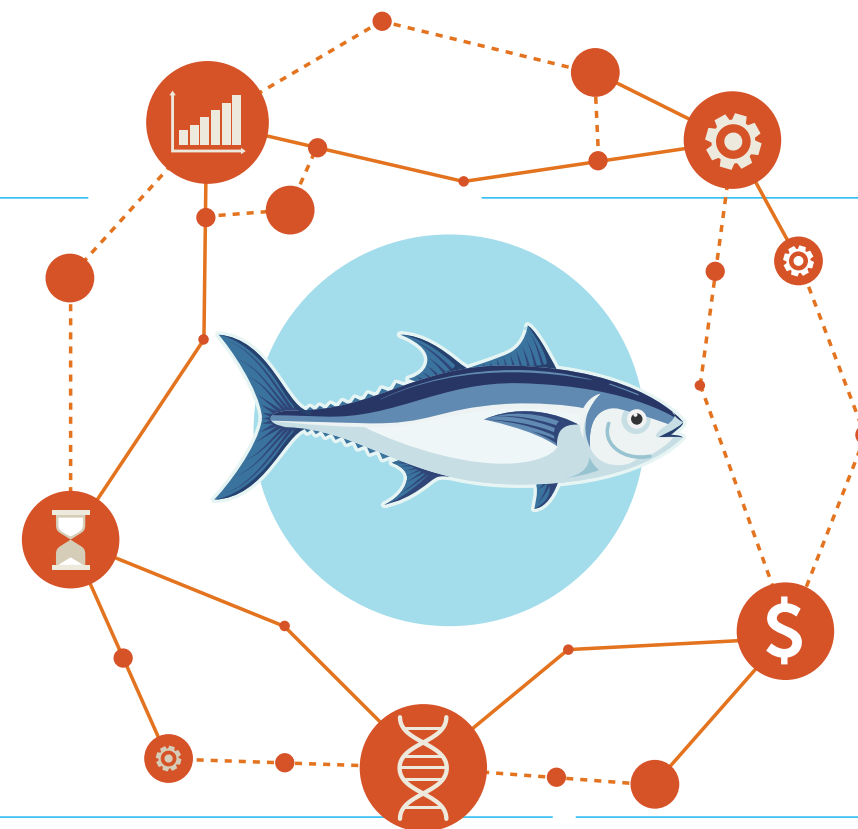




SCRS Update on BFT Management Strategy Evaluation (MSE) 2022



References

1. [Splash Page: https://iccat.github.io/abft-mse/](https://iccat.github.io/abft-mse/) with Shiny Apps and quilt plots
2. Decision Guide (SCI_153B) Atlantic Bluefin Tuna MSE – Final Results & Decision Guide Package
3. SCRS_2022_169. Results, features, and interpretations of the four remaining BFT MSE candidate management procedures

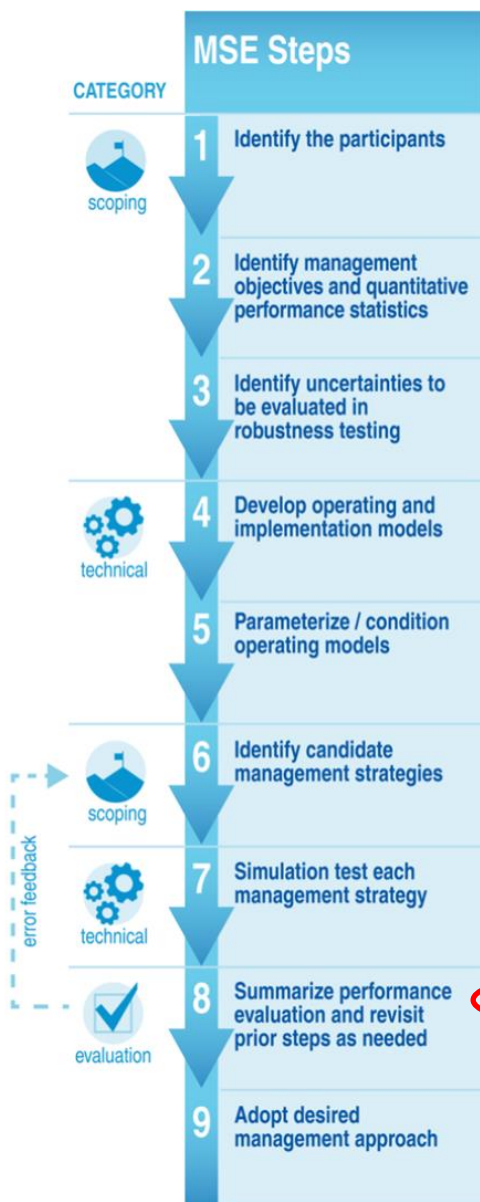


Presentation Overview:

1. Review of BFT MSE structure and process update
2. Key Performance Statistics
3. Key Decisions before Panel 2
4. Next steps



It has been a long trip, and ICCAT is nearing the finish line



2011: First MSE papers for bluefin at ICCAT

2014: Eastern management measure called for MSE development & technical group formed (Rec. 14-04)

2015: ICCAT called for MSE development for 8 stocks, including bluefin (Rec. 15-07)

2017: Initial MSE framework developed by ICCAT

2018: ICCAT adopted conceptual management objectives (Rec. 18-03)

2019-22: Nearly 20 formal science meetings, countless informal meetings & 13 dialogue meetings (e.g., Ambassador meetings and Panel 2)

2022 (November): Commission may adopt an MP



Where are we now?

