DEVELOPMENT STATE OF THE WESTERN ATLANTIC SKIPJACK TUNA MSE PROCESS IN JUNE 2024

Rodrigo Sant'Ana[1] & Bruno Mourato[2]

SUMMARY

This document describes proposed updates to the Western Atlantic Skipjack tuna Management Strategy Evaluation process including the revisions to operating models and management procedures. Operating models are now using a relative abundance index based on the inverse-variance average weighting across the distinct indices available, and the index-based and model-based management procedures include a tune parameter that could allow the maximization of the yields up to a desired level. It also implemented an asymmetrical decision rule for both classes of MPs. Due to the dependence on updated data to adjust the final simulations, this exercise also used past data and, therefore, these results cannot be interpreted as possible final results.

RÉSUMÉ

Le présent document décrit des actualisations proposées à apporter au processus d'évaluation de la stratégie de gestion pour le listao de l'Atlantique Ouest, y compris des révisions des modèles opérationnels et des procédures de gestion. Les modèles opérationnels utilisent désormais un indice d'abondance relative basé sur la pondération moyenne par l'inverse de la variance pour les différents indices disponibles, et les procédures de gestion basées sur un indice et basées sur un modèle incluent un paramètre de calibrage qui pourrait permettre la maximisation des productions jusqu'à un niveau souhaité. Il appliquait également une règle de décision asymétrique pour les deux types de MP. En raison de la dépendance à l'égard de données actualisées pour ajuster les simulations finales, cet exercice a également utilisé les données passées et ces résultats ne peuvent donc pas être interprétés comme de possibles résultats finaux.

RESUMEN

Este documento describe las actualizaciones propuestas para el proceso de evaluación de la estrategia de ordenación para el patudo del Atlántico occidental, incluidas las revisiones de los modelos operativos y de los procedimientos de ordenación. Los modelos operativos utilizan ahora un índice de abundancia relativo basado en la ponderación media de la varianza inversa de los distintos índices disponibles, y los procedimientos de ordenación basados en índices y modelos incluyen un parámetro de calibración que podría permitir maximizar los rendimientos hasta un nivel deseado. También aplicó una regla de decisión asimétrica para ambas clases de MP. Debido a la dependencia de los datos actualizados para ajustar las simulaciones finales, este ejercicio también utilizó datos pasados y, por lo tanto, estos resultados no pueden interpretarse como posibles resultados finales.

KEYWORDS

Management procedures, stock assessment, performance metrics, closed-loop simulation, harvest strategy

[1] Laboratório de Estudos Marinhos Aplicados, Escola Politécnica, Universidade do Vale do Itajaí. Rua Uruguai, 458, Itajaí, Santa Catarina, Brazil.
[2] Laboratório de Ciências da Pesca, Instituto do Mar, Universidade Federal de São Paulo (UNIFESP), Av. Doutor Carvalho de Mendonça, 144, 11070-100, Santos, Brazil.

1 Introduction

Since 2020, the Western Atlantic skipjack (W-SKJ) management strategy evaluation (MSE) framework has been developed by the Standing Committee Research and Statistics Tropical Tunas Species Group (SCRS/TT-SG) (Huynh *et al.*, 2020; Mourato *et al.*, 2022a; Mourato *et al.*, 2022b; Sant'Ana *et al*., 2023). The Commission adopted conceptual management objectives for W-SKJ in 2022 (ICCAT Res. 22-02, 2022) and started to operationalize those objectives at the May 2023 Panel 1 intersessional meeting.

The SCRS is scheduled to provide a final set of candidate management procedures (CMPs) to the Commission in late 2024. The W-SKJ MSE technical team, after consultation with Panel 1 in February of 2024 and the Tropical Tunas MSE Sub-Group, made important updates to the MSE framework. The purpose of this document is to describe part of these updates to the W-SKJ MSE process including the revisions to operating models and the CMPs. As the input dataset required to the update of the WSKJ MSE will be presented during the 2024 YFT Stock Assessment meeting, the results presented here does not be interpreted as a final reflection Western Atlantic skipjack tuna Management Strategy Evaluation.

The idea of this document is to present the evolution in the structure of the operational models derived from the 9 scenarios consolidated in the latest WSKJ stock assessment, which now includes the inclusion of a relative abundance index combined from the average weighted by the inverse of the variance of the 4 indices used in the last stock valuation. As well, both management procedures based on abundance indices and empirical rules and those based on models now include a tune parameter that allows maximizing fishing yields based on desired limits for the stock and also an empirical rule that allows regulating, symmetrically and/or asymmetrically the variation in TAC over time.

