

A CHECK OF OPERATING MODEL PREDICTIONS FROM THE VIEWPOINT OF IMPLEMENTATION OF THE MANAGEMENT PROCEDURE IN 2022

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Abstract: We examined observations of input index/data (core vessels longline CPUE, close-kin mark recapture data) for the Cape Town procedure (CTP) comparing to the 2019 operating model (OM) prediction. These examinations indicate that all the observations are consistent with the predicted ranges from the 2019 OM. Regarding the input index/data for the CTP, therefore, there is no evidence to support a declaration of Exceptional Circumstances. As there is no estimate available from genotyping in 2022, with respect to recruitment, the age 1 trolling index was checked. There is no considerable current recruitment decline to declare Exceptional Circumstances. Accordingly, regarding a decision on implementation of the recommended TAC (17,647 t, calculated by the CTP in 2020 to be applied to the 2021-2023 fishing seasons) for the 2023 season, it is concluded that no modification of the value of this TAC is required because: 1) there is no conclusive evidence to support a declaration of Exceptional Circumstances from the viewpoints of a check of the OM predictions and other potential factors (the extent by which the total reported global catch exceeds the TAC, unaccounted mortality, results of stock assessment conducted in 2020 and OM reconditioning in 2022, potential change in operation pattern of Indonesian longline fleet); and 2) no unexpected change has been detected in the fisheries' indicators examined. Additionally, we also review the metarules process which was done at the OMMP12 meeting in June 2022 to consider validity of operation of the CTP using the new CPUE series based on generalized additive model ("new GAM") regarding a TAC recommendation for the 2024-2026 seasons. This paper continues to follow the conclusion from the OMMP12 that, using the new GAM series along with other currently available information as inputs, the CTP can be applied as it was adopted in 2019 to provide TAC advice for the 2024-2026 seasons.

要旨： ケープタウン方式 (CTP) の入力指数/データ (コア船はえ縄 CPUE、近縁遺伝子標識再捕データ) の観測値を 2019 年のオペレーティングモデル (OM) の予測値と対比させて精査した。この精査では全ての観測値が 2019 年の OM の予測範囲と矛盾しないことを示している。したがって、CTP の入力指数/データに関しては、例外的状況の宣言を支持する証拠はない。遺伝子標識からの 2022 年の推定値は欠損することから、加入状況に関しては 1 歳魚の曳縄指数を確認した。例外的状況を宣言するような重大な現在の加入の減少はない。これらに基づき、2023 年漁期に対して勧告された TAC (2021-2023 年漁期に適用するため 2020 年に CTP によって算定された 17,647 トン) の実施の決定に関して、この TAC 値の変更は必要ないと判断される。理由は以下の通り：1) OM 予測の確認ならびにその他の可能性のある要因 (総報告全球漁獲が TAC を超過する程度、未考慮死亡および 2020 年に実施された資源評価ならびに 2022 年に実施された OM 再条件付けの結果、インドネシアはえ縄船団の操業パターン変化の可能性) の観点から例外的状況の宣言を支持する決定的な証拠がないこと；2) 精査した漁業指標に予期せぬ変化がなかったこと。上記に加えて、2024-2026 年漁期の TAC 勧告に関して、一般化加法モデルに基づく新たな CPUE シリーズ ("new GAM") を用いた CTP の計算の妥当性を検討するために 2022 年 6 月の OMMP12 会合で行われたメタルールプロセスについてもレビューする。本文書でも、他の現在入手可能な情報とともに new GAM シリーズを入力データとして、2024-2026 年漁期の TAC 勧告を提供するため、2019 年に採択された設定のまま CTP を適用できるという OMMP12 の結論を踏襲する。

1. Introduction

Since 2011, the Commission for the Conservation of Southern Bluefin Tuna (CCSBT) has used

a management procedure (MP) to guide the setting of the global total allowable catch (TAC) for southern bluefin tuna (SBT; *Thunnus maccoyii*). The previous MP ("Bali procedure") was replaced with a newly developed and adopted MP ("Cape Town procedure (CTP)") in 2019. The CTP was developed because of cessation of the scientific aerial survey in 2018 which had provided an index of recruitment required for the input to the Bali procedure. The CTP was used to recommend a TAC for the 2021-2023 seasons in 2020. This year (2022), the CTP is applied to recommend a TAC for the 2024-2026 seasons.

