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Evaluation of the extension of the modified swordfish harvest strategy to 2026

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1 Summary

A modified harvest strategy for broadbill swordfish was adopted in 2022 to account for significant undercatch. The modified harvest strategy assumed undercatch to continue until 2024 and cease thereafter. In 2023, the Tropical Tuna Ressource Assessment Group (TTRAG) requested that the modified harvest strategy be re-tested for an extension of the undercatch period to 2026. This report presents the outcomes of this re-testing of the modified harvest strategy. In summary, the performance of the modified harvest strategy remained unimpacted by the extension of the undercatch period to 2026. Total Allowable Commercial Catches (TACC) were maintained at a higher level by taking the undercatch into account when setting Recommended Biological Commercial Catch (RBCC) while still meeting management objectives.

2 Introduction

A modified version of the harvest strategy (HS) for broadbill swordfish was tested and adopted in 2022 (Hillary, 2022) to account for an extended period of undercatch experienced by the fishery since 2019 (cf. catch well below the TACC). As these undercatch levels had not been tested in the recent Management Strategy Evaluation for the fishery (Hillary, 2020), the TTRAG had agreed that they represented exceptional circumstances. Under the modified harvest strategy, the harvest control rule was updated such that any recommended reduction in catch would first account for the projected undercatch. The adoption of the modified harvest strategy resulted in TACC levels remaining constant at 1,047t for 2022 and 2023.

The undercatch has been caused in part by a change in economic conditions including but not limited to those brought about by the COVID-19 pandemic. The undercatch was initially expected to resolve itself once economic conditions returned to normal, and so the modified version of the harvest strategy tested by Hillary (2022) projected an undercatch extending to 2024 but ending thereafter. However, it is still unclear at this stage whether the undercatch will have resolved itself by 2025 when the TACC for 2026 will need to be set. As such, TTRAG 38 requested that the modified harvest strategy be re-tested with an undercatch period further extending to 2026.

This report presents the outcomes of this updated testing of the modified harvest strategy. The projections were revised with the latest catch, TACC and CPUE time-series for broadbill swordfish (up to 2022; Tremblay-Boyer et al. 2023), with an undercatch period now extending for an additional two years to 2026. Catch, CPUE, spawning biomass depletion, recruitment and TACC were projected to 2030 to verify whether the modified harvest strategy was able to meet management objectives under an extended undercatch period.

3 Methods

The testing of the extended modified harvest strategy followed the procedure outlined by Hillary (2022), namely the operating model framework developed as part of the 2020 MSE was used to project future conditions, the TACC was updated using the modified harvest control rule tested in 2022 (Figure 1), and predicted CPUE was compared against management objectives.

The operating model used was the reference case MSE scenario (*noDW2N*; Hillary, 2020) whereby the Northern Distant Water fishery in area 2 was removed, and there was no move-

ment between areas 1 (i.e., the ETBF area) and 2. Three steepness values were used (0.65, 0.8 and 0.95) and the mortality-at-age vector was set to the 'base' configuration from Hillary (2020). Similar to Hillary (2022), a low recruitment period was implemented between 2017 and 2020 with recruitment set to 50% of the default value. Note that this recruitment period was not prolonged further based on the signal in the size distribution data indicating an increase in the prevalence of recruit-sized individuals in the catch (Tremblay-Boyer and Williams, 2023).

Model projections covered the years 2016 to 2030, with the harvest strategy starting in 2023. Catches, TACC and CPUE were fixed to observed values up to 2022 (2022 being the last year with catch and standardised CPUE records; Tremblay-Boyer et al. 2023). Catches for the undercatch period were fixed at 600t annually as in Hillary (2022), and TACCs were set to the value of the RBCC for all projection years. Three scenarios were used:

- An undercatch period spanning 2023 to 2024 using the modified HCR to set TACCs (i.e. updating Hillary 2022's analysis with the most recent catch, TACC and CPUE records);
- An undercatch period spanning 2023 to 2026 using the original HCR to set TACCs;
- An undercatch period spanning 2023 to 2026 using the modified HCR to set TACCs.

The performance of the modified harvest strategy under the extended undercatch period was assessed by verifying that projected CPUE reached the management objective defined for this fishery (i.e., within 20% of 2012–2015 CPUE levels). Projected values for key quantities (catches, TACC, depletion in spawning stock biomass and recruitment) were compared with the original harvest strategy (pre-2022) and with the current version of the harvest strategy to ensure no unexpected behaviour was occurring.

