Report of the Intersessional Meeting of Panel 4 on North Atlantic Swordfish Management Strategy Evaluation (MSE)
(Online, 8 October 2024)

1. Opening of the meeting and meeting arrangements

Mr. Amar Ouchelli (Algeria), Chair of Panel 4 opened the meeting and welcomed the participants. The ICCAT Secretariat explained the arrangements for the virtual meeting, including the 30-minute lunch break halfway through the meeting.

2. Appointment of the Rapporteur

Dr. Chelsea Gray (United States) was appointed as Rapporteur.

3. Adoption of Agenda

The Agenda was adopted without modification and is included as **Appendix 1**.

The List of participants is included in **Appendix 2.**

4. Review of the North Atlantic swordfish MSE framework and workplan defined in Rec. 23-04

Dr. Kyle Gillespie (SCRS Swordfish Species Group Coordinator and North Atlantic Swordfish (SWO-N) Rapporteur) delivered a presentation under the title "North Atlantic Swordfish MSE – final Results" (**Appendix 3**). Dr Gillespie reviewed the discussions, decisions, and requests made by the Panel at its intersessional meetings and the 28th Regular Meeting of the Commission in 2023. He explained that the goals of this meeting were to communicate the final results of the management strategy evaluation (MSE) process and to provide information and support for Panel 4 decision-making on management procedure (MP) specifications. This work will set the path for the Commission adopting an MP at the annual meeting in November (detailed further in *Recommendation by ICCAT replacing Recommendation 22-03 extending and amending Recommendation 17-02 for the conservation of North Atlantic Swordfish* (Rec. 23-04)).

Operating Models (OMs)

Dr. Gillespie explained the Operating Models (OMs) that underpin the MSE: the Reference OMs (most important for uncertainties) and Robustness OMs (which are most important for scenario and stress testing). Out of seven robustness tests, the presentation focused on three: R2 (catchability), R3 (Biomass scale) and R5 (Climate Change impact on recruitment).

Management Objectives and Key Performance Indicators (PIs)

The *Resolution by ICCAT on development of initial management objectives for North Atlantic swordfish* (Res. 19-14) established conceptual management objectives addressing four areas: safety, stock status, stability, and yield.

To evaluate the management objectives (safety, stock status, stability, and yield) through MSE, PIs that included timeframes were established. The primary PIs for each management objective can be found in the Report of the Third Intersessional Meeting of Panel 4 on North Atlantic Swordfish Management Strategy Evaluation (MSE) (Online, 10-11 October 2023) and the presentation in Appendix 3 to the Report. Dr. Gillespie presented on the outstanding options for the management objectives, namely the stability clause and value for the safety. For stability, the Panel discussed that the value will be largely dependent on which Candidate Management Procedures (CMP) is selected. For safety, Dr. Gillespie noted that the Panel eliminated 5% as an option, which left 10 or 15% as the probability of the stock falling below B_{LIM} at any point during the 30-year evaluation period. On status, the Panel previously agreed that the stock should

have a 60% or greater probability of occurring in the green quadrant of the Kobe matrix. It was noted that selecting a CMP with a Probability of green Kobe (PGK) of 70% could still occur with this management objective.

Decisions made by Panel 4 in 2023

Dr. Gillespie discussed the decisions made by the Panel in 2023 related to MP specifications, including a 200 t minimum Total Allowable Catch (TAC) change threshold, that the selected TAC will apply to the entire stock, and the use of a 3-year management cycle. He also provided a high-level overview of the work completed by the Standing Committee on Research and Statistics (SCRS) as a result of the workplan outlined in Rec. 23-04.

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

Dr. Gillespie explained how the combined index is calculated, using data from 7 CPCs accounting for 95% of the catch in the North Atlantic. The combined index explored several approaches and tested for stability when there were data gaps and lags, with the model running until 2022. A 2-year lag in the model was introduced pursuant to *Recommendation by ICCAT replacing Recommendation 22-03 extending and amending Recommendation 17-02 for the conservation of North Atlantic swordfish* (Rec. 23-04). Overall, the Panel noted an increase in the combined index which led to increased TACs produced by the MSE in comparison to the preliminary results presented in 2023.

6. CMPs and their preliminary results, including robustness testing

There were three main CMP types: Constant Exploitation (CE), Mostly Constant Catch (MCC9 and MCC11), and two versions of the Fox surplus production model (SPSSFox and SPSSFox2). CE and SPSSFox had a ± 25% cap stability limit. SPSSFox2 employed a bifurcated approach, which was identical to SPSSFox but had no cap on TAC decreases when $B<B_{MSY}$. Both MCC variants have no cap on stability. CMP tuning targets were presented for both 60% and 70% PGK. All CMPs met the minimum standard for safety and status management objectives.

Following discussion amongst numerous CPCs, the Panel decided to eliminate CE_b, CE_c, SPSSFox2_b, SPSSFox2_c, and SPSSFox_c. The remaining CMPs are as follows: MCC9_b, MCC9_c, MCC11_b, MCC11_c, and SPSSFox_b. One CPC voiced a preference for retaining the 'c' variants of the MCC CMPs, noting less of a decrease in TAC across the short and medium time frames. Several CPCs voiced a preference for only retaining 'b' variants of the CMPs but were willing to retain MCC9_c and MCC11_c following the previous intervention.

7. Development of an Exceptional Circumstances Protocol (ECP)

Rec. 23-04 directs the SCRS to develop the scientific components of an Exceptional Circumstances Protocol (ECP) for SWO-N and a review of Panel 4's draft ECP in 2024. Dr. Gillespie noted that the extra time would allow the SCRS to ensure that the elements were updated properly. If requested, a small working group can take this on in 2025.

He also noted that models for albacore and bluefin tuna only included ECPs *after* the selection of MPs, which reduce the workload of the SCRS (as a single MP can have multiple ECs) and allow for appropriate ECs to be modeled. He also suggested that consistency should be maintained between SWO-N ECP development and ECP development by other ICCAT Panels.

