# NORTH ATLANTIC SWORDFISH MSE – FINAL RESULTS

**ICCAT Panel 4 Meeting on N-SWO MSE**

**8 October 2024**

**Resources: Swordfish MSE website**

**Swordfish MSE results**

ICCAT CICTA CICAA

# Goals

*Communicate final results for the North Atlantic Swordfish Management Strategy Evaluation*

*Provide information to support Commission decision making on MP selection and MP specifications*

# Presentation outline – PA4 agenda

4. Review of North Atlantic Swordfish MSE and workplan defined in Rec. 23-04
5. Summary of work completed on the North Atlantic swordfish combined index
6. CMPs and their ~~preliminary~~ final results, including robustness testing
7. Development of an Exceptional Circumstances Protocol
8. Other matters

# Operating models

- Reference operating models
  - The most important uncertainties in the stock and the fishery

- Robustness operating models
  - Other potentially important uncertainties or scenarios
  - May be considered less plausible
  - “Stress tests”

# Final reference OM grid

| *Variable* | *Stock assessment base case model* | *Operating model grid* | | |
|---|---|---|---|---|
| Steepness | 0.88 | 0.69 | 0.8 | 0.88 |
| Natural mortality | 0.2 | 0.1 | 0.2 | 0.3 |

# Robustness tests

- Plausible but less likely scenarios / stress tests for CMPs

| *Test name* | *Type* | *Description* |
|---|---|---|
| **R1** | **Catchability** | Evaluate impact of an assumed 1% annual increase catchability, that is not accounted for in the standardization of the indices of abundance (historical and projection) |
| **R2** | | Same as R1, but bias in the indices of abundance is only for the historical period |
| **R3** | **Biomass scale** | Robustness test to evaluate the ability of the CMPs to recover the stock from a low initial level. The historical indices were modified by adding a persistent slope such that the SB/SBMSY = 0.6 in the terminal year of the OM conditioning |
| **R4** | **Climate change impact on recruitment** | Evaluate impact of cyclical pattern in recruitment deviations in projection period; a proxy for impact of climate change on stock productivity. Recruitment is lower than expected for the first 15 years of the projection period, and then higher than expected in the following 15 years |
| **R5** | | Evaluate impact of lower than expected recruitment deviations for first 15 years of projection period; a proxy for impact of climate change on stock productivity. Similar to R4, but recruitment returns to average after the first 15 years |
| **R6** | **IUU** | Evaluate impact of illegal, unreported, or unregulated catches. The catch is consistently 10% higher than the TAC |
| **R7** | **Index observation error** | Evaluates impact of additional observation error in the index of abundance. The standard deviation of the log-normal observation error is doubled from the base case (R0) |

# Management objectives

Objectives fall into 4 categories:

| 19-14 | SWO |
|---|---|
| RESOLUTION BY ICCAT ON DEVELOPMENT OF INITIAL MANAGEMENT OBJECTIVES FOR NORTH ATLANTIC SWORDFISH | |

1. Safety [15%, 10%, ~~5%~~]

   E.g. "There should be a [__]% or less probability of the stock falling below $B_{LIM}$ at any point during the 30-year evaluation period."

2. Stock status [~~51%~~, 60%, 70%]

   E.g. The stock should have a greater than [__]% probability of occurring in the green quadrant of the Kobe matrix

3. Stability [25% / no cap / bifurcation]

   E.g. Any increase or decrease in TAC between management periods should be less than [__]%

4. Yield

   E.g. Maximize overall catch

# Key performance indicators

| *Management objectives* | *Corresponding key performance indicators* |
|---|---|
| **Status**<br>The stock should have a [60, 70]% or greater probability of occurring in the green quadrant of the Kobe matrix. | **PGK$_{SHORT}$**: Probability of being in the Kobe green quadrant (i.e., SB≥SB$_{MSY}$ and F<F$_{MSY}$) in years 1-10<br>**PGK$_{MED}$**: Probability of being in the Kobe green quadrant (i.e., SB≥SB$_{MSY}$ and F<F$_{MSY}$) in years 11-20<br>**PGK$_{ALL}$**: Probability of being in the Kobe green quadrant (i.e., SB≥SB$_{MSY}$ and F<F$_{MSY}$) over years 1-30<br>**PNOF:** Probability of not overfishing (F<F$_{MSY}$) over years 1-30 |
| **Safety**<br>There should be a [5, 10, 15]% or less probability of the stock falling below B$_{LIM}$ (0.4*B$_{MSY}$) at any point during the 30-year evaluation period. | **LRP$_{ALL}$**: Probability of breaching the limit reference point (i.e., SB<0.4*SB$_{MSY}$) in any of years 1-30<br><br>(**nLRP** (not breaching the LRP) is used when it is more appropriate for higher values of performance metrics to indicate a 'safer' outcome, such as in trade-off plots. For example, a 15% LRP threshold is equivalent to a nLRP threshold of 85%. |
| **Yield**<br>Maximize overall catch levels. | **TAC1**: TAC in the first management cycle (2025-27)<br>**AvTAC$_{SHORT}$**: Median TAC (t) over years 1-10<br>**AvTAC$_{MED}$**: Median TAC (t) over years 11-20<br>**AvTAC$_{LONG}$**: Median TAC (t) over years 21-30 |
| **Stability**<br>Any increase or decrease in TAC between management periods should be less than [25]%. [Also test no stability limitation and bifurcated stability when B<B$_{MSY}$.] | **VarC**: Mean variation in TAC (%) between management cycles over years 1-30 |

# Decisions made by PA4 in 2023

- Management objectives
  - Performance indicator probabilities
  - Tuning objectives
- CMP specifications
- MP implementation schedule

# Decisions made by PA4 in 2023

Operationalizing management objectives

- Safety: probability of not breaching the limit reference point at any point in the projection period
  - [85%, 90%, ~~95%~~]
- Status: probability being in the green quadrant of the Kobe plot
  - [~~51%~~, 60%, 70%]
- Stability: variation in TAC between management cycles
  - [25%, no cap, no cap on TAC decreases if the MP's estimated $SB<SB_{MSY}$]

# Decisions made by PA4 in 2023

## Tuning

- Application of 60% PGK threshold for all 3 time periods:
  - short (years 1 – 10)
  - medium (years 11 – 20)
  - long (years 21 – 30)

## Stability

- Develop a variation of the SPSSFox CMP with a bifurcated TAC change rule
  - ±25% cap, with no cap on TAC decreases if the MP's estimated $B<B_{MSY}$

# Decisions made by PA4 in 2023

MP specifications:

- TAC for all the North Atlantic
- TAC: sum of landings + dead discards
- 3-year management cycle
- 200 t minimum TAC change threshold

CMP type

- Some CMPs and tunings eliminated

# Decisions made by PA4 in 2023

- MP implementation schedule

| | | *Activity* | | | | | *Data inputs* | |
|---|---|---|---|---|---|---|---|---|
| Year | Management cycle | MP run | MP advice implemented | Stock assessment | MSE Review | Exceptional circumstances evaluated | Combined index* | Exceptional circumstance indicators |
| 2024 | | x | | | | | x | |
| 2025 | 1 | | x | | | x | | x |
| 2026 | | | | | | x | | x |
| 2027 | | x | | | | x | x | x |
| 2028 | 2 | | x | [x] | | x | | x |
| 2029 | | | | [x] | | x | | x |
| 2030 | | x | | | [x] | x | x | x |
| 2031 | 3 | | x | | | x | | x |
| 2032 | | | | | | x | | x |
| 2033 | | x | | | | x | x | x |

*The combined index may be updated every year, depending on the requirements set out in the exceptional circumstances protocol.

# Work completed after SCRS in 2023

- Updating the combined index and generating final CMP results
  - Data for combined index model available in early November 2023 (1-year data-lag)
  - Original model did not converge, a new model with a different error distribution was developed
  - CMP results recalculated but little time for thorough review before COMM

# Workplan in Rec. 23-04

"7. During 2024, the SCRS shall, taking into account the progress made to date, to identify final operational management objectives:

a. Review and approve the North Atlantic swordfish combined index to be used for testing the CMPs in the management strategy evaluation (MSE), and pursuant to 7f below, recalculate the performance metrics for the current suite of CMPs;

b. Review the MCC CMP variants in light of the changes to the combined index and increase the number of TAC steps, if appropriate;

c. Update the combined index with 2023 catch data, if possible;

d. Develop the scientific components of the Exceptional Circumstances Protocol (ECP) for North Atlantic swordfish and review Panel 4's draft ECP;

e. Conduct robustness testing envisioned in the 2024 SCRS Swordfish Workplan, including related to Climate Change and the effectiveness of minimum size limits, and add robustness tests of the impact on CMP performance of various data gaps within the combined index;

f. Assess the effect of and develop results for a two-year data lag in advance of the 2024 SCRS plenary meeting. If the combined index and updated evaluations of the CMPs are not finalized by the conclusion of the 2024 SCRS plenary meeting, the SCRS should provide final results using fishing year 2022 as the terminal year for the combined index, thereby incorporating a 2-year data lag.

In support of the above efforts, the SCRS and Panel 4 shall hold one or more MSE dialogue meetings, as necessary, in 2024. At the 2024 ICCAT annual meeting, the Commission shall review the final CMPs and select one for adoption and application to establish the TAC for 2025-2027 and future years."

# Presentation outline – PA4 agenda

4. Review of North Atlantic Swordfish MSE and workplan defined in Rec. 23-04

5. Summary of work completed on the North Atlantic swordfish combined index

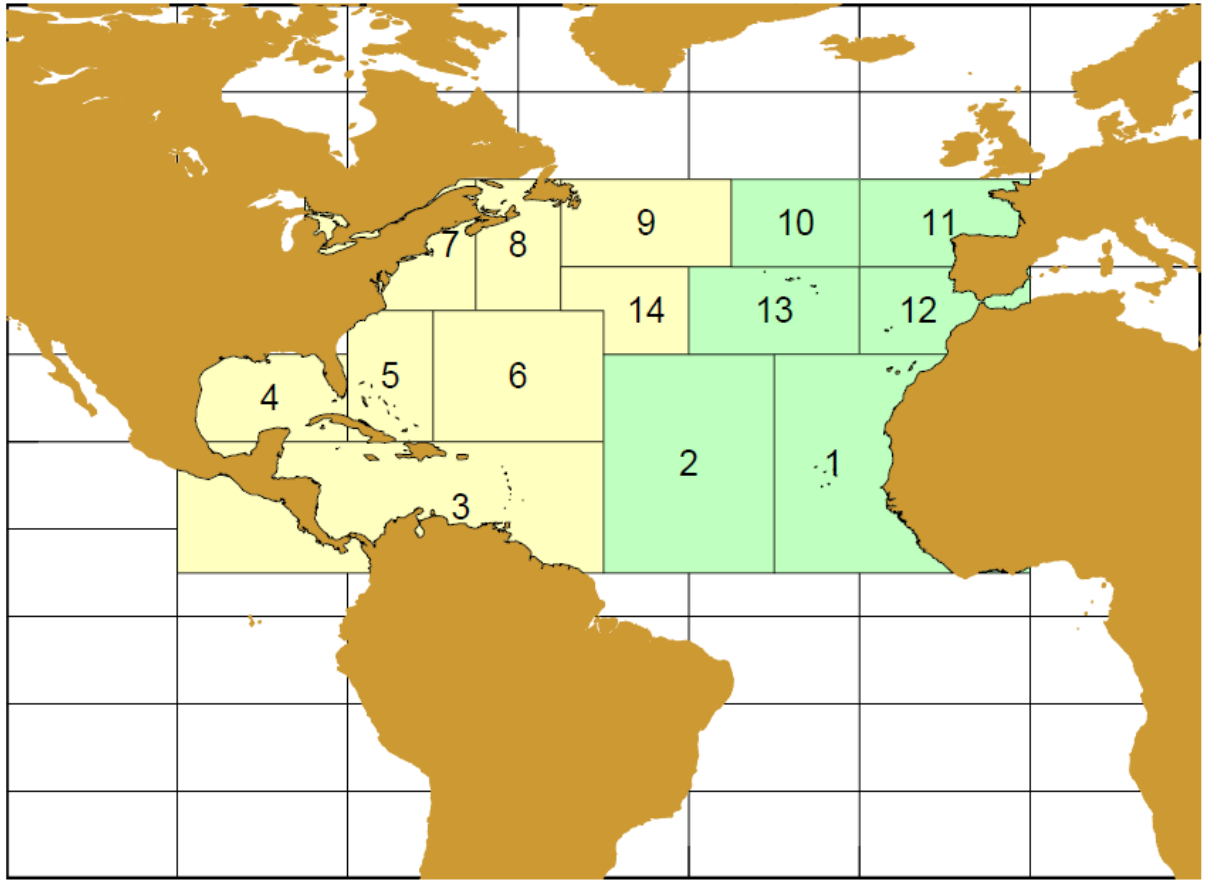
6. CMPs and their ~~preliminary~~ final results, including robustness testing

7. Development of an Exceptional Circumstances Protocol

8. Other matters

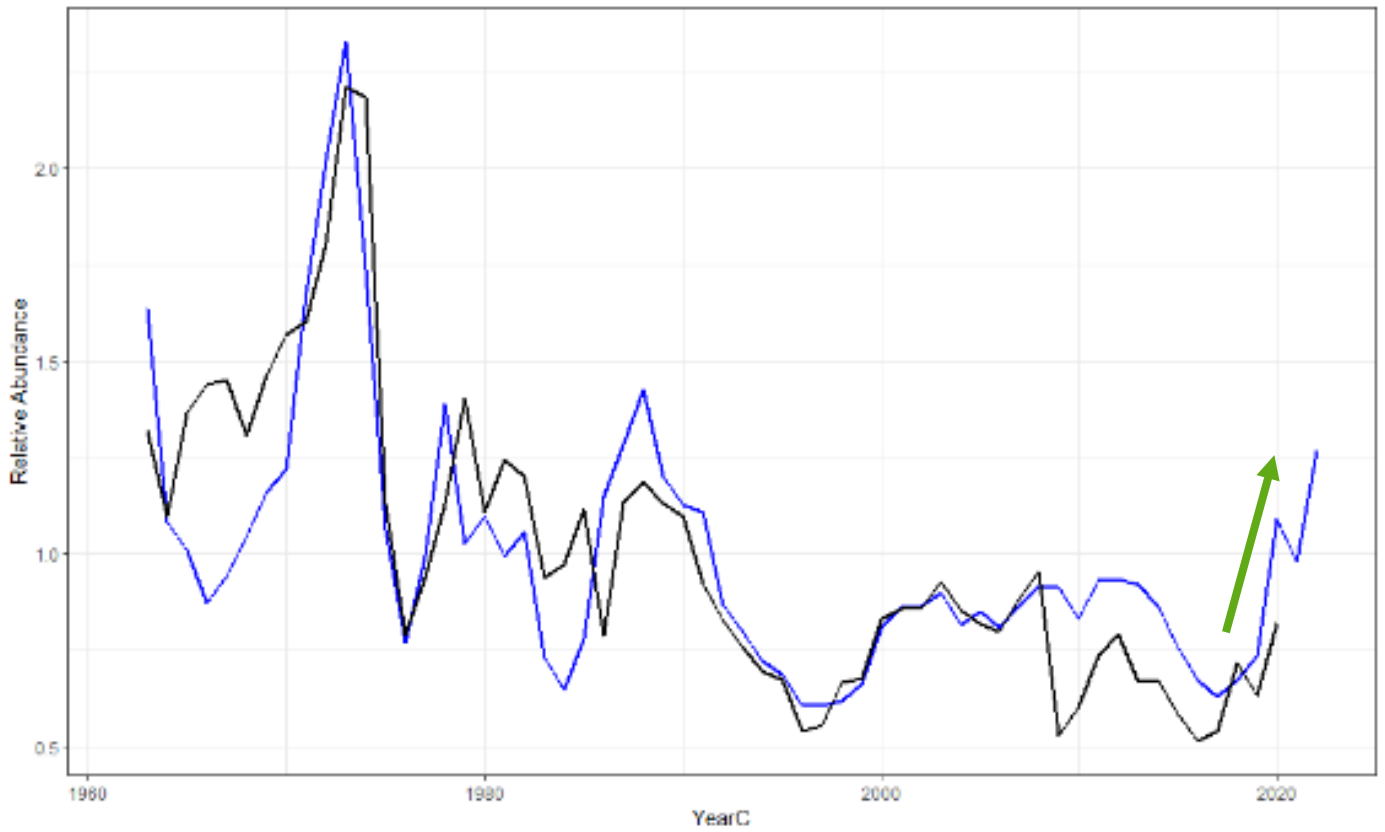
# Updating the combined index

- Data from 7 CPCs accounting for ~95% of catch in the North Atlantic
- Model-based standardization
- Abundance indicator for all CMPs

