

Consideration of Exceptional Circumstances for the Swordfish MP 2024

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IOTC WPM 2024

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Abstract

The IOTC adopted the swordfish management procedure (MP) in 2024 (IOTC 2024a, d), which is to be used to recommend the Total Allowable Catch (TAC) for this stock. The WPM15 will review running of the MP, to check technical aspects, and provide the recommended TAC for consideration at the 27th meeting of the IOTC Scientific Committee in December 2024. As part of the MP schedule, the Commission has adopted an annual review of evidence for exceptional circumstances, to check for conditions that could make the implementation of the TAC advice risky to the stock or fishery.

The Exceptional Circumstances Guidelines (Appendix 6A in IOTC (2021)) specify a three-stage process: (i) examining evidence for exceptional circumstances, (ii) determining severity and impact, and (iii) recommending any management or research action that should be taken. A wide range of information is reviewed to examine if there is evidence for exceptional circumstances, e.g., changes in the knowledge of stock or fishery uncertainties against which the MP was tested. The Exceptional Circumstances Guidelines provide a scientific process for developing appropriate management responses to exceptional circumstances and, hence, provide transparency in TAC decision-making by the Commission.

This paper summarises the outcomes from a review of a wide range of information, including from the preliminary review conducted by the 22nd Working Party on Billfish (4-7 September 2024), in considering if there is evidence of exceptional circumstances. The key conclusions of the review are that there are no exceptional circumstances identified in 2024, relating to:

- **Stock status, population dynamics or biology** - The 2023 stock assessment estimates of SB/SB_{MSY} and F/F_{MSY} were shown to be within the 90% probability interval of the estimates from the operating models used to test the performance and tune the MP. While no EC relating to biology or population dynamics were identified this year, the 2025 EC review could look to assess any new research pertaining to stock structure.
- **Fishery or fishing operations** - There are no identified changes in recent fishery operations (e.g. methods/approaches). Shifts in relative catch proportions by fishery over time (noted by WPB22) have been incorporated into the MSE operating models, and the subsequent MP performance tested and demonstrated to be acceptable. Fishery catch levels and proportions from the 2 most recent years of data are not substantially different to those considered by the OMs.
- **Catch data inputs** – There have been no significant recent changes in the quality and representativeness of swordfish catch data to be utilised by the MP.
- **CPUE data inputs** - StdCPUE time series estimates from the 2023 standardisation process (for period to 2022) and the 2024 standardisation process (for period to 2023) are very similar. Prediction skill of the NWIO Japanese longline CPUE remains acceptable but Japanese longline effort trends should continue to be monitored and considered in annual EC reviews and as part of the larger MP review in 2031.

However, with respect to the operation of the MP, an error was identified in the original simulation analyses that, when corrected (without retuning), resulted in the MP not reaching the management objective. This represents an exceptional circumstance. Correcting the error and retuning the MP results in an MP that does reach the objective, with similar performance measure outcomes. Therefore, the recommended action is to use the corrected and retuned MP to recommend the TAC for 2026-2028.

1. Introduction

The IOTC adopted the swordfish management procedure (MP) in 2024 via Resolution 24/08 (IOTC, 2024a), which will be used to recommend an annual Total Allowable Catch (TAC) for a 3-year period. As part of the MP schedule, the Commission has adopted an annual review of evidence for exceptional circumstances, to check for conditions that could make implementing the MP TAC advice risky. Exceptional circumstances are conditions or data that fall outside the range of uncertainties that the MP was tested against, i.e., the reference set of operating models used for Management Strategy Evaluation (MSE), and the robustness tests. The Exceptional Circumstances Guidelines (IOTC–2021–SC24 Appendix 6A) provide a scientific process for examining evidence for exceptional circumstances, evaluating potential impacts, and developing appropriate management responses if necessary. This process of examining evidence for exceptional circumstances provides a safety-net around the MP TAC advice and transparency in TAC decision making by the Commission.

The exceptional circumstances review process has three stages:

- 1) determine whether any exceptional circumstances exist,
- 2) determine the severity and impact of the exceptional circumstances on achieving the objectives of the MP, and
- 3) if necessary, identify the research and/or management actions that could be taken by the IOTC.

The swordfish MP is due to be run for the first time in 2024 to provide advice to the Commission on TACs for 2026-2028. This report provides advice on evidence of exceptional circumstances in 2024, using the same report template and structure as developed by Preece and Williams (2022) for bigeye tuna.

2. Examining evidence for the existence of exceptional circumstances in 2024

The information that should be checked for evidence of exceptional circumstances is specified in the Guidelines (IOTC–2021–SC24 Appendix 6A).

The MP is specified in Resolution 24/08 (IOTC, 2024a).

The operating models used to MSE test the adopted MP included a range of uncertainties and conditions (Brunel and Mosqueira 2024a, 2024b) (**Table 1**), and the robustness tests (that test implementation errors, 2-year management lag and recruitment failure) are specified in Brunel and Mosqueira (2024c).

The data input specification of the CPUE is in Matsumoto et al. (2023) and the outputs of the 2024 standardisation are found here ([link](#)). Catch data preparation is specified in IOTC (2024a) and IOTC (2024b).