The CTP was adjusted (tuned) and tested to achieve the management objective¹ under certain assumptions/predictions about SBT stock and fishery. Thus, it is essential to check whether the current status of SBT stock falls within the range predicted when the CTP was developed in 2019, and whether any of the assumptions made then have subsequently been shown to be invalid. As a part of the "metarules" process for the MP (CCSBT 2012²), the Extended Scientific Committee (ESC): (1) annually reviews stock and fishery indicators, and any other relevant data or information on the stock and fishery; and (2) every three years conducts an in-depth stock assessment. Then, on the basis of (1) and (2) above, the ESC determines whether there is evidence for Exceptional Circumstances. If the ESC agrees that Exceptional Circumstances exist, then the ESC will (1) determine the severity of the Exceptional Circumstances; (2) formulate advice on the action required depending upon the severity; and (3) report to the Extended Commission (EC) that Exceptional Circumstances exist and provide the advice mandated in such an eventuality.

One of the most important criteria used to determine the existence of Exceptional Circumstances is whether input index/data (observations) for the CTP are outside the predicted (projected) range for which the CTP was tested, where this "range" is defined as the 95% probability intervals for projections for the index/data in question made using the reference set of operating models (OMs) during the testing of the MP (CCSBT 2012). The Japanese core vessels longline CPUE (Itoh and Takahashi 2022a), absolute abundance estimate (for 2-year old SBT) and the number of matches from the gene-tagging (GT) project (Preece and Bradford 2022), and parent-offspring pairs (POPs) and half-sibling pairs (HSPs) data from the close-kin mark recapture (CKMR) project (Farley et al. 2022) are originally necessary inputs for the CTP (Hillary et al. 2020a). As CPUE input for the CTP, the core vessels CPUE is replaced with a newly developed CPUE series in 2022 due to technical problems recognized in the core vessels CPUE (CCSBT 2022). The new CPUE series is based on standardization by generalized additive model (GAM) and all vessels data whereas the

¹ The CCSBT management objective is to rebuild the stock to the reference point of 30% of the pre-exploitation spawning stock biomass by 2035 with a 50% probability.

² The technical specifications of the CTP are available from <http://www.ccsbt.org/>.

core vessels CPUE has been standardized by generalized linear model (GLM) (Itoh and Takahashi 2022b).

In this paper, the Base case (reference set) OM prediction done in 2019 is compared to the most recent observations of the input index/data for the CTP to check whether these index/data are within the range predicted by the OM projection. As this check is done regarding the TAC recommended for 2023 (2021-2023 seasons) in 2020 using the core vessels CPUE for the CTP, we focus on the core vessels CPUE in this examination. Based on this examination, the possible occurrence of Exceptional Circumstances and its severity are discussed along with other factors that are also related to the possibility of the occurrence of Exceptional Circumstances. In addition, we also review the metarule process which was done at the 12th Operating Model and Management Procedure technical meeting (OMMP12) in June 2022 to consider validity of operation of the CTP using the new GAM-based CPUE series ("new GAM") regarding a TAC recommendation for the 2024-2026 seasons.

2. Japanese core vessels longline CPUE index

When the core vessels observed longline CPUE indices, "w0.8" and "w0.5", are used for input to the CTP, the average of the two is calculated. This averaged CPUE index for 2021 barely lies within the 95% probability intervals for the Base case OM predictions conducted in 2019 (Fig. 1). It should be noted that the core vessels CPUE values between 2018 and 2020 were lower than that calculated last year. This is due to that the subsequent addition of data changed values of these years.

