

**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 *Champscephalus gunnari* (Table 1). In 2006/07, the fishing season was from 15 November 2006 to 14 November 2007, with a catch limit for *C. gunnari* of 4 337 tonnes and a mid-season limit of 1 084 tonnes during the spawning period from 1 March to 31 May (Conservation Measure 42-01). The catch of *C. gunnari* reported to October 2007 was 3 940 tonnes, but fishing is continuing.

Table 1: Catch history for *Champscephalus 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	3 940*

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 1985/86 to 2006/07 are presented in Figure 1.

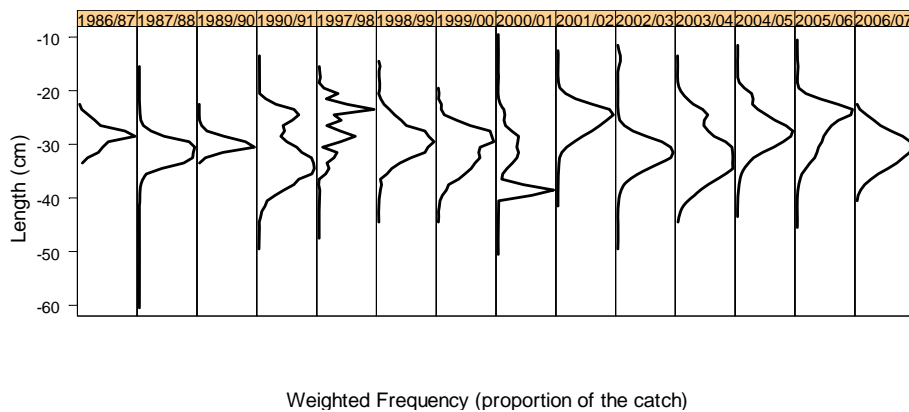


Figure 1: Catch-weighted length frequencies for *Champsocephalus gunnari* in Subarea 48.3 (source: observer, fine-scale and STATLANT data).

2. Stocks and areas

4. Within Subarea 48.3, *C. gunnari* is restricted to the shelf area generally shallower than 500 m deep. Differences in length distribution have been noted between Shag Rocks and South Georgia (WG-FSA-06/51). In the September 2007 survey 2+ and 3+ fish were abundant at South Georgia, with 3+ fish (of the same size as at South Georgia) caught at Shag Rocks. 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. 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-07/56). 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).

Trawl surveys

6. In August/September 2007 the UK undertook a random stratified bottom trawl survey of the South Georgia and Shag Rocks shelves (WG-FSA-07/56). 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 120 000 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, 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. The 2007 survey only sampled 49 hauls compared to 63 hauls in 2006, so only eight strata were used with the two shallower strata combined at Shag Rocks and NE Georgia and the three depth-strata within S South Georgia were pooled (Figure 2; Table 2).

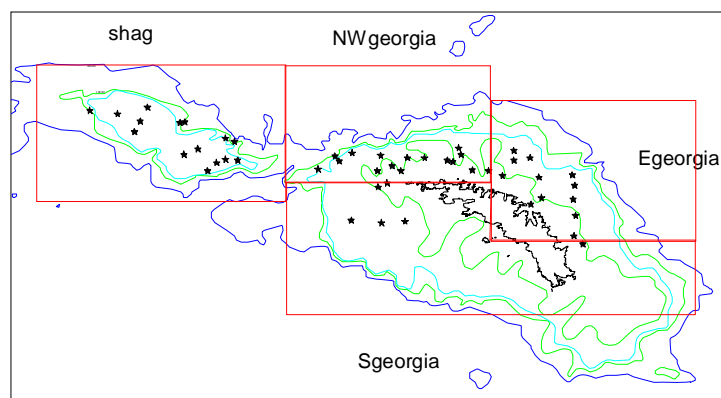


Figure 2: Position of stations in the 2007 UK Subarea 48.3 icefish survey with area strata overlaid.