“The SCRS has made substantial progress in testing candidate management procedures (CMPs) and considers the MSE to be complete...

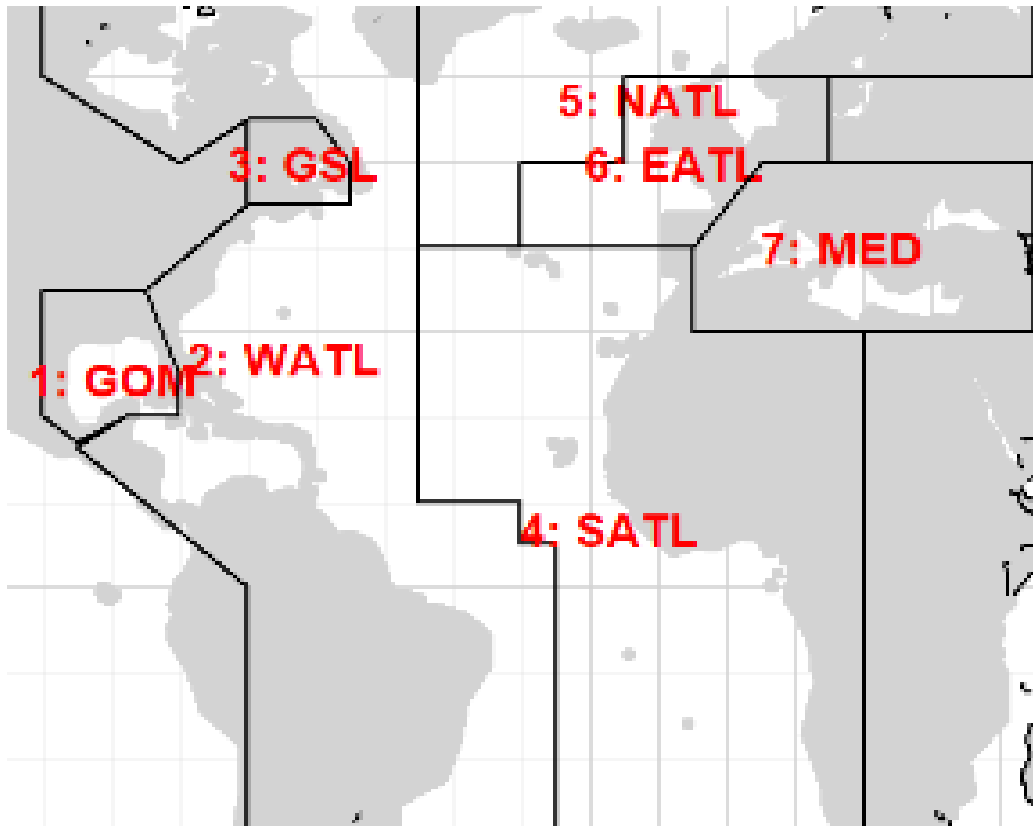
There are now four CMPs remaining, [and]...

They provide **viable, robust options** for setting total allowable catches (**TACs**) for Atlantic bluefin tuna in **2023 and beyond.**”



OM structure

- Area definitions



- Operating **M**odel Specifications

- Time period (history) 1864-2020
- Two Stocks with 3 spawning areas (GOM, WATL, MED)
- 7-area model
- 4 Quarters (Jan-Mar, Apr-Jun, Jul-Sept, and Oct-Dec)
- Age structured (3 age groups)
- Multi-fleet (indices for fitting OM's)
 - 14 CPUE indices
 - 5 fishery independent indices
- It considers Movement (rate of fish moving) vs Mixing (proportion in each area)

