**FISHERY REPORT: *CHAMPSOCEPHALUS GUNNARI*
HEARD ISLAND (DIVISION 58.5.2)**

CONTENTS

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1. Details of the fishery

1.1 Reported catch

The trawl fishery for *Champsocephalus gunnari* in Division 58.5.2 has caught 99 tonnes from a catch limit of 102 tonnes in 2008/09 (Conservation Measure 42-02). Historical reported catches of *C. gunnari* along with catch limits and number of vessels active in the fishery are shown in Table 1.

Table 1: Catch history for *Champsocephalus gunnari* in Division 58.5.2 (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)
1971/72	-	-	5 860
1973/74	-	-	7 525
1974/75	-	-	9 710
1976/77	-	-	15 201
1977/78	-	-	5 166
1989/90	-	-	2
1991/92	-	-	5
1992/93	-	-	3
1994/95	-	311	0
1995/96	-	311	0
1996/97	1	311	227
1997/98	3	900	115
1998/99	1	1 160	2
1999/00	2	916	137
2000/01	2	1 150	1 136
2001/02	2	885	865
2002/03	2	2 980	2 345
2003/04	2	292	78
2004/05	2	1 864	1 851
2005/06	1	1 210	660
2006/07	1	42	1
2007/08	1	220	199
2008/09	1	102	99

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 1996/97 to 2008/09 are presented in Figure 1. Data from 2006/07 have not been included because the total catch for that season was 1 tonne.
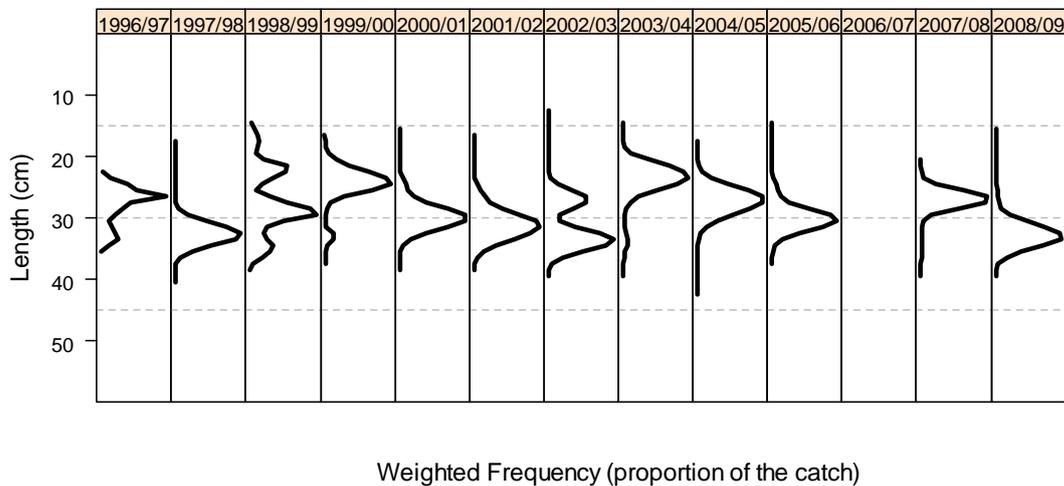
Figure 1:   Catch-weighted length frequencies for *Champsocephalus gunnari* in Division 58.5.2 (source: observer, fine-scale and STATLANT data). The plots include data from both the commercial fishery and research trawl surveys.

4.   With respect to the catch-weighted length frequencies in Figure 1, the Working Group recalled the apparent progression in the cohorts in Figure 1 from 1999/2000 to 2002/03, and noted a similar pattern evident from 2003/04 to 2005/06, and 2007/08 to 2008/09 but recalled that:

(i)   the length frequencies reflect lengths of fish in the catch and not the whole population;

(ii)   there is a minimum size limit for *C. gunnari* in this fishery of 240 mm to protect juvenile fish (younger than 2.5 years) and that, if the proportion of fish smaller than this size exceeds 10% in a haul, then the vessel must move to a new fishing area;

(iii)   the modal lengths will be dependent on the time of year in which the fishery was prosecuted and the potential density-dependent growth that might occur (SC-CAMLR-XX, Annex 5, Appendix D; WAMI-01/4);

(iv)   abundance of fish cannot be inferred from these plots;

(v)   the cohorts represented in these plots need to be interpreted from the survey data, which surveys the whole population.

