CCAMLR's approach to data-limited exploratory toothfish fisheries: the trend analysis (2020).

CCAMLR Secretariat

16 March 2021

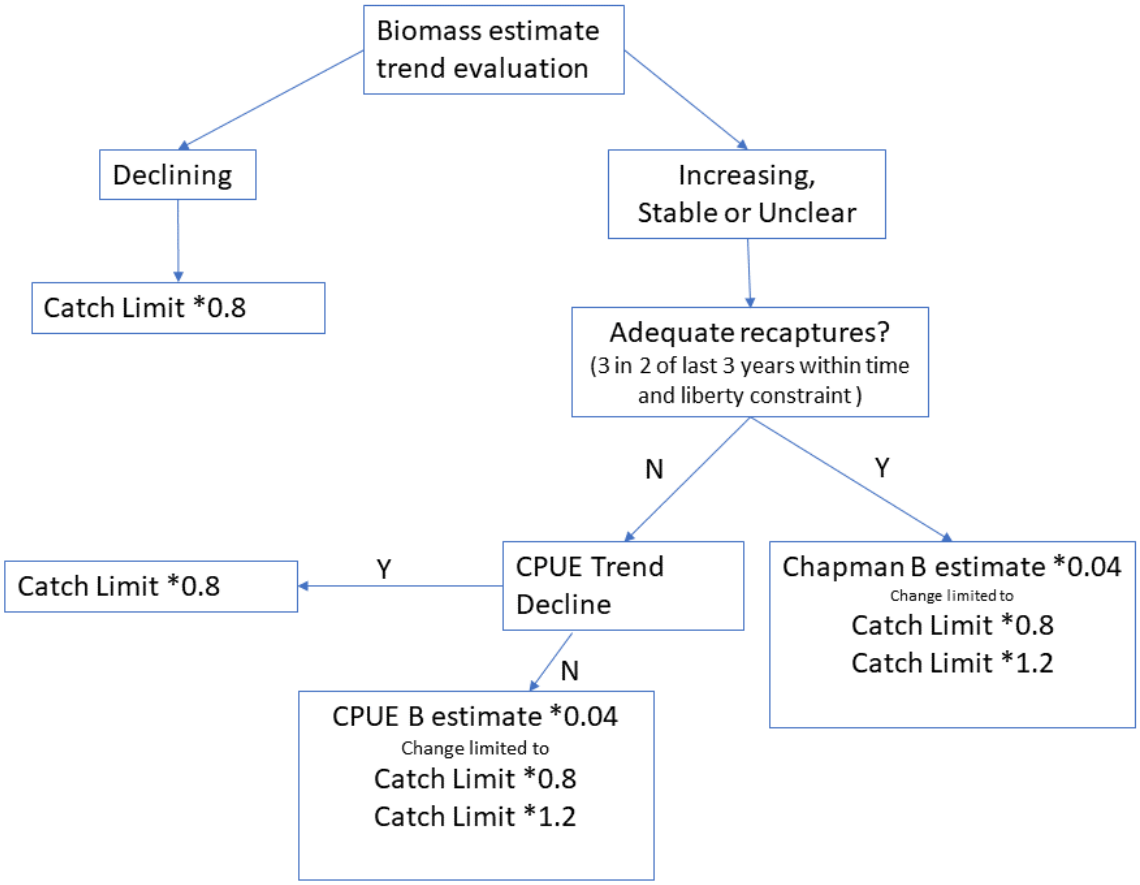

Figure 1: Schematic of the decision rules used to determine catch limits in data-limited fisheries.

Background

For data-limited toothfish fisheries in the Southern Ocean there are generally no fishery-independent data on the status of the stock. Therefore, the collection of such data is included in the CCAMLR management process that sets the requirements for vessels to participate in those fisheries.

Determining the appropriate catch limits in data-limited toothfish fisheries that allow sufficient data collection for stock assessments, but that do not place stocks at risk in the interim of having an assessment, is a widespread topic in fisheries generally and one that has been a longstanding issue for CCAMLR (SC-CAMLR-XXIX, paragraphs 3.128-3.129).