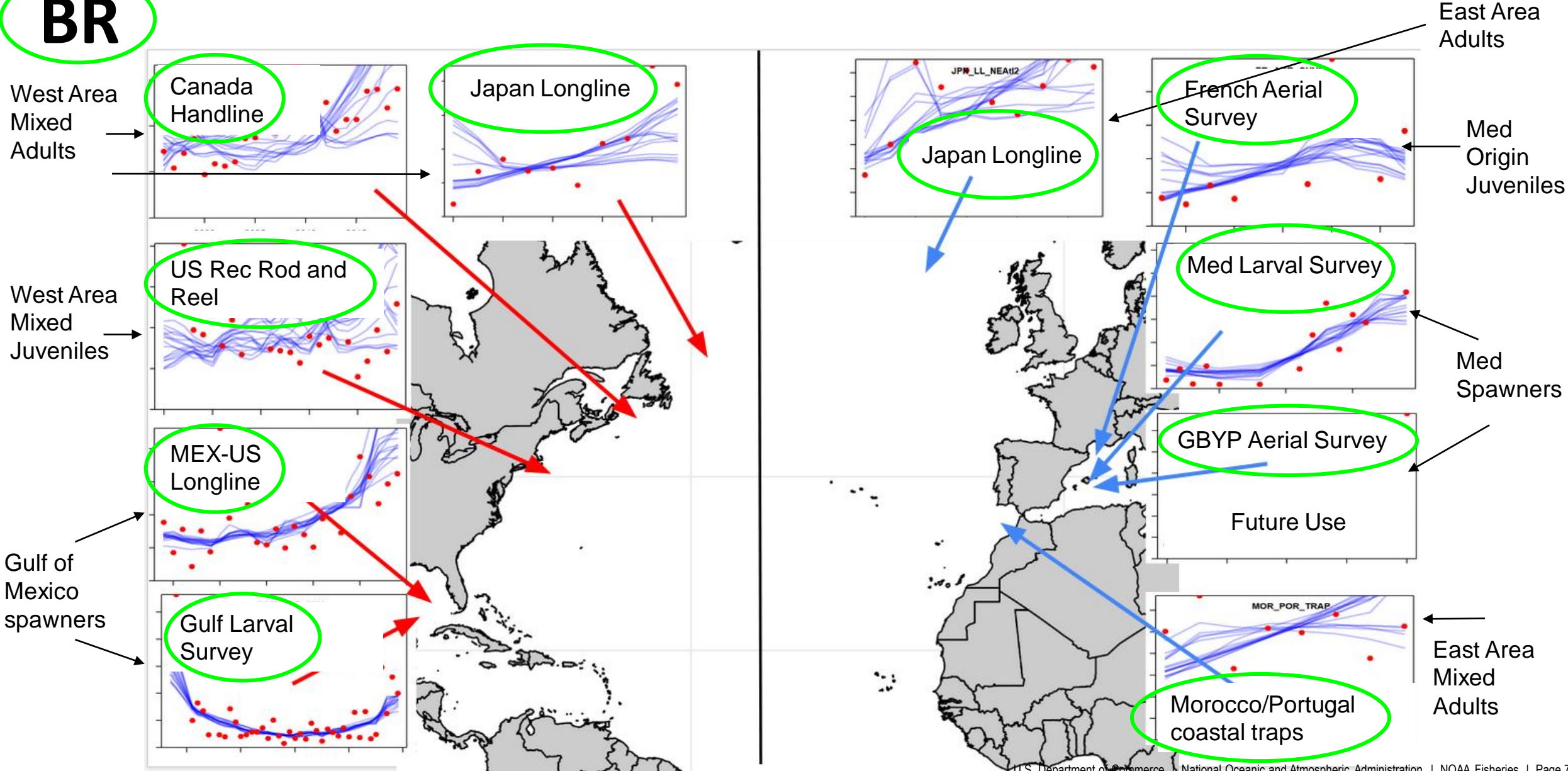


9 Initial CMPs; 4 CMPs remain

CMP	# of Indices	Approach
BR: Butterworth Rademeyer	10	Uses relative harvest rates compared to a reference year (2017), applied to the 3-year moving average of combined master E&W abundance indices.
FO: Hanke- Duprey	6	Uses a 3-year moving average of indices representative of young, medium and old fish to calculate an F0.1 estimate which is applied to an estimate of biomass.
LW: Lauretta- Walter	4	Uses a 3-yr average of catch divided by relative SSB to estimate a constant harvest rate metric. Eastern indices are also used in the West to account for stock mixing (but not vice versa).
TC: Carruthers	7	Indices are used to predict area biomass assuming a fixed rate of stock mixing, and that predicted biomass is then multiplied by a constant harvest rate.

Indices of Abundance (red points) and OM fits (blue lines)

BR

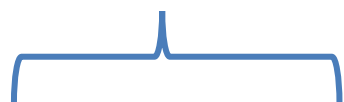
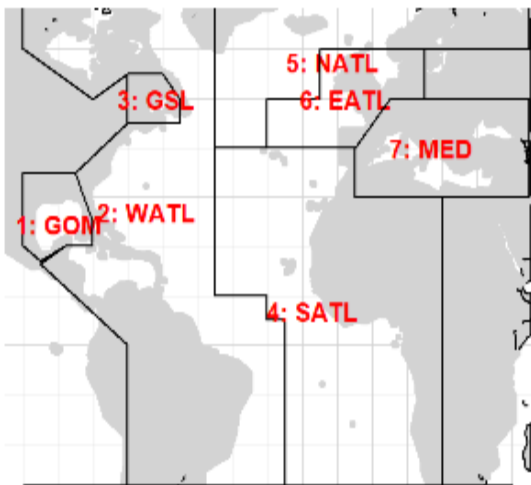