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

Component	Description	Value
Nominal date of survey	Mid-point	9 Sep 2007
Survey timing (days since start of year)		252
Seabed area of survey strata		km ²
Shag Rocks	1. 50–250 m	3 344
[9 and 6 stations]	2. 250–500 m	1 610
Northwest South Georgia	3. 50–150 m	1 816
[5, 3, and 8 stations]	4. 150–250 m	2 189
	5. 250–500 m	2 068
Northeast South Georgia	6. 50–250 m	5 150
[5 and 7 stations]	7. 250–500 m	994
South South Georgia	8. 50–500 m	24 051
[6 stations]		
Bottom trawl survey	Bottom to 6 m	tonnes
Biomass estimates from bootstrap procedure	Mean	97 734
	SE	61 124
	Lower CI	19 563
	Upper CI	233 097
	One-sided lower 95% CI	23 385

8. An estimate of the lower one-sided 95% CI of biomass was calculated for the assessment and is tabled below. The estimated mean value of the standing stock decreased 8% from 105 000 tonnes in January 2006 to 98 000 tonnes in September 2007. The lower one-sided CI decreased 35% from 37 500 to 23 400 tonnes. This appeared to be a combined consequence of the lower number of hauls and higher variability created by the different distribution of icefish encountered in September compared to the distribution generally encountered in January.

Population structure

9. The distribution of densities-at-age was derived using the CMIX program. 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 not constrained to be linearly related to the mean. An initial run provided good estimates of the mean and standard deviations of 2+ and 3+ fish, but did not estimate the small 4+ cohort well. A final run was undertaken with the 2+ and 3+ means and SDs fixed, and with the 4+ cohort constrained to have a standard deviation of less than 35. The results (Table 4 and Figure 3) indicate a high density of 3+ fish, with a 2+ cohort present that may not have been fully selected by the survey.

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

Parameter	Value
Size range included	150–480 mm
Initial bounds:	Age 2: 180–220 Age 3: 280–320 Age 4: 330–450
Survey date	253
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)	213	298	390
Standard deviations of mixture components	23	29	35
Total density of each mixture component	1235.1	4753.1	191.2
SD of each mixture component density	337.5	1123.2	81.3
Density %	20.0	76.9	3.1
Sum of the observed densities =	6319.8		
Sum of the expected densities =	6178.4		

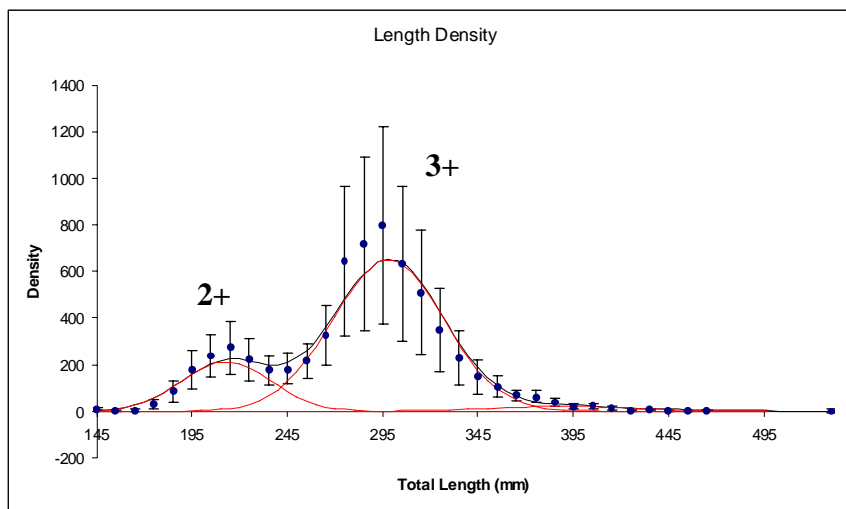


Figure 3: CMIX analysis of truncated length-density distribution from the 2007 bottom trawl survey in Subarea 48.3, with error bars representing standard errors.

3.2 Parameter values

Fixed parameters

10. The fixed parameters used in the assessment remained unchanged from 2006 (Table 5). A second run was done using the von Bertalanffy parameters derived by North (2005).

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

Component	Parameter	CCAMLR	North	Units
Natural mortality	M	0.71	0.71	y^{-1}
VBGF	K	0.17	0.27	y^{-1}
VBGF	t_0	-0.58	-0.26	y
VBGF	L_∞	557	517	mm
	Date '0'	245	245	d
Length to mass	'a'	6E-10	6E-10	kg, mm
Length to mass	'b'	3.4	3.4	

Removals

Fishing mortality (catches since survey)

11. Catches taken after the assessment of biomass from the bottom trawl survey (i.e. 20 September 2007) must be included within the assessment. In 10 days fishing since the survey and prior to the meeting, 188 tonnes were taken by a single vessel. A further 205 tonnes of quota remain to be taken this season.

