**SC-04-INFO-08**

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# Management approaches to data-limited toothfish fisheries in CCAMLR

*Please note that National Reports and SC Working Group reports shall be classified as working papers*

*Relates to agenda item: 7.3 and 10* Working paper ☐ Info paper ☒


## Delegation of CCAMLR



## Abstract

In exploratory fishery, where there is no data with which to directly estimate the biomass of the stock being fished, there remains a need to determine precautionary catch limits. CCAMLR uses two approaches to estimate biomass of toothfish in data-limited areas; a comparative seabed-area approach and a mark-recapture estimate from toothfish tagging programme. In areas where both of theses methods have been applied a trend analysis approach is used to determine the most appropriate biomass estimation method to use. The catch limit is applied at 4% of the most recent biomass estimate unless the trend indicates a declining trend in biomass. Changes in catch limits are limited in the range -20% to +20% in order to provide relative stability in catches as research develops. The approaches taken by CCAMLR aims to determine catch limits that allow sufficient data collection to generate fully integrated stock assessments but that do not place stocks at risk in the intervening period.

**Management approaches to data-limited toothfish fisheries in CCAMLR**

Determining appropriate levels of catch in data-limited toothfish fisheries that allow sufficient data collection to generate fully integrated stock assessments but that do not place stocks at risk in the intervening period is a longstanding issue for CCAMLR (SC-CAMLR-XXIX, paragraphs 3.128-3.129).

CCAMLR has introduced a process for proposing and reviewing research in data-limited areas (see Parker et al 2013), a key part of which is the definition of "research blocks" that provide a geographic focus for all research fishing (Figure 1). A central element that underpins this process is the provisional estimate of biomass in the proposed research blocks. At the start of research, and in the absence of any fishing data from that research block, the biomass is estimated using a method that takes the biomass estimates in areas that have integrated stock assessments and assumes the same density of fish in the fishable seabed area in research block. As fishing data becomes available this simple "seabed-area comparison' approach can be scaled by the relative CPUE in the assessed area and the research block using the CPUE-by-seabed area analogy method sensu Agnew et al. (2009). For *D. mawsoni* the biomass estimate from the assessed fishery in the Ross Sea region is used as the reference area; for *D. eleginoides* the assessment from the Heard and Macdonald Island is used as this is the assessed fishery that is geographically closest to the current research blocks for this species (Figure 1).