One CMP, Two TACs = One basin-wide management package

Rule for West
area TAC

Rule for East
area TAC



West TAC



East TAC

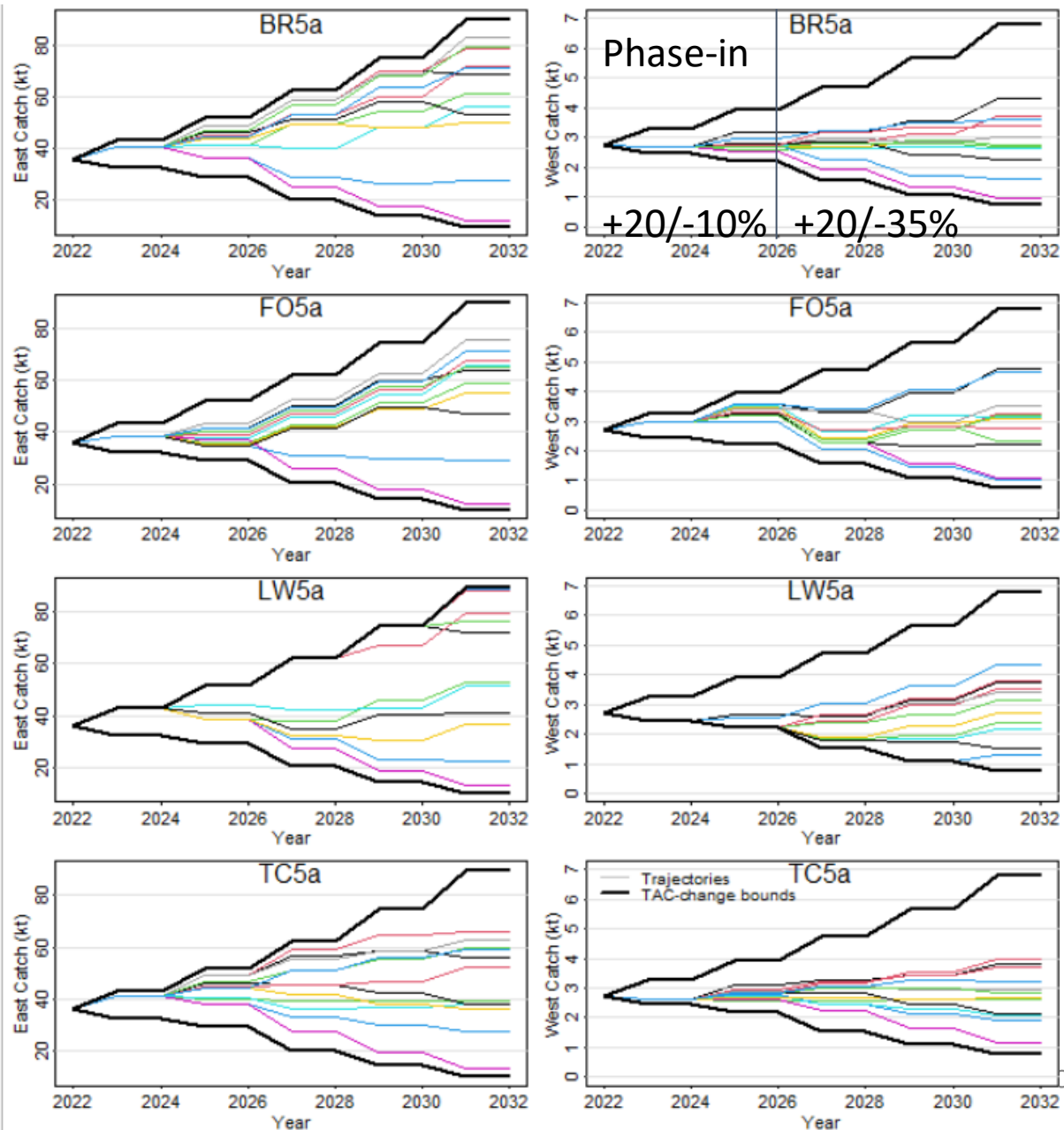
Each CMP is a ‘package-deal’ in that one single CMP calculates separate TACs for the West and East management areas.

All results tested and presented here assume that the operational management objectives and other CMP specifications (e.g., management cycle length) are the same for both stocks/management areas.

CMP Variant	Management cycle length	PGK	TAC stability (after phase-in)
5a	2 years	60%	+20%/-30%
5b	3 years	60%	+20%/-30%
6a	2 years	70%	+20%/-30%
6b	3 years	70%	+20%/-30%
5c	3 years	60%	+20%/-35%



One CMP, Two TACs = One basin-wide management package



Include an initial 'phase-in' period where TAC changes are limited to a 20% increase and 10% decrease for: i) two cycles of a 2-yr setting, or ii) one cycle for a 3-yr setting.

After the 'phase-in' period there is a +20/-30 (or 35%) stability clause

This is illustrated here for a 2-yr management cycle for the four CMPs.

The colored lines are individual simulations randomly chosen.