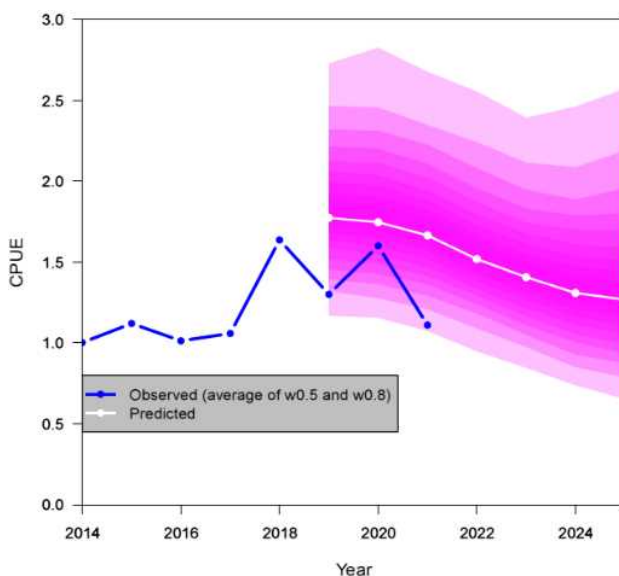


Fig. 1. The average of the two core vessels' longline CPUE series, "w0.5" and "w0.8", observed over 2014-2021 (blue line with points) and the future index as projected in 2019 from 2019 to 2025 for the "Base case" ("reference set") OM, where the white line with points is the median projected CPUE, and the purple shades

represent percentiles from 2.5% to 97.5% in increments of 5%.

3. Abundance for 2-year old SBT estimated from the gene-tagging (GT)

Absolute abundance estimates for age 2 SBT obtained from the GT are used as a recruitment indicator in the CTP. Currently, four estimates are available for age 2 SBT of 2016, 2017, 2018, and 2019 (Preece and Bradford 2022). The CTP uses the number of matches and the abundance estimates for age 2 in TAC calculation (as the 5-year average weighted by the number of matches; Hillary et al. 2022b).

There is not an estimate of age 2 abundance (for 2020) available this year, because the 2020 tagging field work was cancelled due to COVID-19 restrictions, poor weather conditions and difficulty finding fish (Preece and Bradford 2022). Thus, comparison could not be made this year, and condition is the same as last year (2021), i.e., the abundance estimate for age 2 SBT and the number of matches for 2019 lie within the 95% probability intervals for the Base case OM predictions in 2019 (Fig. 2).