2 Material and Methods

The WSKJ MSE development structure is guided by the work plan presented and approved by the TT MSE Subgroup of the SCRS and the ICCAT Commission. Among the main structured tasks for the evolution of this MSE and final adoption of a management measure are:

1) inclusion of an abundance index combined from existing abundance indices for the stock to be used in the management procedures proposed for this stock.

2) inclusion of a tune parameter to maximize fishing activity yields, respecting the probability limits of being in the green quadrant of the Kobe diagram defined for the stock.

3) incorporation of an empirical rule that allows dealing with symmetric and/or asymmetric variations in TAC over time depending on the trend in stock status.

4) updating W-SKJ capture data and the respective relative abundance indices estimated for the stock by each of the CPCs engaged in its exploitation.

5) reconditioning the operating models at light of the updated datasets available and rerun the closed-loop simulation the update the WSKJ MSE results.

6) development of robustness scenarios that allow for the incorporation of possible expected variations due to the effects of climate change on the western Atlantic skipjack stock.

This document is aimed in to present a summary of the tasks 1, 2 and 3 scheduled to be developed before the availability of the updated catch and relative abundance indices time series datasets and that were already achieved.

For the combine index three distinct methods of average were tested, the first one based on the simple average between the available indices; the second based on the weighted average between the available indices considering each respective representativeness on total landings, and; a third one based on the inverse-variance weighted average between the available indices. As recommended by the SCRS TT MSE Subgroup, the inverse-variance weighted average method was chosen for final implementation.

The tune parameters were structured in each MP (**Table 1**) as a relative multiply constant parameter that could, for example, weighting the actual fishing mortality rate to more close or distant from the reference level F_{MSY} for model-based MPs or to weight the exploitation rate in the case of management procedures based on empirical index-based rules. Finally, identically to what was developed and used in the NSWO MSE, the resulting ratio between recent values and the baseline values is used to adjust the TAC based on a pre-determined decision-rule that can be defined to respond symmetric or asymmetrically depending on the behavior of the tendency of the stock.

3 Results

Figure 1 shows a summary of the comparison combined index trajectory and the biomass trajectory for the historical and projection period. In the case of the projection period, this figure still presents the tracking comparison between these two quantities distinguished for three different MPs implemented. In general, the combined index has tracked well the tendency observed in biomass during the historical period and this pattern still observed for the projection period independent of the MP used along all simulations.

To achieve the minimum of the 70% probability of the stock being in a green quadrant of the Kobe diagram a long the projection time, independent of the MP implemented, the tune parameters must be around the 75% of the F_{MSY}. This brings a maximization of the total yield to TAC values close of the 22,000 metric tons. However, as commented before, at this moment, this kind of interpretation still must be considered preliminary since the updated datasets still not included in these simulations. **Figures 2**, **3** and **4** shown the trajectories for B/B_{MSY}, F/F_{MSY} and TAC for the Iratio MPs respectively and **Figures 5**, **6** and **7** shown the same quantities for the Surplus Production MPs tested here.

Finally, there is a perceptive stability pattern in the Surplus Production MPs than the model-free ones in terms of achieving the 70% PGK for the distinct tune parameter tested (**Figures 8** and **9**). Another important pattern that must be considered is the stability of the MPs was based on the utilization of shorter management intervals (e.g. lower than 3 years). Assuming that the process of the MSE and the adoption of an MP must simplify the update of the management over time, based on more stable results, a implementation of intervals of management lower than 3 years could be considered. **Figure 10** shown a general behaviour of the empirical rule that helps to dealing with TAC variation between management intervals. Additionally, due to the dependence on updated data to adjust the final simulations, this exercise also used past data and, therefore, these results cannot be interpreted as possible final results.

4 Acknowledgements

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Table 1. Description of the tune parameters tested for each MP presented here.