Table 1 – Structural uncertainty grid used to develop the swordfish operating model

Selectivity	Double normal		
Steepness	0.6	0.75	0.9
Growth + Maturity	Slow growth, late maturity (Wang et al., 2010)	Fast growth, early maturity (Farley et al., 2016, otoliths)	
Natural Mortality	Low = 0.2	High = 0.3	Sex-specific Lorenzen M (Farley et al. (2016), otoliths)
Sigma R	0.2	0.4	0.6
ESS	2	20	
CPUE scaling	Biomass		
CPUEs	JPN late + EU.PRT	JPN late	TWN + EU.PRT
Catchability increase	0%	1% / year	

The following items, specified in the Exceptional Circumstances Guidelines, have been examined:

- New knowledge about the stock, population dynamics or biology,
- Changes in fisheries or fishing operations,
- Changes to input data to the MP, or missing data, or
- Inconsistent implementation of the MP advice (e.g., total catch is greater than, or less than, the TAC) or changes to the operation of the MP.

2.1 New knowledge - Stock, population dynamics or biology

2.1.1 *Biology and population dynamics*

There was no new information on biology or biological parameters for the population dynamics presented in 2024 (including none at WPB21).

Both the 2023 assessment and the MP operating models utilised the same inputs to inform population parameters and similar ranges of these parameters where multiple values were explored in the assessment grid or OMs (**Tables 1** and **2**). The WPB22 (Sept 2024) did not consider any new biological research on swordfish that was relevant to the assessment or OM population dynamics. The SB/SB_{MSY} time-series from the 2023 assessment was shown to be within the range of the operating models and projections and indicated that the population dynamics are reasonably stable (**Figure 1** upper).

The WPB21 (in 2023) reviewed papers on swordfish movement (which can have implications for assumed stock structure) in specific subregions. These papers (West et al., 2023, Romanov et al., 2023, Neiblas et al., 2023) did not present any evidence to support different stock structure assumptions to those in the assessment and OMs. However, previous research presented to WPB18 in 2020 (Grewe et al., 2020) did identify some evidence of potential north-south stock structuring for swordfish in the Indian Ocean. Furthermore, the recent WPB22 noted in discussions that there has recently been additional research completed that also indicates the potential for population structuring into northern and southern Indian Ocean stocks (IOTC, 2024e), which contrasts current assumptions of a single stock. That research was not available to WPB but will be presented to WPB23 in 2025 for review and discussion and can be re-

considered as part of future EC and/or MSE review processes. Based on information currently available, there are no exceptional circumstances in relation to biology and population dynamics in 2024.

2.1.2 Stock status

The 2023 stock assessment (Fu, 2023) estimated that the stock is not overfished and not subject to overfishing. The key uncertainties considered in the 48 models in the reference set of models of the 2023 assessment are CPUE, growth, length composition data, recruitment variability and steepness (**Table 2**).

Brunel and Mosqueira (2024a) compared the SB/SB_{MSY} and F/F_{MSY} estimates from the 2023 stock assessment with those from the range of scenarios included in the swordfish operating models (**Figure 1**). The 2023 stock assessment estimates of SB/SB_{MSY} and F/F_{MSY} were shown to be within the 90% probability interval of the estimates from the operating models used to test the performance and tune the MP (**Figure 1**), and therefore there is no evidence for exceptional circumstances with respect to stock status. The next assessment is currently scheduled for 2026 (but may need to be rescheduled for 2025).

Table 2 - Final model options for the 2023 assessment consist of a full combination of options below, with a total of 48 models. Reference model options are highlighted (Source – Fu, 2023).

Model options	Description
<i>CPUE</i>	<ul style="list-style-type: none"> • <i>cj</i> – CPUE options from revised model (UJPLL, UPOR, UZAF) • <i>ct</i> - CPUE options from the atlCPUE model (UJPLL, UTWLL, UIND)
<i>growth</i>	<ul style="list-style-type: none"> • GoMf – Otolith based growth estimates by Farley et al. 2016. • <i>GtMf</i> – Estimates by Wang et al. 2010.
Length composition data	<ul style="list-style-type: none"> • CL20 – A maximum of 20 for the effective sample size • CL05 – A maximum of 5 for the effective sample size
<i>Recruitment variability</i>	<ul style="list-style-type: none"> • R2 – recruitment $\sigma_R=0.2$ • <i>R4</i> – recruitment $\sigma_R=0.4$.
<i>Steepness</i>	<ul style="list-style-type: none"> • h70 – Stock-recruitment steepness parameter 0.7 • h80 – Stock-recruitment steepness parameter 0.8 • h90 – Stock-recruitment steepness parameter 0.9