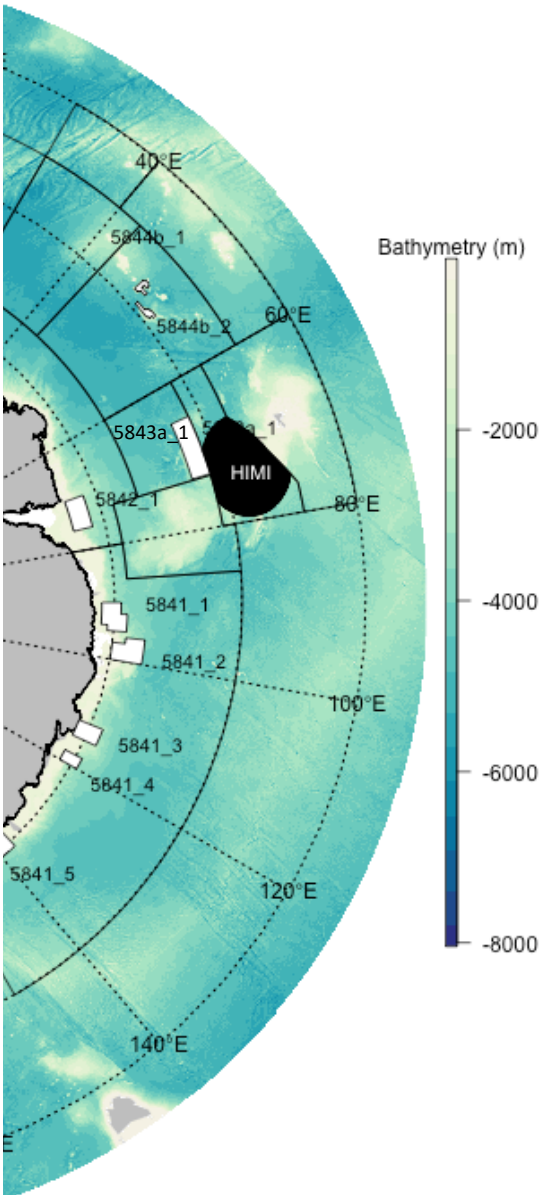


Figure 1. Location of research blocks (white) in data-limited toothfish fisheries in CCAMLR Subarea 58.4. The research blocks 5844b_1, 5844b_1 and 5843a_1 target *D. eleginoides* and the area of the assessed fishery reference area for these research blocks in the Heard and McDonald Islands (HIMI) is shown in back. Based on the GEBCO 2018 bathymetry data the fishable seabed area (seabed within the depth range 600–1800 m) of research blocks 5844b_1, 5844b_1 and 5843a_1 is 3526km$^2$, 5987 km$^2$ and 19923 km$^2$ respectively.

A requirement of all fishing for toothfish in the data-limited fisheries is that fish are tagged and released at a rate of between 3 to 5 fish per tonne in order that mark-recapture data can be used to estimate the biomass using the Peterson/Chapman estimation methods (Hillary 2009). The estimation of the biomass using the CPUE by seabed area method is intended for use until sufficient mark-recapture data becomes available at which time the tag-based biomass estimates would be the preferred option.

In order to provide a catch limit that will allow research fishing to be conducted, while taking account of the potential the risk to the stock, a 4 % exploitation rate is applied to the biomass estimates for each research block. This exploitation rate was agreed as a level that was unlikely to impede the recovery of stocks in areas that might have been exposed to unknown levels of historical fishing. In theory the different methods for biomass estimation should provide similar results, however, there are differences in estimates between methods that may be due to a systematic bias in the methods (including tag survival, migrations and other factors – see Figure 2). A key challenge for CCAMLR has been to determine which biomass estimate to use as a basis for determining a catch limit when there is a substantial difference in the estimates from the two methods.

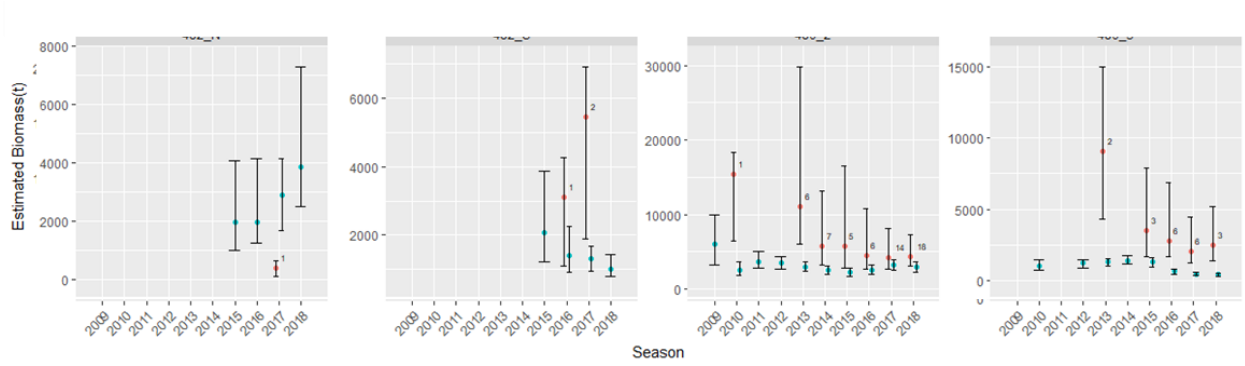


Figure 2 CPUE-by-seabed area (blue) and Chapman (pink) biomass estimates with bootstrapped confidence intervals for toothfish in four research blocks. Numbers of recaptures (excluding within season) are displayed adjacent to the Chapman estimates

In 2017 CCAMLR developed a set of decision rules to determine the catch limit for each research block in which the current biomass was taken as 4% from the most recent Chapman

mark-recapture estimate where there were adequate recaptures. Importantly 'adequate recaptures' was defined as being at least three recaptures per year in at least two of the last three years. Where there were not adequate recaptures the current biomass was taken as 4% of the most recent CPUE by seabed area estimate.