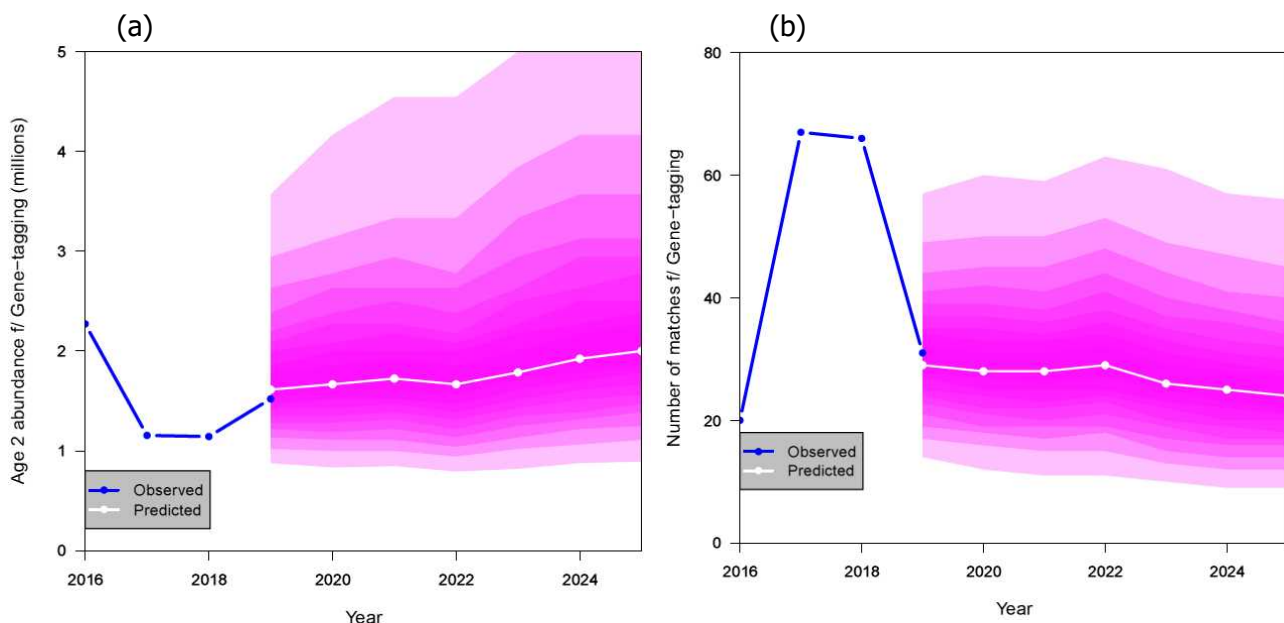


Fig. 2. The age 2 SBT abundance estimate (a) and the number of matches (b) for 2019 from last year's (2021) gene-tagging (GT) analysis, and the future abundance estimates and numbers of matches as projected in 2019 from 2019 to 2025 for the "Base case" ("reference set") OM, where the white lines with points are the medians, and the purple shades represent percentiles from 2.5% to 97.5% in increments of 5%.

4. Data from the close-kin mark recapture (CKMR)

Parent-offspring pairs (POPs) and half-sibling pairs (HSPs) data from the CKMR are used to estimate time series of spawning stock abundance in the CTP (Hillary et al. 2022b). Fig. 3 compares observed CKMR data available in 2022 (Farley et al. 2022) and the predicted 2022 CKMR data from the 2019 OM. The observed CKMR POPs and HSPs data fall within the

predicted range from the 2019 OM.