Model-free MP	*Tune parameter*	*Model-based MP*	*Tune parameter*
Iratio_MOD	1.00	SP_01	1.00
Iratio_MODA	0.83	SP_01A	1.01
Iratio_MODB	0.80	SP_01B	1.02
Iratio_MODC	0.78	SP_01C	1.03
Iratio_MODD	0.76	SP_01D	1.04

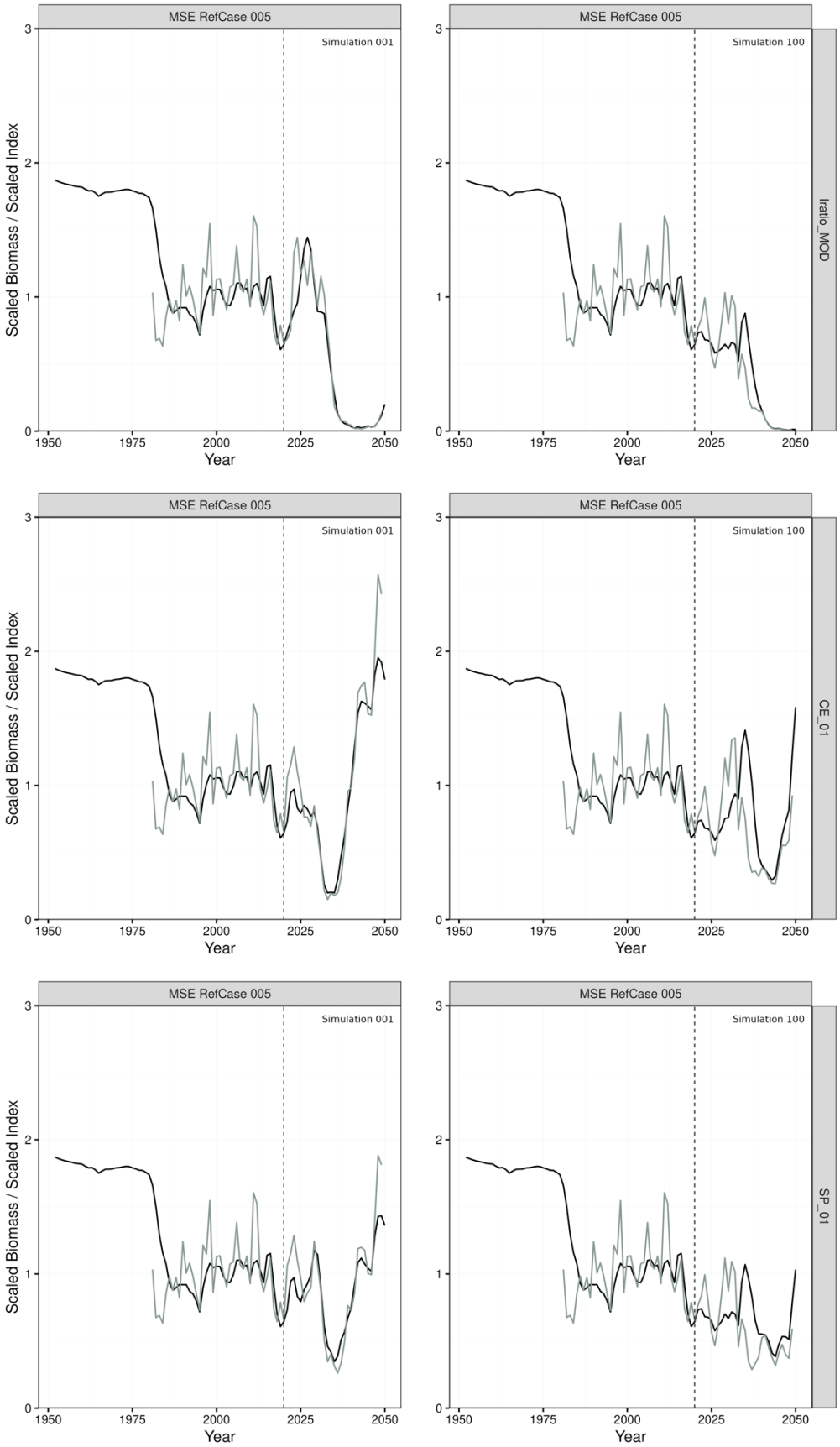

Figure 1. Tracking comparison between scaled biomass (black) and scaled combined index (gray) over time for the Reference Case 005 and distinct management procedures and simulations.