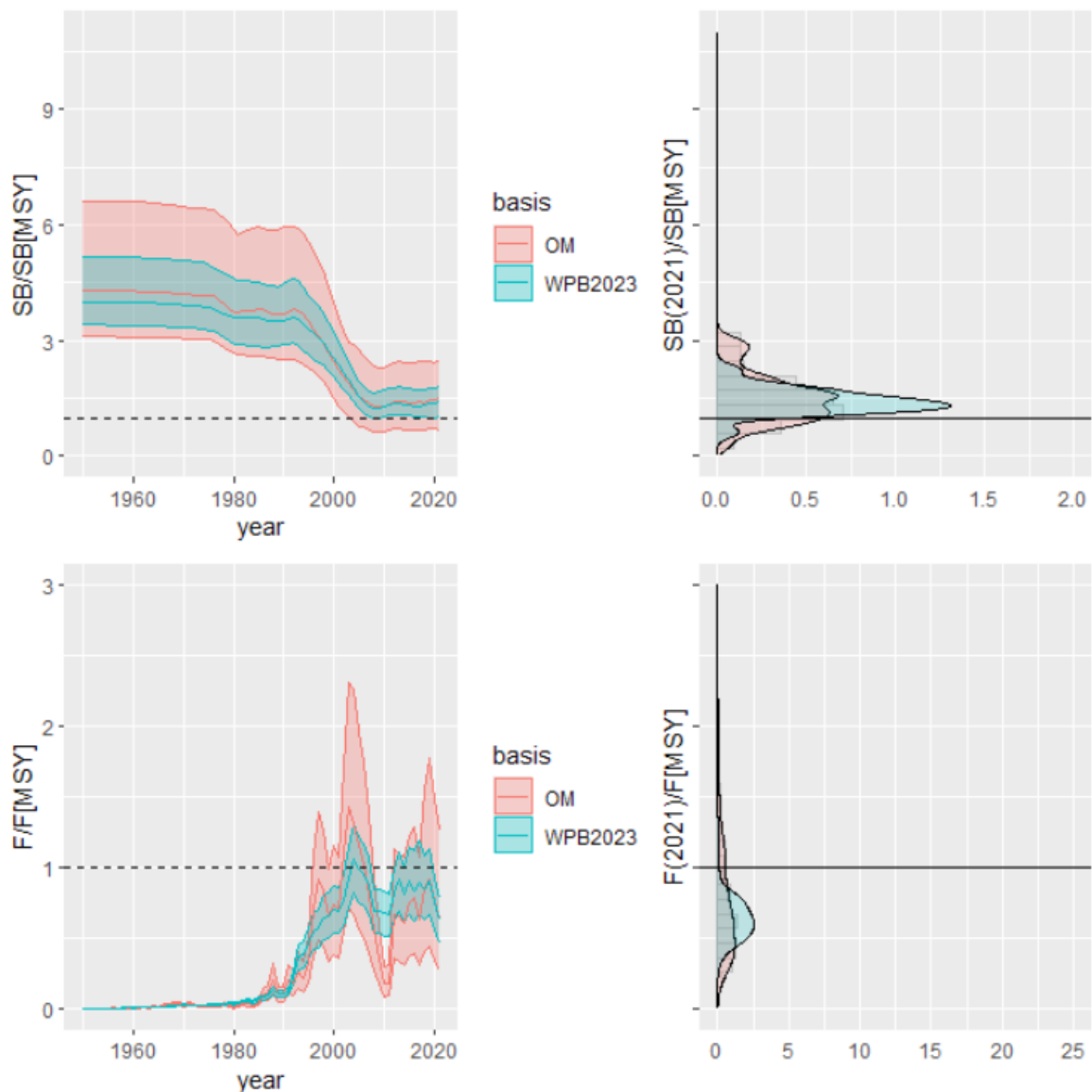


Figure 1 - Historical swordfish stock development (left) and stock status in 2021 (right) in the Operating Model developed for the MSE (red) and in the WPB 2023 swordfish assessment (blue).

2.2 Fishery or fishing operations

WPB22 did not identify any recent significant changes in fishery operations (e.g fishing methods, gears etc) in the key fisheries catching swordfish in the Indian Ocean.

The WPB22 noted, however, that a) there has been a shift in the relative levels of Swordfish catch from distant water fisheries to coastal fisheries over time and, b) in association with that, a decline in Japanese longline fishing effort and catch in the north-west Indian Ocean that might have potential implications for whether the Japanese CPUE can index stock abundance in that area. The overall shift in catch between fisheries is discussed here (below) and the Japanese CPUE implications are discussed further under section 2.3.2 (below).

Regarding the shift in catch from distant water to coastal fisheries (point a above), it is clear from the most recent review of IOTC statistical data for Swordfish (IOTC, 2024c) that this has been occurring since 2004, with significant shift in total amount and relative proportions of

catch by fishery type occurring between 2010 and 2020 (**Figure 2, Figure 3**). While shifts in relative catch levels between fisheries can have implications for size selectivity of the fisheries and associated fishing mortality at age, these changes in catch data have been incorporated into MSE operating models, and the MP performance has been tested under these conditions. The most recent 2 years of data are not substantially different to recent catches (IOTC 2024c, IOTC Secretariat, pers com., 2024, **Figure 3**).

On the basis that there are no identified changes in recent fishery operations and no substantial differences in the recent relative proportions of catch by fishery type to those used the OMs for the MSE, there are not any identified exceptional circumstances in relation to fisheries and fishing operations.