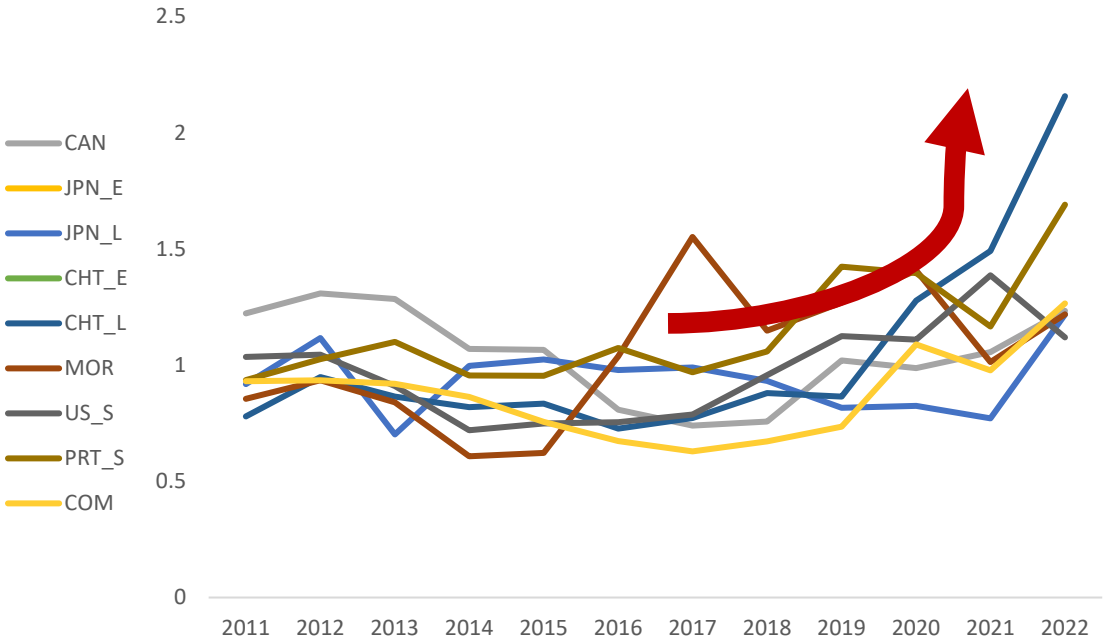


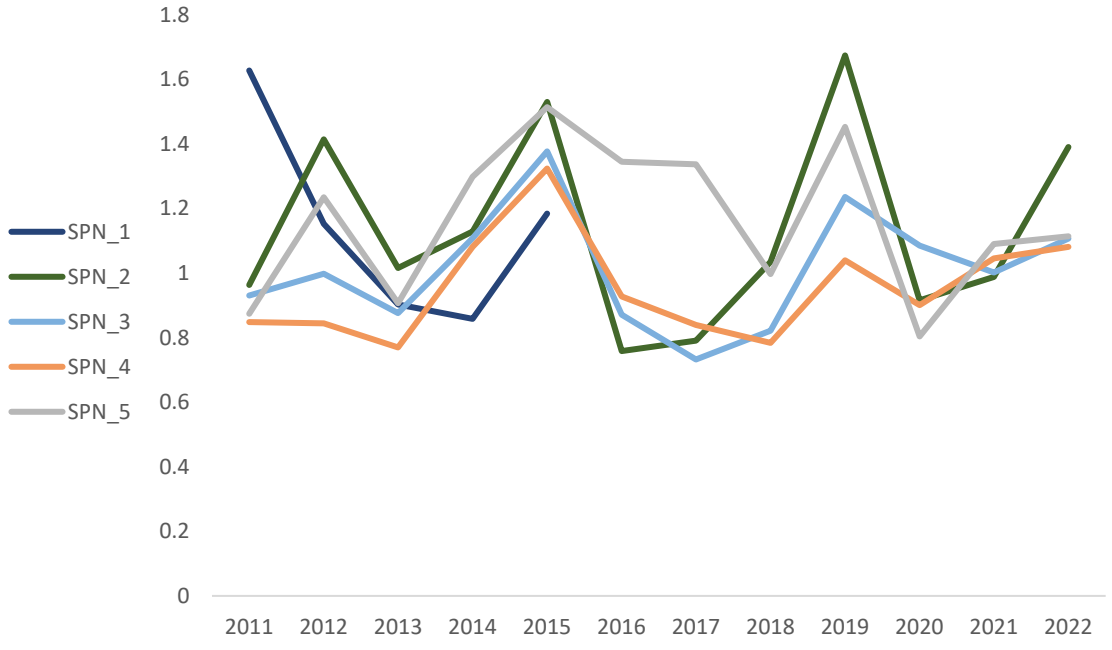
# Updating the combined index

- Several approaches explored
  - Data treatment
  - Fleets to be included
  - Analysis for targeting
  - Spatial-temporal VAST model and Tweedie model
- Tested for stability when there are data gaps and lags
- Data to 2022 (2-year data lag)



# Reconditioning the Operating Models

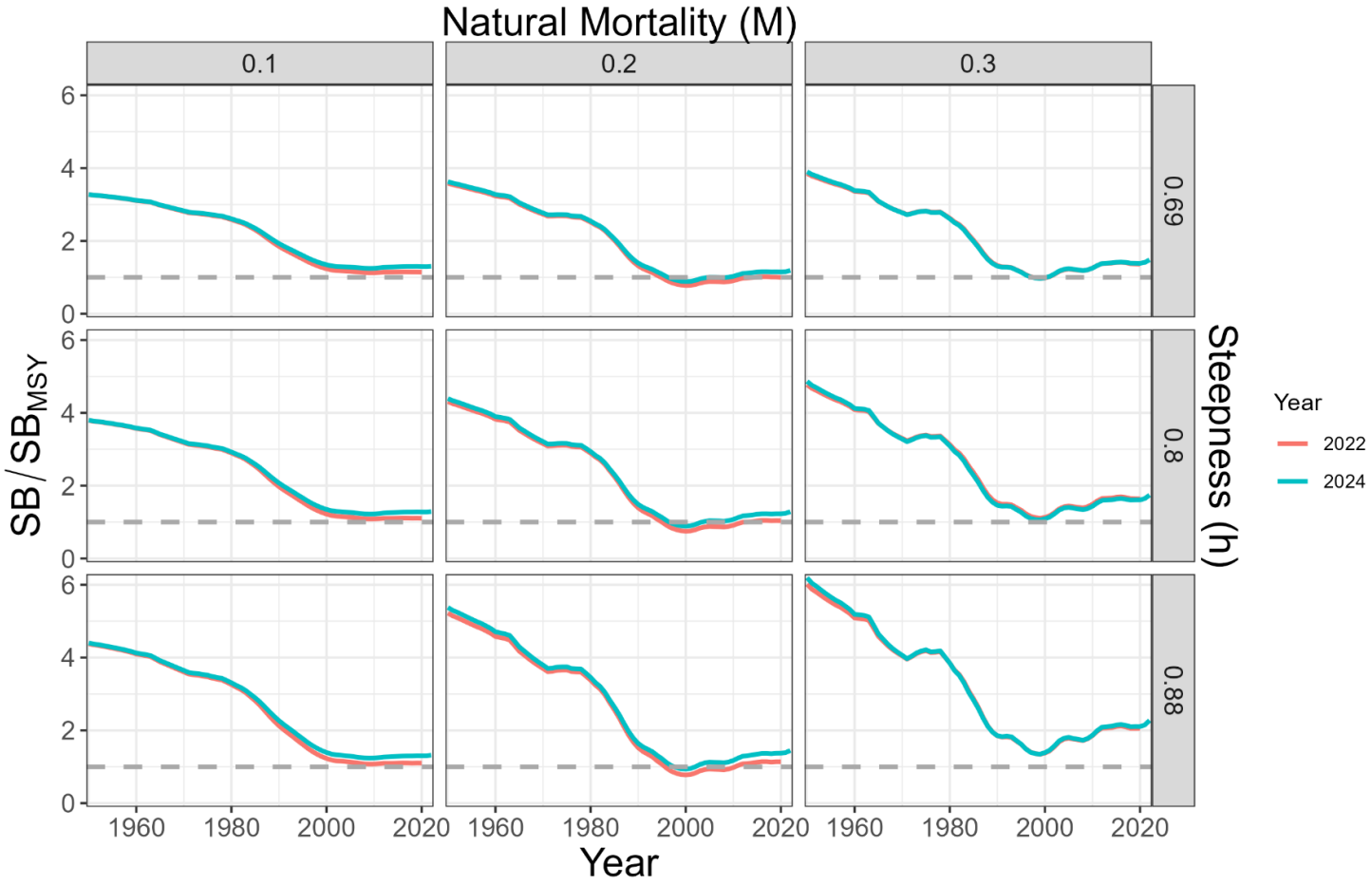



- OMs reconditioned, CMPs tweaked to improve performance relative the updated OMs

# Operating Models

## Reference Set




**2024 OMs**

| OM # | M | h | SB0 | F/F$_{MSY}$ | SB/SB$_{MSY}$ |
|---|---|---|---|---|---|
| 1 | 0.1 | 0.69 | 430,260 | 0.71 | 1.30 |
| 2 | 0.1 | 0.80 | 370,240 | 0.71 | 1.29 |
| 3 | 0.1 | 0.88 | 335,753 | 0.69 | 1.32 |
| 4 | 0.2 | 0.69 | 154,718 | 0.74 | 1.19 |
| 5 | 0.2 | 0.80 | 133,280 | 0.68 | 1.28 |
| 6 | 0.2 | 0.88 | 120,145 | 0.62 | 1.45 |
| 7 | 0.3 | 0.69 | 82,676 | 0.59 | 1.48 |
| 8 | 0.3 | 0.80 | 71,069 | 0.53 | 1.74 |
| 9 | 0.3 | 0.88 | 66,124 | 0.43 | 2.27 |

All Reference OMs:

$F<F_{MSY}$

$SB>SB_{MSY}$

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# CMP types

| | CE | MCC9 | MCC11 | SPSSFox | SPSSFox2 |
|---|---|---|---|---|---|
| **Type** | Empirical | Empirical | Empirical | Model | Model |
| **Index** | Combined | Combined | Combined | Combined | Combined |
| **Steps** | N/A | 9 | 11 | N/A | N/A |
| **Minimum TAC** | N/A | 4000 t | 4609t | N/A | N/A |
| **Stability Limit** (maximum allowed change between management cycles) | ±25% cap | None | None | ±25% cap | ±25% cap; no cap on TAC decreases if the MP's estimated $B<B_{MSY}$ |
| **Reference Period** | 2016-2020 | 2017-2019 | 2017-2019 | N/A | N/A |
| **Detailed Description** | Attempts to maintain a constant exploitation rate in the projection period, based on the mean exploitation rate in the recent historical years. | The TAC is adjusted between a set of 9 steps based on the ratio of the mean index over the 3 most recent years compared to the mean index from 2017 – 2019. | Similar to MCC9 but the TAC is adjusted between a set of 11 steps and there is a different minimum TAC. | A Fox surplus production model with a hockey-stick HCR where fishing mortality decreases linearly from 100*BMSY to 40*BMSY. | Like SPSSFox but with a bifurcated stability restriction as described above in "Stability Limit" |

# CMP Tuning

Specified Tuning Targets

b) At least ***60%*** PGK in Short, Medium & Long

c) At least ***70%*** PGK in Short and at least ***60%*** in Medium & Long

**Short**: 2025 – 2034 (1 – 10)

**Medium**: 2035 – 2044 (11 – 20)

**Long**: 2045 – 2054 (21 – 30)

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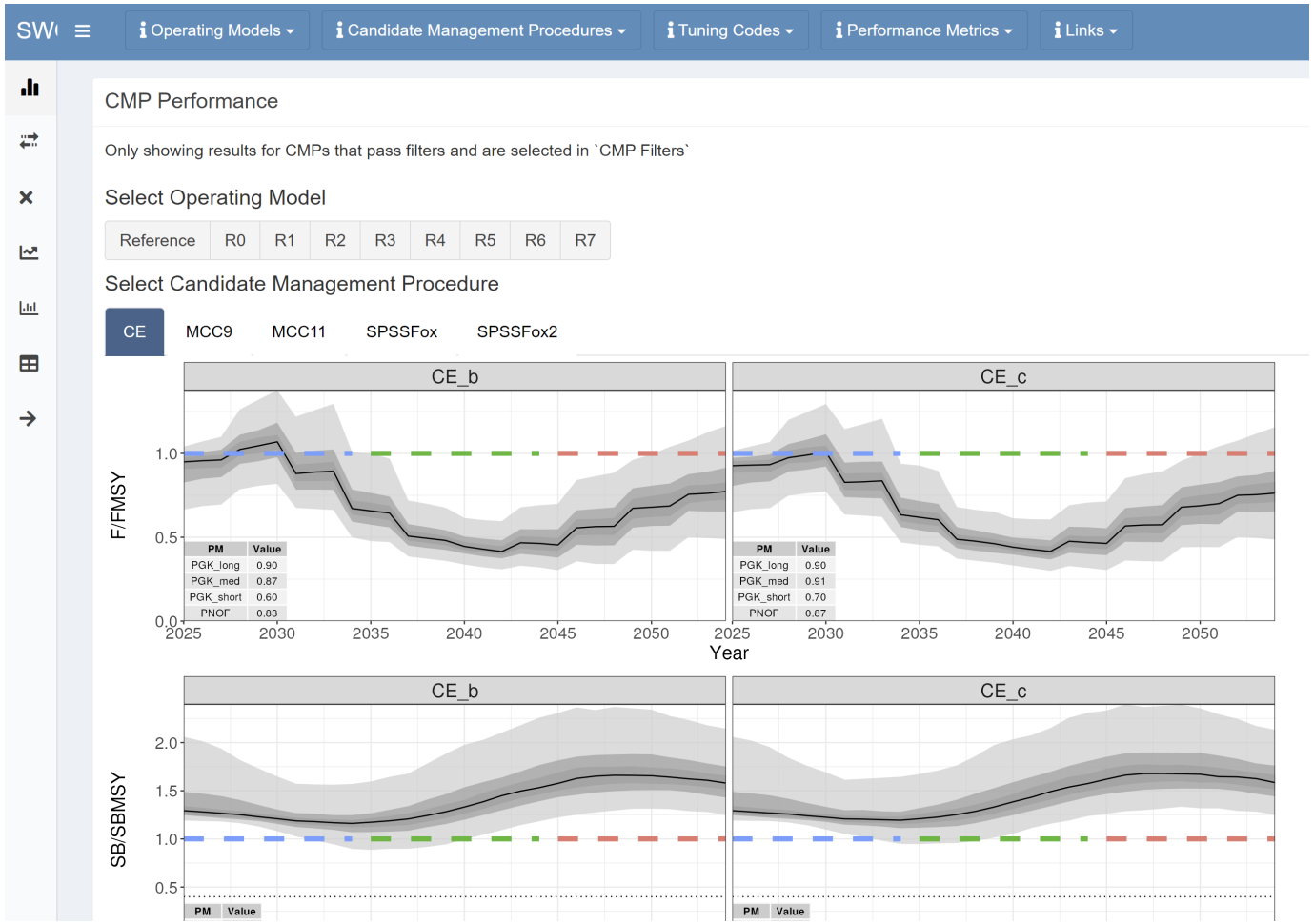
# CMP performance results

- All CMPs meet minimum standards for Safety and Status management objectives

- The CMP short-list contains a variety of TAC setting strategies and rules and span the trade-off space
  - Type: empirical and model-based
  - Interpretation of abundance and exploitation information
  - Frequency and scale of response to signals in the abundance indicator