In 2016, CCAMLR agreed to an approach for estimating biomass in data-limited areas that uses two methods, the CPUE-by-seabed area analogy and the Chapman mark-recapture estimation (WG-SAM-16 paragraph 2.28).

In theory the two methods for biomass estimation should provide similar results, however, differences in estimates between methods may arise due to limitations in these methods (*e.g.*, these do not account for varying tag survival or fish migrations).

In 2017, CCAMLR (WG-FSA-17 paragraphs to 4.28 to 4.38) agreed that, where time-series of such biomass estimates are available, the trends in these estimates, as well as the most recent estimates of biomass, should be used to provide information on setting and/or changing catch limits.

CPUE-by-seabed area analogy

A central element that underpins any assessment is the estimation of the biomass of the target species in the proposed fishing area. While CCAMLR has a number of data-limited toothfish fisheries it also has data-rich fisheries that are assessed using an integrated assessment software (CASAL), and, information from these assessed fisheries is used to guide the assessment of data-limited fisheries.

In the absence of any fishing data from an area, an initial estimate of biomass can be obtained using the biomass estimated in an area that has an integrated stock assessment and applying the same density of fish to the fishable seabed area in the unfished area. This process enables an initial estimation of biomass in data-limited areas.

As fishing data becomes available this simple 'seabed area' approach can be scaled by the ratio of the Catch Per Unit Effort (CPUE; kg of fish caught per km of fishing line) in the assessed area to that in the data-limited area (*i.e.*, the CPUE-by-seabed area analogy method; Agnew et al., 2009) such that the biomass B can be estimated as:

$$B_x = \frac{C_x \times A_x \times B_r}{C_r \times A_r}$$

Where the subscripts x and r denote parameters from the research block and reference/assessed area respectively. C is the median of the haul by haul CPUE where the total catch (kg) on a line, including fish that are tagged and released, is divided by the length of line (km). A is the seabed area (km^2) in the depth range 600-1800m and B_r is the current biomass estimate (kg) from the most recent assessment in the reference area.

Chapman mark-recapture estimation

A requirement for participating in all CCAMLR data-limited toothfish fisheries is that fish are tagged and released at a rate of 3 to 5 fish per tonne such that mark-recapture data can be used to estimate the biomass using mark-recapture data (*i.e.*, the Peterson/Chapman estimation methods).

The Chapman mark-recapture-based estimate of biomass relies on the assumption that the ratio of tagged and untagged fish in the population is represented by that ratio in the catch. The biomass B in fishing season s can be estimated as:

$$B_s = \frac{C_s(n_{s-1} + 1)}{m_j + 1}$$

where n_{s-1} is the number of tagged fish available for recapture at the end of the previous fishing season, C_s is the catch in season s (as with CPUE the catch includes fish that are tagged and released) and m_j is the number of tagged fish recaptured in season s (excluding within-season recaptures).

Trend Analysis decision rules

A set of trend analysis decision rules were developed by the Working Group on Fish Stock Assessments (WG-FSA-17) to determine a catch limit for each research block in a data-limited fishery.

The first step in this process it to determine the current biomass from the most recent Chapman estimate where there were sufficient tag recaptures, which is defined as being at least three recaptures per year in at least two of the last three years (WG-FSA-17 paragraph 4.33). Where there were not sufficient tag recaptures the current biomass is taken as the most recent CPUE by seabed area estimate.

The time-series of biomass estimates from both methods are used to evaluate the trends in biomass. An inverse variance weighted least-squares regression is used to incorporate the confidence of each biomass estimate in the determination of the trend in the biomass time-series. In order to compare between trends across research blocks the standardized regression (*beta*) coefficient of the slope is estimated.

Each trend is then evaluated using a threshold of *beta*=0.1 so that the overall trend is determined to be:

- Decreasing (**D**) if either of the two trends is less than the negative threshold, and both trends are less than 0.
- Increasing (**I**) if either of the two trends is greater than the positive threshold, and both trends are greater than 0.
- Stable (**S**) if both trends are less than the positive threshold and greater than the negative threshold.
- Unclear (**U**) if one trend is greater than the positive threshold and the other is negative, or, if one trend is less than the negative threshold and the other positive.