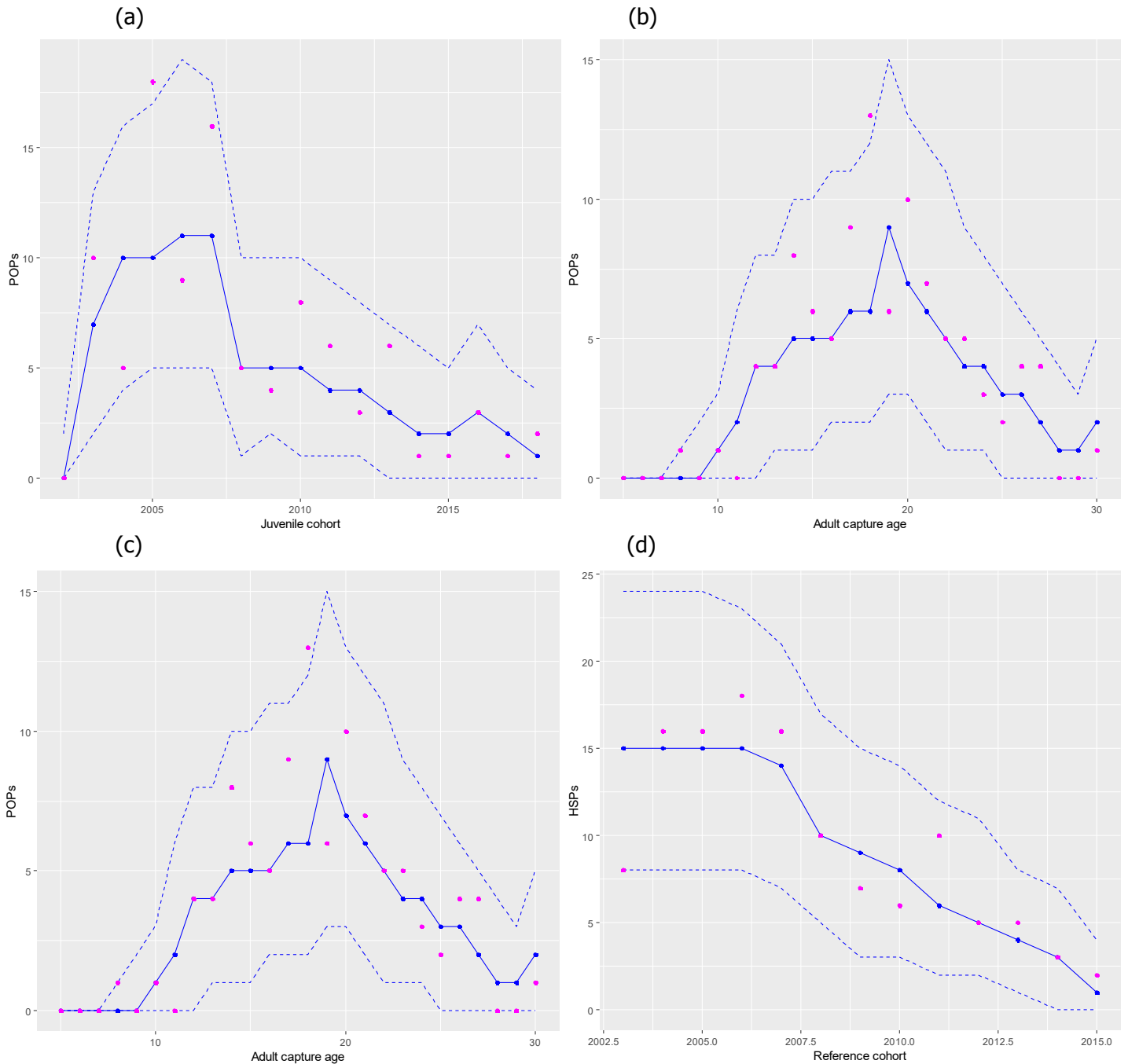


Fig. 3. Observations (magenta points) available in 2022 and predictions (blue solid and dashed lines indicate the median and 95% probability intervals) from the 2019 OM of CKMR POPs and HSPs data. POPs aggregated by juvenile cohort (a), POPs aggregated by adult capture age (b), POPs aggregated by adult capture year (c), HSPs aggregated by the initial (reference) cohort level (d), and total matches of POPs and HSPs (e).

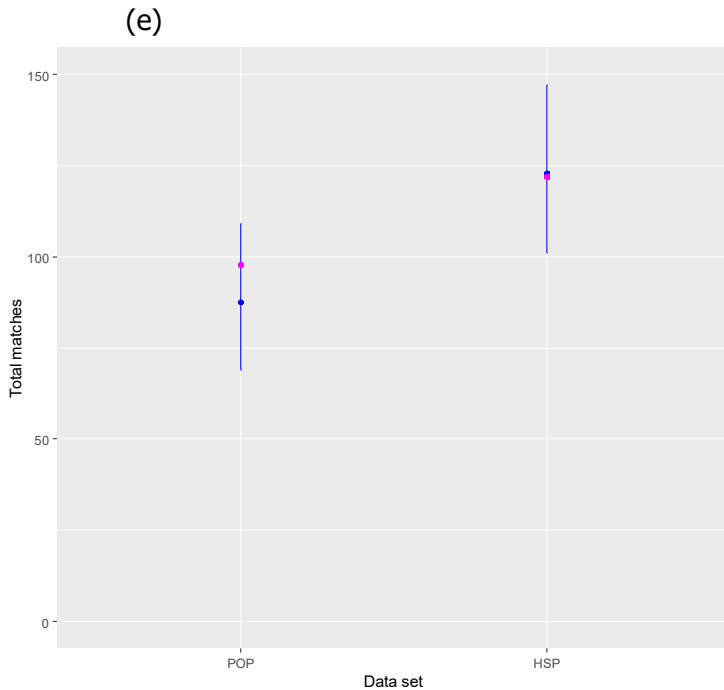


Fig. 3 (cont'd). Observations (magenta points) available in 2022 and predictions (blue solid and dashed lines indicate the median and 95% probability intervals) from the 2019 OM of CKMR POPs and HSPs data. POPs aggregated by juvenile cohort (a), POPs aggregated by adult capture age (b), POPs aggregated by adult capture year (c), HSPs aggregated by the initial (reference) cohort level (d), and total matches of POPs and HSPs (e).