It was suggested by the SCRS Chair that the ECP be consistent with the ECP of other ICCAT species, with the SCRS drafting the scientific components of such a protocol. The Panel 4 Chair would then work with the Panel to advance review and provide feedback on the draft. The Panel agreed with this suggested approach.

8. Other matters

With regard to the implementation schedule of the CMPs, it was requested that the schedule reflect a review of the MSE in 2029, with both the MSE review and stock assessment timing remaining in brackets.

In closing, numerous CPCs requested the floor to provide comments on next steps, leading into the Annual Meeting. Canada shared they would be proposing modifications to the allocation table for the stock via a proposal. The United States and the European Union both independently stated they will work on tabling a proposal for consideration at the 24th Special Meeting of the Commission in November 2024.

9. Adoption of the report and closure

The Chair thanked Dr. Gillespie, the SCRS, interpreters, rapporteur, and participants for their hard work and contributions to the meeting and adjourned the meeting. The meeting report will be adopted by correspondence.

Appendix 1

Tentative Agenda

1. Opening of the meeting and meeting arrangements
2. Appointment of the Rapporteur
3. Adoption of Agenda
4. Review of the North Atlantic swordfish MSE framework and workplan defined in Rec. 23-04
5. Summary of work completed on the North Atlantic swordfish combined index
6. Candidate Management Procedures (CMPs) and their preliminary results, including robustness testing
7. Development of an Exceptional Circumstances Protocol (ECP)
8. Other matters
9. Adoption of the Report and closure

Appendix 2

List of Participants*[1]

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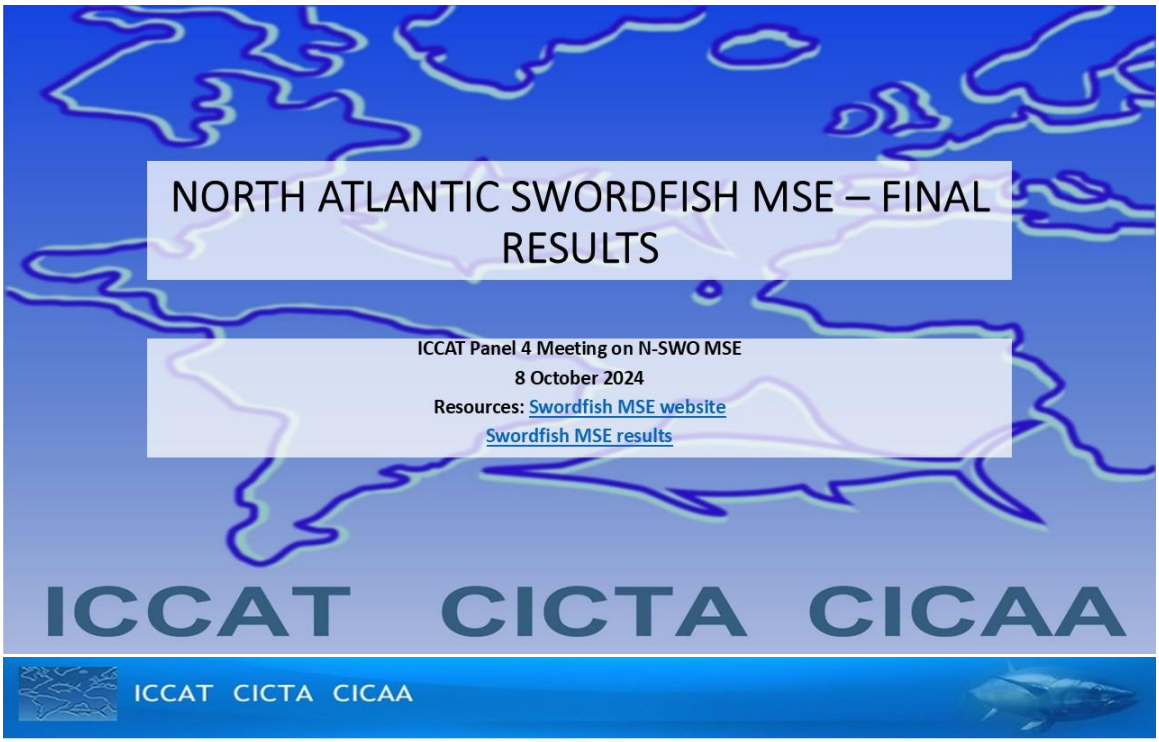
Appendix 3



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

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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

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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"

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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

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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)

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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

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Key performance indicators

Management objectives	*Corresponding key performance indicators*
Status 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., $SB \geq SB^{MSY}$ and $F<F^{MSY}$) in years 1-10 **PGK^{MED}**: Probability of being in the Kobe green quadrant (i.e., $SB \geq SB^{MSY}$ and $F<F^{MSY}$) in years 11-20 **PGK^{ALL}**: Probability of being in the Kobe green quadrant (i.e., $SB \geq SB^{MSY}$ and $F<F^{MSY}$) over years 1-30 **PNOF:** Probability of not overfishing ($F<F^{MSY}$) over years 1-30
Safety 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 (**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 Maximize overall catch levels.	**TAC1**: TAC in the first management cycle (2025-27) **$AvTAC^{SHORT}$**: Median TAC (t) over years 1-10 **$AvTAC^{MED}$**: Median TAC (t) over years 11-20 **$AvTAC^{LONG}$**: Median TAC (t) over years 21-30
Stability 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

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Decisions made by PA4 in 2023

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

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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}]

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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}

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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

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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.

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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

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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."