In cases where there is not sufficient data to compute a trend in Chapman estimates, the overall trend would be determined to be Unclear. Following the trend evaluation, a decision process (Fig. 1) is used to determine the appropriate biomass estimate and associated catch limit at an exploitation rate of 4% of that biomass estimate. This process further includes a maximum change of +/- 20% in the catch limit between years in order to provide stability in the planning process.

The latest estimates obtained using this method are shown in Table 1 and a map of those research blocks is shown in Figure 2. Recommended catch limits are subject to approval by the Commission.

Table 1. Latest Research Blocks biomass (B, tonnes) and catch limits (CL, tonnes) estimated using the trend analysis. ISU: increasing, stable or unclear; D: declining; Y: Yes; N: No. Recommended catch limits are subject to approval by the Commission.

Subarea or Division	Research Block	Species	CL 2020	Trend decision	Adequate recaptures	CPUE Trend Decline	B	0.04xB	0.8xCL	1.2xCL	Recommended CL for 2021
48.6	486_2	*D. mawsoni*	140	ISU	Y	N	2697	108	112	168	112
48.6	486_3	*D. mawsoni*	38	ISU	N	N	706	28	30	46	30
48.6	486_4	*D. mawsoni*	163	ISU	Y	Y	13374	535	130	196	196
48.6	486_5	*D. mawsoni*	329	D	Y	Y	15975	-	263	395	263
58.4.1	5841_1	*D. mawsoni*	138	ISU	N	N	7672	307	110	166	166
58.4.1	5841_2	*D. mawsoni*	139	ISU	N	N	5291	212	111	167	167
58.4.1	5841_3	*D. mawsoni*	119	ISU	N	Y	4282	-	95	143	95
58.4.1	5841_4	*D. mawsoni*	23	-	N	-			18	28	
58.4.1	5841_5	*D. mawsoni*	60	ISU	N	N	4712	188	48	72	72
58.4.1	5841_6	*D. mawsoni*	104	ISU	N	Y	4596	-	83	125	83
58.4.2	5842_1	*D. mawsoni*	60	ISU	Y	N	6173	247	48	72	72
58.4.3	5843a_1	*D. eleginoides*	24	ISU	N	Y	1195	-	19	29	19
58.4.4	5844b_1	*D. eleginoides*	23	D	N	Y	342	-	18	28	18
58.4.4	5844b_2	*D. eleginoides*	18	D	N	Y	238	-	14	22	14
88.2	882_1	*D. mawsoni*	192	ISU	N	N	4866	195	154	230	195
88.2	882_2	*D. mawsoni*	232	ISU	Y	Y	4470	179	186	278	186
88.2	882_3	*D. mawsoni*	182	ISU	N	N	4247	170	146	218	170
88.2	882_4	*D. mawsoni*	128	ISU	Y	Y	8198	328	102	154	154
88.2	882H	*D. mawsoni*	160	ISU	Y	N	3015	121	128	192	128
88.3	883_1	*D. mawsoni*	16	ISU	N	Y	1289	-	13	19	13
88.3	883_2	*D. mawsoni*	20	ISU	N	Y	3247	-	16	24	16
88.3	883_3	*D. mawsoni*	60	ISU	N	N	5679	227	48	72	72
88.3	883_4	*D. mawsoni*	60	ISU	Y	N	2942	118	48	72	72
88.3	883_5	*D. mawsoni*	8	ISU	N	Y	103	-	6	10	6