5. Discussion and conclusion

TAC for 2023 (recommended for the 2021-2023 seasons in 2020)

We examined observations of input index/data available in 2022 (core vessels longline CPUE, CKMR POPs and HSPs) for the CTP comparing to the 2019 OM prediction in sections 2 and 4 above. These examinations indicate that all the current observations are consistent with the predicted ranges from the 2019 OM (Fig. 1 and 3). Regarding the input index/data for the CTP, therefore, there is no evidence to support a declaration of Exceptional Circumstances.

There is no estimate of age 2 abundance available from the GT in 2022, and consequently comparison between the current observation of age 2 abundance and the prediction from the 2019 OM could not be made this year (above). As such, with respect to recruitment status, we checked the age 1 recruitment index from the trolling survey ("grid-type trolling index (TRG)"; Itoh 2022). Although the recent trend shows somewhat a low recruitment level from 2017 to 2022, there is no considerable current recruitment decline detected to declare Exceptional Circumstances.

Muscle tissue samples of adult SBT collected for the CKMR in the 2019/20 and 2020/21

spawning seasons are currently in Bena, Indonesia, as transportation of the samples to Australia was prevented due to COVID-19 travel restrictions and delays in renewing the Implementing Agreement between CSIRO and AMAFRHR for the monitoring program (Farley et al. 2022). Consequently, there is no sequencing data available in 2022 for kin-finding analysis. Furthermore, targeted sampling of adult SBT did not occur at the Bena Fishing Port in the 2021/22 season due to disruptions caused by institutional changes in Indonesia, and collection of additional 1500 tissue samples in 2022/23 is proposed to compensate for the lack of the sampling in 2021/22 (Farley et al. 2022). In the 2019 OM for testing the CTP, it was assumed that "analysis of data" from the CKMR for finding POPs would be done as scheduled. Given improved stock status in recent years (below) and identification of additional POPs using new juvenile data from the 2019/20 season, the current situation can be considered not serious for the CKMR POPs. Therefore, we just raise a flag and note that these have the potential to become evidence for Exceptional Circumstances in the future if the situation is not improved. We anticipate that the 2019/20 and 2020/21 samples are sent from Indonesia to Australia in September 2022.

In addition to those input index/data for the CTP, the following factors are considered to check whether there is possible evidence for Exceptional Circumstances: 1) the extent by which the total reported global catch exceeds the TAC (the overcatch of the TAC); 2) unaccounted mortality (UAM); and 3) current stock status information from in-depth stock assessment/updated OM reconditioning and future projections; 4) potential change in operation pattern of Indonesian longline fleet.

When testing the CTP in 2019, the assumption was made that TACs would not be exceeded in future years. The recent reported catches in 2017, 2018, 2019, 2020, and 2021 were under the global TAC by 535 t, 399 t, 505 t, 1426 t, and 1030 t (tentative), respectively (CCSBT Secretariat 2022). Accordingly, this does not provide evidence for Exceptional Circumstances.

The CTP was developed and tested considering non-cooperating Non-Members (NCNM) UAM (i.e., the "MP approach", see paragraph 53 in CCSBT (2016)), and thus it is not necessary to care NCNM UAM as far as its scale is smaller than that was assumed when the CTP was tested in 2019. The amount which is equal to a 10% of LL1 catch was assumed as NCNM UAM in the OM. A 10% of the quota for LL1 (Japan, New Zealand, Korea, European Union, and South Africa longlines) for 2022 is approximately 890 t. The average actual estimate for NCNM UAM over 2007 to 2017 ranges 94 t to 648 t, depending on estimation method (GLM or Random Forest) and catchability (of Japanese or Taiwanese longlines) used (Edwards et al. 2020). On average, the actual scale of the estimates for NCNM UAM is smaller than the assumed, and accordingly does not seem to provide evidence for Exceptional

Circumstances. However, yearly estimates of longline effort for NCNM UAM appear to increase recent years (Edwards and Hoyle 2022), and thus the ESC should continue to keep a careful watch on changes of the scale of NCNM UAM.