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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

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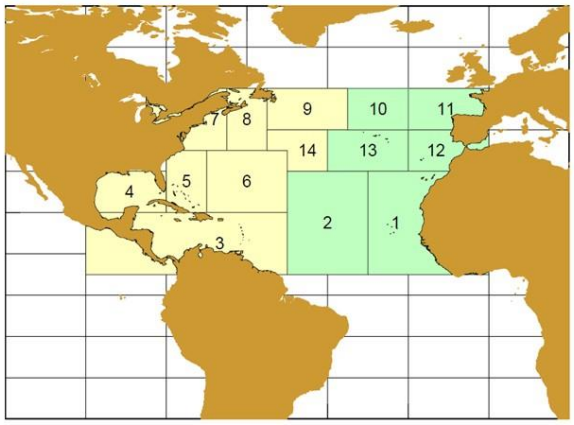
Updating the combined index

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



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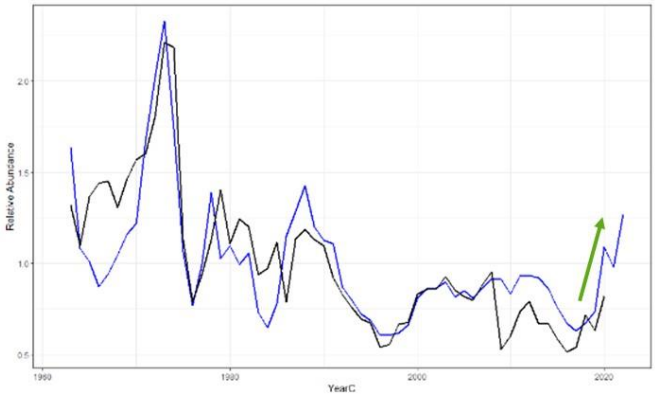
Updating the combined index

- 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)



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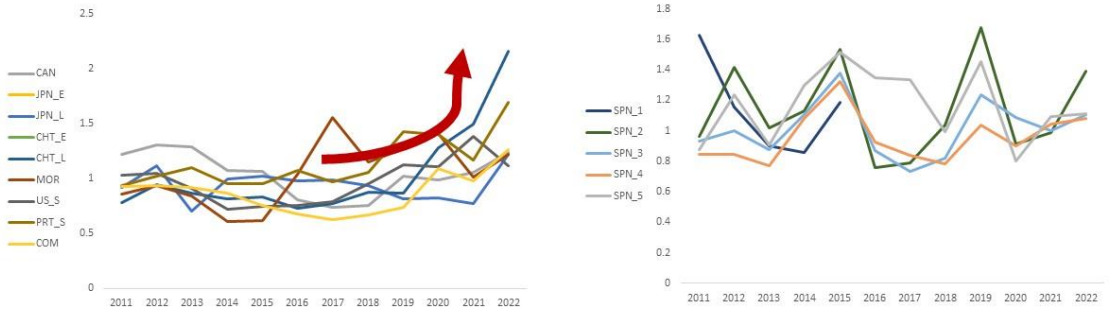
Reconditioning the Operating Models



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

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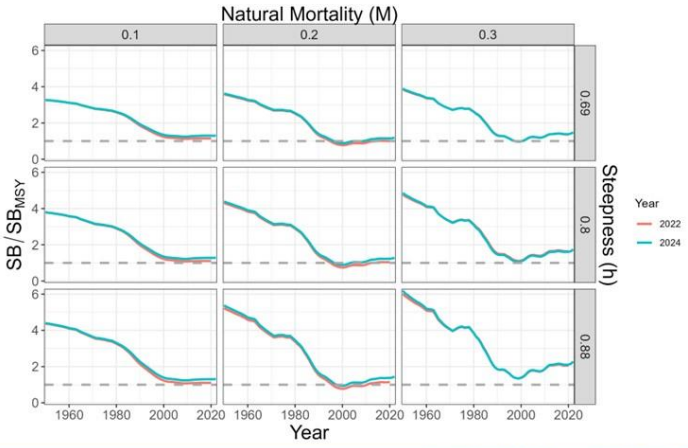
Operating Models

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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Presentation outline

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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"

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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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Workplan in Rec. 23-04

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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

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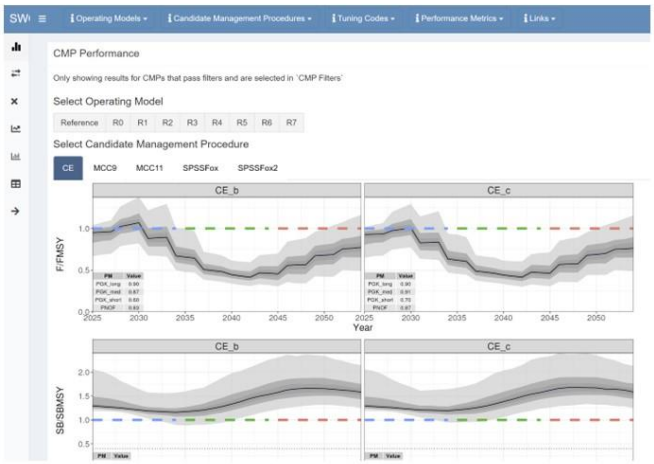
SWO App



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

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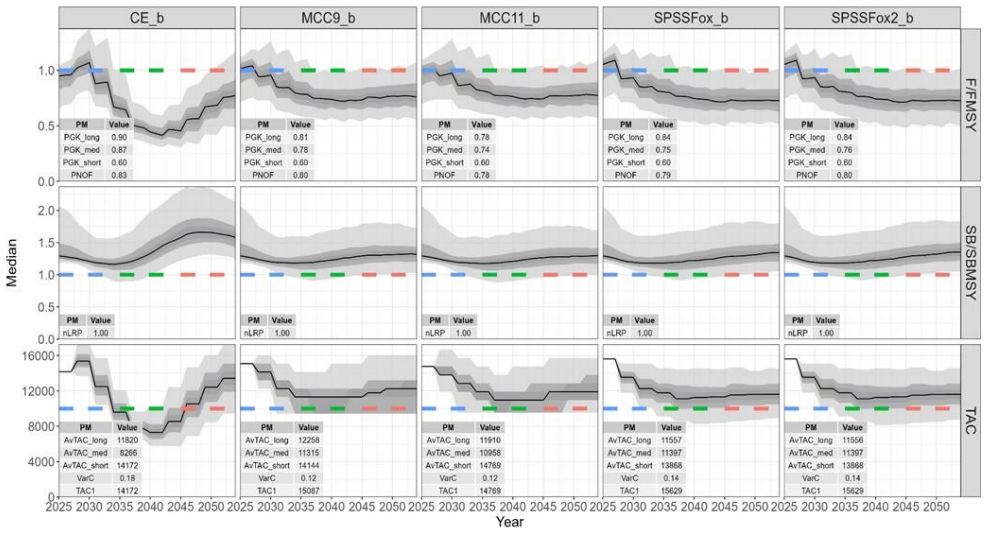
CMP performance