# SWO App

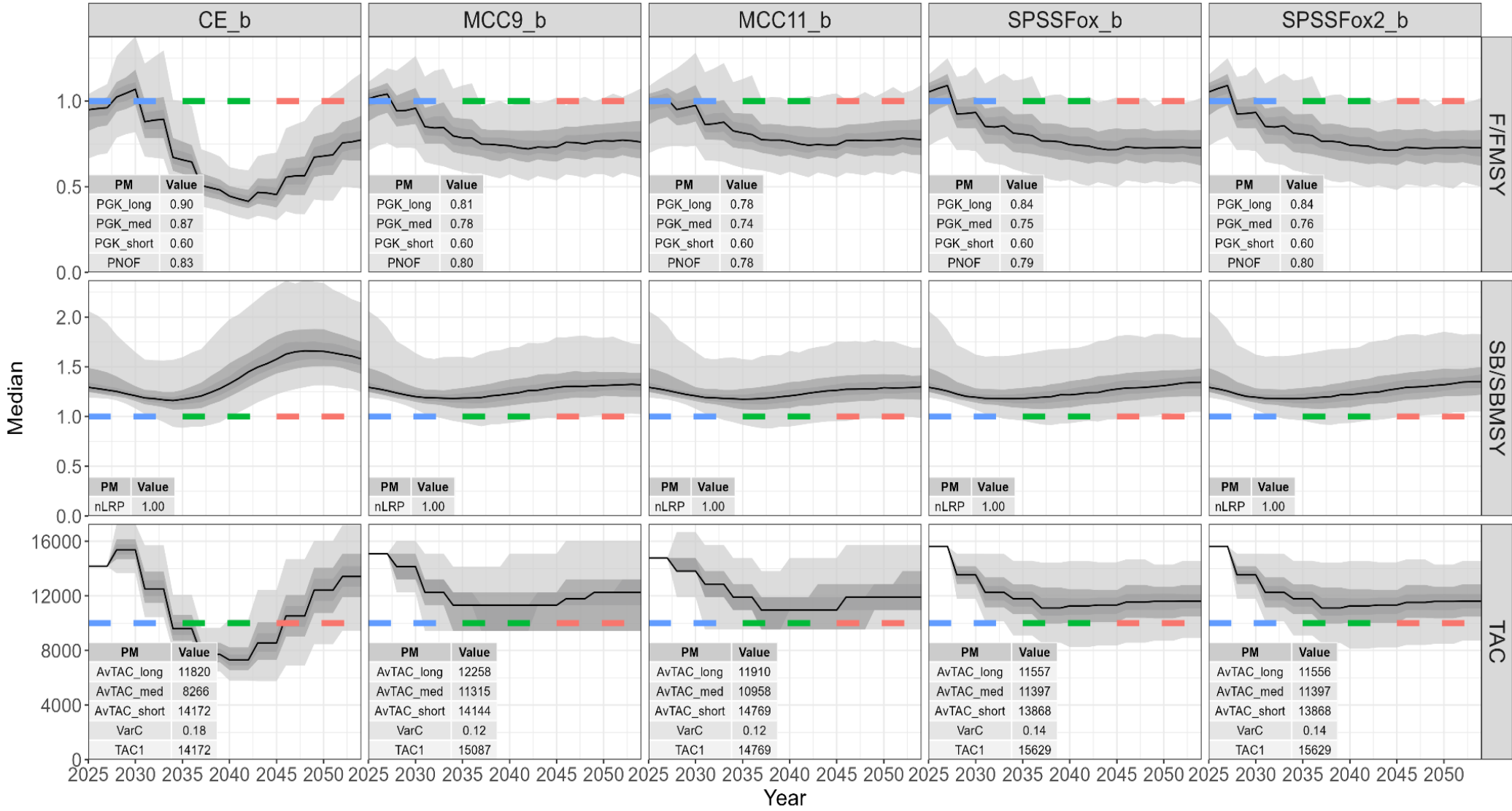



https://shiny.bluematterscience.com/app/swomse

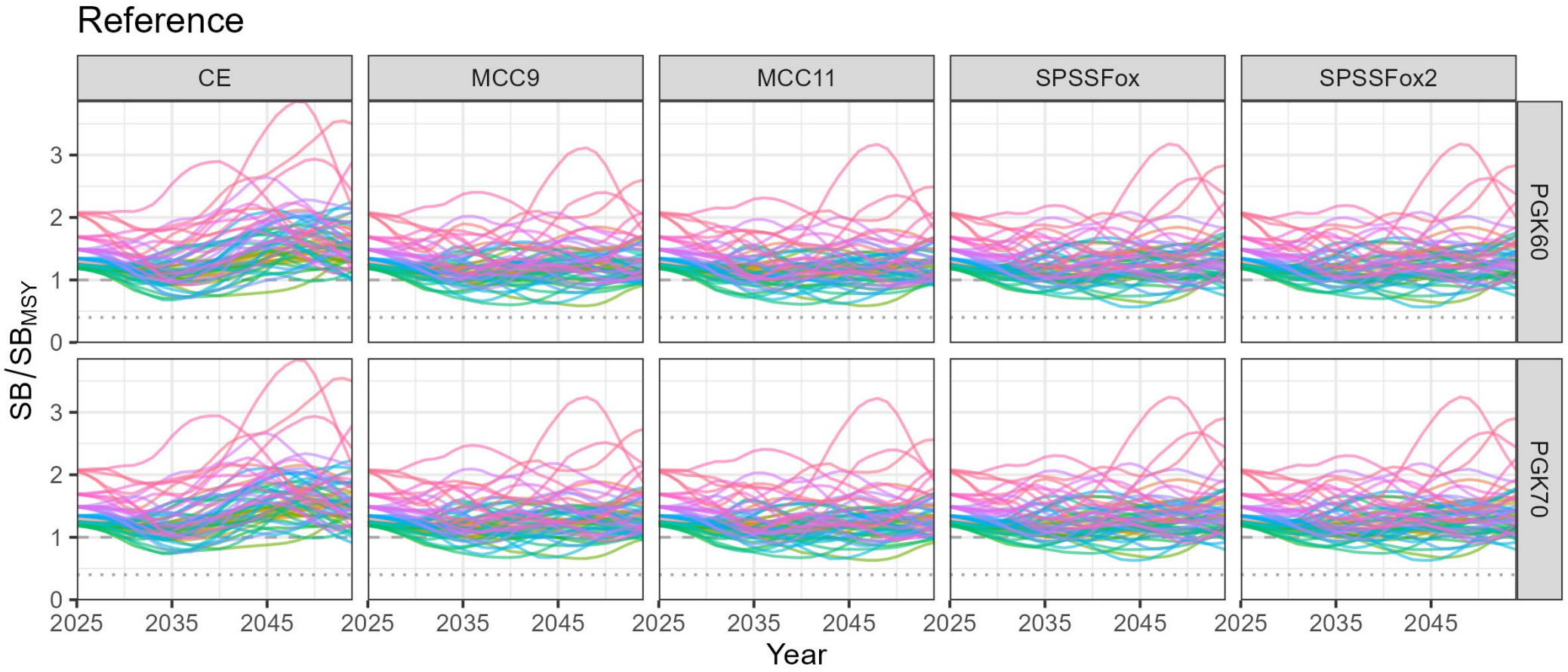
# CMP performance

# Projection time series

Median, 60th, 70th, and 90th percentiles



# Biomass time series by simulation



# 'b' vs 'c' Tuning

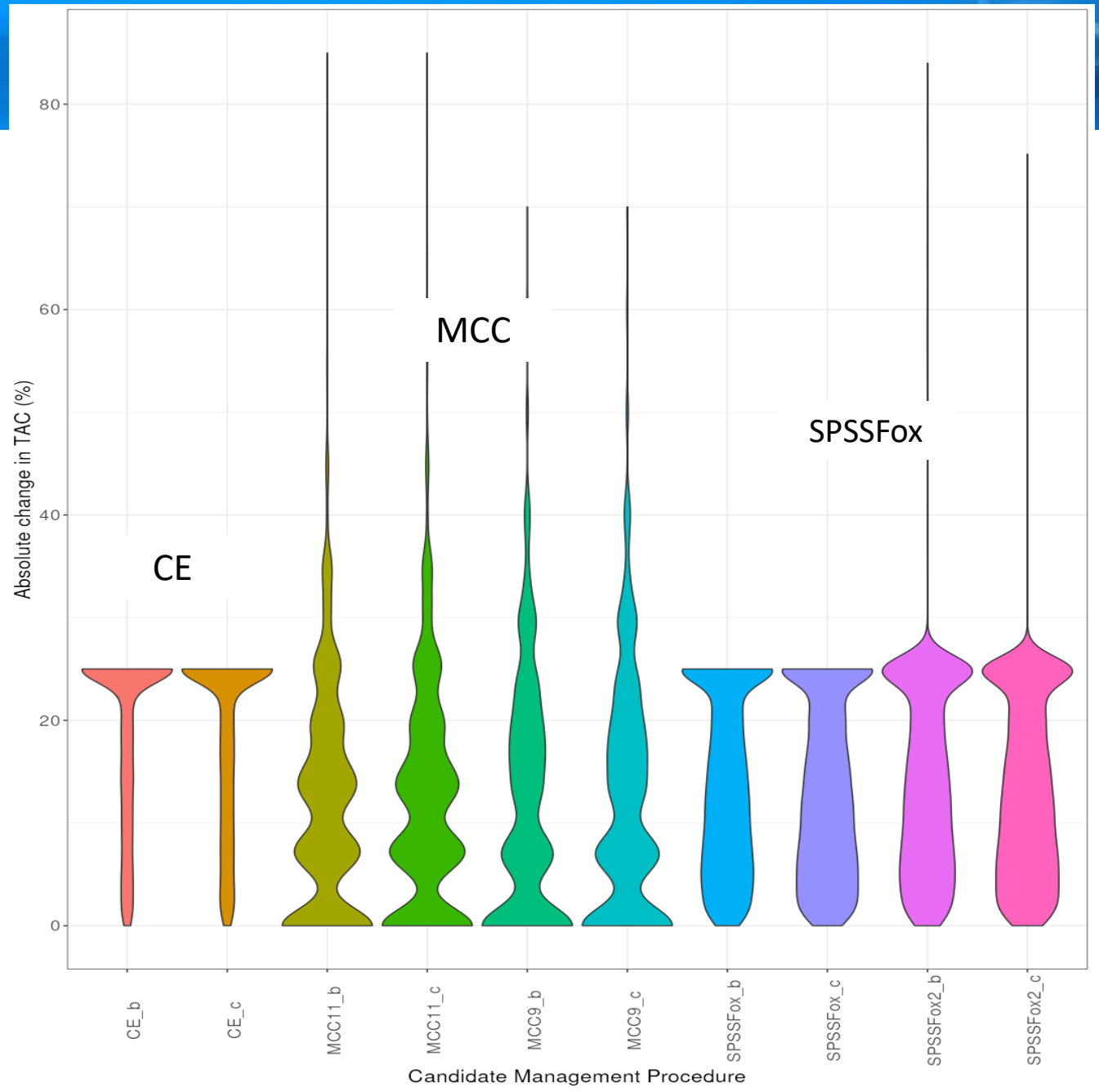
**'c' tunings**:
higher PGK & PNOF
& lower TAC

| | 'b' Tuning (PGK60) | 'c' Tuning (PGK70) |
|---|---|---|
| nLRP | 1 | 1 |
| PGK_short | 0.6 | 0.7 |
| PGK_medium | 0.74 – 0.87 | 0.80 – 0.91 |
| PGK_long | 0.78 – 0.90 | 0.82 – 0.90 |
| PNOF | 0.78 – 0.83 | 0.83 – 0.87 |
| | | |
| VarC | 0.12 – 0.18 | 0.12 – 0.18 |
| | | |
| TAC1 | 14,172 – 15,629 | 13,846 – 14,952 |
| AvTAC_short | 13,868 – 14,769 | 13,609 – 14,289 |
| AvTAC_medium | 8,266 – 11,397 | 8,241 – 11,523 |
| AvTAC_long | 11,556 – 12,258 | 11,522 – 11,934 |

# CMP performance

# Stability – percent change

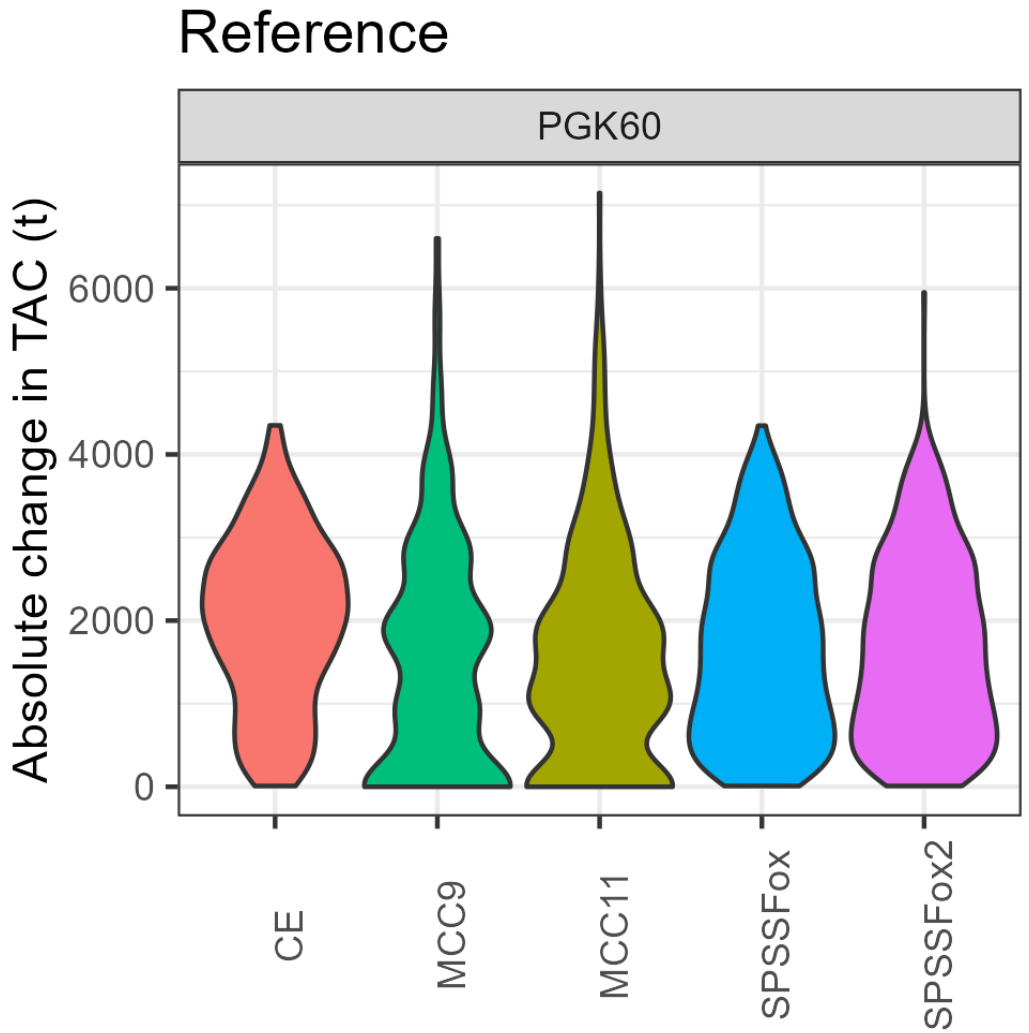
# Reference OMs



# CMP performance

Stability – change in tonnage

Reference OMs



# CMP performance – Quilt plot, reference OMs

| | MP | AvTAC_long | AvTAC_med | AvTAC_short | nLRP | PGK | PGK_med | PGK_short | PNOF | VarC | TAC1 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | CE_b | 11,820 | 8,266 | 14,172 | 1.00 | 0.79 | 0.87 | 0.60 | 0.83 | 0.18 | 14,172 |
| 2 | CE_c | 11,934 | 8,241 | 13,846 | 1.00 | 0.84 | 0.91 | 0.70 | 0.87 | 0.18 | 13,846 |
| 3 | MCC9_b | 12,258 | 11,315 | 14,144 | 1.00 | 0.73 | 0.78 | 0.60 | 0.80 | 0.12 | 15,087 |
| 4 | MCC9_c | 11,794 | 10,887 | 13,609 | 1.00 | 0.80 | 0.84 | 0.70 | 0.85 | 0.12 | 14,516 |
| 5 | MCC11_b | 11,911 | 10,958 | 14,769 | 1.00 | 0.71 | 0.74 | 0.60 | 0.78 | 0.12 | 14,769 |
| 6 | MCC11_c | 11,523 | 11,523 | 14,289 | 1.00 | 0.77 | 0.80 | 0.70 | 0.83 | 0.12 | 14,289 |
| 7 | SPSSFox_b | 11,557 | 11,397 | 13,869 | 1.00 | 0.73 | 0.75 | 0.60 | 0.79 | 0.14 | 15,629 |
| 8 | SPSSFox_c | 11,531 | 11,336 | 13,370 | 1.00 | 0.81 | 0.83 | 0.70 | 0.85 | 0.13 | 14,952 |
| 9 | SPSSFox2_b | 11,556 | 11,397 | 13,869 | 1.00 | 0.73 | 0.76 | 0.60 | 0.80 | 0.14 | 15,629 |
| 10 | SPSSFox2_c | 11,522 | 11,336 | 13,370 | 1.00 | 0.81 | 0.83 | 0.70 | 0.85 | 0.13 | 14,952 |

# CMP performance – Quilt plot, reference OMs

| | MP | AvTAC_long | AvTAC_med | AvTAC_short | nLRP | PGK | PGK_med | PGK_short | PNOF | VarC | TAC1 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | CE_b | 11,820 | 8,266 | 14,172 | 1.00 | 0.79 | 0.87 | 0.60 | 0.83 | 0.18 | 14,172 |
| 2 | MCC9_b | 12,258 | 11,315 | 14,144 | 1.00 | 0.73 | 0.78 | 0.60 | 0.80 | 0.12 | 15,087 |
| 3 | MCC11_b | 11,911 | 10,958 | 14,769 | 1.00 | 0.71 | 0.74 | 0.60 | 0.78 | 0.12 | 14,769 |
| 4 | SPSSFox_b | 11,557 | 11,397 | 13,869 | 1.00 | 0.73 | 0.75 | 0.60 | 0.79 | 0.14 | 15,629 |
| 5 | SPSSFox2_b | 11,556 | 11,397 | 13,869 | 1.00 | 0.73 | 0.76 | 0.60 | 0.80 | 0.14 | 15,629 |