Most of the key stock status summary ratios resulted from the 2020 stock assessment are improved compared to the last (2017) assessment (e.g., median relative Total Reproductive Output, TRO, is 0.13 in 2016 and 0.20 in 2019) (CCSBT 2020, Hillary et al. 2020b). In addition, although it was not a comprehensive stock assessment, reconditioning of the OM conducted in the 2022 OMMP12 using the new GAM CPUE series and updated data indicates further improvement of the stock (e.g., median TRO is 0.22 in 2021; CCSBT 2022, Hillary et al. 2022a). Future projections based on this reconditioning show that the CTP reaches a median TRO depletion of 0.28 with a probability of 0.50 by 2035, which is still within an acceptable range of achieving the interim management objective of a median TRO depletion of 0.30 by 2035. Thus, there is no evidence for Exceptional Circumstances with respect to updated stock status.

A large portion of catch by Indonesian longline fleet has been from Area 1 since 2011 (Indonesia 2022, Setyadji et al. 2022). In 2021, however, catch in Area 2 considerably increases compared to that in Area 1. This may indicate some potential change in operation pattern of Indonesian longline fleet. Indonesian fishery has been assumed to operate mainly in SBT spawning ground (Area 1) in the OM. Although this change in operation pattern does not immediately affect the OM, we raise a flag with respect to future Exceptional Circumstances. Future changes in operation pattern of this fleet should continue to be monitored along with an effort for resolving the uncertainty associated with the size and age composition of this fishery (Farley et al. 2021).

Regarding a decision on implementation of the recommended TAC (17,647 t, calculated by the CTP in 2020 to be applied to the 2021-2023 fishing seasons) for the 2023 season, it is therefore concluded that no modification of the value of this TAC is required because: 1) there is no conclusive evidence to support a declaration of Exceptional Circumstances related to the factors discussed above; and 2) no unexpected change has been detected in the fisheries' indicators examined (Patterson 2022, Takahashi and Itoh 2022).

Validity of operation of the CTP and TAC recommendation for the 2024-2026 seasons

At the OMMP12 meeting in June 2022, based upon the results from the OM reconditioning with updated data and future projections, metarules process was applied regarding validity of operation of the CTP for TAC recommendation for the 2024-2026 seasons, and advice to the ESC was discussed (CCSBT 2022). Note that the new GAM CPUE series was used in both the reconditioning and future projections with the CTP.

The OMMP group confirmed the following points for evaluating the consequences of the use of the new GAM series (CCSBT 2022): the new GAM series was within the bounds of the projections conducted in 2019 (when the CTP was adopted) using the core vessels series; the bounds of the TRO projections with the CTP using the new GAM series and updated data overlapped substantially with those of the 2019 projections; the interim rebuilding target ($\Pr(\text{TRO}/\text{TRO}_0 > 0.20) = 0.70$ by 2035) agreed in 2011 (when TAC advice based on the MP commenced) has been met with a 0.87 probability; although some increase was estimated for 2020, the estimates of unreported longline effort by NCM fleets were generally consistent with previous estimates (Edwards and Hoyle 2022), and thus increase was not sufficiently large to trigger Exceptional Circumstances with respect to UAM.

Based on metarule evaluations of the points above, the OMMP group agreed that: retuning of the CTP is unnecessary; using the new GAM CPUE series along with other currently available information as inputs, the CTP can be applied as it was adopted in 2019 to provide TAC advice for the 2024-2026 seasons (CCSBT 2022). In this paper, we continue to follow these conclusions from the OMMP12.

The code of the CTP and input data for TAC calculation is available to CCSBT members. We ran the code and could obtain 20,647 t that is same as in Hillary et al. (2022b), which is a maximum of 3,000 t increase from previous TAC.

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