2. Stocks and areas

5.   Within Division 58.5.2 this species is restricted to the shelf area in the vicinity of Heard Island in water generally shallower than 500 m. Previous analyses indicate that stocks on the Heard Plateau and Shell Bank have different size structures and recruitment patterns. In 1997, the Working Group agreed that in light of this the two areas should be treated as separate stocks for assessment purposes (see SC-CAMLR-XVI, Annex 5). *Champsocephalus gunnari* have been absent, or present in very low abundances, on Shell Bank over recent years. Due to their low abundance observed in the current year, no assessment has been conducted for the Shell Bank stock for the 2007/08 season.

3. Parameter estimation

3.1 Estimation methods

Standing stock

6.   The results of a bottom trawl survey in 2009 were summarised in WG-FSA-09/34. The survey had been undertaken according to the same design as in previous surveys for this region. Estimates of standing stock biomass for the Heard Island Plateau were made using the bootstrap procedure using the routine outlined in Appendix 1 of WG-FSA-09/33. The location of sample stations in relation to Heard Island and McDonald Islands is shown in Figure 2.
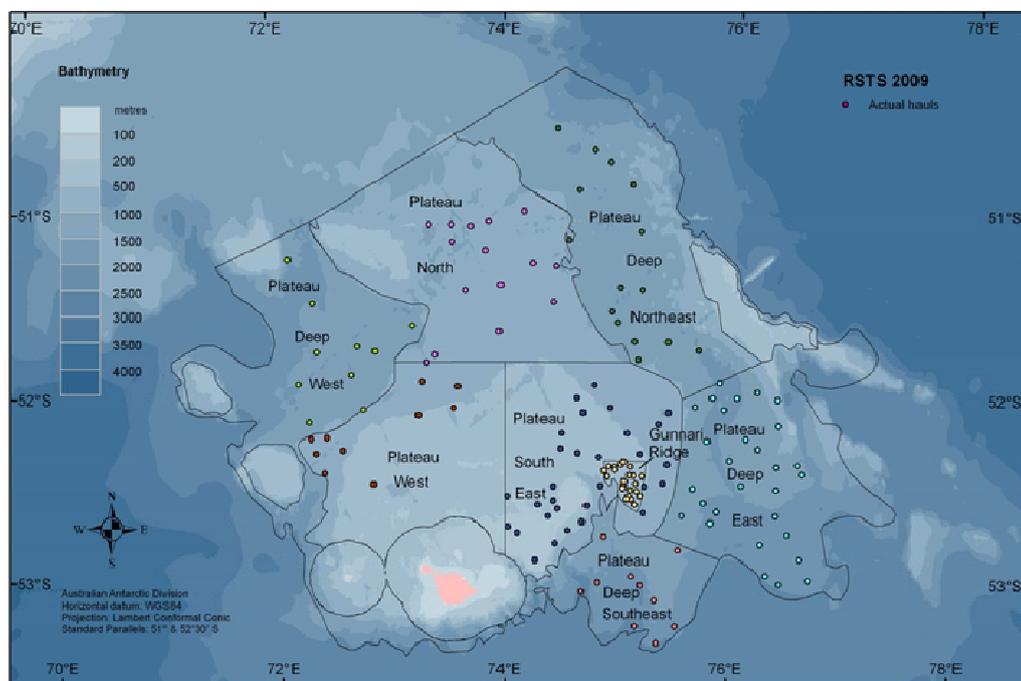

Figure 2:   Strata and sampling hauls from the 2009 random stratified trawl survey in Division 58.5.2 used in the 2009 *Champsocephalus gunnari* assessment. Points are locations of hauls, with 10 stations in Plateau West, 22 stations in Gunnari Ridge and 29 stations in Plateau Southeast used in the 2009 assessment of *C. gunnari*.