# Robustness tests

- Plausible but less likely scenarios / stress tests for CMPs

| *Test name* | *Type* | *Description* |
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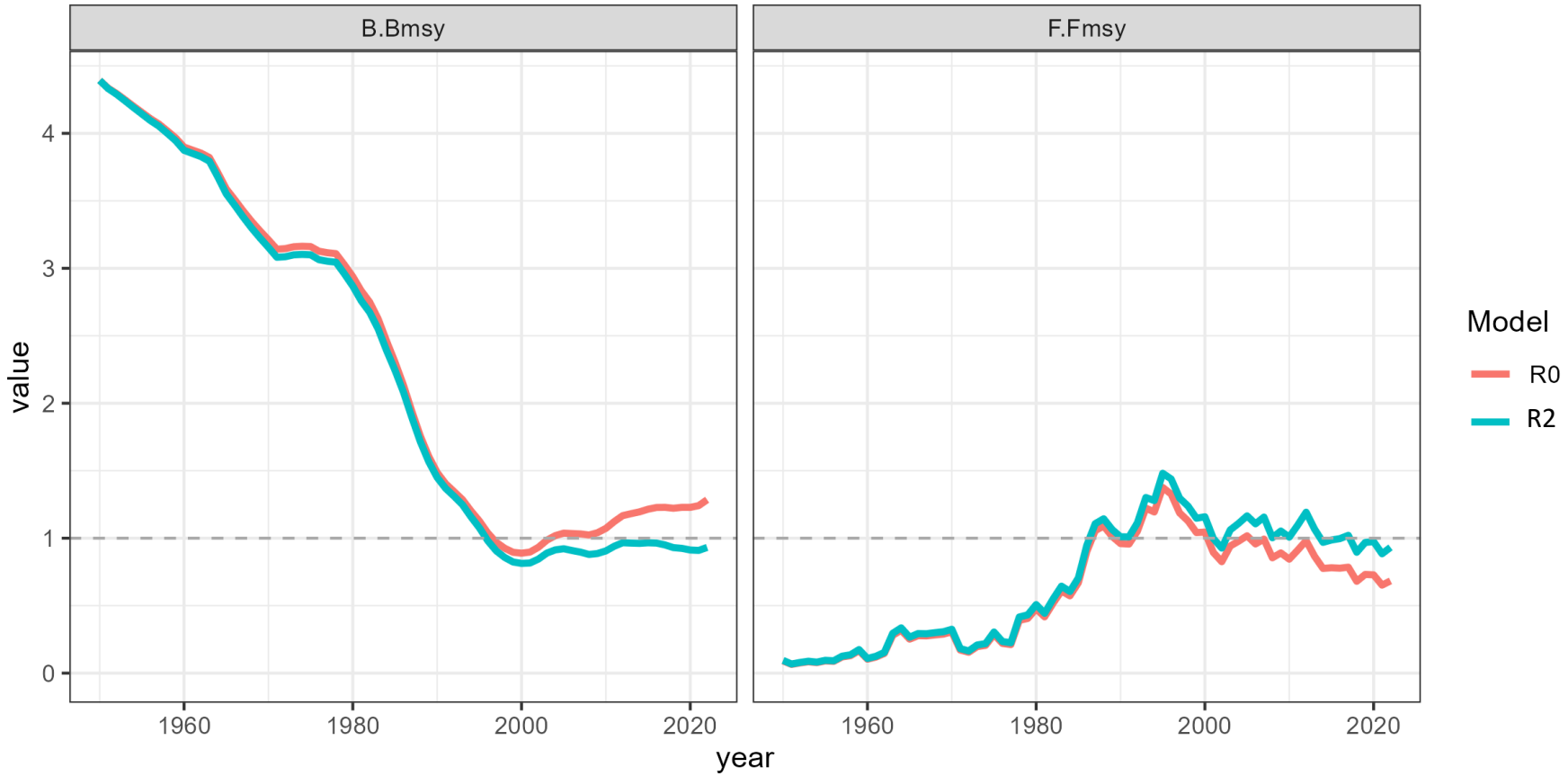
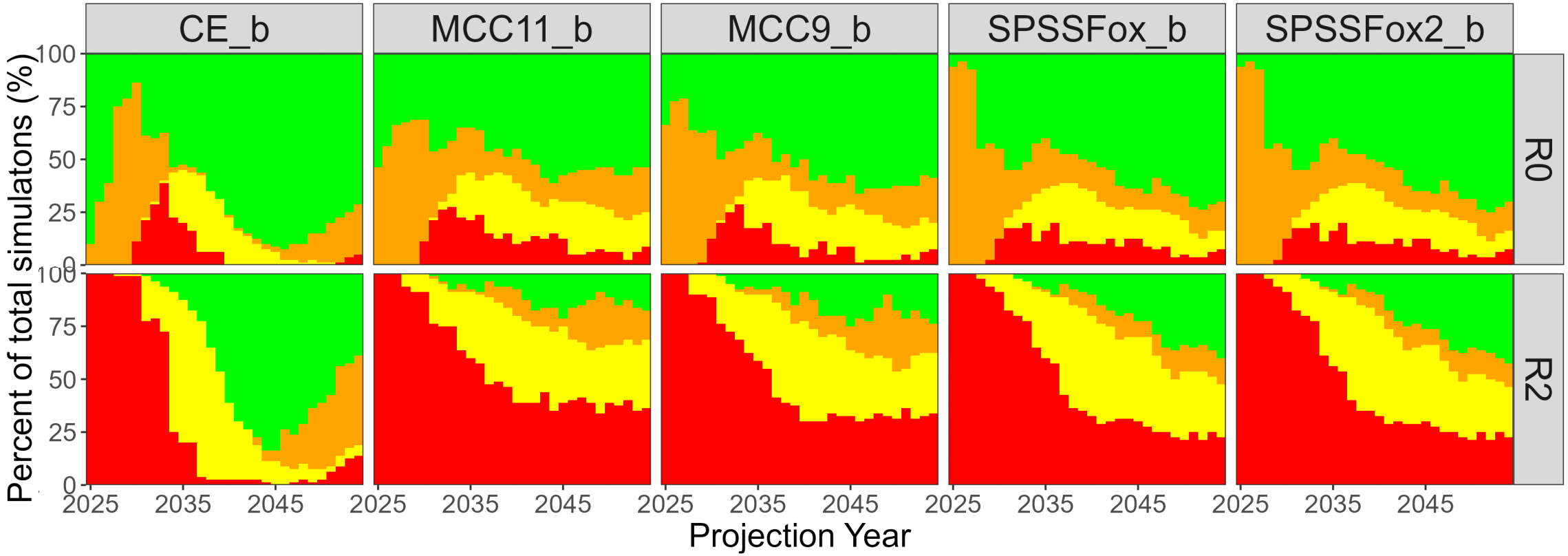
| **R1** | **Catchability** | Evaluate impact of an assumed 1% annual increase catchability, that is not accounted for in the standardization of the indices of abundance (historical and projection) |
| **R2** | | Same as R1, but bias in the indices of abundance is only for the historical period |
| **R3** | **Biomass scale** | Robustness test to evaluate the ability of the CMPs to recover the stock from a low initial level. The historical indices were modified by adding a persistent slope such that the SB/SBMSY = 0.6 in the terminal year of the OM conditioning |
| **R4** | **Climate change impact on recruitment** | Evaluate impact of cyclical pattern in recruitment deviations in projection period; a proxy for impact of climate change on stock productivity. Recruitment is lower than expected for the first 15 years of the projection period, and then higher than expected in the following 15 years |
| **R5** | | Evaluate impact of lower than expected recruitment deviations for first 15 years of projection period; a proxy for impact of climate change on stock productivity. Similar to R4, but recruitment returns to average after the first 15 years |
| **R6** | **IUU** | Evaluate impact of illegal, unreported, or unregulated catches. The catch is consistently 10% higher than the TAC |
| **R7** | **Index observation error** | Evaluates impact of additional observation error in the index of abundance. The standard deviation of the log-normal observation error is doubled from the base case (R0) |

# **Robustness OM**: R2 (increases in catchability)

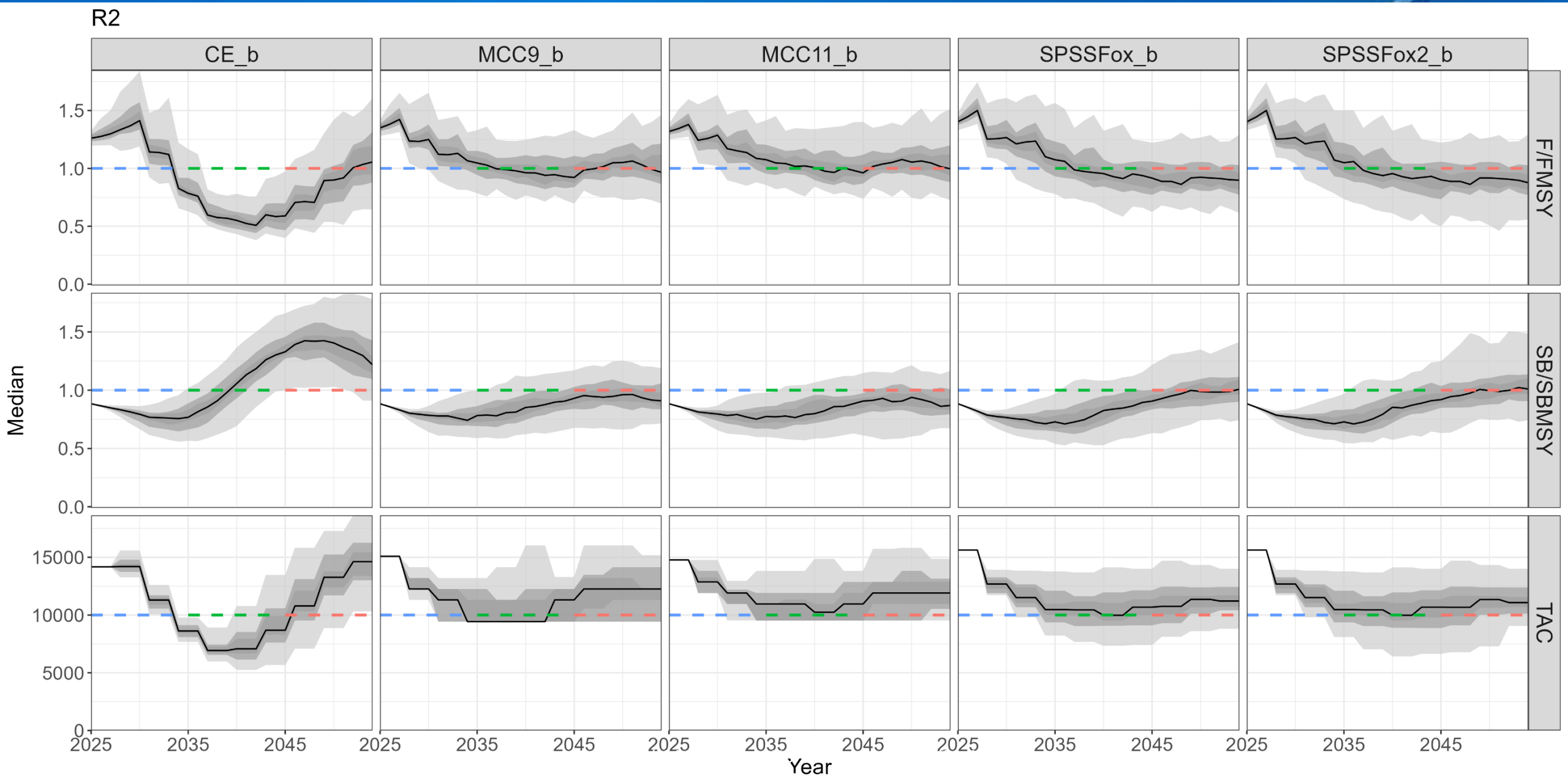
**R2:** Assumes an annual 1% increase in catchability not accounted for in the indices in historical period



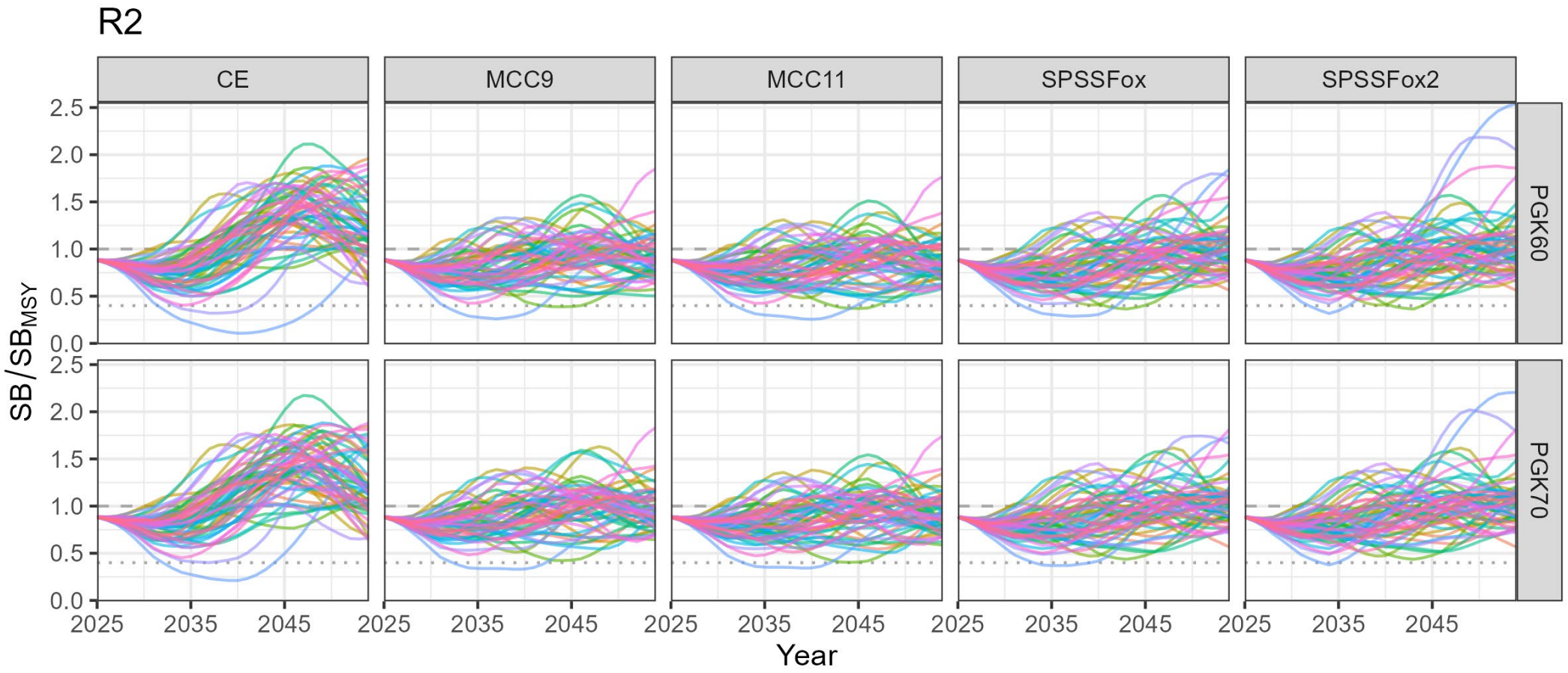
# **Robustness OM**: R2 (increases in catchability)