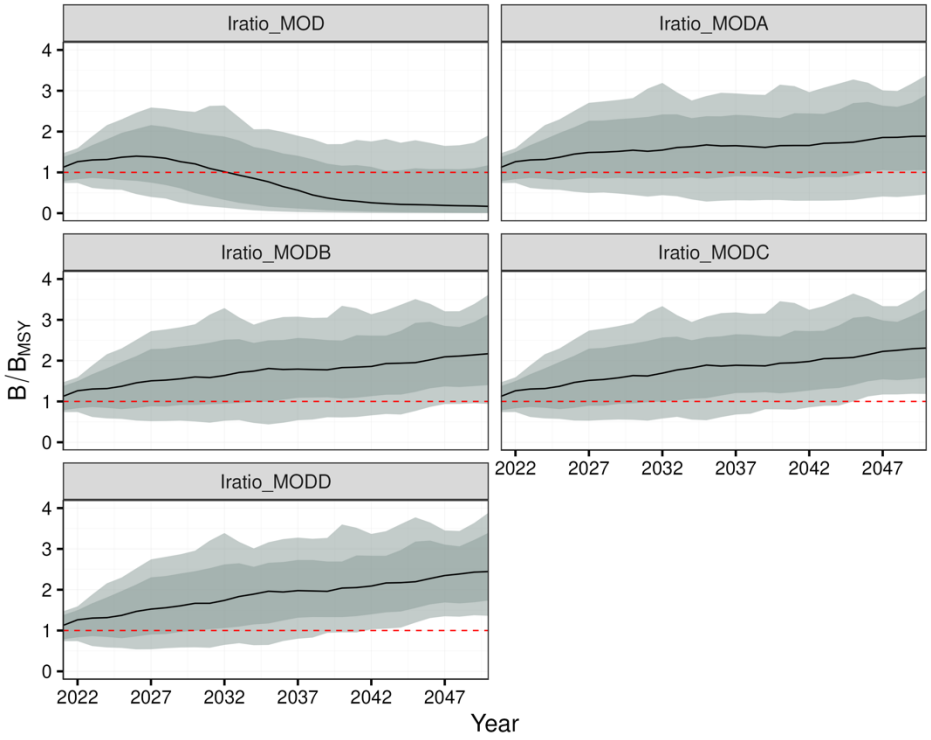

Figure 2. Biomass relative to the biomass of the maximum sustainable yield projections of the nine-reference case operating models for the five distinct tune parameters set for the Iratio MP tested.

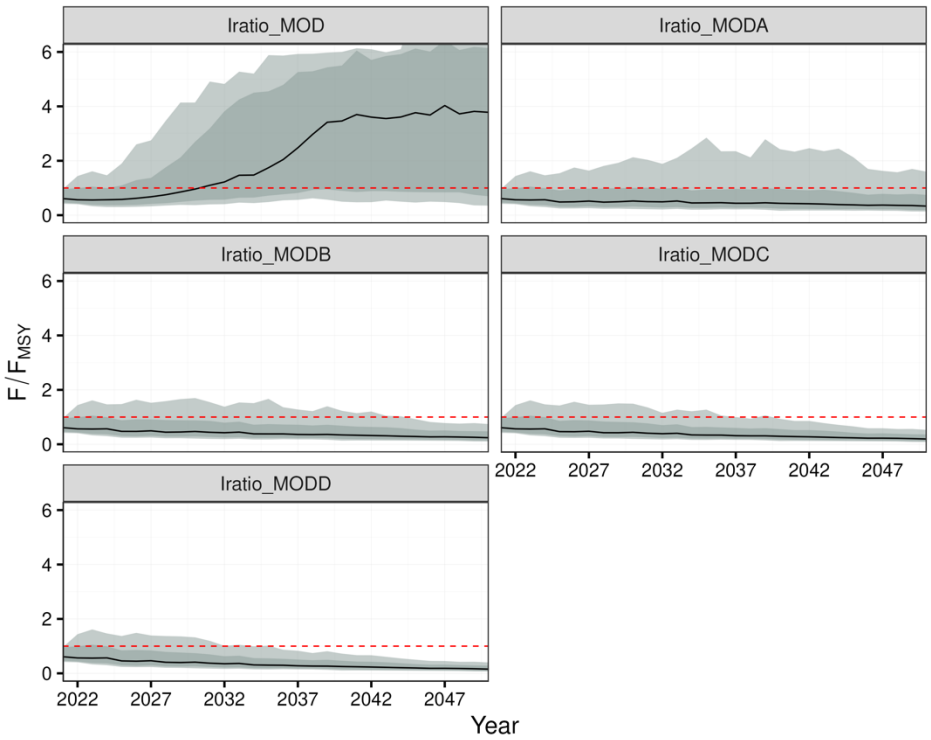

Figure 3. Fishing mortality relative to the fishing mortality of the maximum sustainable yield projections of the nine-reference case operating models for the five distinct tune parameters set for the Iratio MP tested.