Population structure

7. The distribution of densities-at-age was derived using the CMIX program and selecting the mean length for ages 2, 3 and 4 by eye (Table 2). The Working Group noted that the 2007 to 2009 Australian bottom trawl surveys had sampled a large cohort, which now dominates the population structure in 2009 as the 3+ year class (Figure 3). Details of the fit are presented in Table 3.

Table 2: Input parameters for the CMIX analysis of *Champsocephalus gunnari* length density in Division 58.5.2.

| Parameter	Value
Size range included	180–390 mm
Bounds	Age 180: mm
	Age 2: 260 mm
	Age 3: 335 mm
SDs related linearly to the mean	Yes
Bounds on intercept (start, step)	1, 1.15 (1.05, 1.0)
Bounds on slope (start, step)	0.0, 0.055 (0.03, 0.005)
No. function calls	1 000
Reporting frequency	100
Stopping criteria	1E-6
Frequency for convergence testing	5
Simplex expansion coefficient	1
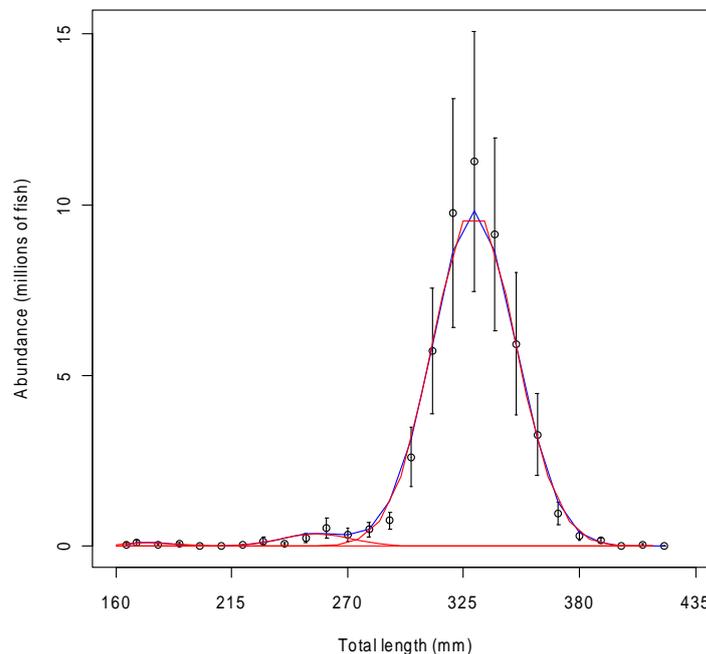
Figure 3: Size distribution of *Champsocephalus gunnari* from the 2009 random stratified trawl survey in Division 58.5.2 with standard errors. Cohorts were present in ages 1, 2 and 3. The plot is dominated by age-3+ fish.

Table 3:   Results generated from CMIX analyses for *Champsocephalus gunnari*
            in Division 58.5.2.

	Component 1 (age 1+)	Component 2 (age 2+)	Component 3 (age 3+)
Mean length (mm)	180	260	335
SD (mm)	11.0	15.5	19.6
Total density (numbers km^{-2})	15.7	68.7	2257.0
SD of component density	9.29	31.3	365.9
Sum of observed densities = 2409.97			
Sum of expected densities = 2340.85			
Intercept = 1.146			
Slope = 0.055			

Other parameters

8.   There were no changes to other parameter values.

3.2 Parameter values

Fixed parameters

9.   The fixed parameters remain unchanged from previous assessments (Table 4).

Table 4:   Fixed parameters used in the 2009 assessment of
            Champsocephalus gunnari in Division 58.5.2.

Component	Parameter	Value	Units
Natural mortality	M	0.4	y^{-1}
VBGF	K	0.323	y^{-1}
VBGF	t_0	0.275	y
VBGF	L_∞	457	mm
Length-to-mass	'a'	2.629E-10	kg/mm
Length-to-mass	'b'	3.515	

Standing stock

10.   Similar to last year, an estimate of standing stock biomass was calculated using the
bootstrap procedure. The area of seabed sampled and an estimate of the one-sided lower 95%
CI of biomass were calculated (Table 5).

Table 5: Seabed areas within three geographic strata used to bootstrap estimates of biomass. Nominal date of survey = 15 April 2009.