In order to provide a method to adjust catch limits based on revised biomass estimates as more data becomes available, but that also provides some stability in catch limits to facilitate research and planning CCAMLR applies a trend-based approach in which the time-series of biomass estimates for research blocks were used to evaluate the trend in biomass. An inverse variance weighted least-squares regression, using a bootstrapped variance of the biomass estimate for each year, was used to incorporate the variance of each biomass estimate in the determination of the slope in the biomass trend estimation.

Each trend was evaluated using the following process using a slope parameter threshold of 0.1 ( using the standardised regression (beta) coefficient of the slope estimates) so that the overall trend was determined to be :

> Decreasing (D) if either of the two trends was less than the negative threshold, and both trends were less than 0.
>
> Increasing (I) if either of the two trends was greater than the positive threshold, and both trends were greater than 0.
>
> Stable (S) if both trends were less than the positive threshold and greater than the negative threshold.
>
> Unclear (U) if one trend was greater than the positive threshold and the other was less than the negative threshold.

When the trend was Decreasing, the catch limit was reduced to 80% of the the most recent catch limit (Figure 3). When the trend was increasing, stable, or unclear, the catch limit was set to 4% of the most recent biomass estimate, using either the tag-based estimate (if recaptures are adequate) or the CPUE-based estimate (if recaptures were not adequate). Any change in the catch limit was restricted to the range 0.8 to 1.2 times the current catch limit in order to provide a

means to avoid potentially negatively impacting ongoing research through large variations in catch levels between years.