The 2023-2024 lines have no variation- they are exactly the TAC in the first year of implementation (C1) for each CMP



2. Key **Performance Statistics** and their interpretation



Performance Statistics for the BFT MSE

(Used to evaluate achievement of management objectives)

Management Objectives (MOs)



Status: The stock should have a greater than **[60 to 70]**% probability of occurring in



the green quadrant of the Kobe matrix

Safety: There should be a less than [__]%



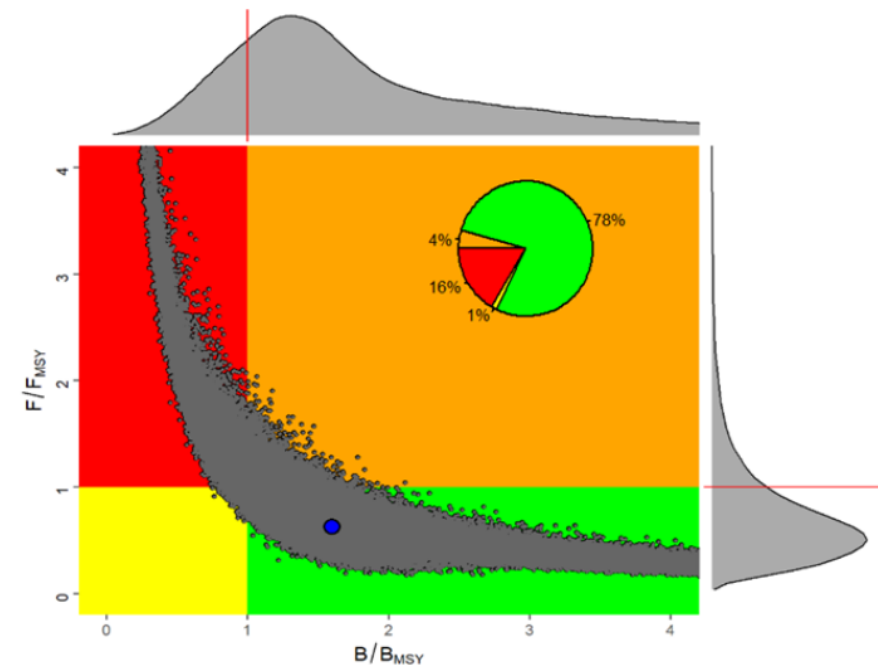
probability of the stock falling below B_{LIM}



Yield:
Maximize overall catch levels
Any increase or decrease in TAC
between management periods
should be less than [__]%

Performance Statistics for Status

- green quadrant ($SSB \geq SSB_{MSY}$ & $U < U_{MSY}$) of the Kobe plot in year 30th of the projection period (PGK).



9/8/2021



Performance Statistics for this MSE

- The stock should have a greater than
- 🐟 [__]% probability of occurring in the green quadrant of the Kobe matrix
 - 🐟 **Safety:** There should be less than [**10 or 15**]% probability of stock falling below B_{LIM} (*40% dynamic SSB_{MSY})
 - 🐟 Maximize overall catch levels
 - 🐟 Any increase or decrease in TAC between management periods should be less than [__]%

- Performance Statistic for Safety**
- **LD** – Lowest Depletion (i.e., SSB relative to dynamic SSB_{msy}) over the projection period

9/8/2021

12



Performance Statistics for this MSE

- 🐟 The stock should have a greater than [__]% probability of occurring in the green quadrant of the Kobe matrix
- 🐟 There should be a less than [__]% probability of the stock falling below B_{LIM} (to be defined)
- 🐟 **Yield:** Maximize overall catch levels
- 🐟 Any increase or decrease in TAC between management periods should be less than [__]%

Performance Statistic for Yield

- **AvC10** – Mean catches (t) over first 10 years
- **AvC30** – Mean catches (t) over 30 years
- **C1** – TAC in first year of Management Procedure implementation, e.g., the **actual TAC in 2023 and 2024** (or 2023-2025) for a given management procedure.