# R2 Time Series

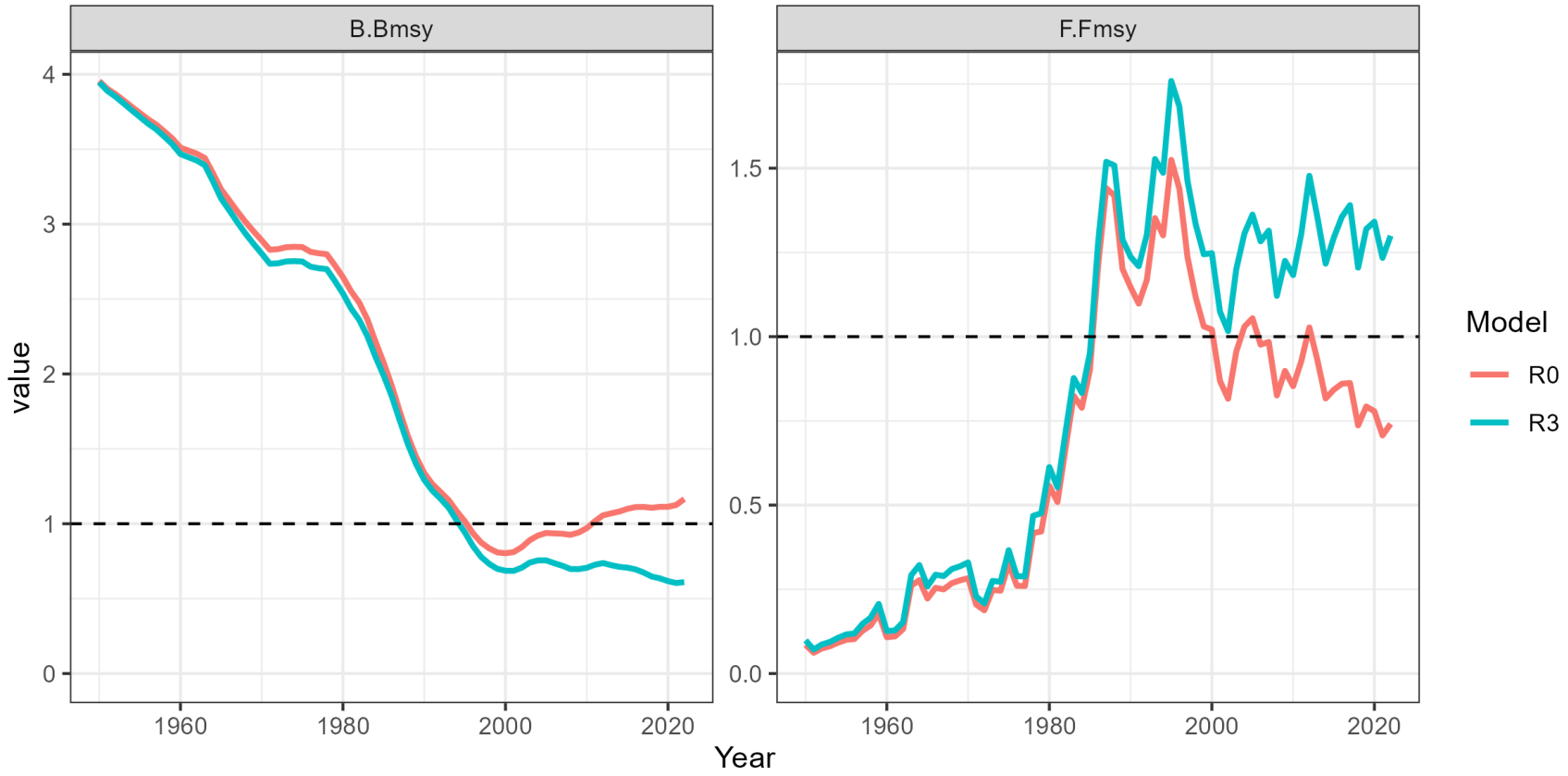


# Biomass time series by simulation

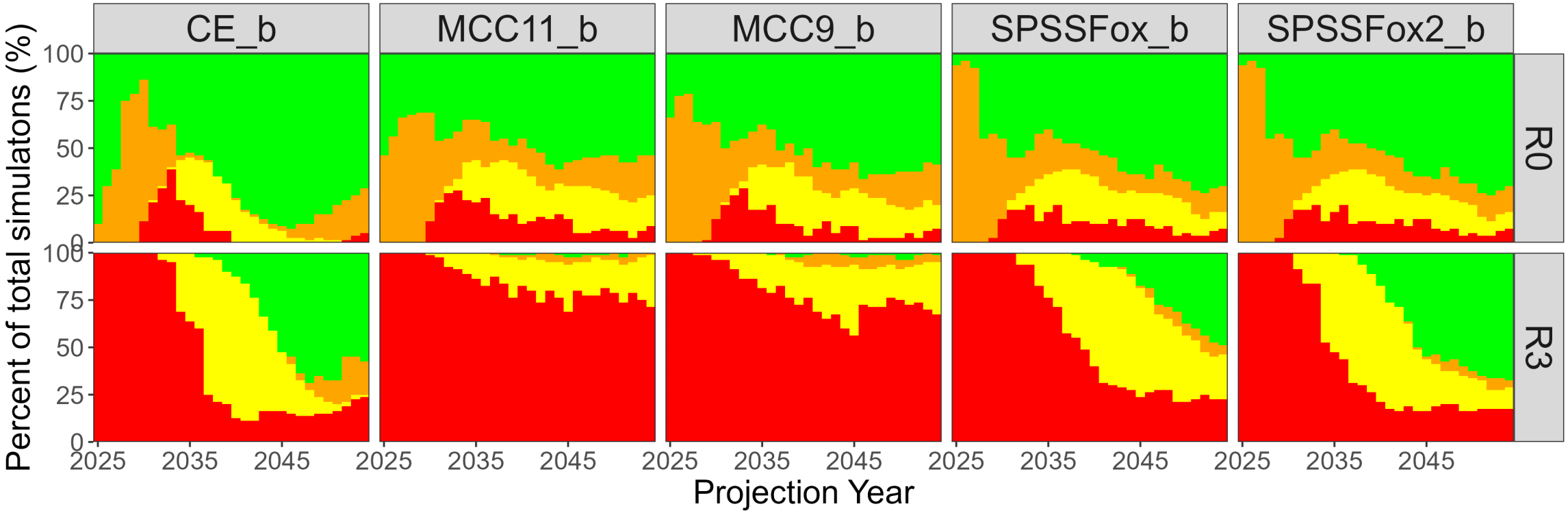


# **Robustness OM**: R3

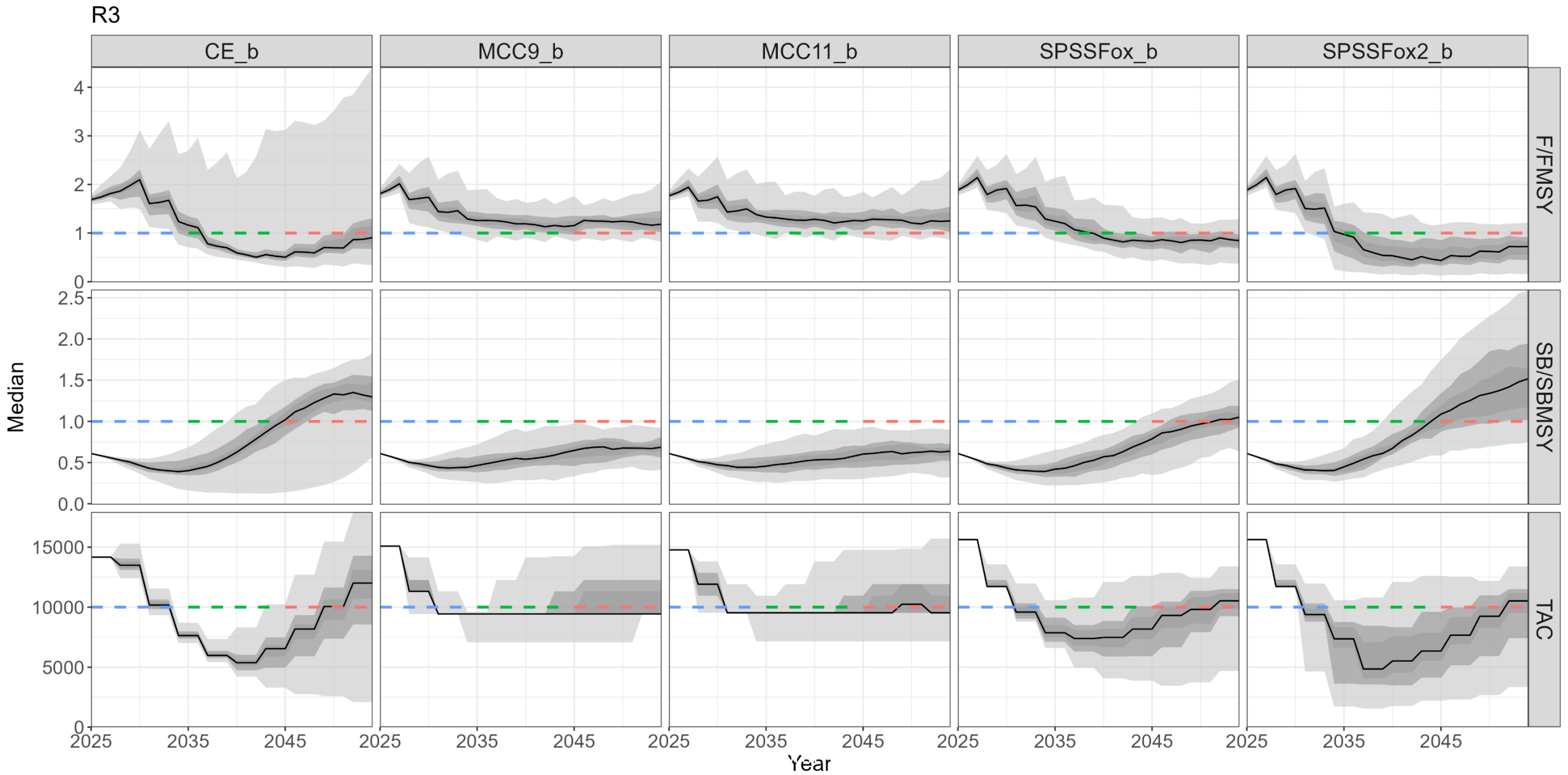
**Evaluate ability of CMPs to rebuild stock:** indices adjusted so that B/BMSY ~0.6 in terminal year