Projection time series

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



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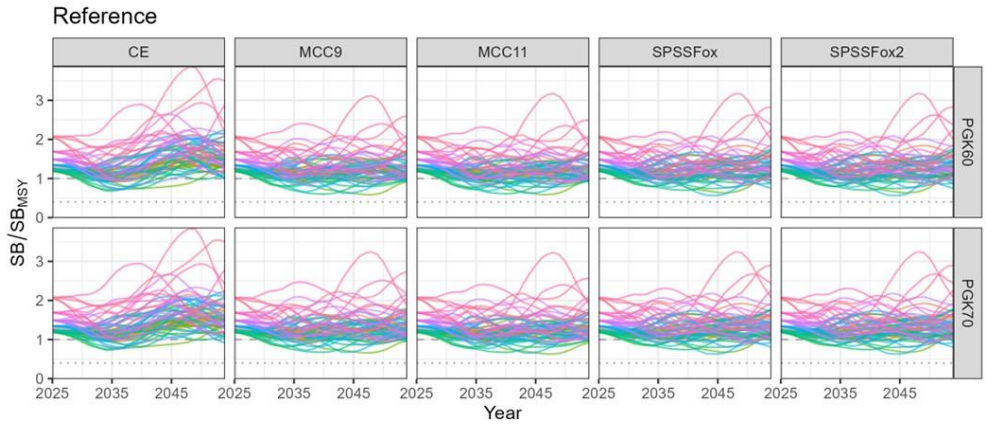
Biomass time series by simulation



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'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

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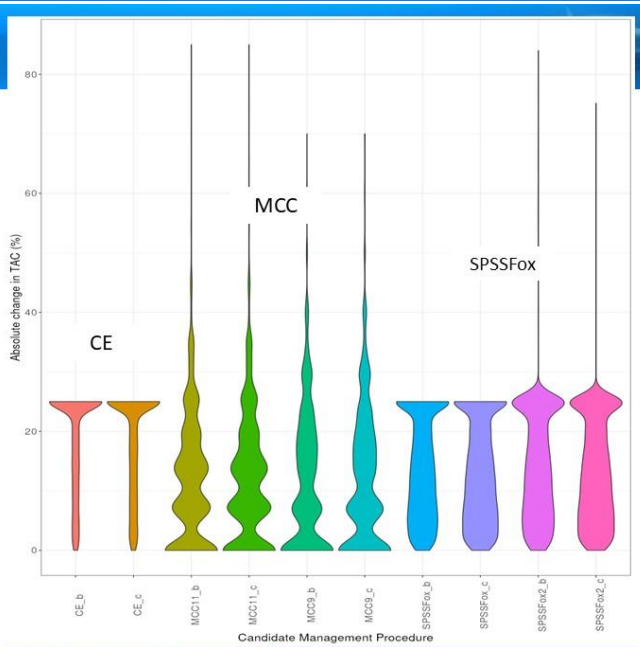
CMP performance

Stability – percent change

Reference OMs



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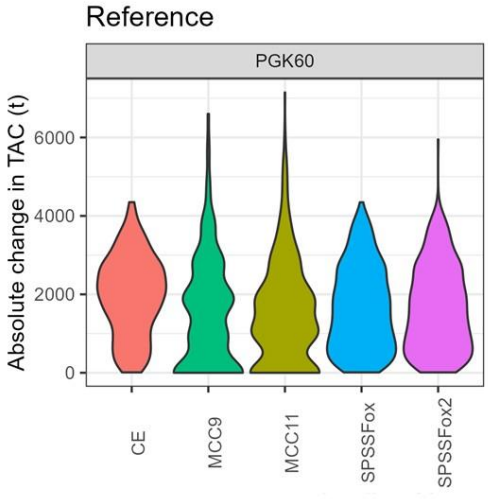
CMP performance

Stability – change in tonnage

Reference OMs



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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

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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

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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)

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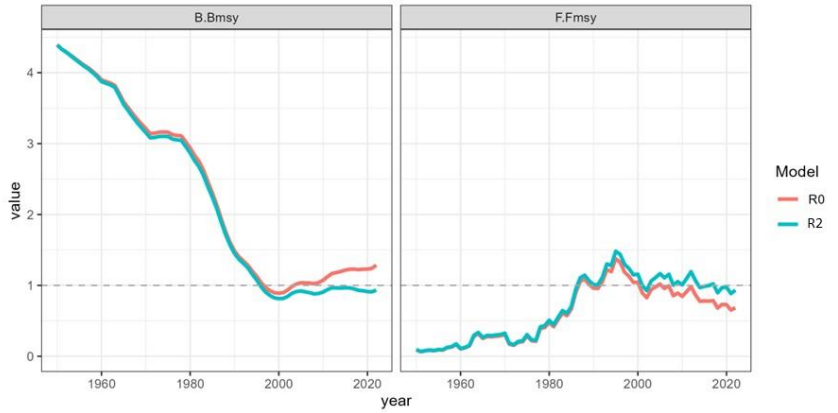
Robustness OM: R2 (increases in catchability)