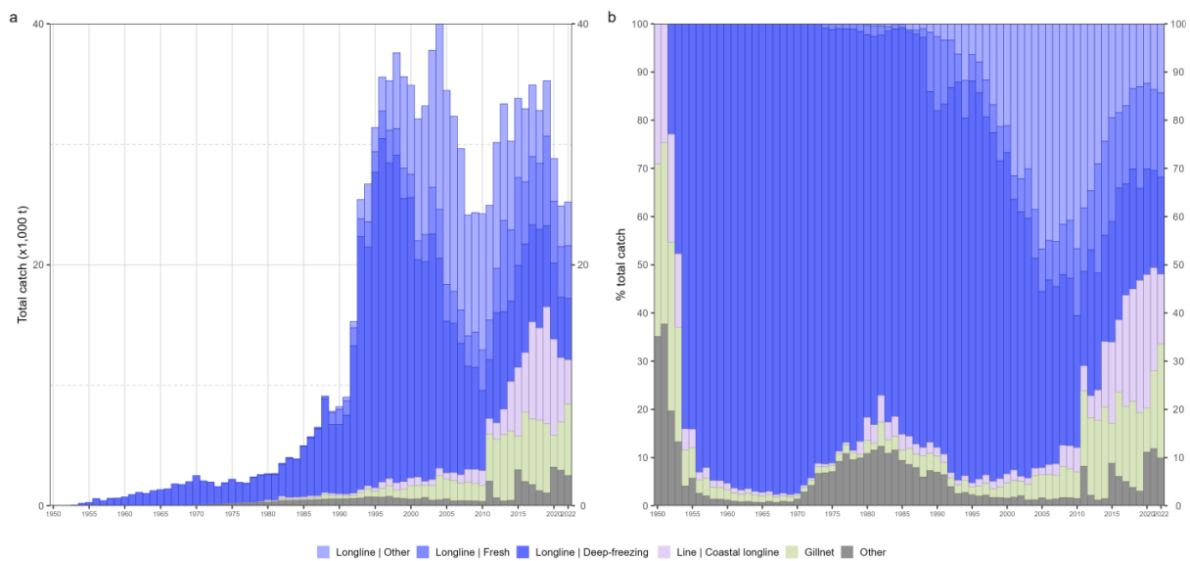


Figure 2 - Annual time series of cumulative retained absolute (a) and relative (b) catches (metric tonnes; t) of swordfish by IOTC fishery type for the period 1950-2022. Data source: [best scientific estimates of retained catches](#).(Source IOTC 2024c).

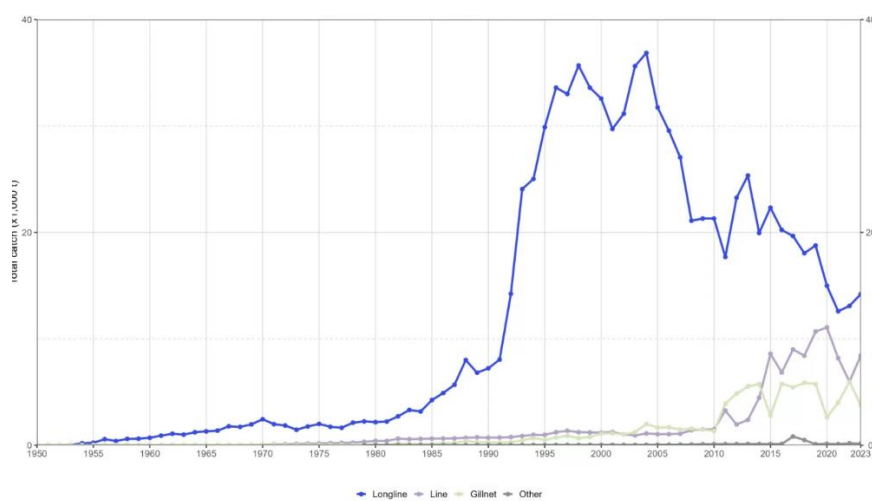


Figure 3 – Annual time series of retained catches (metric tonnes; t) of swordfish by fishery group for the period 1950-2023. Data source: IOTC best estimates of retained catches, 2024.

2.3 MP input data and operation of the MP

2.3.1 Catch data

Total IOTC catch estimates, including 2023 catches, are available for running the MP.

The WPD21 (2023) and WPB22 (2024) reviewed recent nominal catches, fishery features, quality and representativeness of catch data relative to previous years and have noted similar quality and representativeness of reported data (IOTC, 2024c). The most recent review of IOTC statistical data for IOTC Swordfish (IOTC 2024c) noted that “*The quality of the total retained catches of swordfish is considered to be good and overall the best among the five billfish species under IOTC mandate*” (Figure 4).

On the basis of this, there is no evidence of exceptional circumstances pertaining to the catch data.