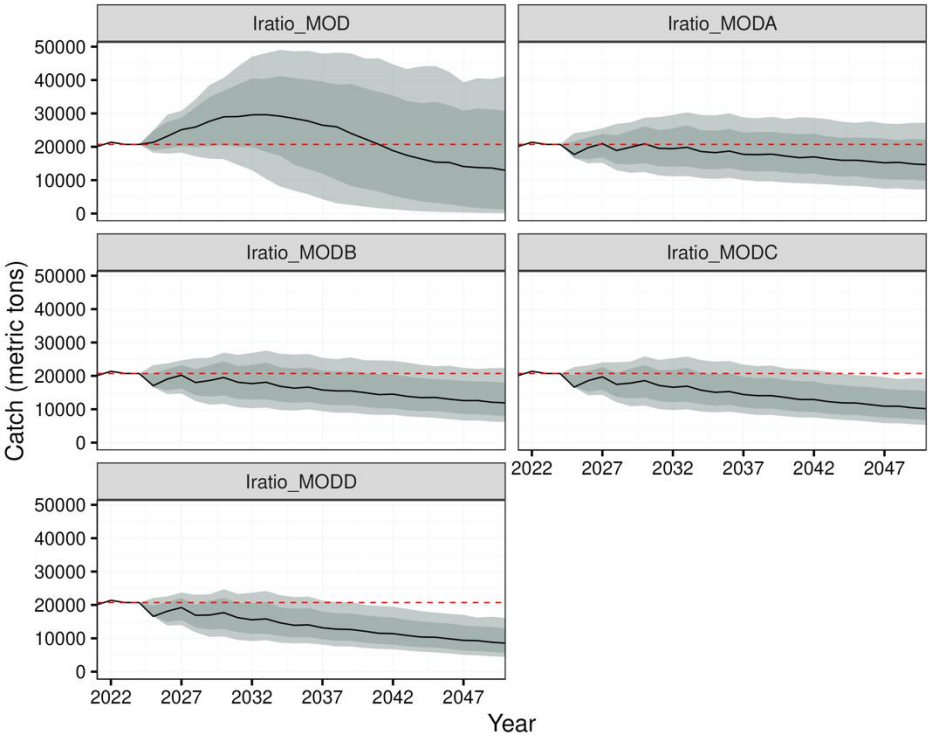

Figure 4. TAC projections of the nine-reference case operating models for the five distinct tune parameters set for the Iratio MP tested.

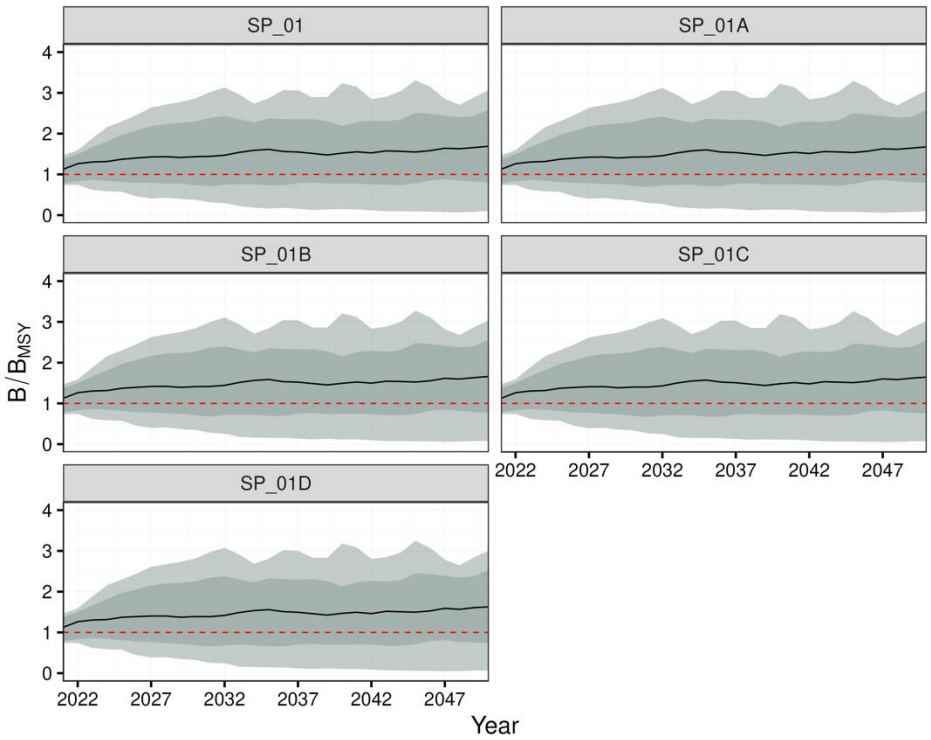

Figure 5. Biomass relative to the biomass of the maximum sustainable yield projections of the nine-reference case operating models for the five distinct tune parameters set for the Surplus Production MP tested.

