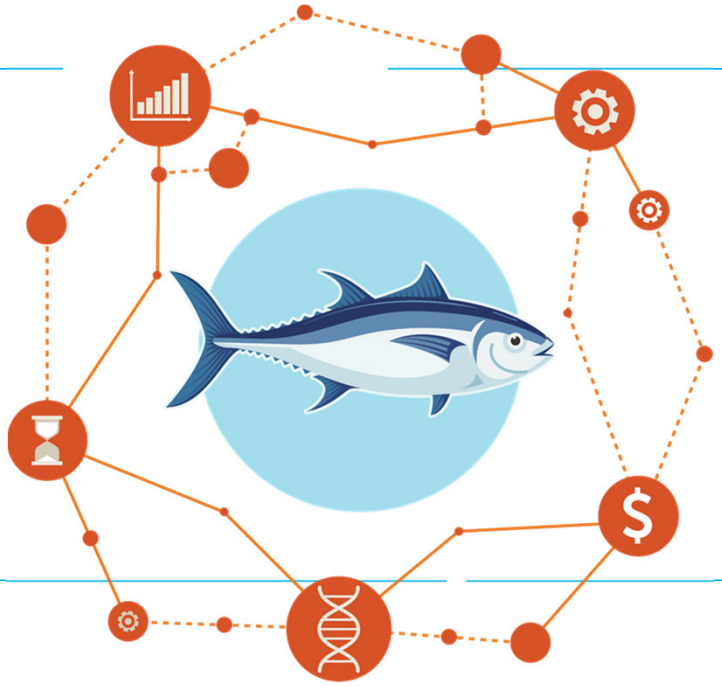
BFT Management Strategy Evaluation (MSE)

2022 Ambassador Meetings



References

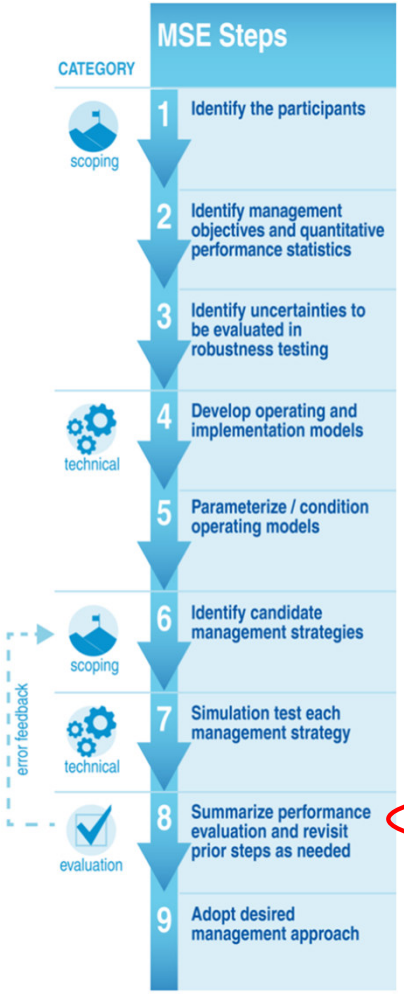
1. Splash Page: https://iccat.github.io/abft-mse/ with Shiny Apps and quilt plots
2. Decision Guide (SCI_153B) Atlantic Bluefin Tuna MSE – Final Results & Decision Guide Package
3. SCRS_2022_169. Results, features, and interpretations of the four remaining BFT MSE candidate management procedures

Outline

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

1. BFT MSE structure and process update

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

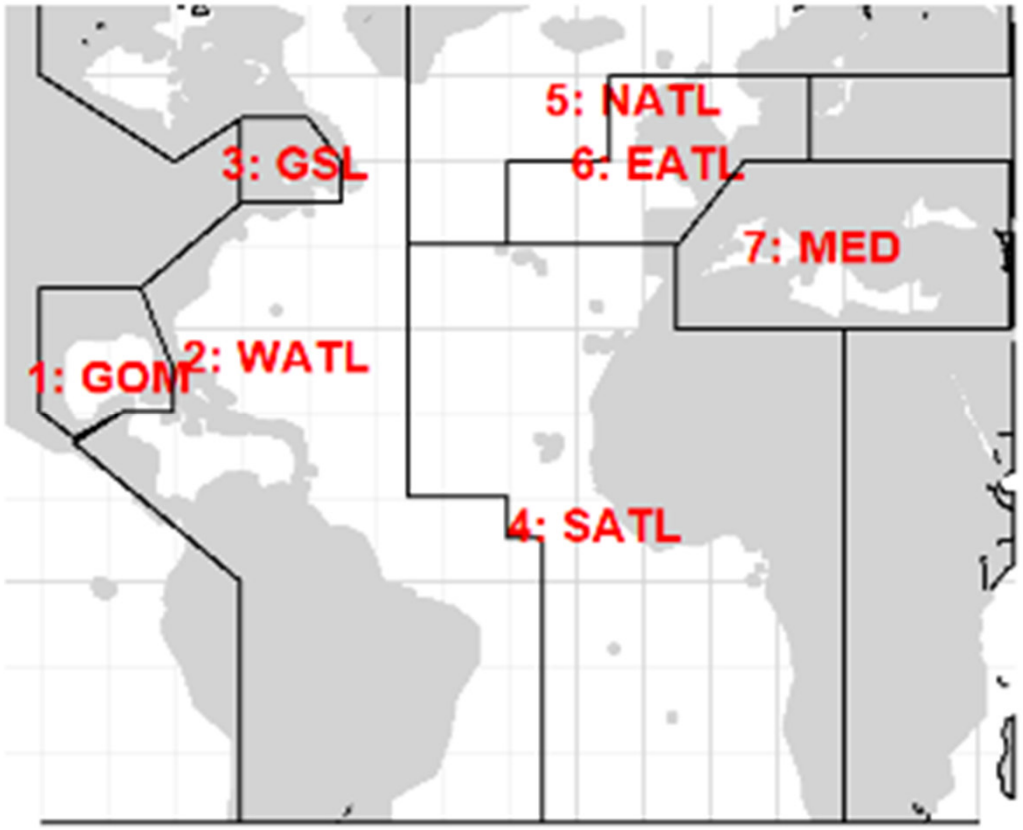
Where are we now?

