### Selectivity

12. A linear selectivity vector was used for *C. gunnari*, starting at and being fully selected by 2 years. This is a greater selectivity on 2-year olds than is usually chosen (normally a selectivity of 0.5 on 2-year-old fish is assumed). Full selectivity was assumed this year because the fish were larger than usual for 2-year olds: 23.6 cm compared with an expected 19.8 cm. Figure 1 shows that the fleet was mostly selecting animals greater than 24 cm in length (i.e. 2-year-old fish). The move-on rule (Conservation Measure 42-01, paragraph 4) was triggered on a number of occasions restricting catches of the smallest fish.

## **4. Stock assessment**

### **4.1 Model structure and assumptions**

13. 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.



### Model configuration

Table 6: GYM configuration for the assessment of *Champsoccephalus gunnari* in Subarea 48.3.

Category	Parameter	Value
Recruitment age	Start	2 years
	Fully selected	2 years
Plus class accumulation		10 years
Oldest age in initial structure		10 years
Maturity	$L_{m50}$	0 mm***
	Range: 0 to full maturity	0 mm
Spawning season	Set so that the status of the stock is determined at the start of each year.	30 Nov–30 Nov
Simulation specification	Number of runs	1
Individual trial specifications	Years to remove initial age structure*	0
	Year prior to projection**	2005
	Reference start date	01/12
	Years to project stock in simulation	2
	Reasonable upper bound for annual $F$	5.0
	Tolerance for finding $F$ in each year	0.000001

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

\*\* GYM requires first year of 2005/06 split-year.

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

## 4.2 Model results

14. A single short-term projection of yield in 2006/07 (Year 1) and 2007/08 (Year 2), was computed:

Year 1	4337 tonnes
Year 2	2885 tonnes.

## 4.3 Discussion of model results

15. The projection of age 2+ fish from 2005/06 gives a projected yield of 4 337 tonnes in the 2006/07 season. This value is considered to be very precautionary since the assessment does not take into account the pelagic component of the population. The Working Group agreed to recommend this catch limit.

16. Some concern was expressed that the fishery had been catching 2-year-old fish, which are not generally assumed to be mature. Mesh size regulations and a move-on rule for large catches of fish smaller than 24 cm applies in this fishery, and should protect most 2-year-old fish (which normally have a modal length of about 20 cm). In 2005/06 the fish were larger than usual, which resulted in them being selected by the fishery. Concern was expressed that the fishery might also catch significant numbers of 2-year-old fish in the 2006/07 fishing

season, if they were again unusually large. There is no information on the abundance or size of these recruits. On the other hand, if next year's recruits are normal sized the fishery will only partially select them.

17. The current decision rules – based on a 75% escapement of a lower 95% confidence limit estimate of the stock – should be sufficiently conservative to ensure that even if the fishery did catch some proportion of a new incoming 2-year-old cohort in 2006/07, the overall reproductive potential of the stock should not be significantly reduced since it will comprise the large stock of 3+-year-old fish estimated by the 2006 survey. However, the issue of future fishing on cohorts that have not been assessed, and for which there is no other estimate of recruitment, was raised in 2005 and remains a point of uncertainty in setting catch levels for icefish stocks (SC-CAMLR-XXIV, Annex 5, Appendix L, paragraph 30). The Working Group recommended that more work be directed at understanding this issue.

18. Dr Agnew informed the Working Group that the UK is planning a September groundfish survey for 2007 with the intention of determining the size of newly recruiting cohorts to this stock.

#### **4.4 Future research requirements**

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

- (i) The acoustic protocol for assessing *C. gunnari* in Subarea 48.3, including:
  - (a) discrimination of *C. gunnari* from other acoustic scatterers
  - (b) further improvements in target strength estimates for *C. gunnari*
  - (c) age-specific patterns in daily vertical distribution of *C. gunnari*
  - (d) combination of trawl and acoustic indices for stock assessment.
- (ii) Investigation of the consequences and solutions to setting catch limits which might result in high harvesting rates on small unassessed recruiting year classes.