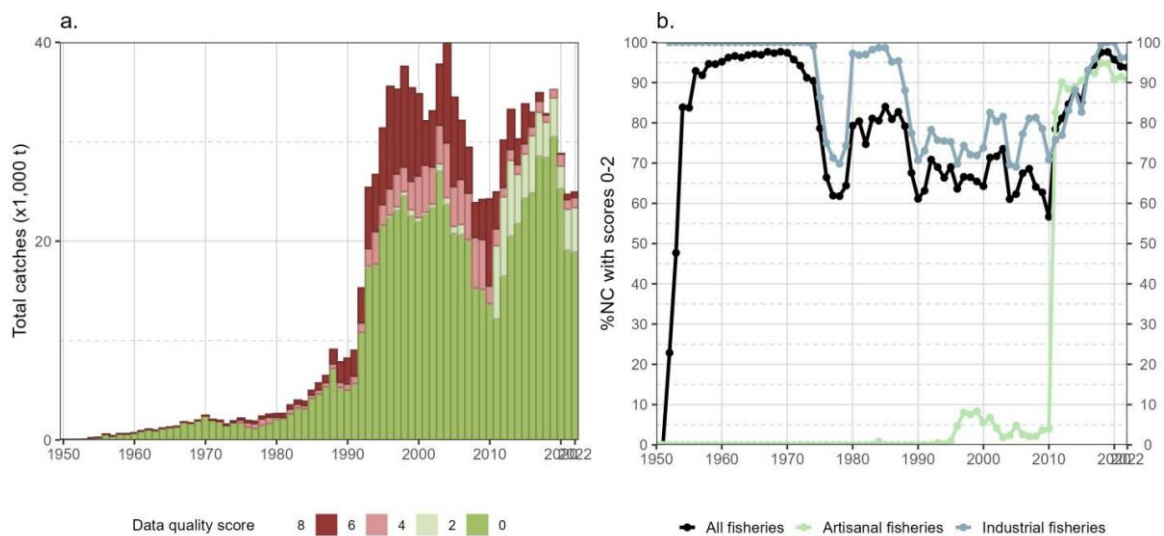


Figure 4 – (a) Annual retained catches (metric tonnes; t) of swordfish estimated by quality score whereby 0 is highest quality and 8 is poorest quality; and (b) percentage of total retained catches fully or partially reported to the IOTC Secretariat for all fisheries and by type of fishery, in the period 1950-2022 (Source – IOTC, 2024c).

2.3.2 CPUE data

The WPB22 review noted two main CPUE related issues for consideration under the review for potential exceptional circumstances for Swordfish.

Firstly, the WPB22 review confirmed that the stdCPUE including 2023 data had been completed, utilising the methodology specified in adoption of the MP (and used in MSE), and was available for running the MP (IOTC, 2024e). WPB22 noted that the stdCPUE series submitted to WPB was missing a value for 2011 but that this was previously internally estimated by the standardisation protocol, due to there being no fishing in that region in 2011 (due to the piracy issue) but that this does not impact the time series estimates nor the recent CPUE slope and distance to target (and therefore will not be an exceptional circumstance).

Figure 5 compares the stdCPUE time series estimates from the 2023 standardisation process (for period to 2022) and the 2024 standardisation process (for period to 2023), showing the two series to be very similar in trends and have relatively small differences, primarily in the more recent years.

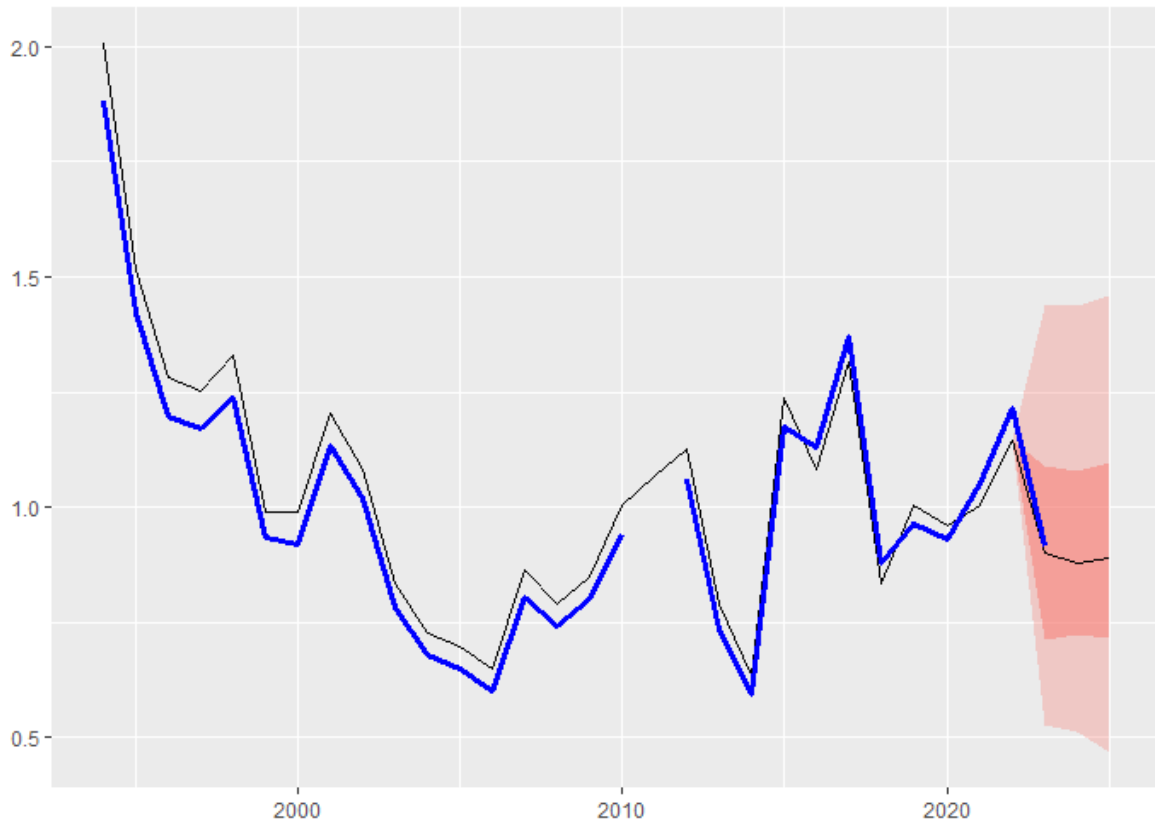


Figure 5 – Comparison of relative stdCPUE time series estimates from the 2023 standardisation process (black line, for the period to 2022) and the 2024 standardisation process (blue line, for the period to 2023) and the near future predicted CPUE (black line, 2023-2025).