Stratum	Estimate	SE	Lower CI	Upper CI	One-sided lower 95% CI
Gunnari Ridge	4 731	1 286	2 587	7 467	2 856
Plateau SE	3 708	1 400	1 559	6 804	1 775
Plateau W	388	133	151	640	184
Pooled	8 827	1 944	5 442	12 939	5 893

Removals

11.   An estimated 15 tonnes of *C. gunnari* were caught following the survey (4 to 21 April 2009).

Initial age structure

12.   The proportion of density-at-age was derived from the CMIX program for ages 1+ to 3+. Modal lengths of the cohorts were estimated by eye in the case of the 3+ cohort, where bounds were set around this obvious mode, and the probable location of the 1+ and 2+ cohorts using the von Bertalanffy parameters (Table 6). Standard deviation of length-at-age was also estimated.

Table 6: Calculation of the proportion of biomass-at-age derived from the survey length-density distribution.

Age class	Mean length (mm)	Density (n km^{-2})	Mean weight (kg)	Proportion of biomass (%)
1+	180	15.7	0.022	0.001
2+	260	68.7	0.081	0.012
3+	335	2257.0	0.197	0.987

Selectivity

13.   A linear selectivity vector was used for *C. gunnari,* starting at 2.5 years and fully selected at age 3.

Recruitment

14.   The short-term projection of *C. gunnari* does not include recruitment data.

Proportion of biomass-at-age

15.   An estimate of the proportion of biomass-at-age was calculated and presented in Table 6. This demonstrates that the age-3+ cohort contributes the highest biomass of animals and is also the most abundant numerically.

4. Stock assessment

4.1 Model structure and assumptions

16.   The GYM, used routinely for the assessment of long-term yield of other species in the CAMLR Convention Area, configured to perform the short-term projection, was used.

Model configuration

Table 7:   GYM model configuration for the assessment of *Champsocephalus gunnari* in Division 58.5.2.

Category	Parameter	Values
Age structure	Plus class accumulation	10 years
	Oldest age in initial structure	11 years
Initial population structure	Age class density	See Table 2
Weight-at-age	Weight–length parameter – A (kg)	2.6×10^{-10} kg
	Weight–length parameter – B	3.515
Maturity	L_{m50} (set so that the status of the whole stock is being monitored)	0 mm*
	Range: 0 to full maturity	0 mm
Spawning season	Set so that status of the stock is determined at the end of each year	30 Nov–30 Nov
Fishery information	Upper bound to annual F	5
	Tolerance to finding F	1E-08
	Tolerance for resolving catches	0.01
Future projection	Age first selected	2.5
	Age fully selected	3.0
	Relative fishing effort	Date: 1 Dec, Effort: 1
2007	Selectivity varied from last	Yes
	Age first selected	2.5
	Age fully selected	3.0
	Relative fishing effort	Date: 1 Dec, Effort: 0
		Date: 15 Apr, Effort: 0
	Catch	15 000 kg
Simulation specifications	Number of runs in simulation	1

(continued)

Table 7 (continued)

Category	Parameter	Values
Individual trial specifications	Years to remove initial age structure	1**
	Year prior to projection	2008***
	Reference start date in year	1 Dec
	Increments in year	365
	Years to project stock in simulation	2
	Reasonable upper bound for annual F	5.0
	Tolerance for finding F in each year	0.000001

* Maturity is not used in the short-term projection. It is set to 0 to allow the GYM to monitor the whole population.
** Set to 1 since 15 tonnes were captured after the survey, else set to 0.
*** GYM requires first year of 2008/09 split-year.

Decision rules

17. To assess a catch level such that fishing should not, without any substantial risk, specified in this instance as no more than 5% probability:

reduce the spawning stock biomass to below 75% of the level that would occur in the absence of fishing within the two years following an abundance biomass estimate provided by a survey.

18. To achieve this, the one-sided lower 95% confidence bound of the biomass estimate is used as the starting point for the projection.