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



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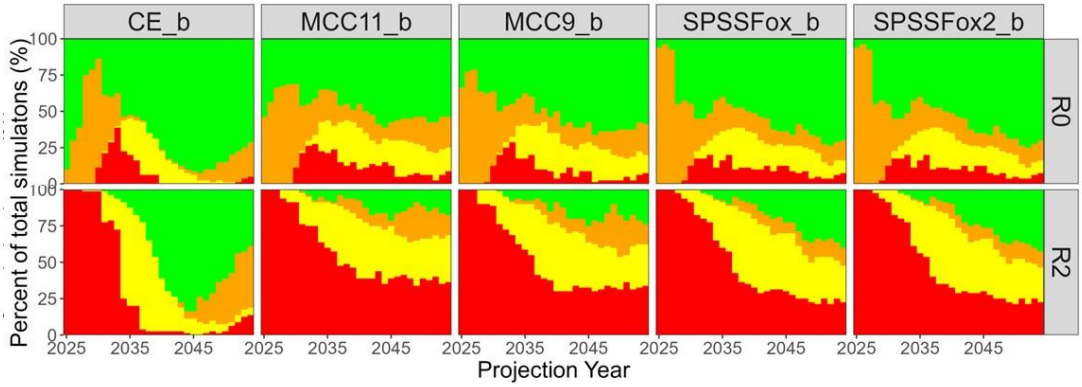
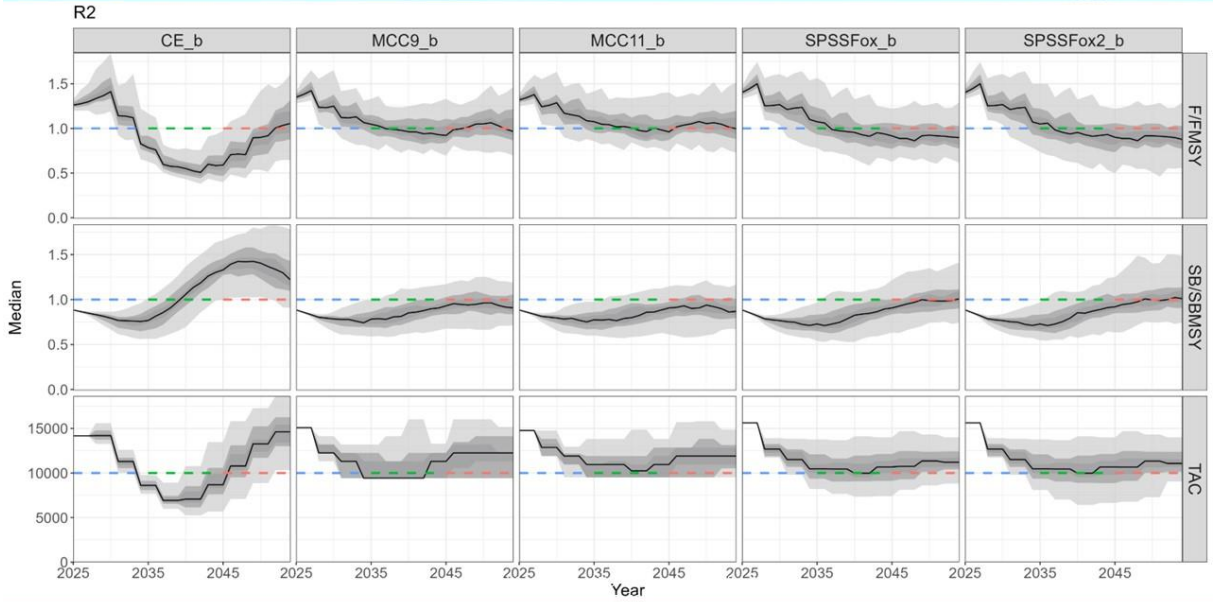
Robustness OM: R2 (increases in catchability)



ICCAT CICTA CICAA **R2 Time Series**



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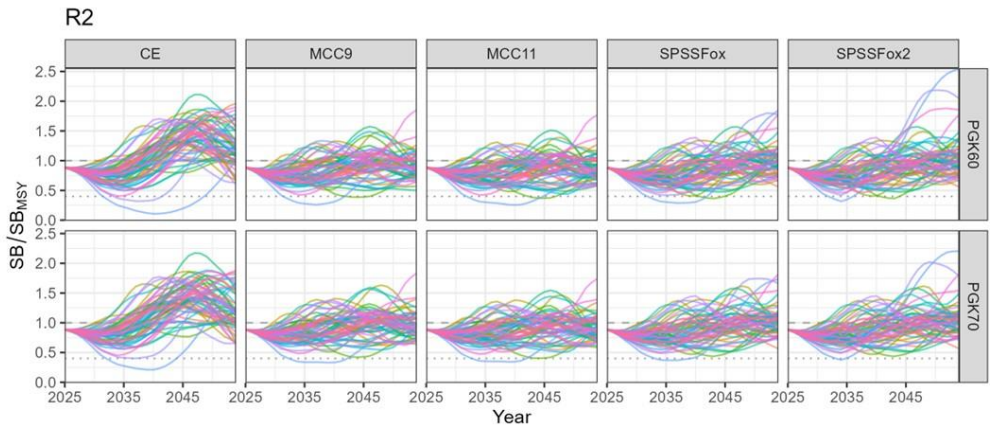
Biomass time series by simulation



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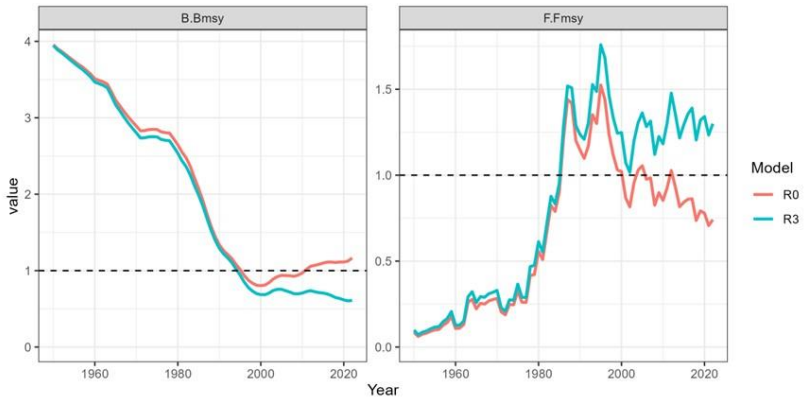
Robustness OM: R3