Secondly, the WPB22 noted with concern the decline in Japanese longline fishing effort and catch in the north-west Indian Ocean (an area of significant swordfish catch) that might have potential implications for whether the Japanese CPUE can still index stock abundance in that area. The decline in effort in this region has been occurring since at least 2007 (Matsumoto et al 2023) (**Figure 6**), and as such, this is not a new issue and should not affect the specified CPUE standardisation or the implementation of the MP at this point in time. The MSE operating models incorporated a range of alternative CPUE series, and MP performance (using the Japan LL CPUE) was robust to these uncertainties, and was shown to reach the target. Furthermore, the NW JP LL CPUE was chosen based on prediction skill and discussions with WPB in previous years. A subsequent and more recent examination of the prediction skill of the NW JP CPUE from the 2023 assessment model indicates that the prediction skill remains acceptable (**Figure 7**).

However, acknowledging this, and that the issue of representativeness of this CPUE series is separate to the function of the MP, the issue of declining Japanese effort should nonetheless continue to be monitored and given more explicit consideration as part of the review of the MP planned for 2031. Further research on alternative sources of monitoring data or new CPUE series, for use in future MPs, could be considered and the evaluation of well-developed alternatives could also form part of the review.

On the basis of the assessment above, there is no evidence of exceptional circumstances pertaining to CPUE data.

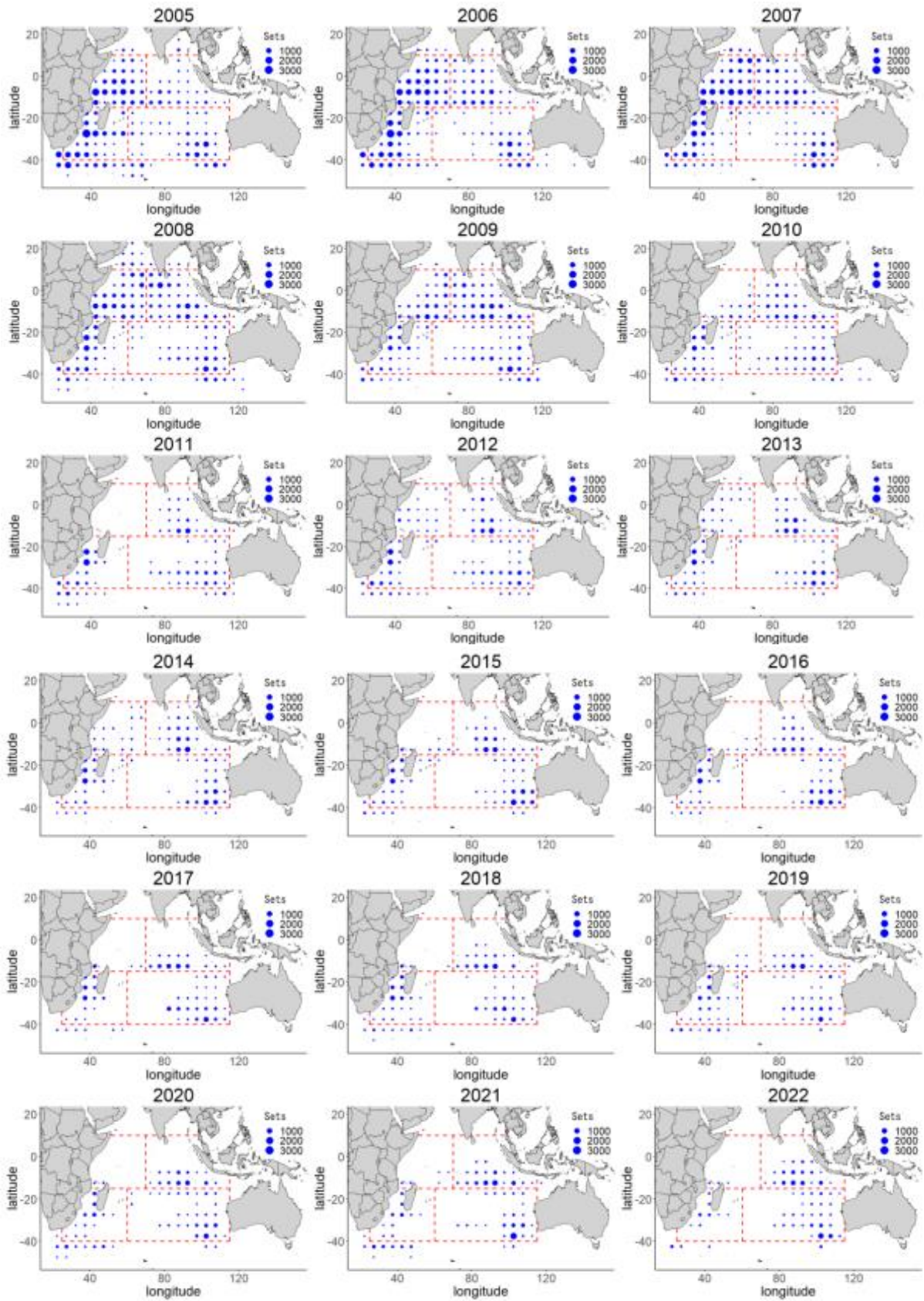


Figure 6. Distribution of fishing effort (number of sets) by Japanese longline fishery in the Indian Ocean (annual from 2005). Dashed lines show boundary for the areas for CPUE standardization (Source – Matsumoto et al 2023).