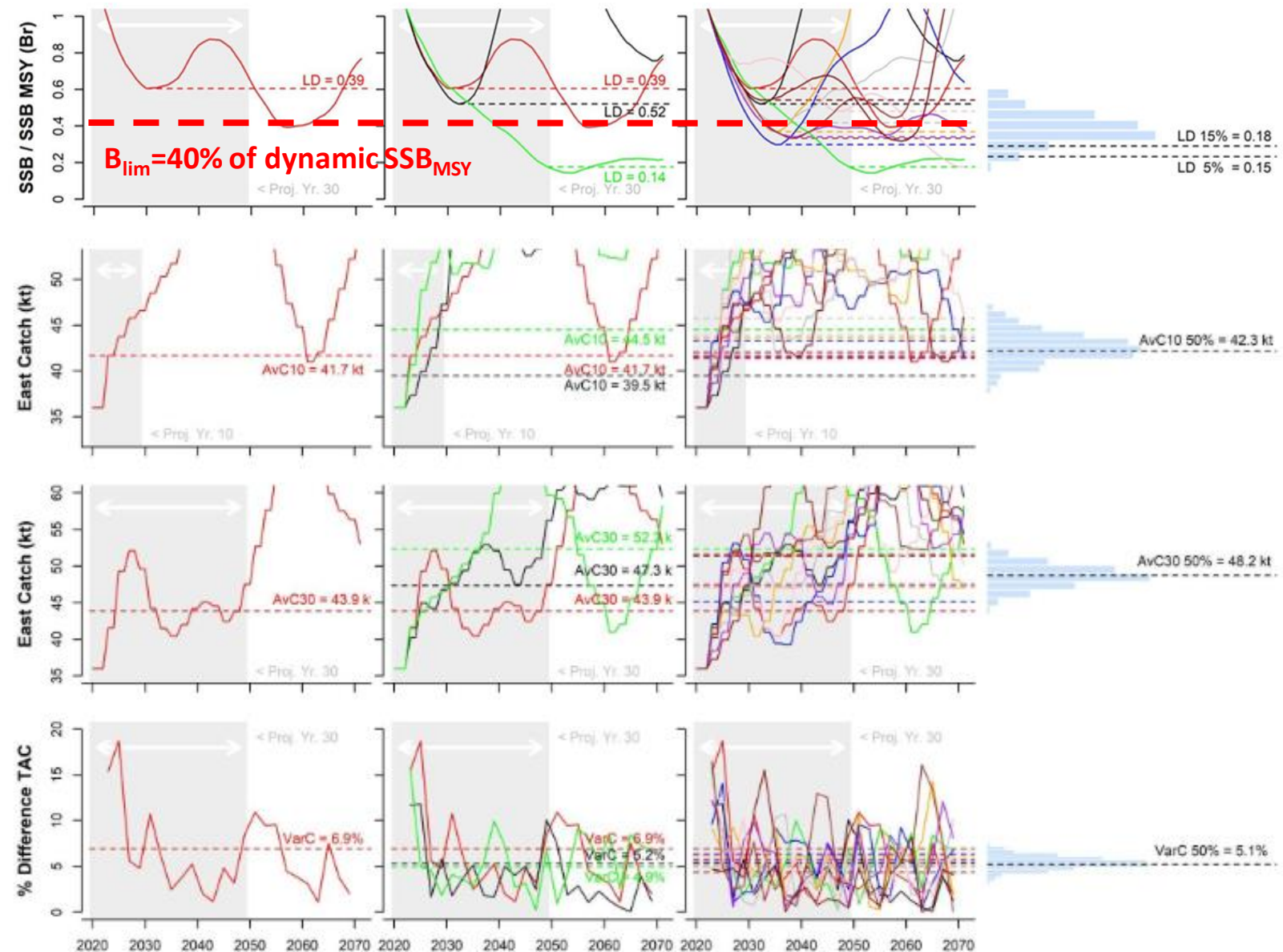
Performance Statistics for the BFT MSE

- 🐟 The stock should have a greater than [__]% probability of occurring in the green quadrant of the Kobe matrix
- 🐟 There should be a less than [__]% probability of the stock falling below B_{LIM} (to be defined)
- 🐟 Maximize overall catch levels
- 🐟 *Stability*: Any increase or decrease in TAC between management periods should be less than [__]%

Performance Statistic for Stability MO

- **VarC** – % Variation in TAC between management periods, guidance from Panel 2 is < 20%

Visual Description of Performance Statistics for the BFT MSE



LD*: Lowest depletion (spawning biomass relative to dynamic SSB_{msy}) over years 11-30 of projections.

AvC10: Average catch years 1-10, measures short term yield

AvC30: Average catch years 1-30, measures long term yield

VarC: Average % Variation in TAC between management periods



Displaying Results: Quilt Plots

Color scale represents relative performance from dark (best) to light (worst) within a column.

Top 5 performance statistics:

Status: PGK: prob green quadrant (i.e., $SSB \geq SSB_{MSY}$ and $U < U_{MSY}$) in year 30

Yield: AvC10: average catch (kt) over years 1-10 (50%tile)

AvC30: average catch (kt) over years 1-30 (50%tile)

Stability: VarC: Variation in catch (%) between 2-yr or 3-yr management cycles (50%tile)

Safety: LD*(15%): 15%tile of lowest depletion relative to dynamic SSB_{msy} over years 11-30

CMP	West				
	PGK (Mean) ▾	AvC10 (50%) ▾	AvC30 (50%) ▾	VarC (50%) ▾	LD (15%) ▾
BR5a	0.6	2.77	2.43	8.81	0.42
FO5a	0.61	2.89	2.59	14.86	0.4
TC5a	0.6	2.67	2.4	7.51	0.4
LW5a	0.6	2.41	2.25	16.52	0.48

PGK 60 tuning; a is 2-year TAC, shown for brevity



Interpreting a Quilt Plot, further

PGK= CMPs are 'tuned' to achieve PGK of 0.6 - 0.7, final ones will match, nearly exact

AvC10- catch in 1000 t, eg. 2.71 is 2710 t. Higher is better!