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



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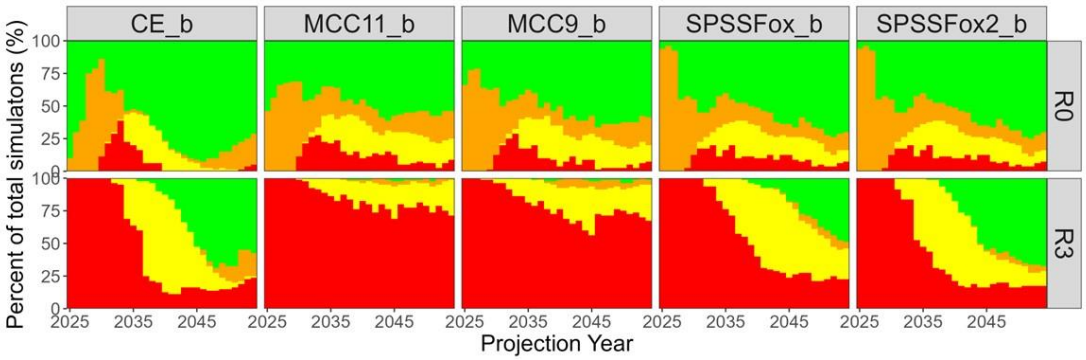
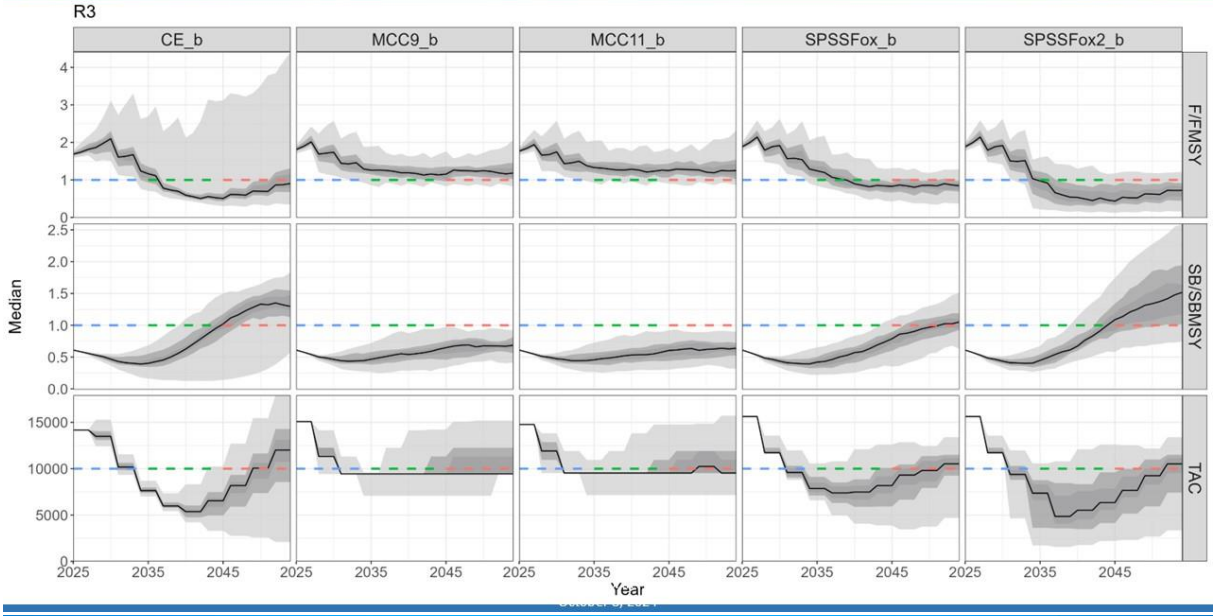
Robustness OM: R3



ICCAT CICTA CICAA **Robustness OM: R3**



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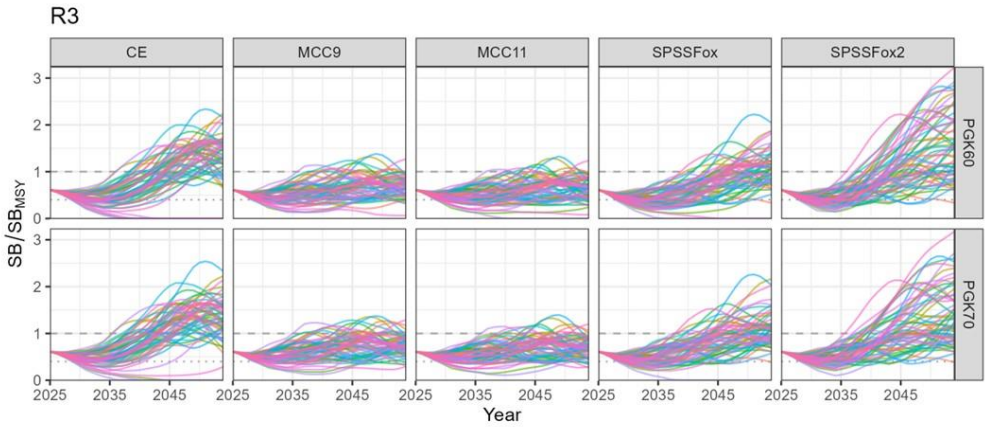
Biomass time series by simulation



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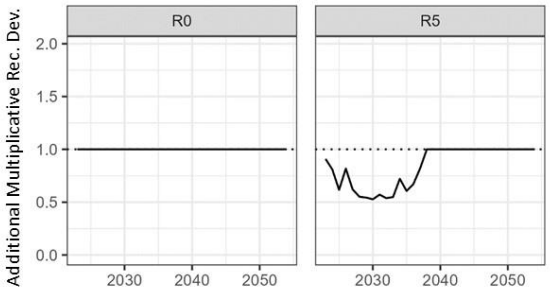
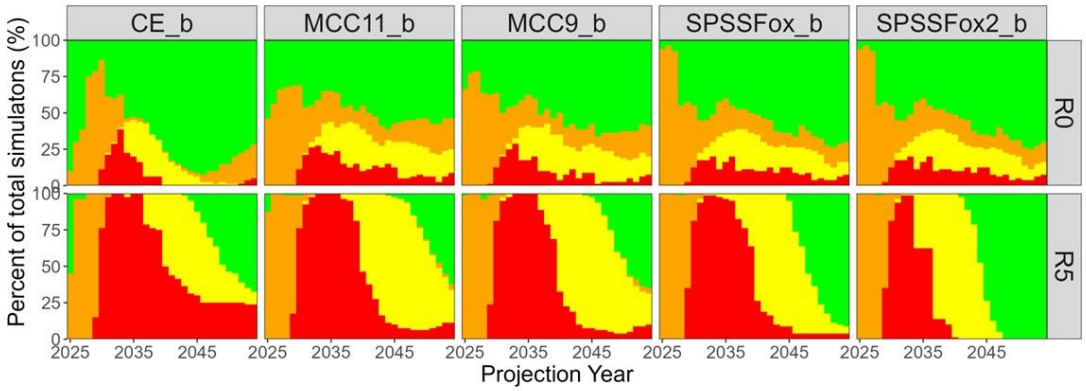
Robustness OM: R5