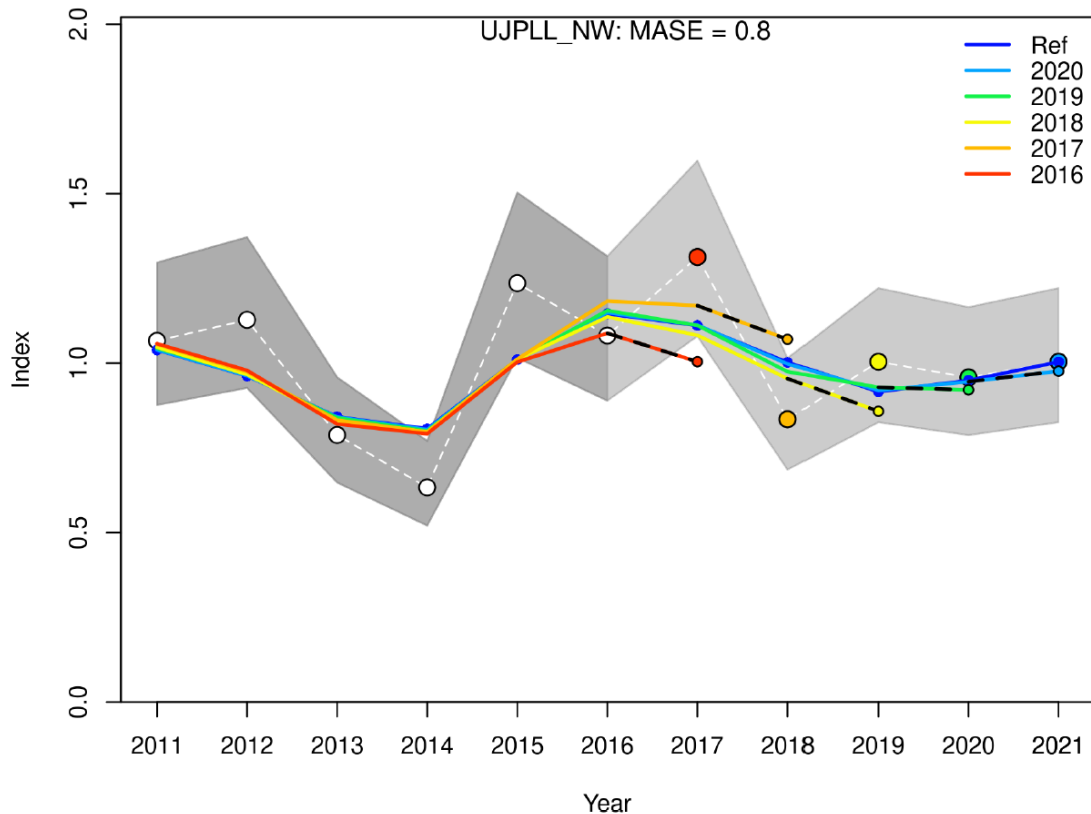


Figure 8 – Prediction skill of the base case 2023 assessment model for the north-west Indian Ocean Japanese longline CPUE. Large, coloured dots, show the CPUE observations over the last five years. Coloured lines show the one-year-ahead predictions obtained from a catch-based hindcast (Carvalho et al, .2021). MASE values less than 1 indicate that the model is able to generate predictions for this series that are better than random.

2.3.3 Catch relative to TAC

The 2024 swordfish MP will be the first TAC to be implemented for swordfish by the IOTC, therefore there is no exceptional circumstance, because a comparison of catch relative to TAC does not exist.

2.3.4 Operation of the MP

During the process of undertaking this review for potential exceptional circumstances, an error was detected in the MSE testing of the candidate MPs presented to the 8th Technical Committee on Management Procedures (TCMP08). Specifically, an error in the configuration of the simulation of CPUE resulted in the most recent values of the CPUE index (2020 to 2022) being unintentionally replaced by simulated values. Subsequently, these values were unintentionally applied in the first MP implementation in the simulation, instead of the actual CPUE values.

A review of the issue (see paper IOTC-2024-WPM15-11rev2) demonstrated that when the adopted MP is implemented using the correct CPUE index, its performance is only slightly affected (i.e. it results in a slightly higher exploitation level, and lower stock size). The MP, however, no longer meets the management objectives that the MP was initially tuned to (p(Kobe green)=60%), achieving a p(Kobe green) of 54%.

When the MP is run with the correct recent CPUE index values and retuned to achieve p(Kobe green) =60%, the overall performance of the retuned MP is very similar to the performance presented at TCMP08 (with a slight decrease in TAC variability) (IOTC-2024-WPM15-11rev2).