4.2 Model results

19. A single deterministic short-term projection of yield in 2009/10 (year 1) was calculated for the Heard Plateau and Gunnari Ridge. Yield estimates derived from the short-term projections for the 2009/10 season are:

Target fishing mortality rate (yr^{-1})	Yield (tonnes)	
	2009/10	2010/11
0.144	880	711

20. The Working Group recalled that the current strategy of spreading catch over two years, while meeting the escapement rule, was to provide for two years of spawning (SC-CAMLR-XVI, Annex 5). The Working Group noted that the 3+ cohort had been reproductively mature for one year and that following another year it was likely that the cohort would disappear (SC-CAMLR-XX, Annex 5, Appendix D, Figure 1). Further, the Working Group noted that the 2008 survey is likely to have underestimated the precautionary yield from this cohort in 2008/09, and therefore the escapement of these fish is likely to have been greater than 75%.

21.   The Working Group agreed that a strategy for fishing on the current 3+ year class could be similar to that applied in the 2005/06 season (SC-CAMLR-XXIII, Annex 5, Appendix M), allowing the catch to be taken in one year (2009/10) with the expectation of no exploitation of that cohort in the following year (2010/11). The Working Group recalled that due to the strong three-year cycle evident in the icefish population in Division 58.5.2, it is unlikely that there will be another sizeable cohort available to the fishery until after 2010/11. When estimated in a scenario based on all fishing in one year and no catch in the second year, the yield estimate for 2009/10 is 1 658 tonnes, with a fishing mortality of 0.288.

4.3 Sensitivity analyses

22.   No specific sensitivity analyses were undertaken at the meeting.

4.4 Discussion of model results

23.   The projection of fish of all age classes from 2007/08 gives a projected yield of 102 tonnes in the 2008/09 season and 96 tonnes in the 2009/10 season. Yield in the second year is similar due to the balance between growth and natural mortality of the single 2+ cohort dominating the population. Yield estimates may alter after 2009/10 following the survey planned in 2009, as small juveniles begin to be recruited to the survey gear.

4.5 Future research requirements

24.   The Working Group noted past recommendations that work on developing a management procedure for *C. gunnari* is a high priority (SC-CAMLR-XX, Annex 5, Appendix D). It also recommended that biological parameters and cohort progression be reviewed based on survey and catch data. The Working Group noted that considerations of environmental variables, predators and prey affecting the recruitment and natural mortality of icefish are likely to be productive areas for future research for developing assessments of icefish.

5. By-catch of fish and invertebrates

5.1 By-catch removals

25.   The total reported by-catch (tonnes) of fish taken in the trawl fishery for *C. gunnari* in recent years is indicated in Table 8 from fine-scale C2 data.

Table 8: Total reported by-catch (tonnes) for four species between 1995/96 and 2008/09 in the *Champsocephalus gunnari* trawl fishery. Limits apply to all fisheries in Division 58.5.2. LIC – *Channichthys rhinoceratus*; NOS – *Lepidonotothen squamifrons;* GRV – *Macrourus* spp.; SRX – rajids. (Source: fine-scale data)

Fishing season	LIC	Limit	NOS	Limit	GRV	Limit	SRX	Limit	Other	Limit
1995/96	0		0		0		0		0	5%*
1996/97	2		0		0		1		2	50**
1997/98	2	80	3	325	0		0	120	2	50
1998/99	1	150	0	80	0		0		0	50
1999/00	2	150	0	80	0		0		1	50
2000/01	1	150	0	80	0	50	0	50	0	50
2001/02	3	150	0	80	0	50	1	50	0	50
2002/03	21	150	0	80	0	465	20	120	5	50
2003/04	6	150	0	80	1	360	3	120	1	50
2004/05	34	150	0	80	0	360	5	120	3	50
2005/06	29	150	0	80	0	360	7	120	2	50
2006/07	3	150	0	80	0	360	0	120	0	50
2007/08	8	150	0	80	0	360	2	120	7	50
2008/09	7	150	1	80	0	360	7	120	8	50

* 5% move-on rule if individual haul exceeds 5%, limit not specified.
** Move-on rule if catch of any by-catch species exceeds 5% of target species.