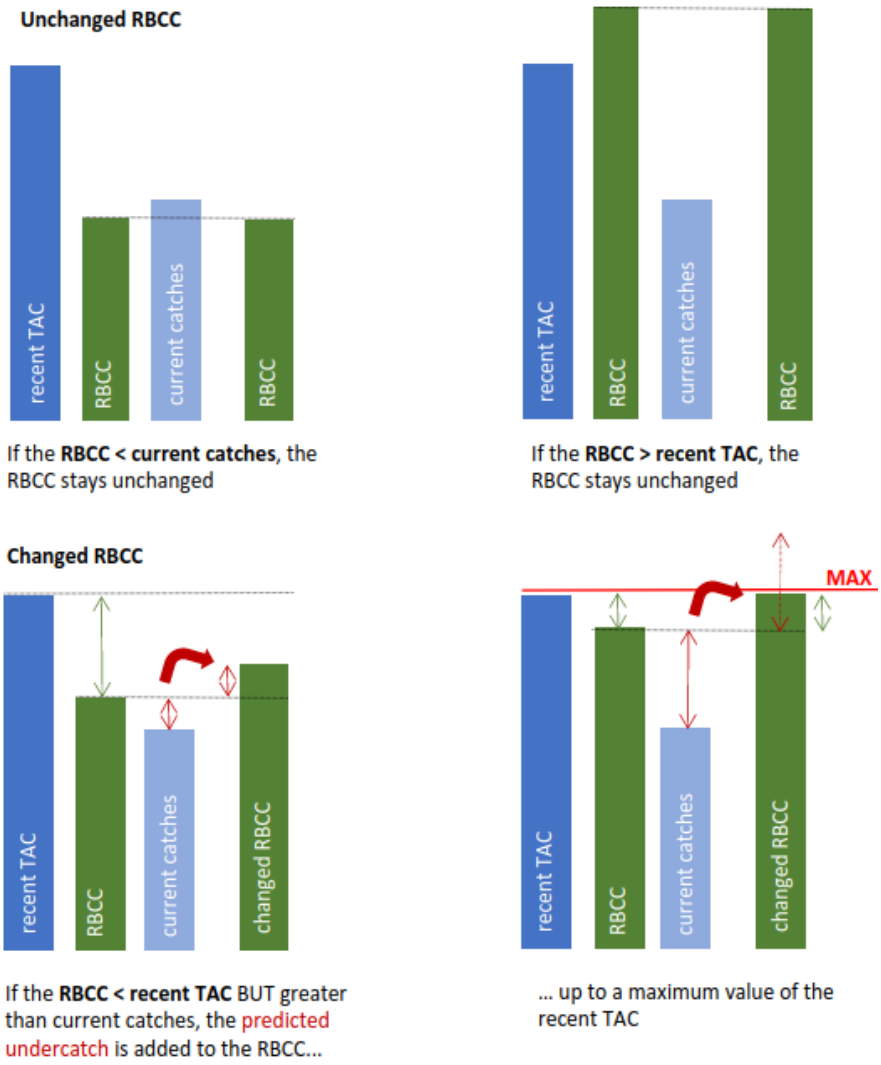

Figure 1: Illustration of the outcomes of the modified Harvest Strategy under different relative levels of recent TACC [TAC in the diagram], Recommended Biological Commercial Catch (RBCC; as prescribed by the original Harvest Strategy) and the predicted undercatch (i.e., the difference between the RBCC and current catches). The top row shows the cases where the RBCC remained unchanged from the original recommendation, the bottom row shows cases where the RBCC is changed as a function of the extent of the predicted undercatch. The green arrows illustrate the difference between the recent TACC and the RBCC under the original harvest strategy; the red arrows illustrate the difference between the original RBCC and current catch levels.

4 Results

A comparison of key quantities under the original and modified harvest strategies with an undercatch period extending to 2026 confirmed that the management objective was reached under both scenarios but that the projected distribution of TACC levels remained consistenly higher under the modified harvest strategy (Figure 2; bottom left panel). All other quantities remained similarly distributed.