The WPM will discuss and make a recommendation to the SC and Commission on whether or not the adopted MP or the corrected and retuned MP should be used for TAC setting this year and in the future.

In addition to reviewing the issue identified above, the opportunity was taken to examine the lag between implementation of TAC advice and the last year of CPUE input data feeding into the MP. The MP adopted in 2024 had been tuned to allow for only 2 years lag between the last year of CPUE input data and implementation of the TAC advice. However, in practice, the lag will be 3 years due to the timing of the SC, Commission meeting and quota year. (e.g. the MP uses CPUE including 2023 data, the MP is run in 2024, the Commission will consider the TAC advice in 2025, and this will be implemented in 2026). This lag is the same as that adopted for the BET MP. Robustness tests of the adopted 2024 MP showed that performance of the MP with respect to the management objective was not impaired by having a different lag. However, other MP performance indicators deteriorated slightly (e.g. minor decrease in the catches). The MP has been corrected for both the CPUE issue and the lag and retuned. This did not result in any noticeable change in the MP performance.

In summary, an error was identified in the original simulation analyses that, when corrected (without retuning) resulted in the MP not reaching the target. This represents an exceptional circumstance. Correcting the error and retuning the MP results in an MP that reaches the target and has similar outcomes in other performance measure. Therefore, the recommended action is to use the corrected and retuned MP to recommend the TAC for 2026-2028.

With respect to implications for the currently adopted Resolution that specifies the MP, if the Commission were to accept the retuned MP, a relatively minor change would be required to the Resolution to specify a new value for the CPUE target to be used in the MP calculation. This is explained in more detail in IOTC-2024-WPM15-11rev2.

3. Discussion and Conclusion

The Exceptional Circumstances Guidelines make it clear that identifying exceptional circumstances does not necessarily result in changes to the recommended TAC. In fact, changes to the recommended TAC should be avoided except in situations where the TAC advice would pose a risk to the stock or the fishery if implemented. The alternatives are to collect more information, or do research, to inform the review of evidence of exceptional circumstances in the next year or years. Another alternative is to proceed with the TAC advice (or precautionary advice) and trigger a review of the MP earlier than planned. Recommending a change to the TAC is appropriate if there is a high risk to the stock. If the TAC is to be adjusted, further evaluation of the scale and severity of the exceptional circumstance provides guidance (% change) on how to calculate an adjustment to the TAC.

A wide range of items are reviewed to examine if there is evidence for exceptional circumstances, i.e., the data inputs to the MP, the range of uncertainties against which the MP was tested, and implementation of MP TAC advice. This review is conducted annually to provide advice to the SC on any risks with the operation of the MP and TAC advice.

The annual review of exceptional circumstances is an important component of providing management advice using an adopted management procedure. It is the safety net process that evaluates the extent to which the MP is operating as expected (from the MP testing) and identifies any risks associated with implementing the MP TAC advice. The review requires consideration of evidence for exceptional circumstances. It provides a scientific process for

developing appropriate management responses if any exceptional circumstances are identified and, hence, provides transparency in TAC decision making by the Commission.

The key conclusions of this 2024 review are that there are no exceptional circumstances identified as pertain to:

- **Stock status, population dynamics or biology** - The 2023 stock assessment estimates of SB/SB_{MSY} and F/F_{MSY} were shown to be within the 90% probability interval of the estimates from the operating models used to test the performance and tune the MP. While no EC relating to biology or population dynamics were identified this year, the 2025 EC review should look to assess any new research pertaining to stock structure.
- **Fishery or fishing operations** - There are no identified changes in recent fishery operations (e.g methods/approaches). Shifts in relative catch proportions by fishery over time (noted by WPB22) have been incorporated into the MSE operating models, and the subsequent MP performance tested and demonstrated to be acceptable. Fishery catch levels and proportions from the 2 most recent years of data are not substantially different to those considered by the OMs.
- **Catch data inputs** – There have been no significant recent changes in the quality and representativeness of swordfish catch data to be utilised by the MP.
- **CPUE data inputs** - stdCPUE time series estimates from the 2023 standardisation process (for period to 2022) and the 2024 standardisation process (for period to 2023) are very similar. Prediction skill of the NWIO Japanese longline CPUE remains acceptable but any further declines in Japanese longline effort should continue to be considered in annual EC reviews and as part of the larger MP review in 2031.

However, with respect to the operation of the MP, an error was identified in the original simulation analyses that, when corrected (without retuning) resulted in the MP not reaching the target. This represents an exceptional circumstance. Correcting the error and retuning the MP results in an MP that does reach the target, with similar performance measure outcomes. Therefore, the recommended action is to use the corrected and retuned MP to recommend the TAC for 2026-2028.

Finally it is worth noting that the WPB22 requested that in future, the WPB meeting agenda includes an agenda item for the annual review of Exceptional Circumstances and that this agenda item is supported by a paper or papers (submitted by meeting participants wishing to review and/or flag exceptional circumstances) which reviews available recent data, information and evidence relevant to the key criteria outlined in the Exceptional Circumstance Guidelines. This will better facilitate discussion and provision of advice from the WPB to the WPM and the IOTC SC. It will also be critical that, in years in which the swordfish MP is run to generate a TAC, the WPB include in its meeting agenda an item for the provision and review of both the catch data and the CPUE series generated according to the MP specification.

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