Patterns in Recruitment Deviations: proxy for impacts of climate change

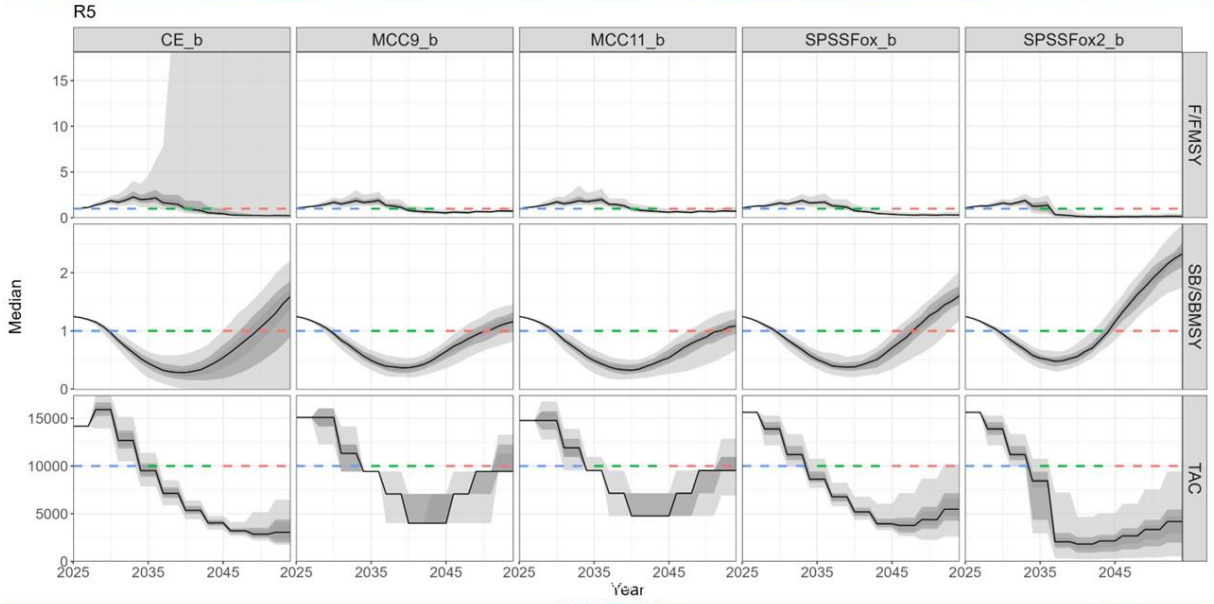
R5: considers the impact of a period of lower than average recruitment for the first fifteen years of the projections



ICCAT CICTA CICAA Robustness OM: R5



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



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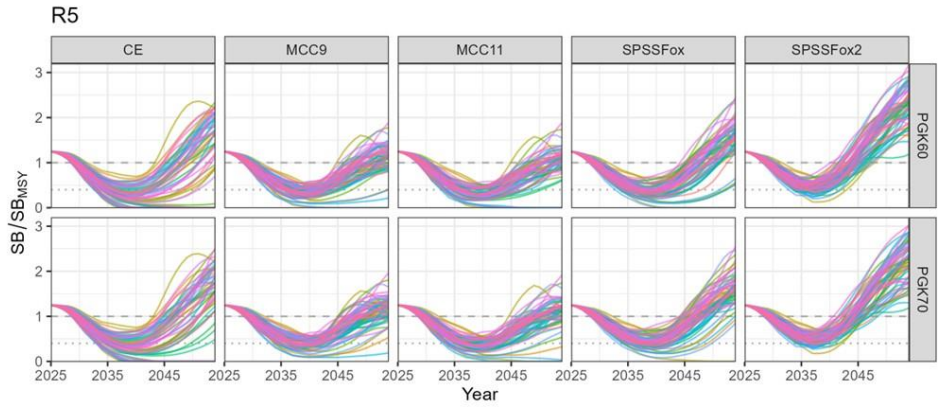
Biomass time series by simulation



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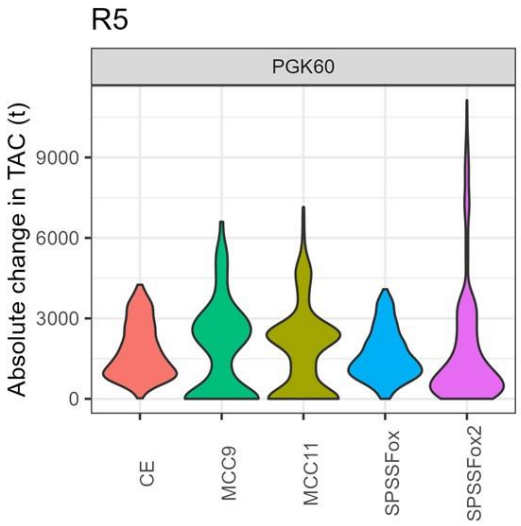
CMP performance

Stability – change in tonnage

R5



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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

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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

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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	±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"

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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.

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Key changes in 2024

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

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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

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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."

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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

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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.

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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.