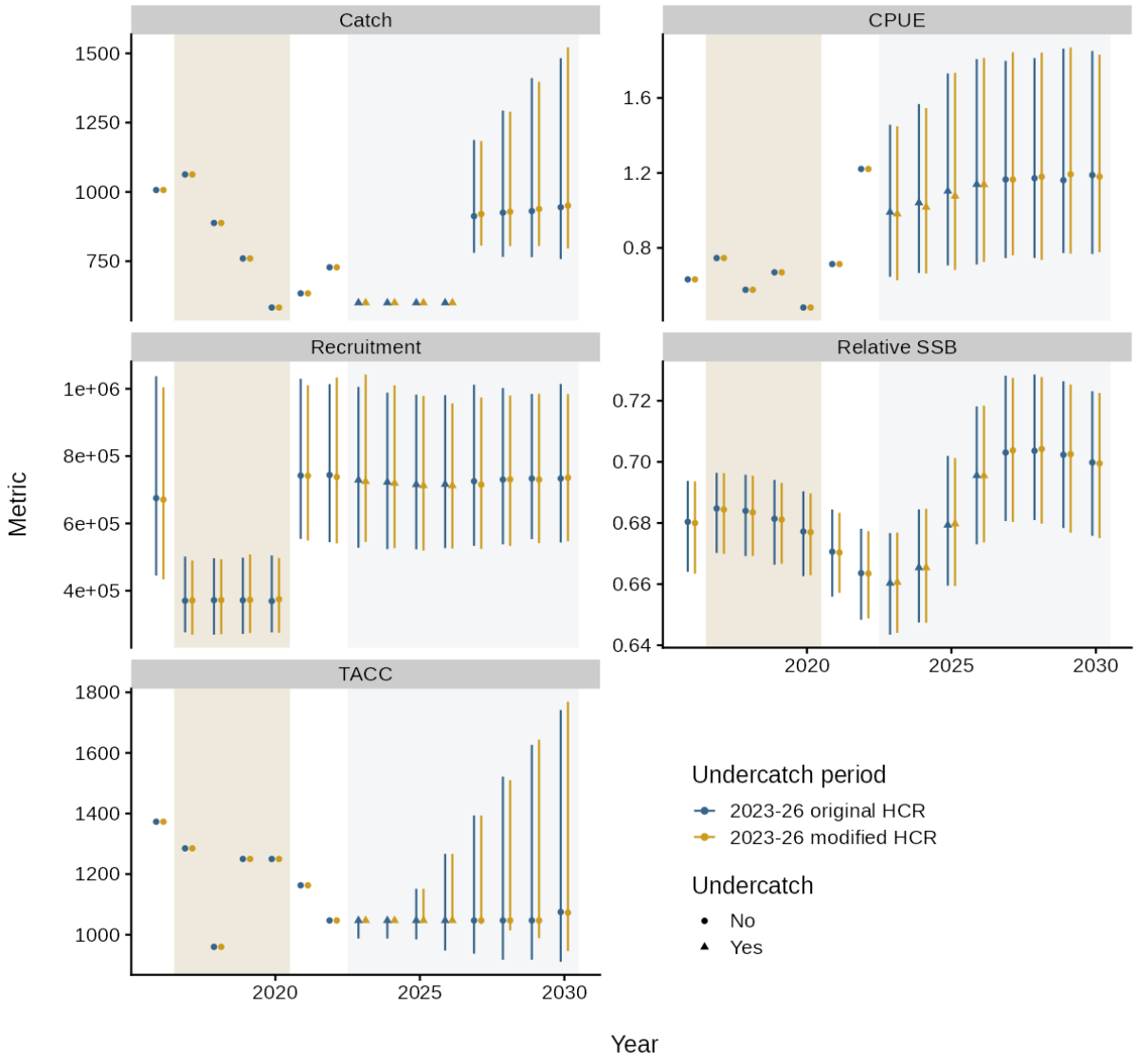

Figure 2: Comparison of summary statistics (median, coloured dot, and 90% prediction interval, bars) for key quantities under the original (dark blue) and modified (yellow) harvest strategy tested with an undercatch period spanning 2023 to 2026. The low recruitment period is higlighted with a beige rectangle; the period from which the harvest strategy is active is highlighted with a grey rectangle.

Under the modified harvest strategy, extending the projected undercatch period from 2024 to 2026 had little impact on harvest strategy performance (Figure 3). The depletion of spawning stock biomass was less pronounced (i.e. relative stock size was larger) when undercatch extended to 2026 as a result of lower levels of fishing mortality incurred on the stock (from the extra years of undercatch).