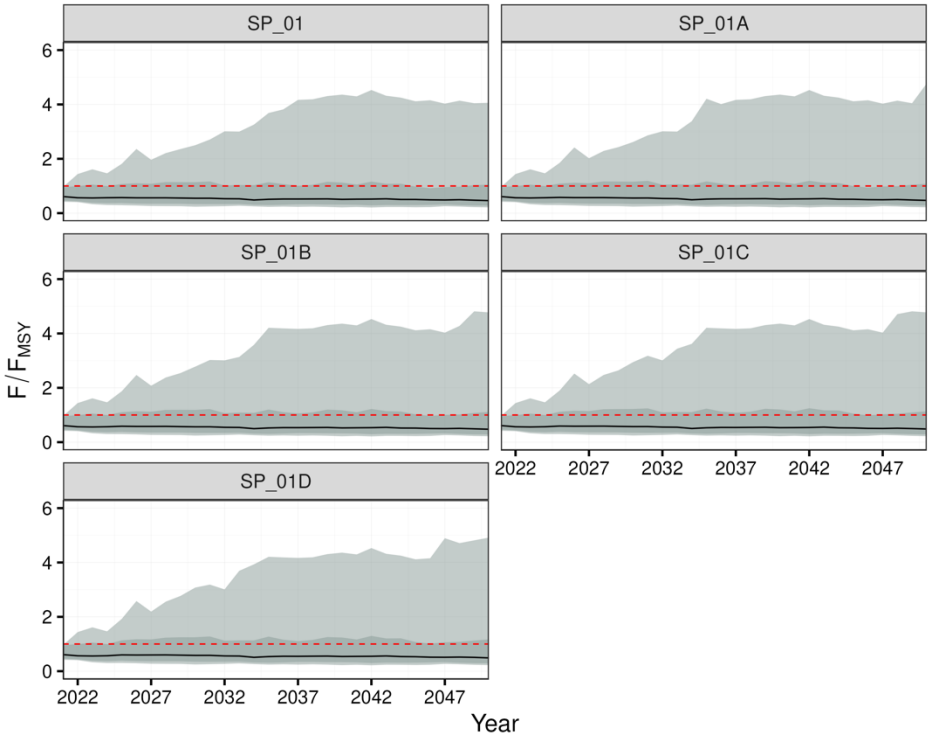

Figure 6. Fishing mortality relative to the fishing mortality of the maximum sustainable yield projections of the nine-reference case operating models for the five distinct tune parameters set for the Surplus Production MP tested.