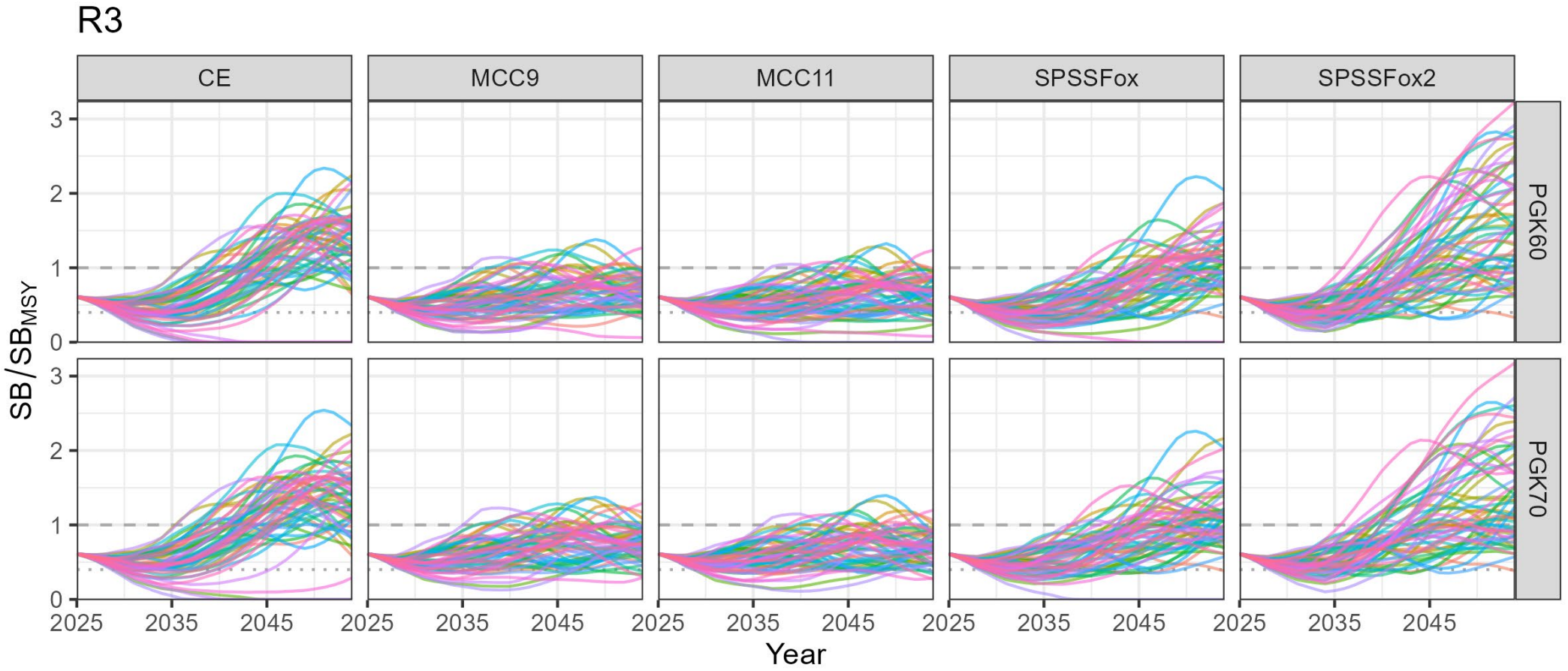
# **Robustness OM**: R3



# Robustness OM: R3



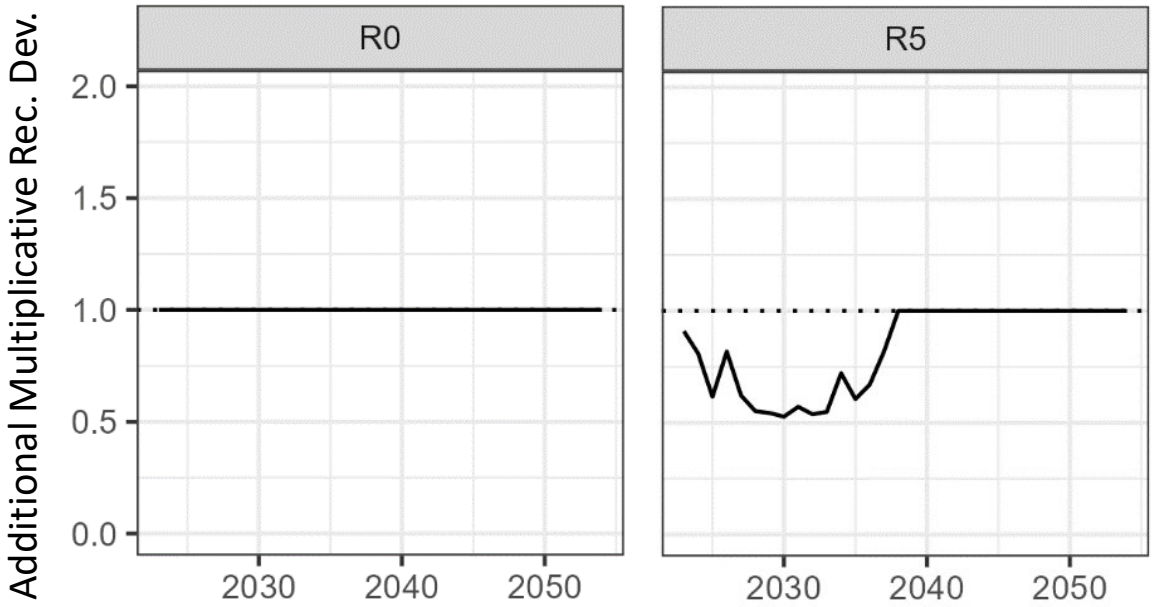
# Biomass time series by simulation



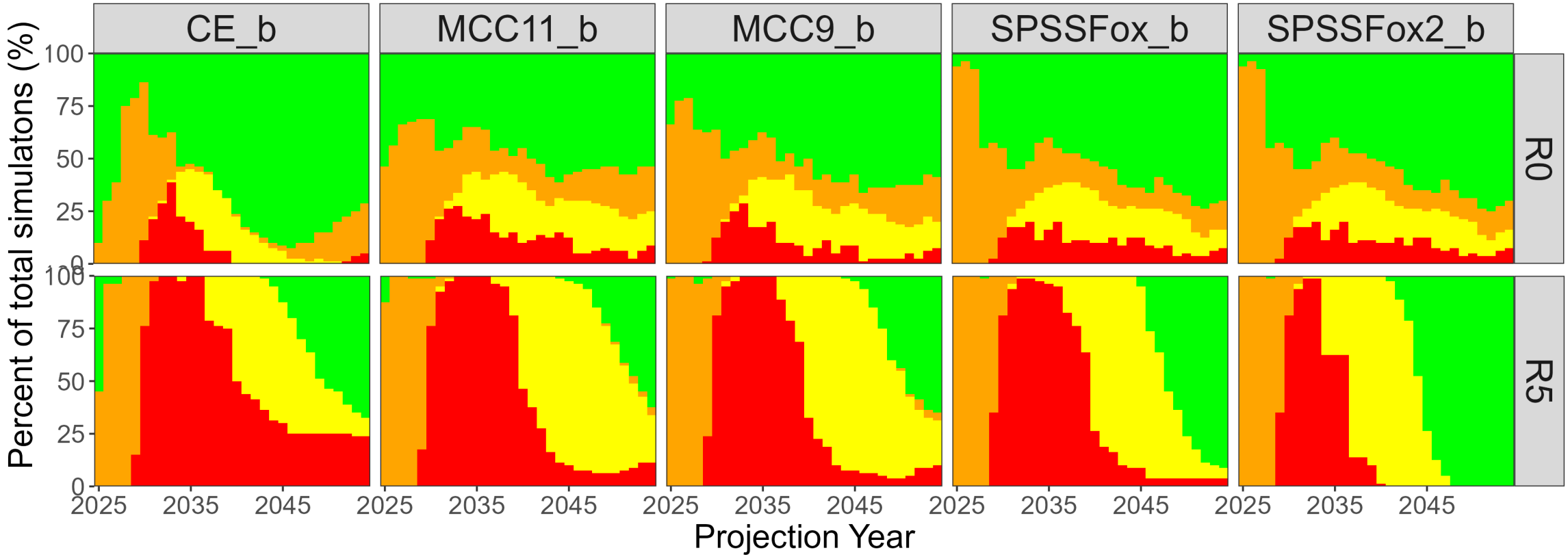
# **Robustness OM**: R5

Patterns in Recruitment Deviations: proxy for impacts of climate change

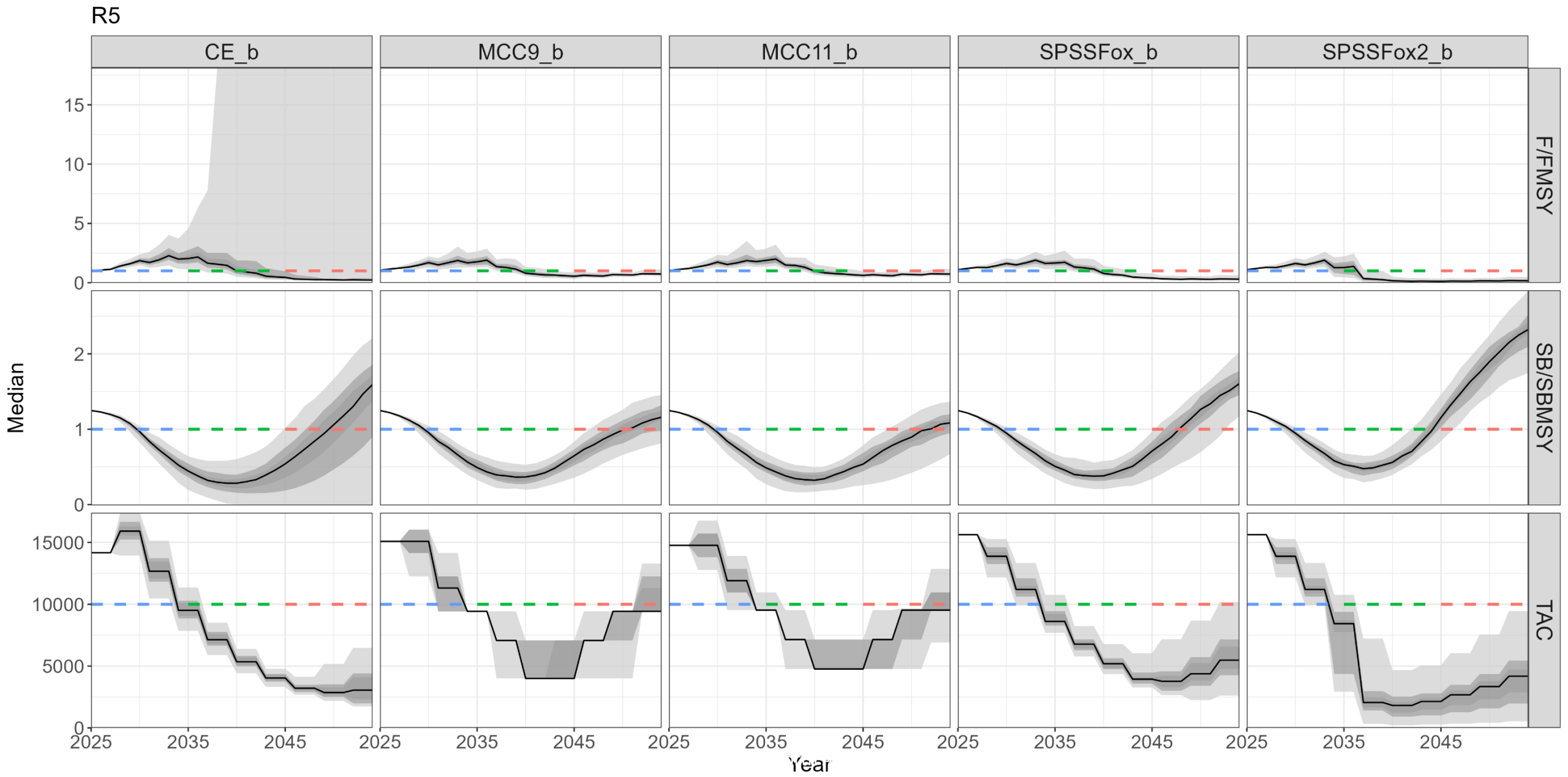
**R5:** considers the impact of a period of lower than average recruitment for the first fifteen years of the projections



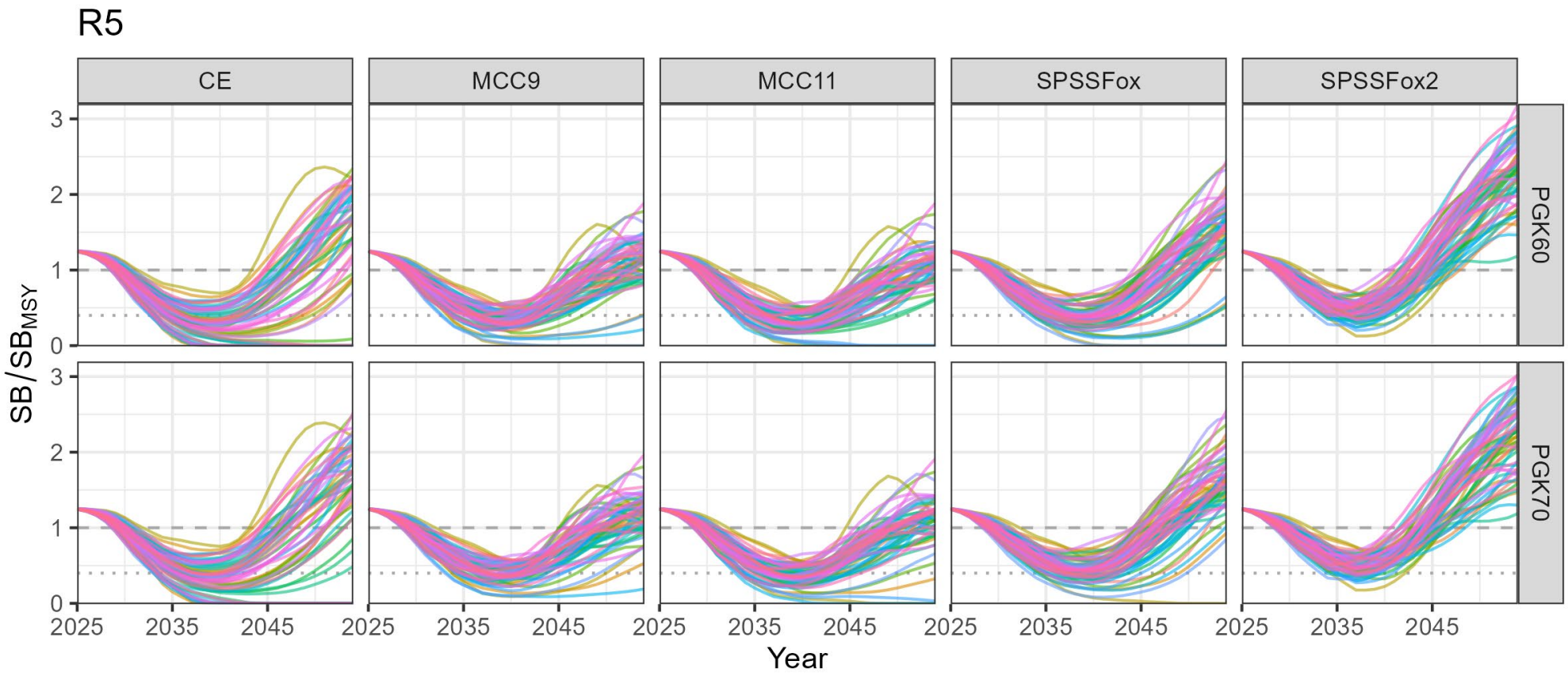
# Robustness OM: R5



# ICCAT CICTA CICAA **R5**: lower than expected recruitment for first 15



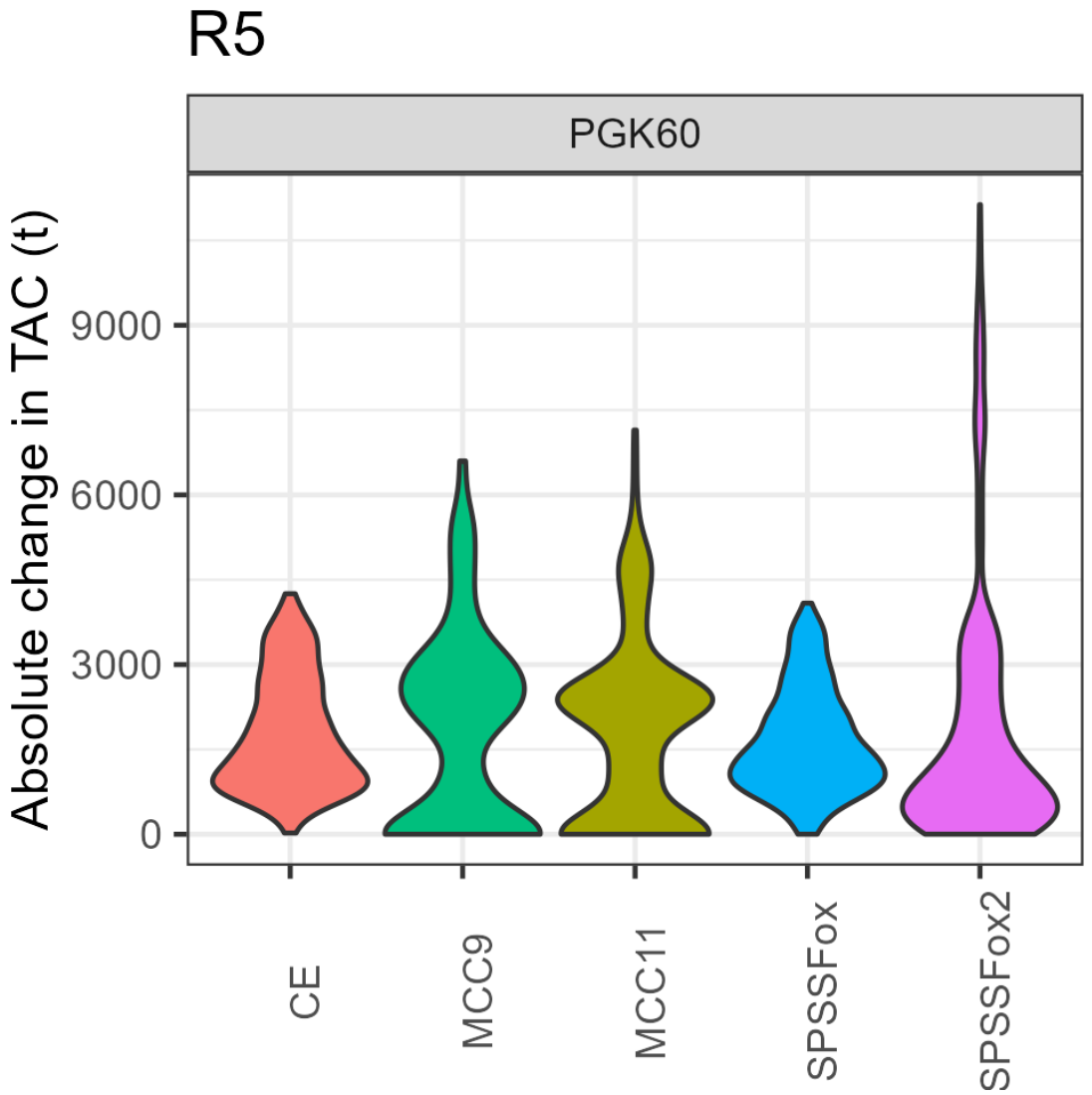
# Biomass time series by simulation



# CMP performance

## Stability – change in tonnage

## R5



| CMP | Positives | Drawbacks |
|---|---|---|
| CE | High PGK in the medium and long time periods | Low stability; very low TAC in medium time span; slow response to low biomass and increased risk of stock crash |
| MCC9 | High stability; high TAC in medium and long time periods | Limited steps available for TAC increase |
| MCC11 | High stability; | Lower PGK (still meets minimum standards) |
| SPSSFox | Very high TAC1; fast response to low biomass; high medium-term TAC | Slow increase in TAC when stock is rebuilding/rebuilt; lowest short and long-term TAC |
| SPSSFox2 | Very high TAC1; fast response to low biomass; high medium-term TAC | Very slow increase in TAC when stock is rebuilding/rebuilt; lowest short and long-term TAC |

# Panel 4 decisions in 2024

- Selection of an MP
  - PA4 may choose to narrow list of CMPs in advance of COMM
  - ‘b’ and ‘c’ tunings are available for each CMP

- MP implementation schedule

# CMP types

| | CE | MCC9 | MCC11 | SPSSFox | SPSSFox2 |
|---|---|---|---|---|---|
| **Type** | Empirical | Empirical | Empirical | Model | Model |
| **Index** | Combined | Combined | Combined | Combined | Combined |
| **Steps** | N/A | 9 | 11 | N/A | N/A |
| **Minimum TAC** | N/A | 4000 t | 4609t | N/A | N/A |
| **Stability Limit** | ±25% cap (maximum allowed change between management cycles) | None | None | ±25% cap | ±25% cap; no cap on TAC decreases if the MP's estimated $B<B_{MSY}$ |
| **Reference Period** | 2016-2020 | 2017-2019 | 2017-2019 | N/A | N/A |
| **Detailed Description** | Attempts to maintain a constant exploitation rate in the projection period, based on the mean exploitation rate in the recent historical years. | The TAC is adjusted between a set of 9 steps based on the ratio of the mean index over the 3 most recent years compared to the mean index from 2017 – 2019. | Similar to MCC9 but the TAC is adjusted between a set of 11 steps and there is a different minimum TAC. | A Fox surplus production model with a hockey-stick HCR where fishing mortality decreases linearly from 100*BMSY to 40*BMSY. | Like SPSSFox but with a bifurcated stability restriction as described above in "Stability Limit" |

# Panel 4 decisions in 2024

- MP implementation schedule

| | | *Activity* | | | | | *Data inputs* | |
|---|---|---|---|---|---|---|---|---|
| Year | Management cycle | MP run | MP advice implemented | Stock assessment | MSE Review | Exceptional circumstances evaluated | Combined index* | Exceptional circumstance indicators |
| 2024 | | x | | | | | x | |
| 2025 | 1 | | x | | | x | | x |
| 2026 | | | | | | x | | x |
| 2027 | | x | | | | x | x | x |
| 2028 | 2 | | x | [x] | | x | | x |
| 2029 | | | | [x] | [x] | x | | x |
| 2030 | | x | | | [x] | x | x | x |
| 2031 | 3 | | x | | | x | | x |
| 2032 | | | | | | x | | x |
| 2033 | | x | | | | x | x | x |

*The combined index may be updated every year, depending on the requirements set out in the exceptional circumstances protocol.

# Key changes in 2024

- Updated combined index
- Reconditioned OMs
- Steps added to MCC
- Updates to robustness tests

# Presentation outline

4. Review of North Atlantic Swordfish MSE and workplan defined in Rec. 23-04

5. Summary of work completed on the North Atlantic swordfish combined index

6. CMPs and their ~~preliminary~~ final results, including robustness testing

7. Development of an Exceptional Circumstances Protocol

8. Other matters

# Workplan in Rec. 23-04

"7. During 2024, the SCRS shall, taking into account the progress made to date, to identify final operational management objectives:

a. Review and approve the North Atlantic swordfish combined index to be used for testing the CMPs in the management strategy evaluation (MSE), and pursuant to 7f below, recalculate the performance metrics for the current suite of CMPs;

b. Review the MCC CMP variants in light of the changes to the combined index and increase the number of TAC steps, if appropriate;

c. Update the combined index with 2023 catch data, if possible;

d. Develop the scientific components of the Exceptional Circumstances Protocol (ECP) for North Atlantic swordfish and review Panel 4's draft ECP;

e. Conduct robustness testing envisioned in the 2024 SCRS Swordfish Workplan, including related to Climate Change and the effectiveness of minimum size limits, and add robustness tests of the impact on CMP performance of various data gaps within the combined index;

f. Assess the effect of and develop results for a two-year data lag in advance of the 2024 SCRS plenary meeting. If the combined index and updated evaluations of the CMPs are not finalized by the conclusion of the 2024 SCRS plenary meeting, the SCRS should provide final results using fishing year 2022 as the terminal year for the combined index, thereby incorporating a 2-year data lag.

In support of the above efforts, the SCRS and Panel 4 shall hold one or more MSE dialogue meetings, as necessary, in 2024. At the 2024 ICCAT annual meeting, the Commission shall review the final CMPs and select one for adoption and application to establish the TAC for 2025-2027 and future years."

# Exceptional circumstances protocol

- Supports identification of EC's and provides possible actions that the commission may choose to undertake.
- Panel 4 is lead developer of the protocol
- PA4 may request support from SCRS on science components of an EC
  - If requested, small working group to take on this task in 2025
- Examples from N-ALB and BFT

# Basic process

1. SCRS evaluates annually whether ECs exist.

2. If EC may exist, SCRS informs COMM and provides advice on whether there may be any changes in science advice.

3. COMM decides on whether alternative management actions are needed and what the actions will be.

# EC principles – BFT example

**Principles of ECs**

a. When there is evidence that the **stock and/or fishery dynamics are in states not previously considered to be plausible** in the context of the management strategy evaluation (MSE);

b. When there is evidence that the **data required to apply the management procedure (MP) are not available or sufficient**, or are no longer appropriate (as defined in Table 1 b); and/or,

c. When there is evidence that **total catch is above the total allowable catch** (TAC) set using the MP.