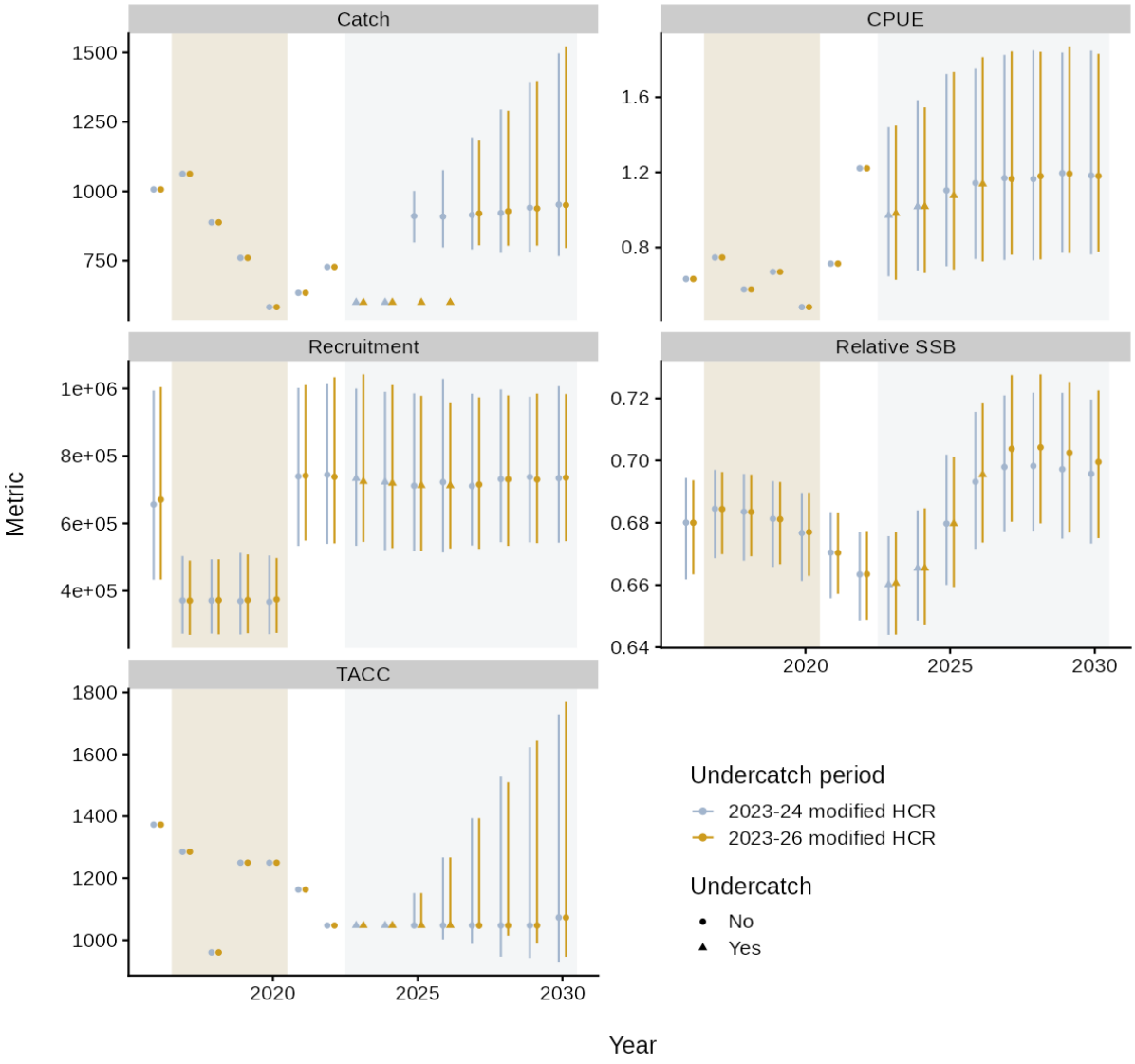

Figure 3: Comparison of summary statistics (median, coloured dot, and 90% prediction interval, bars) for key metrics under the modified harvest strategy tested with undercatch periods occurring spanning 2023 to 2024 (blue) and 2023 to 2026 (yellow). The low recruitment period is higlighted with a beige rectangle; the period from which the harvest strategy is active is highlighted with a grey rectangle.

5 Conclusion

The performance of the modified harvest strategy remained unimpacted by the extension of the undercatch period to 2026. The modified harvest strategy was able to maintain TACCs at a higher level by taking the undercatch into account when setting RBCCs while still meeting management objectives. The extended modified harvest strategy behaved similarly to the currently adopted version (tested with the undercatch period ending in 2024). Spawning biomass depletion is slightly less pronounced with the extended undercatch period due to lower fishing mortality applied to the stock over the period of the projections.

The modified harvest strategy appears robust so far to prolonged undercatch periods under the reference operating model configuration tested here. However, should these exceptional circumstances persist, a management strategy evaluation, including scenarios of representative undercatch and periods of future recruitment failure, should be developed to allow for a more comprehensive testing of the performance of various harvest control rules.

References

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