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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

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Presentation outline

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Other matters

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

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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

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Other supporting information

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

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Candidate Management Procedures

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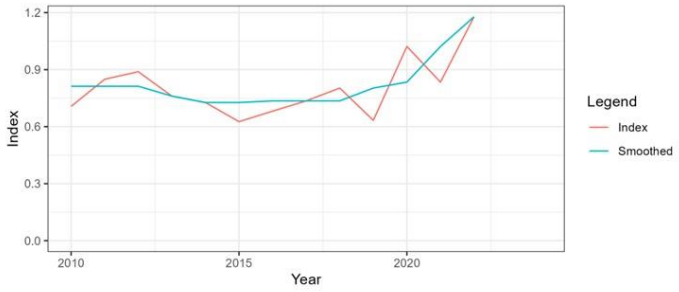
Constant Exploitation: CE

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



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Constant Exploitation: CE

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1. Smooth index using Tukey's Running Median over length 3
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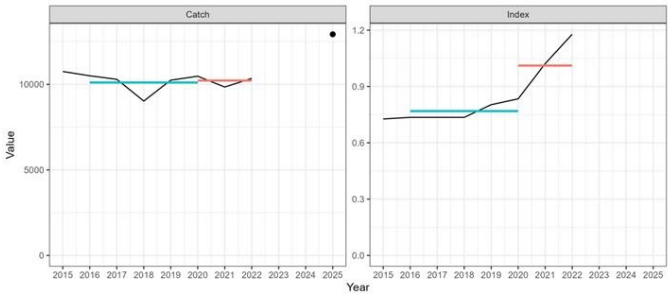
2025 TAC Example

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



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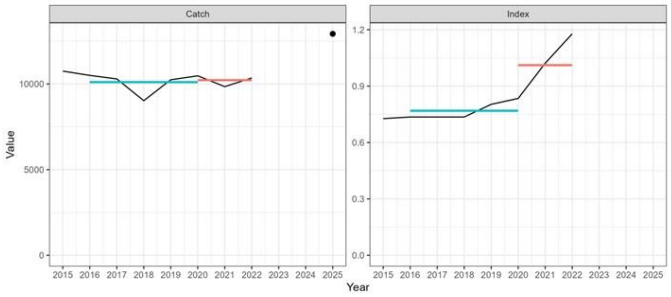
3. Calculate Index Ratio

2025 TAC Example

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



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Constant Exploitation: CE

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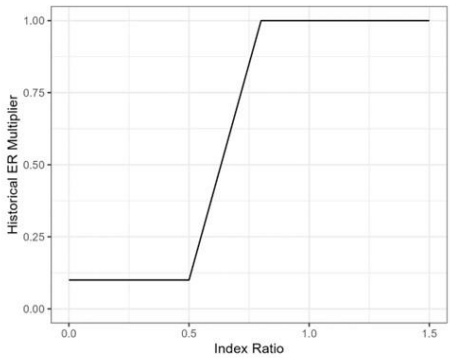
1. Smooth index using Tukey's Running Median over length 3
2. Calculate relative mean *Historical* (2016:2020) and *Current* (y-2, y-1, y) Exploitation Rate (catch/index)
3. Calculate Index Ratio
4. Apply HCR
   a. If *Index Ratio* > 0.8: target ER = historical ER
   b. If *Index Ratio* < 0.5: target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



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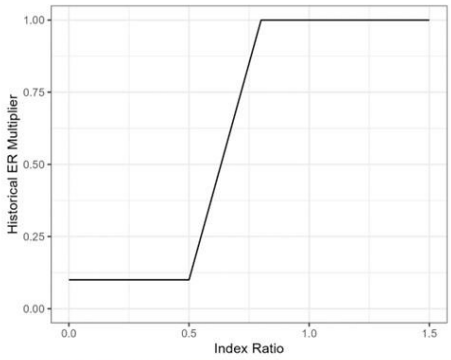

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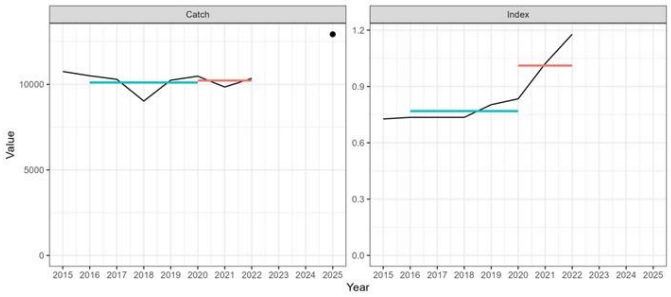
Constant Exploitation: CE

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)

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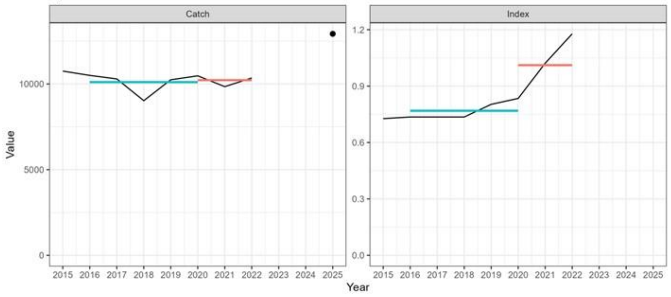
Constant Exploitation: CE

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)

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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

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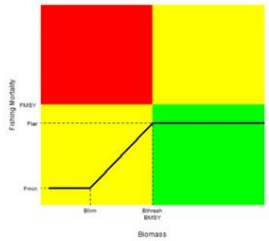
State-Space Surplus Production Fox Model: SPSSFox & SPSSFox2

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}

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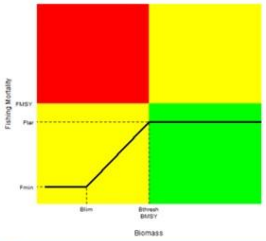
State-Space Surplus Production Fox Model: SPSSFox & SPSSFox2

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

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



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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 1 Index 2 Index 3 Index 4 Index 5

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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 θ is the tuning parameter that results in achieving the desired short-term PGK (currently tested at 51%, 60%, and 70%).

Index = 0.5 Index = 1.0 Index = 1.5

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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.

$0.50 < I_{rat} < 0.75$ $0.75 < I_{rat} < 1.25$ $1.25 < I_{rat} < 1.50$

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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

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

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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