# EC summary

- PA4 may choose to develop a protocol in 2025; SCRS may be asked to support development of science components

- PA4 may wish SCRS to consider the types of indicators that may be appropriate for SWO

# Presentation outline

4. Review of North Atlantic Swordfish MSE and workplan defined in Rec. 23-04

5. Summary of work completed on the North Atlantic swordfish combined index

6. CMPs and their ~~preliminary~~ final results, including robustness testing

7. Development of an Exceptional Circumstances Protocol

8. Other matters

# Other matters

- NSWO MSE workplan in 2025
  - Additional robustness tests
    - Climate change
    - Minimum size limits
  - Exceptional circumstances protocol

# Summary

- The Commission is scheduled to select a MP to generate TAC in 2025+
- Final CMP performance results are available
- A variety of CMP types are available for selection, all meeting minimum standards for the Safety and Status management objectives
- Detailed information on MSE structure and CMP results are available:
  - N-SWO MSE website
  - Interactive results website

# Other supporting information

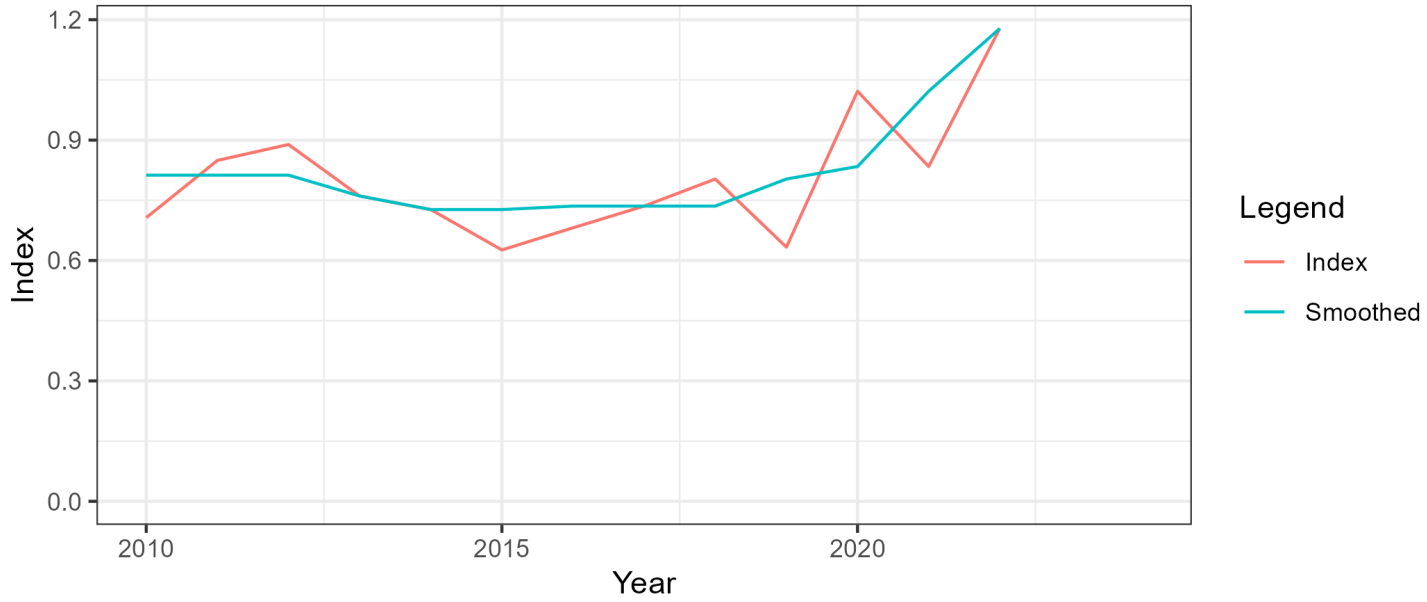
*The following slides are not planned for presentation, but they contain useful additional information*

# Candidate Management Procedures

# **Constant Exploitation:** CE

**Aims to keep exploitation rate at a constant level: the mean exploitation rate from 2016 – 2020**

1. Smooth index using Tukey's Running Median over length 3



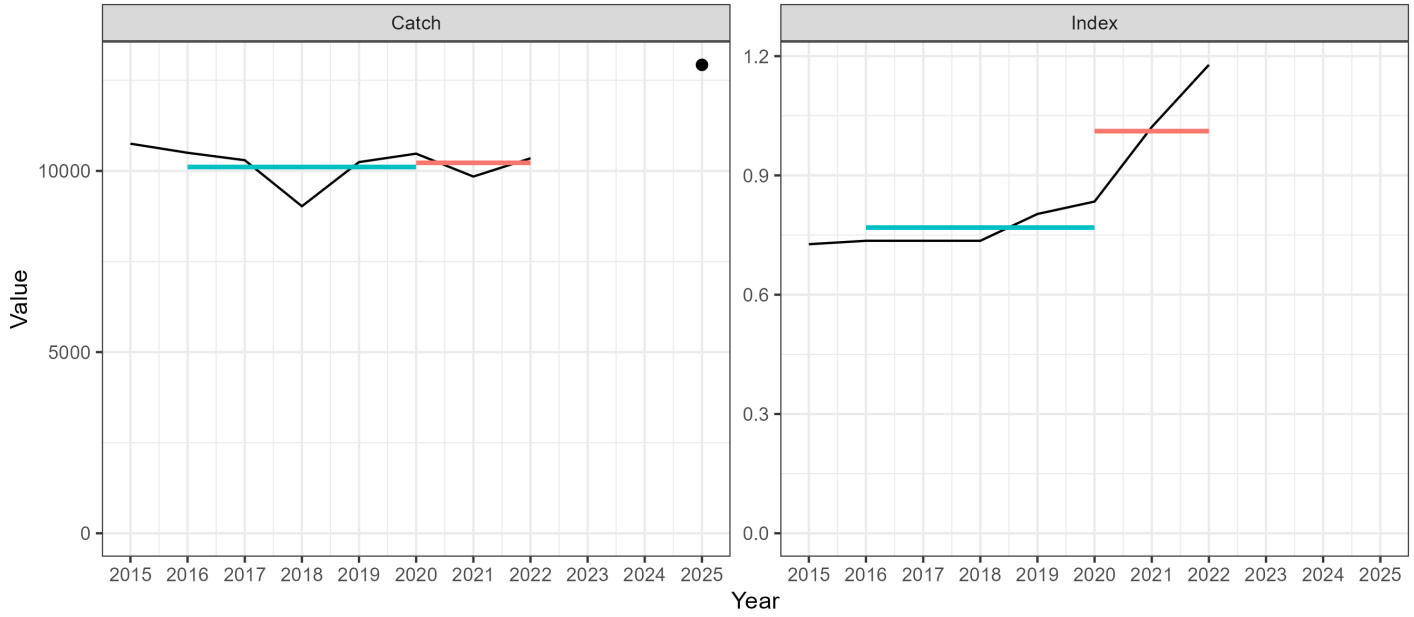
# Constant Exploitation: CE

**Aims to keep exploitation rate at a constant level: the mean exploitation rate from 2016 – 2020**

1. Smooth index using Tukey's Running Median over length 3
2. Calculate relative mean *Historical* (2016:2020) and *Current* (y-2, y-1, y) Exploitation Rate (catch/index)

**2025 TAC Example**

- Historical ER: 10,108 / 0.768 = 13,148
- Current ER: 10,223 / 1.011 = 10,108



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1. Smooth index using Tukey's Running Median over length 3
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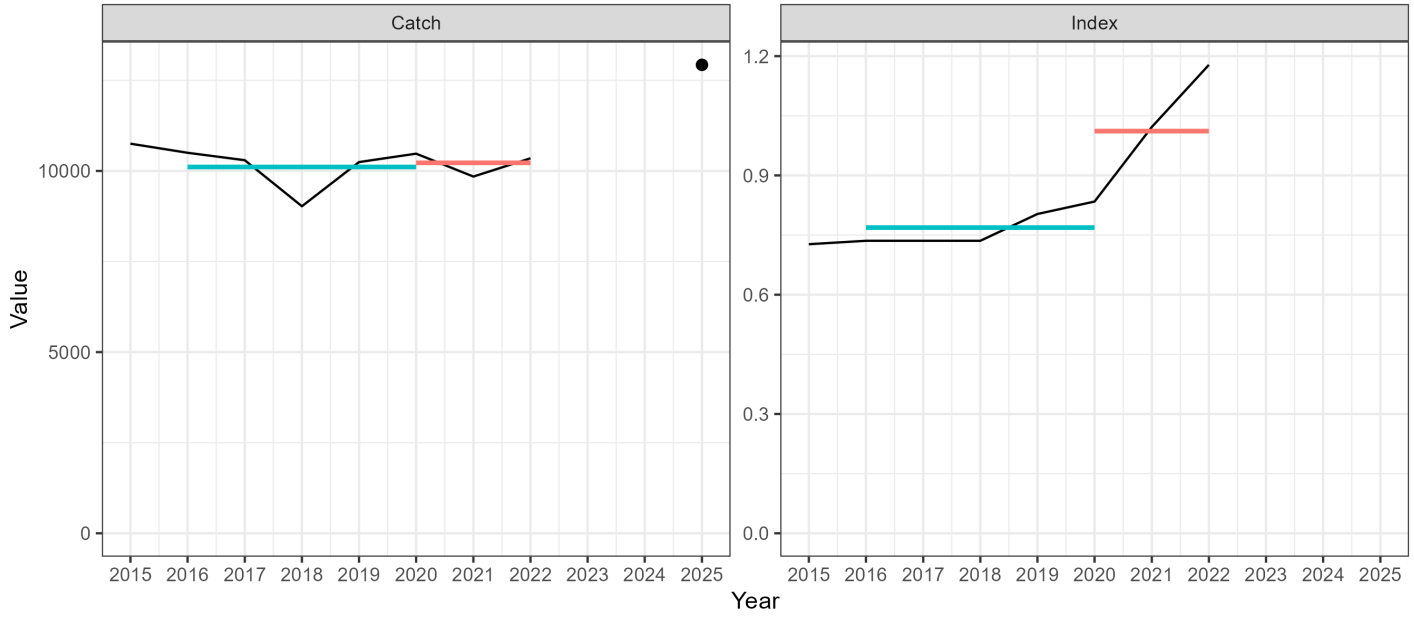
3. Calculate Index Ratio

**2025 TAC Example**

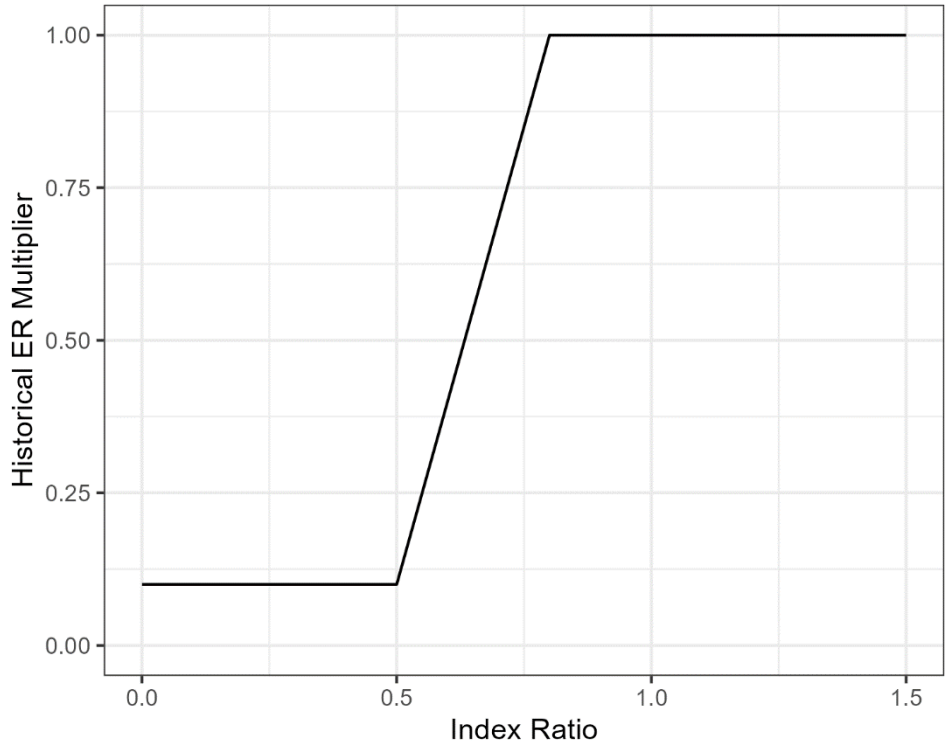
- Historical ER: 10,108 / 0.768 = 13,148
- Current ER: 10,223 / 1.011 = 10,108
- Index Ratio: 1.31



# **Constant Exploitation:** CE

**Aims to keep exploitation rate at a constant level: the mean exploitation rate from 2016 – 2020**

1. Smooth index using Tukey's Running Median over length 3
2. Calculate relative mean *Historical* (2016:2020) and *Current* (y-2, y-1, y) Exploitation Rate (catch/index)
3. Calculate Index Ratio
4. Apply HCR
   a. If *Index Ratio* > 0.8: target ER = historical ER
   b. If *Index Ratio* < 0.5: target ER = 0.1 historical ER
   c. Otherwise: linear decrease in target ER



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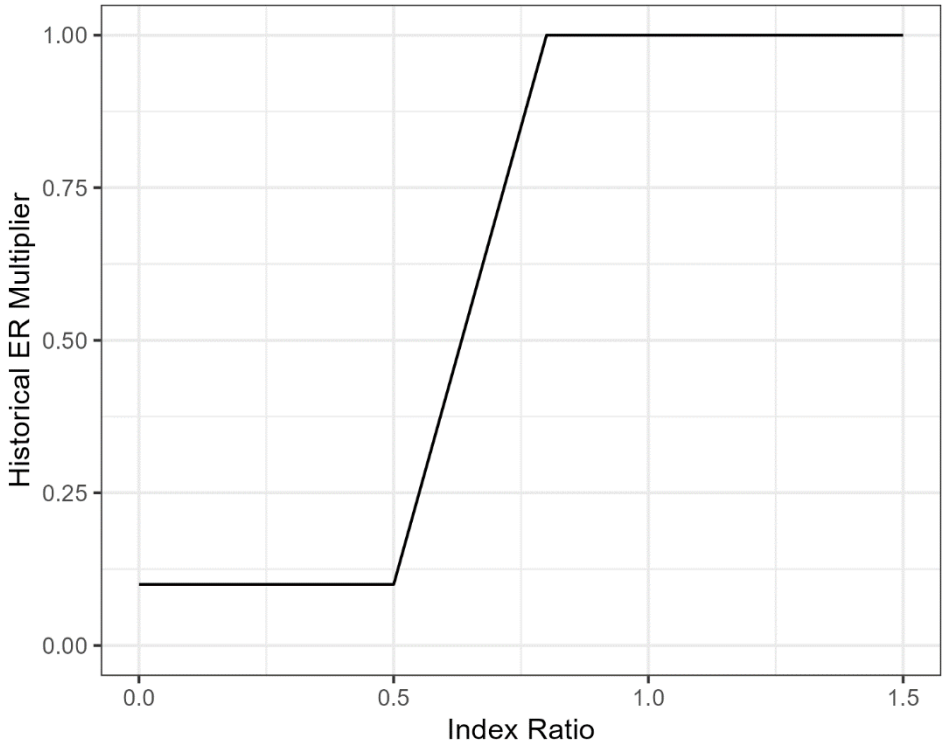



**2025 TAC Example**

- Historical ER: 10,108 / 0.768 = 13,148
- Current ER: 10,223 / 1.011 = 10,108
- Index Ratio: 1.31
- Target ER = Historical ER