VarC- Here lower is less variable TACs, so lower is better

LD*15%- Here must be above 0.4 (which means 40%), i.e. above B_{lim} ($0.4 * \text{dynamic SSB}_{msy}$), to satisfy PA2 requirement

	West				
	PGK (Mean) <small>◀▶</small>	AvC10 (50%) <small>◀▶</small>	AvC30 (50%) <small>◀▶</small>	VarC (50%) <small>◀▶</small>	LD (15%) <small>◀▶</small>
BR5a	0.6	2.77	2.43	8.81	0.42
FO5a	0.61	2.89	2.59	14.86	0.4
TC5a	0.6	2.67	2.4	7.51	0.4
LW5a	0.6	2.41	2.25	16.52	0.48

5 is PGK 60 tuning; a is 2-year TAC, shown for brevity



Understanding methodology for ranking CMPs - Default weighting

- PGK is unweighted since it is used for tuning
- AvC10 and AvC30 are both weighted 0.5 to total 1 for yield objectives
- VarC is weighted 1
- LD is weighted 1

CMP	West				
	PGK (Mean)	AvC10 (50%)	AvC30 (50%)	VarC (50%)	LD (15%)
BR5a	0.6	2.77	2.43	8.81	0.42
FO5a	0.61	2.89	2.59	14.86	0.4
TC5a	0.6	2.67	2.4	7.51	0.4
LW5a	0.6	2.41	2.25	16.52	0.48

Overall, this gives equal weighting for status, yield, stability and safety objectives, per PA2 guidance on default weighting.



3. Key Decisions before Panel 2



Decision Points before Panel 2 (14 Oct 2022)

1. **Operational management objective for Safety:** LD*10% or LD*15% probability of being below B_{lim} (40% of dynamic SSB_{MSY}) in years 11-30 of projections.
2. **Operational management objective for Stock Status:** 60% or 70% probability of occurring in the green quadrant ($SSB \geq SSB_{MSY}$ & $U < U_{MSY}$) of the Kobe plot in year 30 of the projection period (PGK).
3. **Management Cycle Length:** 2-year or 3-year TAC setting intervals.
4. **Operational management objective for Stability:** This is a subsidiary decision needed only for the 3-year TAC setting. Following the phase-in period, allowing greater possible reductions in TAC change between management cycles: moving the default of +20/-30% to +20%/-35%.
5. **Management Procedure:** BR, FO, LW or TC.
6. **Timeframe for review of Management Procedure.**



.... *Decision point 5*: Management procedure: FO, BR, or TC

Quilt Plot #2 - East

order	CMP	Tuning	Variant	TAC ₁ (kt) (or C1)	AvC20 (kt)	AvgBr	Br20	Br30 (5%)	LD (5%)	LD (10%)	POF	PNRK	OFT (P>0)
1	BR	PGK60%	2-yr	40.57	44.29	1.34	1.29	0.58	0.33	0.43	0.06	0.97	0.92
2	BR	PGK60%	2-yr	40.57	47.63	1.21	1.15	0.44	0.27	0.38	0.11	0.93	0.88
3	TC	PGK70%	2-yr	38.91	34.38	1.52	1.51	0.49	0.32	0.42	0.09	0.93	0.89
4	TC	PGK60%	2-yr	41.28	39.02	1.38	1.36	0.38	0.24	0.35	0.18	0.85	0.83
5	BR	PGK60%	3-yr, -35%	40.57	48.45	1.25	1.21	0.33	0.21	0.33	0.13	0.89	0.85
6	FO	PGK70%	3-yr	38.29	43.88	1.39	1.35	0.3	0.25	0.36	0.25	0.8	0.83
7	BR	PGK60%	2-yr	40.57	41.81	1.38	1.35	0.42	0.25	0.36	0.08	0.93	0.87
8	TC	PGK70%	3-yr	38.29	33.86	1.56	1.55	0.42	0.25	0.35	0.07	0.93	0.87
9	FO	PGK70%	2-yr	38.29	38.87	1.52	1.49	0.45	0.34	0.45	0.13	0.9	0.89
10	LW	PGK60%	2-yr	43.2	40.46	1.33	1.3	0.41	0.27	0.37	0.18	0.87	0.87
11	TC	PGK60%	3-yr, -35%	40.94	38.74	1.41	1.39	0.3	0.18	0.27	0.17	0.84	0.81
12	LW	PGK70%	2-yr	43.2	34.79	1.48	1.47	0.51	0.32	0.43	0.09	0.94	0.91
13	FO	PGK60%	3-yr, -35%	38.29	44.51	1.39	1.35	0.25	0.21	0.33	0.22	0.81	0.81
14	FO	PGK70%	3-yr	38.29	40.19	1.49	1.46	0.35	0.26	0.37	0.13	0.89	0.87
15	LW	PGK60%	3-yr, -35%	43.2	43.16	1.29	1.24	0.31	0.19	0.3	0.16	0.87	0.85
16	LW	PGK70%	3-yr	43.2	35.78	1.46	1.42	0.41	0.23	0.35	0.07	0.94	0.89