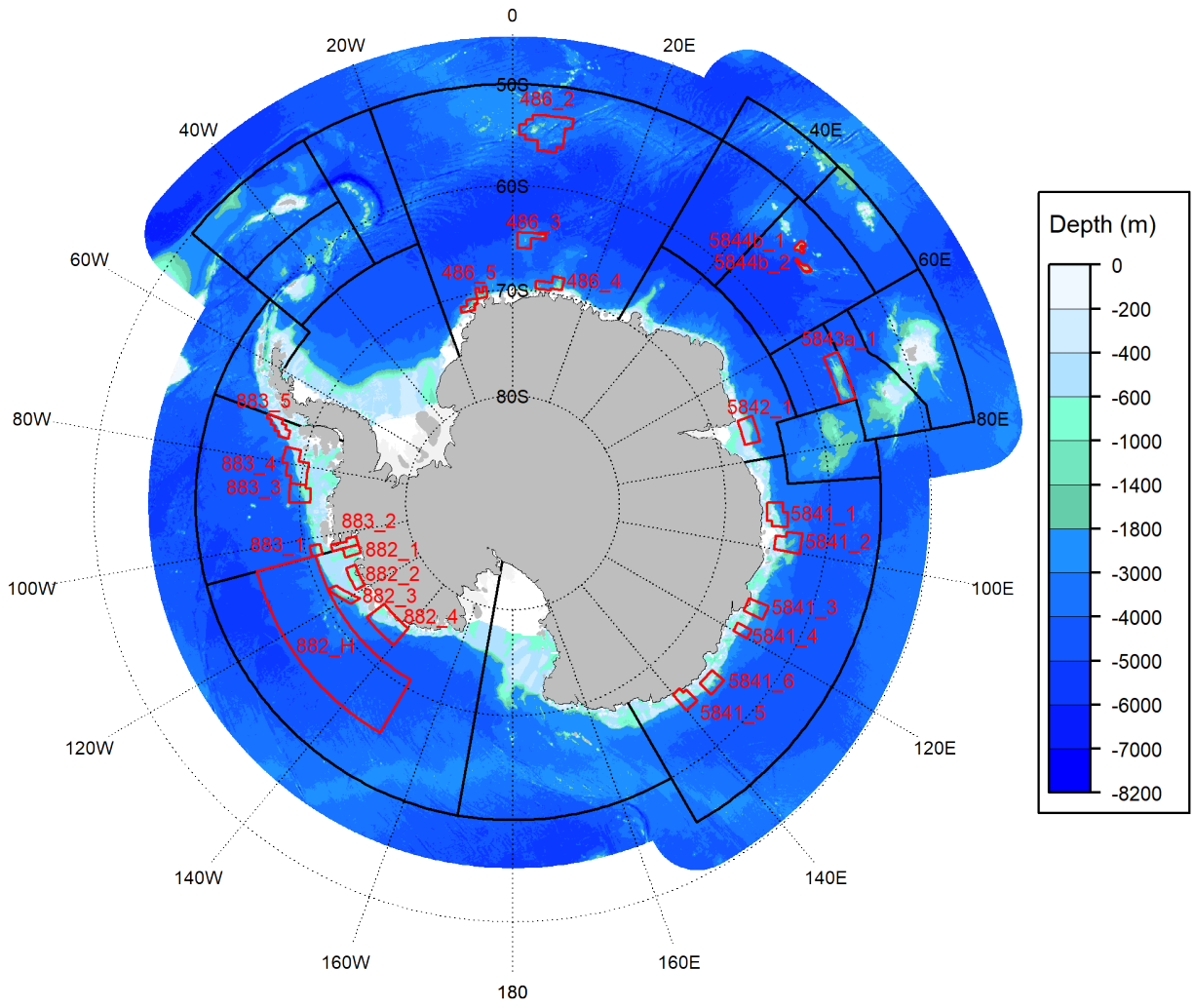

Figure 2: Location of the Research Blocks for which the trend analysis was last used. The fishable depth range (600m-1800m) is highlighted in shades of green.

Additional Resources

- Fishery Summary for Subarea 48.6: pdf, html
- Fishery Summary for Division 58.4.1: pdf, html
- Fishery Summary for Division 58.4.2: pdf, html
- Fishery Summary for Division 58.4.3a: pdf, html
- Fishery Summary for Division 58.4.4b: pdf, html
- Fishery Summary for Subarea 88.2: pdf, html
- Fishery Summary for Subarea 88.3: pdf, html
- Fisheries Documents Browser