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

#### **5.1 By-catch removals**

20. The total reported by-catch of fish taken in recent years is indicated in Table 7.

Table 7: Total reported by-catch (tonnes) for five species between 1998/99 and 2005/06. NOG – *Gobionotothen gibberifrons*, SSI – *Chaenocephalus aceratus*, SGI – *Pseudochaenichthys georgianus*, NOR – *Notothenia rossii*, NOS – *Lepidonotothen squamifrons*.

Fishing season	NOG	Limit	SSI	Limit	SGI	Limit	NOR	Limit	NOS	Limit
1998/99	0	1470	0	2200	0	300	0	300	0	300
1999/00	0	1470	0	2200	0	300	0	300	0	300
2000/01	0	1470	0	2200	4	300	0	300	0	300
2001/02	0	1470	5	2200	5	300	0	300	0	300
2002/03	0	1470	1	2200	5	300	0	300	0	300
2003/04	0	1470	0	2200	2	300	0	300	0	300
2004/05	0	1470	1	2200	25	300	0	300	0	300
2005/06	0	1470	0	2200	6	300	1	300	0	300

## 5.2 Mitigation measures

21. 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

22. Details of seabird by-catches this year are reported in Appendix D, paragraphs 22 to 24.

23. Seabird mortality in this trawl fishery is summarised in Table 8 (from Appendix D, Table 14).

Table 8: Number of seabirds killed in the trawl fishery in Subarea 48.3. DIC – *Diomedea chrysostoma*, DIM – *Diomedea 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

## 6.1 Mitigation measures

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

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

25. 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. *C. 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 (see Everson et al., 1999). 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 for the 2005/06 season and advice for 2006/07

### 8.1 Conservation measures

Table 9: Summary of provisions of Conservation Measure 42-01 for *Champocephalus gunnari* in Subarea 48.3 and advice to the Scientific Committee for the 2006/07 season.

Paragraph and topic	Summary of CM 42-01	Advice for 2006/07	Paragraph reference
1. Access (gear)	Trawling only Bottom trawl prohibited	Continue	
2. Access (area)	Fishing prohibited within 12 n miles of South Georgia from 1 March to 31 May.	Continue	
3. Catch limit	2 244 tonnes 561 tonnes between 1 March and 31 May	Revise to 4 337 tonnes with 1 084 tonnes (25% of catch) between 1 March and 31 May	
4. Move-on rule	Move on if >100 kg caught of which >10% by number are <240 mm TL.	Continue	
5. Season	15 November 2005 to 14 November 2006	Revise	
6. By-catch	By-catch rates as in CM 33-01 to apply, plus move-on rule.	Continue	
7. Mitigation	In accordance with CM 25-03.	Continue	
8. Seabirds	Any vessel catching 20 seabirds to cease fishing.	Continue	
9. Observers	Each vessel to carry at least one CCAMLR scientific observer and may include one additional scientific observer.	Continue	
10. Data: catch and effort	(i) Five-day reporting system as in CM 23-01 (ii) Monthly fine-scale reporting system as in CM 23-04 on haul-by-haul basis.	Continue	
11. Target species	<i>Champocephalus gunnari</i> By-catch is any species other than <i>C. gunnari</i> .	Continue	
12. Data: biological	Monthly fine-scale reporting system as in CM 23-05. Reported in accordance with the Scheme of International Scientific Observation.	Continue	
13. Research	20 research trawls to be conducted as described in Annex 42-01/A between 1 March and 31 May.	Continue	

### 8.2 Management advice

26. The Working Group recommended that the catch limit for *C. gunnari* should be set at 4 337 tonnes in 2006/07 and 2 885 tonnes in 2007/08 based on the outcome of the short-term assessment.

27. All other components of Conservation Measure 42-01 should remain with an appropriate pro rata of the catch taken in the period 1 March to 31 May (1 084 tonnes).

### **Reference**

Everson, I., G. Parkes, K-H. Kock and I. Boyd. 1999. Variations in standing stock of the mackerel icefish *Champscephalus gunnari* at South Georgia. *J. Appl. Ecol.*, 36: 591–603.