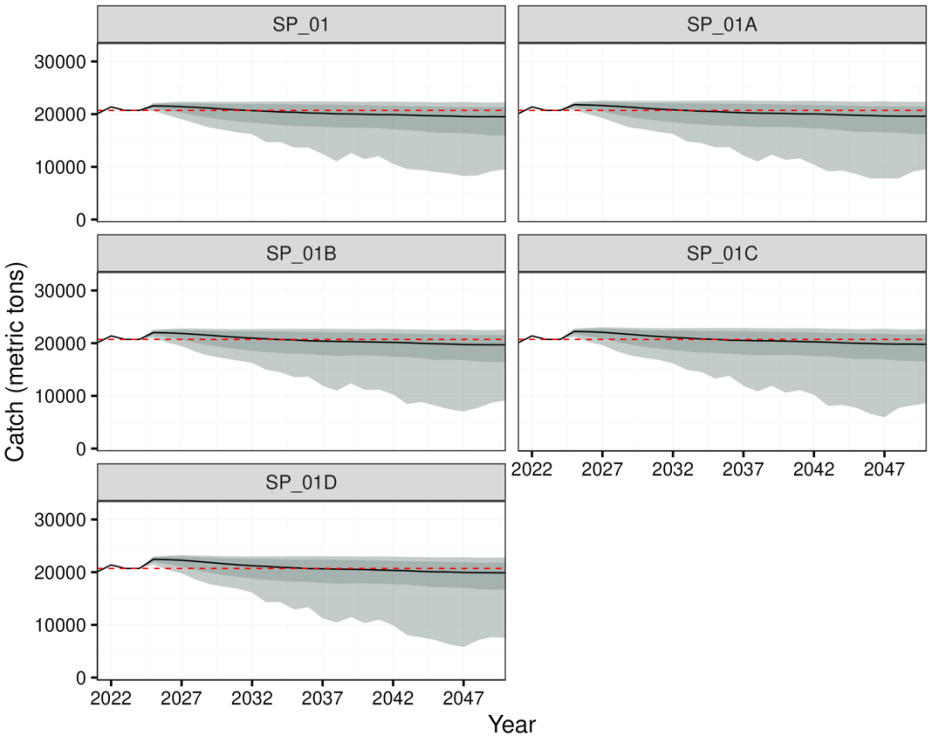

Figure 7. TAC projections of the nine-reference case operating models for the five distinct tune parameters set for the Surplus Production MP tested.

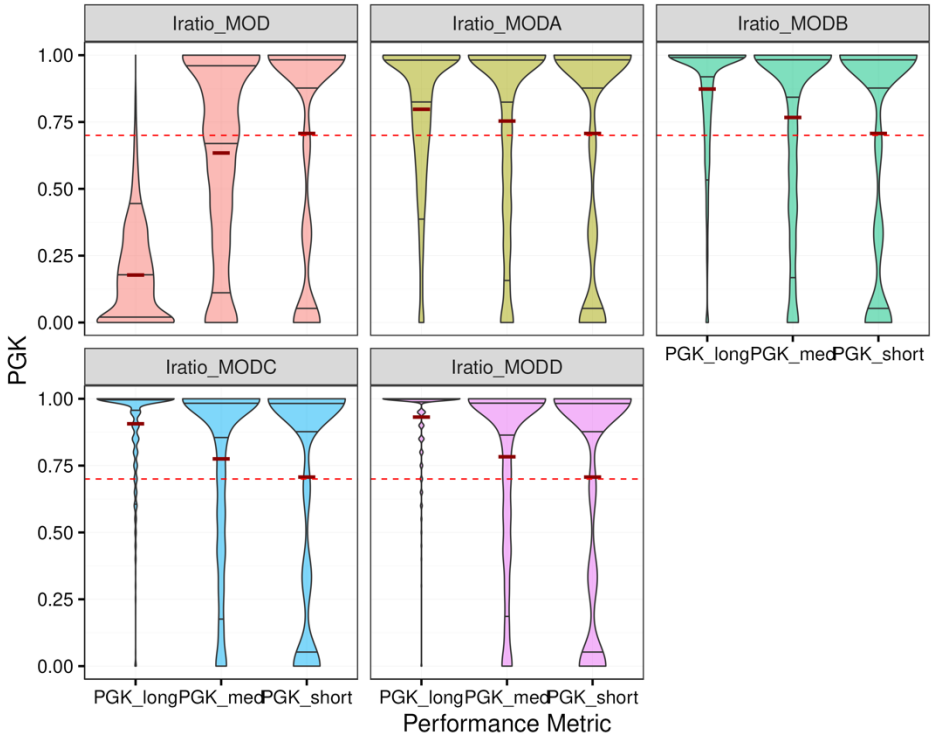

Figure 8. Performance metric violin plot for the probability of being in the green quadrant of the Kobe diagram for the different tune parameters implemented for the Iratio MP tested.