CMPs are ordered based on Primary Quilt Tot column

Red outlined CMPs do not meet the LD*15%



Decisions, revisited

1. **Operational management objective for Safety:** LD*10% of LD*15% [No CMPs meet LD*10, SCRS recommends using decision point 2 for added precaution, if desired.]
2. **Operational management objective for Stock Status:** 60% or 70% PGK. [This is the **most influential** decision on the yield vs. status tradeoff] **Request to evaluate 65% PGK**
3. **Management cycle length:** 2- or 3-yr TAC setting. [Any interval can meet PA2 objectives but see (4), below.]
4. **Operational management objective for Stability:** for 3-yr TAC setting and **PGK60%** [For 60%PGK and 3-yr, SCRS recommends moving the default stability from +20/-30% to +20%/-35% to meet LD*15%.]
5. **Management procedure:** BR, FO, or TC. [SCRS is of the opinion that any of the CMPs meet PA2 objectives and represent robust management procedures.] **ONE CMP dropped**
6. **Timeframe for review of Management Procedure** [~6 years, round multiple of either 2 or 3-yr TAC settings, **Agree PA2**]



Management Advice Framework (*draft*)

Year	Run MP	Exceptional Circumstances	Stock Assessment/ health check	MP Review
2022	Adopt MP			
2023		Adopt EC protocol		
2024	If 2-yr cycle	Check		
2025	If 3-yr cycle	Check		
2026	If 2-yr cycle	Check		
2027		Check	As status check & to inform reconditioning	Start reconditioning of MSE & consider new data/methods
2028	If 2 or 3-yr cycle	Check		Finish reconditioning of MSE & consider new data/methods
2029		Check		

Management Procedure sets TACs for 2 (or possibly 3) years for both East and West by modifying previous TACs based on recent indices

Less frequent stock assessments will occur on a predetermined interval as 'health or status' checks and to inform reconditioning for MP review

Exceptional circumstance provisions specify situations when MP can be overridden, e.g. index outside range tested, inability to update an index for multiple years, natural disasters, etc. Evaluated annually by SCRS

MP review/revision and MSE 'reconditioning' which includes refitting to new data, incorporation of new information or new methodology would be considered (groundbreaking science, exceptional circumstances, etc) at predetermined intervals.



4. Next steps

- 14 October: 4th Panel 2 intersessional meeting **-COMPLETED-**
 - This presentation will form the basis of the PA 2 presentation
 - Decision Guide will be submitted to PA 2
 - PA 2 may make a recommendation on a CMP and its variants
- 14 - 21 November: Annual Commission meeting
 - ICCAT scheduled to adopt MP
- 2023: Develop & adopt exceptional circumstances protocol for the BFT MSE



Other Resources

[Harveststrategies.org](https://www.harveststrategies.org) MSE outreach materials
(multiple languages)



What are Harvest Strategies?

Harvest strategies are an essential tool in making sustainable fisheries management decisions. Adopting harvest strategies leads to...

[Learn more](#)

HS Case Studies

[Learn more](#)

RESOURCES

WHAT IS MSE?

DATA VISUALIZATION TOOLS

HS UPDATE

Webinar focused on how harvest strategies will help the EU secure sustainable tuna fisheries

[Learn more](#)

[Atlantic Bluefin Tuna MSE splash page, including interactive Shiny App \(Eng only\)](#)

Atlantic Bluefin Tuna MSE

Tom Carruthers tom@bluematterscience.com

28 July, 2021



Documentation

[Trial Specifications Doc \(.docx\)](#)

[CMP Developers Guide \(.html\)](#)

[Trial Specifications Doc \(.pdf\)](#)

Shiny App

[Latest version](#)

[Legacy \(2020\) version](#)

R package

[ABTMSE R Package](#)

Operating Model Reports

Summary Reports

[Low length comp fit OM comparison \(.html\)](#)

[High length comp fit OM comparison \(.html\)](#)

Index Statistic Summary Reports

[Low length comp fit index stats \(.html\)](#)

[High length comp fit index stats \(.html\)](#)

Individual OM Diagnostic Reports

[Reference Grid OM summary and individual reports \(.html\)](#)

[Robustness Set OM summary and individual reports \(.html\)](#)

Meeting reports

[September 2020 Second Intersessional Meeting of the ICCAT ABT MSE technical group \(ENG\)\(.pdf\)](#)

[April 2021 First Intersessional Meeting of the Bluefin Tuna Species Group \(ENG\)\(.pdf\)](#)

Acknowledgements

This work was carried out under the provision of the ICCAT Atlantic Wide Research Programme for Bluefin Tuna (GBYP), funded by the European Union, several ICCAT CPCs, the ICCAT Secretariat and by other entities (see: <http://www.iccat.int/GBYP/en/Budget.htm>). The contents of these materials do not necessarily reflect the point of view of ICCAT or other funders and in no ways anticipate ICCAT future policy in this area.