5.2 Assessments of impact on affected populations

26. Insufficient information was available to update assessments.

27. No stock assessments of individual by-catch species were undertaken in 2009. By-catch limits of *Channichthys rhinoceratus* and *Lepidonotothen squamifrons* are based on assessments carried out in 1998 (SC-CAMLR-XVII, Annex 5, paragraphs 4.204 to 4.206) and by-catch limits of the grenadier *Macrourus carinatus* are based on assessments carried out in 2002 and 2003 (SC-CAMLR-XXII, Annex 5, paragraphs 5.244 to 5.249).

5.3 Mitigation measures

28. Conservation Measure 33-02 currently applies to this fishery. Move-on rules are included in the annual conservation measures established for this fishery (e.g. Conservation Measure 42-02).

6. By-catch of birds and mammals

29. Seabird by-catch in the fishery targeting *C. gunnari* in Division 58.5.2 remains low with zero observed seabird mortalities for the 2008/09 season (SC-CAMLR-XXVIII, Annex 7, Table 5).

Table 9: 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
2002/03	1309		2	2	2
2003/04	1215				
2004/05	1301		5	3	
2005/06	1086				
2006/07	936				2
2007/08	700				
2008/09	39				

30.   No incidents of marine mammal by-catch have been observed while fishing for *C. gunnari* since 2005/06.

31.   WG-IMAF assessed the level of risk of incidental mortality of seabirds in Division 58.5.2 as category 4 (average-to-high) (SC-CAMLR-XXVIII, Annex 7, Table 13 and Figure 2).

6.1 Mitigation measures

32.   The provisions of Conservation Measure 25-03 apply to this fishery.

7. Ecosystem implications/effects

33.   Bottom trawl and midwater trawl gear is used to target both *C. gunnari* and *Dissostichus eleginoides* in Division 58.5.2. The potential impacts of fishing gear on benthic communities are limited by the small size and number of commercial trawl grounds, a strategy of fishing trawling gear lightly, and the protection of large areas sensitive to the effects of bottom trawling (SC-CAMLR-XXIII, Annex 5, paragraph 5.211).

34.   Research is currently being undertaken by Australia to develop ecosystem models for the Heard Island Plateau, including *C. gunnari* and their main predators, which will subsequently be used to inform management strategy evaluations on the *C. gunnari* fishery (SC-CAMLR-XXVI/BG/6, paragraph 21).

8. Harvest controls and management advice

8.1 Conservation measures

35.   The limits on the fishery for *C. gunnari* in Division 58.5.2 are defined in Conservation Measure 42-02. The limits in force and the Working Group's advice to the Scientific Committee for the forthcoming season are summarised in Table 10.

Table 10: Limits on the fishery for *Champsocephalus gunnari* in Division 58.5.2 in 2008/09 (Conservation Measure 42-02) and advice to the Scientific Committee for 2009/10.

Element	Limits in force	Advice for 2009/10
Access (gear)	Trawling only.	Carry forward
Access (area)	Definition of area open for fishing.	Carry forward
	Chart illustrating area open (Annex 42-02/A).	Carry forward
Catch limit	102 tonnes	Revise to 1658 tonnes
Move-on rule	Move on if >100 kg caught of which >10% by number are less than minimum size (24 cm).	Carry forward
Season	1 December to 30 November	Same period
By-catch	By-catch rates as in CM 33-02 to apply.	Carry forward
Mitigation	In accordance with CM 25-03.	Carry forward
Observers	Each vessel to carry at least one scientific observer and may include one additional CCAMLR scientific observer.	Carry forward
Data	Ten-day reporting system as in Annex 42-02/B Monthly fine-scale reporting system as in Annex 42-02/B on haul-by-haul basis. Fine-scale reporting system as in Annex 42-02/B. Reported in accordance with the Scheme of International Scientific Observation.	Carry forward
Target species	*Champsocephalus gunnari* By-catch is any species other than *C. gunnari*.	Carry forward
Environmental protection	Regulated by CM 26-01. No offal discharge.	Carry forward

8.2 Management advice

36.   The Working Group recommended that the catch limit for *C. gunnari* in 2009/10 be no more than 1 658 tonnes, with the expectation that the catch limit in 2010/11 will be zero.

37.   The Working Group recommended that other measures in the conservation measure be retained.