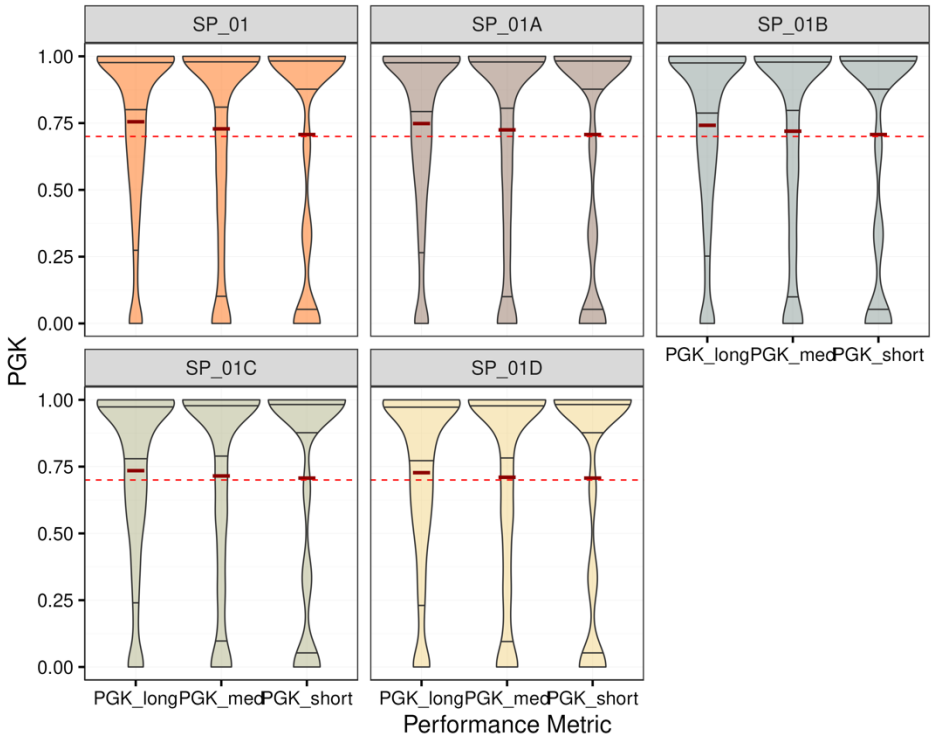

Figure 9. Performance metric violin plot for the probability of being in the green quadrant of the Kobe diagram for the different tune parameters implemented for the Surplus Production MP tested.

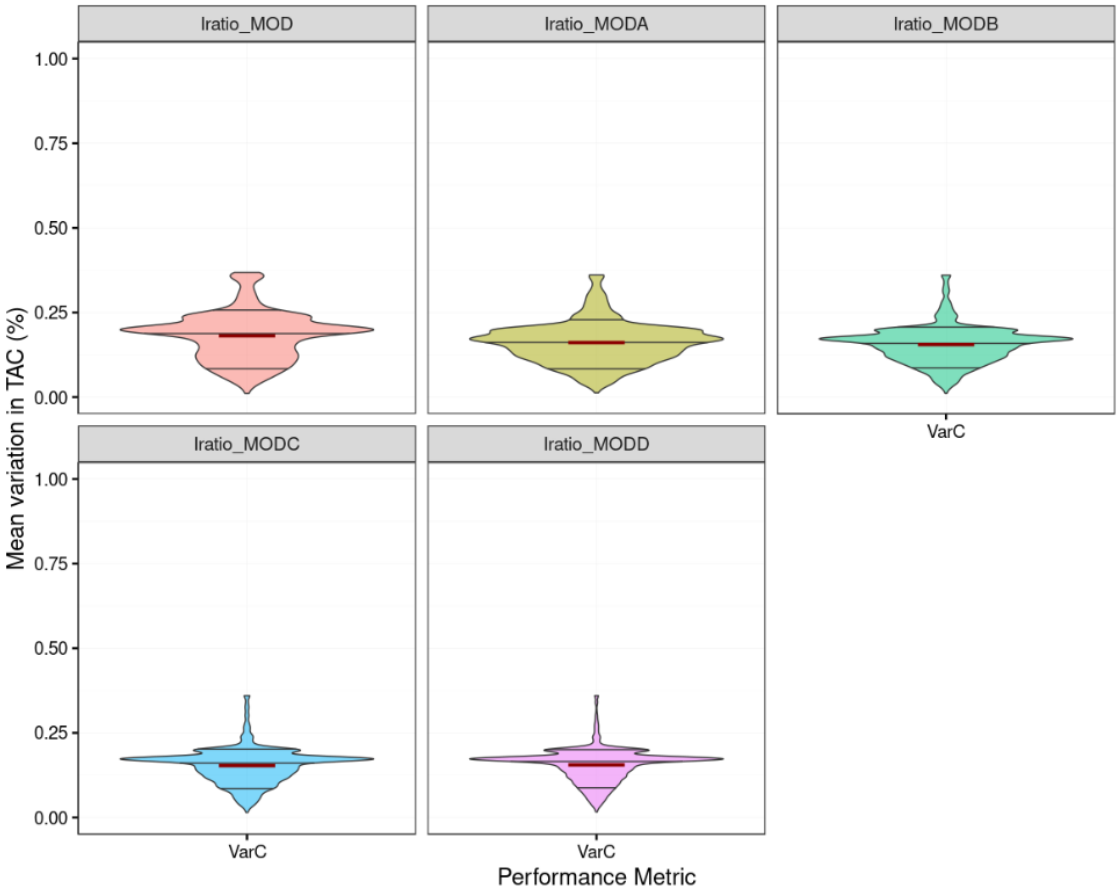

Figure 10. Performance metric violin plot for the relative mean variation in total allowable catches between management periods.