Initial age structure

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

Selectivity

13. 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

14. 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. The GYM was run with two sets of von Bertalanffy parameters and two sets of catches since the survey (188 and 393 tonnes), the latter being the catch plus the remaining catch limit for this season.

4.2 Model configuration

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

Category	Parameter	Value
Recruitment age	Start	2.5 years
	Fully selected	2.5 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**	2006
	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 2006/07 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.

4.3 Model results

15. A single short-term projection of yield in 2007/08 (Year 1) and 2008/09 (Year 2), was computed:

	CCAMLR VBs Post-survey catch 188 tonnes	CCAMLR VBs Post-survey catch 393 tonnes	North (2006) VBs Post-survey catch 188 tonnes	North (2006) VBs Post-survey catch 393 tonnes
Year 1	2641	2462	2522	2500
Year 2	1656	1569	1478	1464

4.4 Discussion of model results

16. Using the CCAMLR VB parameters and assuming that the remaining catch is taken in the 2006/07 season, the projection of age 2+ fish from 2006/07 gives a projected yield of 2 462 tonnes in the 2007/08 season. If the remaining quota is not taken in 2006/07, the yield for 2007/08 is 2 641 tonnes.

17. These values are considered precautionary since the assessment does not take into account the pelagic component of the population. The Working Group recommended the catch limit based on the CCAMLR von Bertalanffy parameters and assuming that the 2006/07 catch is taken in full.

4.5 Future research requirements

18. 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) Consideration of optimal survey design and stratification, particularly the survey coverage of the southern shelf, and the effects of different stratification schemes on the assessments.
- (iii) Development of an icefish population model.

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 7. Fish by-catch was negligible.

Table 7: 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	0	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 8 (from SC-CAMLR-XXVI, Annex 6, Part II, Table 10). The number of seabirds caught (6) was the lowest caught since recording began in the 2000/01 season. Three birds were released alive.

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
2006/07	111	1	2	3	

6.1 Mitigation measures

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

7. Ecosystem implications/effects

23. 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 and management advice

8.1 Conservation measures

24. The limits on the fishery for *C. gunnari* in Subarea 48.3 are defined in Conservation Measure 42-01. The limits in force in 2006/07 and the Working Group's advice to the Scientific Committee for the forthcoming 2007/08 season are summarised in Table 9.

Table 9: Limits on the fishery for *Chamsocephalus gunnari* in Subarea 48.3 in 2006/07 (Conservation Measure 42-01) and advice to the Scientific Committee for 2007/08.

Element	Limit in 2006/07	Advice for 2007/08
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	4 337 tonnes with 1 084 tonnes (25% of catch) between 1 March and 31 May.	2 462 tonnes; catch limit for 1 March to 31 May no longer limited to 25% of the catch limit
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	20 research trawls to be conducted as described in Annex 42-01/A between 1 March and 31 May.	Remove this requirement
Environmental protection	Regulated by CM 26-01. No offal discharge.	Carry forward

8.2 Management advice

25. The Working Group recommended that the catch limit for *C. gunnari* should be set at 2 462 tonnes in 2007/08 and 1 569 tonnes in 2008/09 based on the outcome of the short-term assessment.

26. The Working Group recognised that the spawning of *C. gunnari* has little spatial overlap with the fishery and that the requirement of vessels fishing between 1 March and 31 May to undertake 20 research trawls is likely to increase the risk of seabird mortality. The Working Group recommended that the existing Conservation Measure 42-01 be amended to:

- (i) remove the requirement that vessels fishing between 1 March and 31 May be required to undertake 20 research trawls (as detailed in Conservation Measure 42-01, Annex A);
- (ii) that the catch during 1 March to 31 May not be limited to 25% of the catch limit.

27. The Working Group recommended that the impact of changes in Conservation Measure 42-01 should be reviewed at WG-FSA-08, particularly with respect to the maturity of fish caught throughout the year and the timing of fishing effort (particularly during the March–May period).

References

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- North, A.W. 2005. Mackerel icefish size and age differences and long-term change at South Georgia and Shag Rocks. *J. Fish. Biol.*, 67 (6): 1666–1685.