# Constant Exploitation: CE

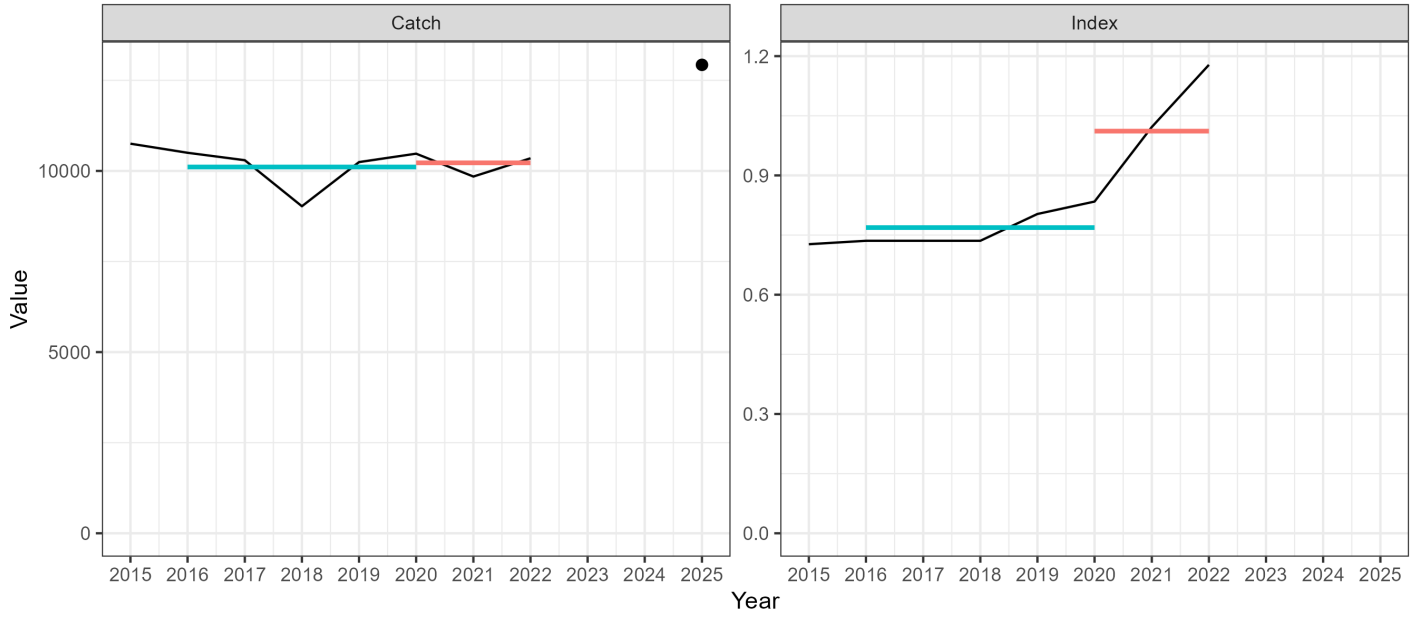
**Aims to keep exploitation rate at a constant level: the mean exploitation rate from 2016 – 2020**

1. Smooth index using Tukey's Running Median over length 3
2. Calculate relative mean *Historical* (2016:2020) and *Current* (y-2, y-1, y) Exploitation Rate (catch/index)
3. Calculate Exploitation Rate ratio (Historical/Current)
4. Apply HCR
5. Calculate TAC

$$\mathrm{TAC}_y = \theta \frac{\mathrm{ER}_{\mathrm{target}}}{\mathrm{ER}_{\mathrm{current}}} \mathrm{TAC}_{y-1}$$

**2025 TAC Example**

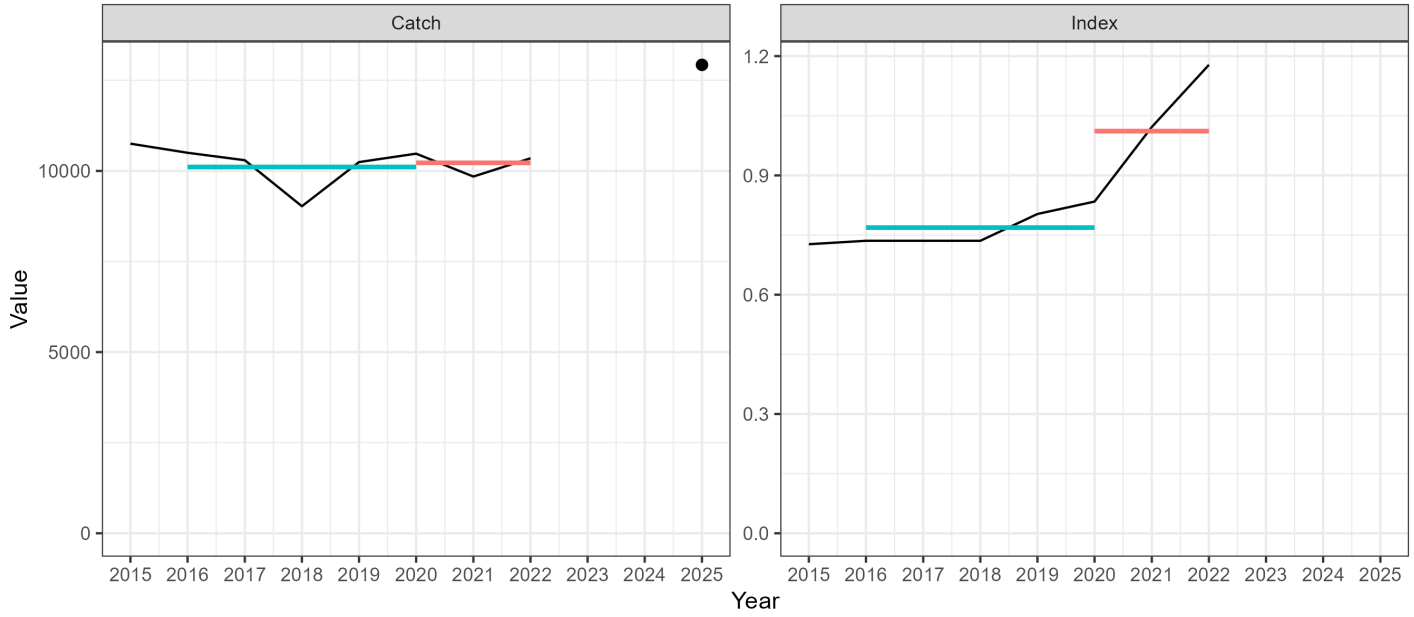
- Historical ER: 10,108 / 0.768 = 13,148
- Current ER: 10,223 / 1.011 = 10,108
- Index Ratio: 1.31
- Target ER = Historical ER
- TAC = 13,567 (1.31 * last TAC)



# Constant Exploitation: CE

**Aims to keep exploitation rate at a constant level: the mean exploitation rate from 2016 – 2020**

1. Smooth index using Tukey's Running Median over length 3
2. Calculate relative mean *Historical* (2016:2020) and *Current* (y-2, y-1, y) Exploitation Rate (catch/index)
3. Calculate Exploitation Rate ratio (Historical/Current)
4. Apply HCR
5. Calculate TAC
6. Apply max change constraint (no greater than 25%)




**2025 TAC Example**

- Historical ER: 10,108 / 0.768 = 13,148
- Current ER: 10,223 / 1.011 = 10,108
- Index Ratio: 1.31
- Target ER = Historical ER
- ~~TAC = 13,567 (1.31 * last TAC)~~
- TAC = 12,927 (1.25 * last TAC)

# **State-Space Surplus Production Fox Model:** SPSSFox & SPSSFox2

**TAC is set with a fixed F policy, adjusted by estimated stock status from Fox SP Model**

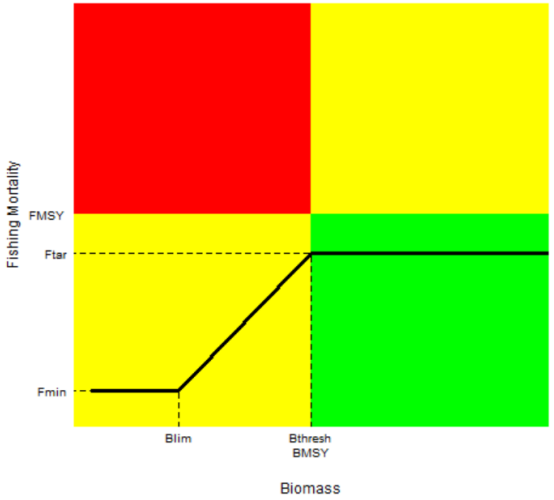
1. Smooth index using Tukey's Running Median over length 3
2. Apply *SAMtool::SP_SS* assessment model
3. Apply HCR

# State-Space Surplus Production Fox Model: SPSSFox & SPSSFox2

**TAC is set with a fixed F policy, adjusted by estimated stock status from Fox SP Model**

1. Smooth index using Tukey's Running Median over length 3
2. Apply *SAMtool::SP_SS* assessment model
3. Apply HCR

$$F_{\text{set}} = \begin{cases} F_{\text{targ}} & \text{if } B_{\text{curr}} \geq B_{\text{thresh}} \\ F_{\text{targ}}(-0.367 + 1.167\frac{B_{\text{curr}}}{B_{\text{thresh}}}) & \text{if } B_{\text{lim}} < B_{\text{curr}} < B_{\text{thresh}} \\ F_{\text{min}} & \text{otherwise} \end{cases}$$



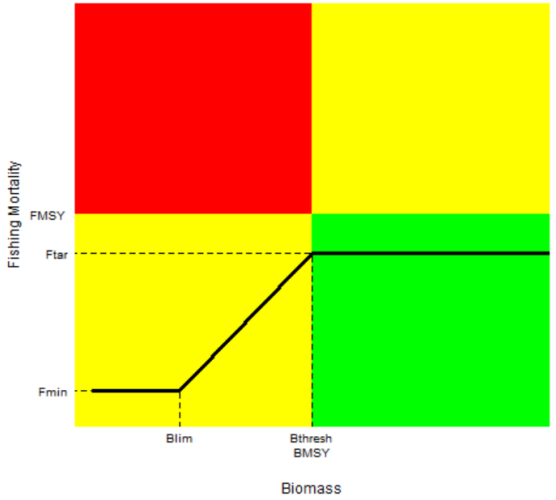

$F_{targ}$ = tunepar x 0.15
$B_{curr}$ = estimated current biomass
$B_{thresh}$ = estimated BMSY
$B_{lim}$ = 0.4 $B_{thresh}$
$F_{min}$ = 0.1 $F_{targ}$

# State-Space Surplus Production Fox Model: SPSSFox & SPSSFox2

**TAC is set with a fixed F policy, adjusted by estimated stock status from Fox SP Model**

1. Smooth index using Türkiye's Running Median over length 3
2. Apply *SAMtool::SP_SS* assessment model
3. Apply HCR
4. Calculate TAC = $F_{set}$ x $B_{curr}$
5. Apply maximum TAC change constraint
   a. SPSSFox: +/- 25%
   b. SPSSFox2: no downward constraint if estimated B/BMSY < 1

$$F_{\text{set}} = \begin{cases} F_{\text{targ}} & \text{if } B_{\text{curr}} \geq B_{\text{thresh}} \\ F_{\text{targ}}(-0.367 + 1.167\frac{B_{\text{curr}}}{B_{\text{thresh}}}) & \text{if } B_{\text{lim}} < B_{\text{curr}} < B_{\text{thresh}} \\ F_{\text{min}} & \text{otherwise} \end{cases}$$



# Mostly Constant Catch (MCC)

- The goal of the MCC (Mostly Constant Catch) CMPs is to have the catch remain as constant as possible and:
  - Only increase if the Combined Index increased substantially, and,
  - Only decrease if the Combined Index declined substantially.
- It does this by using a stepped CMP, where the implemented TAC is one of the available values associated with predetermined steps.


Index = 0.5 Index = 1.0 Index = 1.5

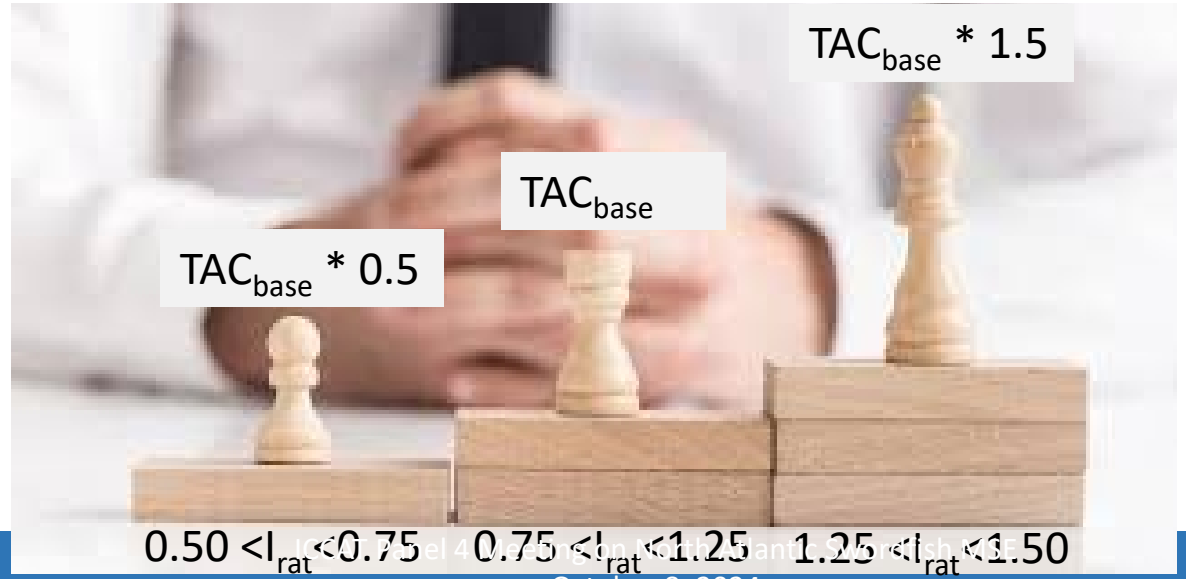
# Mostly Constant Catch (MCC)

- First an estimate of the constant catch that would result in achieving PGK60 and also achieve the probability of triggering the LRP <15% if used as the MP was approximated. This equaled ~12,600 t.
- This value was then used to calculate a $TAC_{base}$ , $TAC_{base}$ is used to set all the values of TAC for each of the steps in the MCC.
  - The base TAC ($TAC_{base}$) was calculated as:
    - $TAC_{base} = \theta * 12{,}600$
    - where $\theta$ is the tuning parameter that results in achieving the desired short-term PGK (currently tested at 51%, 60%, and 70%).

# Mostly Constant Catch (MCC)

- An index ratio ($I_{rat}$) is then calculated by comparing the current 3-year average of the Combined Index ($I_{curr}$) to a historical 3-year average of the Combined Index ($I_{base}$):
  - $I_{rat} = I_{curr} / I_{base}$

- A series of steps were then developed to cover a range of $I_{rat}$ values.
  - Each step had a set TAC to be used when the current $I_{rat}$ fell within the steps allocated range of $I_{rat}$ values.



# Mostly Constant Catch (MCC)

## MCC9

$$\Delta_{TAC} = \begin{cases} 1.7 & \text{if } I_{rat} \geq 1.7 \\ 1.6 & \text{if } 1.6 \leq I_{rat} < 1.7 \\ 1.5 & \text{if } 1.5 \leq I_{rat} < 1.6 \\ 1.4 & \text{if } 1.4 \leq I_{rat} < 1.5 \\ 1.3 & \text{if } 1.3 \leq I_{rat} < 1.4 \\ 1.2 & \text{if } 1.2 \leq I_{rat} < 1.3 \\ 1.0 & \text{if } 0.75 \leq I_{rat} < 1.2 \\ 0.75 & \text{if } 0.5 \leq I_{rat} < 0.75 \end{cases}$$

## MCC11

$$\Delta_{TAC} = \begin{cases} 1.85 & \text{if } I_{rat} \geq 1.85 \\ 1.75 & \text{if } 1.75 \leq I_{rat} < 1.85 \\ 1.65 & \text{if } 1.65 \leq I_{rat} < 1.75 \\ 1.55 & \text{if } 1.55 \leq I_{rat} < 1.65 \\ 1.45 & \text{if } 1.45 \leq I_{rat} < 1.55 \\ 1.35 & \text{if } 1.35 \leq I_{rat} < 1.45 \\ 1.25 & \text{if } 1.25 \leq I_{rat} < 1.35 \\ 1.15 & \text{if } 1.15 \leq I_{rat} < 1.25 \\ 1.00 & \text{if } 0.75 \leq I_{rat} < 1.15 \\ 0.75 & \text{if } 0.5 \leq I_{rat} < 0.75 \\ 0.5 & \text{if } I_{rat} < 0.5 \end{cases}$$

# MCC steps

| Step number | MCC9 | | | MCC11 | | |
|---|---|---|---|---|---|---|
| | Icur values | TAC PGK60 (tonnes) | TAC PGK70 (tonnes) | Icur values | TAC PGK60 (tonnes) | TAC PGK70 (tonnes) |
| 11 | | | | > 1.85 | 17,628 | 17,055 |
| 10 | | | | 1.75 - 1.85 | 16,675 | 16,133 |
| 9 | > 1.7 | 16,030 | 15,423 | 1.65 - 1.75 | 15,722 | 15,211 |
| 8 | 1.6 - 1.7 | 15,087 | 14,516 | 1.55 - 1.65 | 14,769 | 14,289 |
| 7 | 1.5 - 1.6 | 14,144 | 13,609 | 1.45 - 1.55 | 13,816 | 13,367 |
| 6 | 1.4 - 1.5 | 13,201 | 12,702 | 1.35 - 1.45 | 12,863 | 12,445 |
| 5 | 1.3 - 1.4 | 12,258 | 11,794 | 1.25 - 1.35 | 11,911 | 11,523 |
| 4 | 1.2 - 1.3 | 11,315 | 10,887 | 1.15 - 1.25 | 10,958 | 10,602 |
| 3 | 0.75 - 1.2 | 9,429 | 9,073 | 0.75 - 1.15 | 9,528 | 9,219 |
| 2 | 0.50 - 0.75 | 7,072 | 6,804 | 0.50 - 0.75 | 7,146 | 6,914 |
| 1 | < 0.50 | 4,000 | 4,000 | < 0.50 | 4,764 | 4,609 |