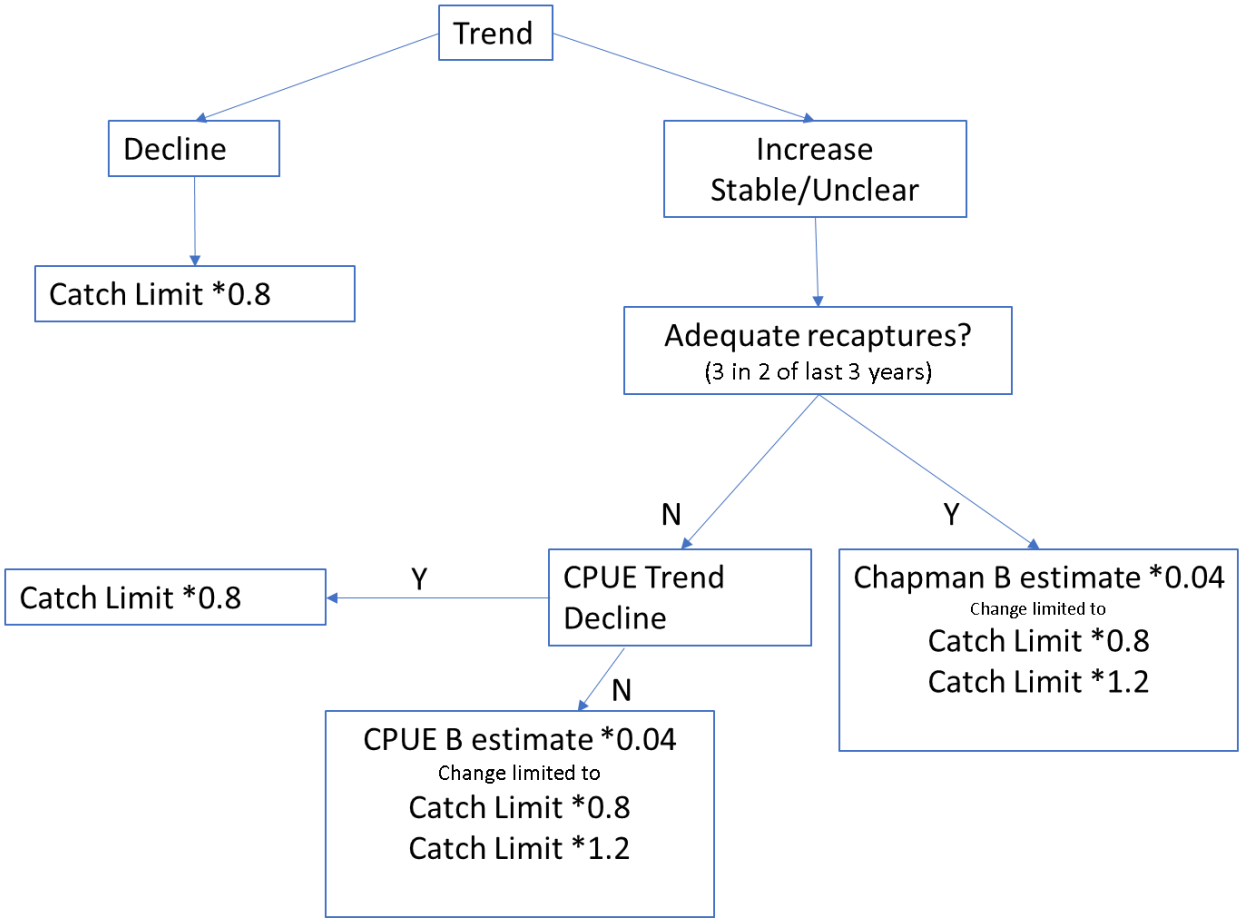


Figure 3. Decision process for the application of trend-based decision rules.

The outcome of the process (Table 1) for research block 1 was that there were adequate recaptures, so the biomass estimate was based on the Chapman mark-recapture estimate; however, as the trend was decreasing the proposed catch limit was set to 0.8 times the current catch limit. In research block 4 there were not adequate recaptures so the biomass estimate was based on the CPUE-by-seabed area method, 4% of which was 343 tonnes compared to a current catch limit of 228 tonnes. Accordingly the catch limit was increased but that increase was restricted to 1.2 times the current catch limit, i.e 274 tonnes (Table 1).

Table 1 Catch limits for research blocks (RB) in CCAMLR data-limited toothfish fisheries in 2018/19 based on trend-based decision rules.

| RB | Target Species | Adequate Recaps | B (t) | 0.04*B | Trend Decision | Current Catch limit (CL) | 0.8*CL | 1.2*CL | proposed catch limit (t) |
|---|---|---|---|---|---|---|---|---|---|
| 1 | *D. mawsoni* | Y | 4372 | 175 | D | 169 | 135 | 203 | 135 |
| 2 | *D. mawsoni* | Y | 2521 | 101 | D | 40 | 32 | 48 | 32 |
| 3 | *D. mawsoni* | Y | 8387 | 335 | D | 120 | 96 | 144 | 96 |
| 4 | *D. mawsoni* | N | 8569 | 343 | I.S.U | 228 | 182 | 274 | 274 |
| 5 | *D. mawsoni* | N | 6520 | 261 | I.S.U | 96 | 77 | 115 | 115 |
| 6 | *D. mawsoni* | N | 4497 | 180 | I.S.U | 97 | 78 | 116 | 116 |
| 7 | *D. mawsoni* | N | 3683 | 147 | I.S.U | 186 | 149 | 223 | 149 |
| 8 | *D. mawsoni* | N | 591 | 24 | I.S.U | 16 | 13 | 19 | 19 |
| 9 | *D. mawsoni* | N | 4004 | 160 | I.S.U | 42 | 34 | 50 | 50 |
| 10 | *D. mawsoni* | N | 4069 | 163 | I.S.U | 108 | 86 | 130 | 130 |
| 11 | *D. mawsoni* | N | 4585 | 183 | I.S.U | 42 | 34 | 50 | 50 |
| 12 | *D.eleginoides* | N | 470 | 19 | I.S.U | 20 | 16 | 24 | 19 |
| 13 | *D.eleginoides* | N | 298 | 12 | I.S.U | 28 | 22 | 34 | 22 |
| 14 | *D.eleginoides* | N | 1263 | 51 | I.S.U | 38 | 30 | 46 | 46 |

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Summary

Data-limited exploratory toothfish fisheries in CCAMLR have a specific geographic focus in ‘research blocks’ and all follow  a detailed research that is endorsed by the Scientific Committee and Commission. A transparent process to estimate biomass using different approaches has been agreed as has a procedure to determine the most appropriate biomass estimate to use as a basis for setting a catch limit for future research.

Further details and the evolution of approaches to managing exploratory fisheries can be found particularly in the reports of CCAMLR’s Working Groups on Fish Stock Assessment (WG-FSA https://www.ccamlr.org/en/meetings/20) and Statistics, Assessment and Modelling (WG-SAM https://www.ccamlr.org/en/meetings/21).

References

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