"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."

Except from 2022 SCRS Report Decision Guide

Review: ABFT MSE Structure

Area definitions



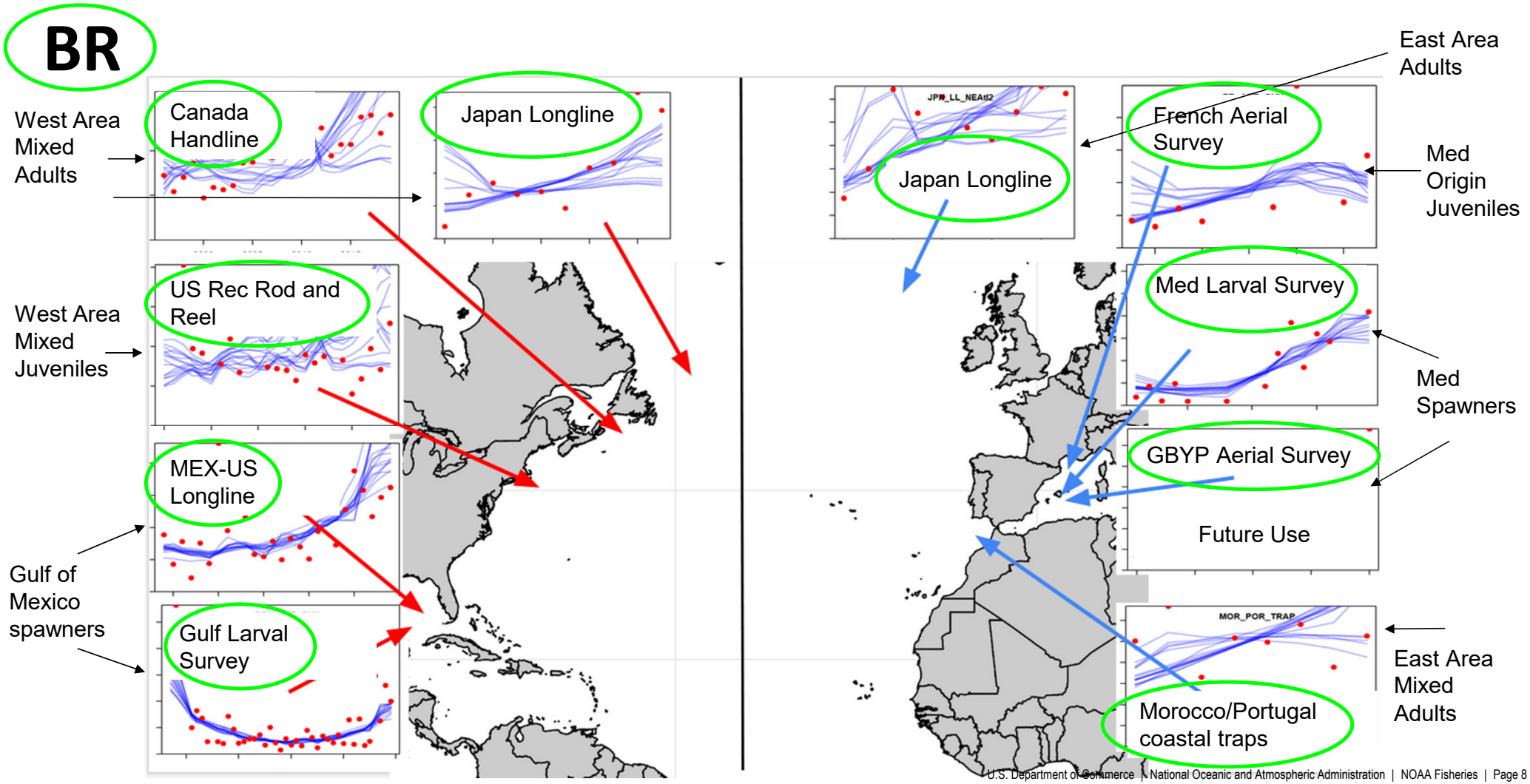
Model Specifications

- 1864-2020
- 7-area model
- Two Stocks
  - 3 spawning areas (GOM+WATL & MED)
- 4 Quarters (Jan-Mar, Apr-Jun, Jul-Sept, and Oct-Dec)
- Multi-fleet (indices for fitting OMs)
  - 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)



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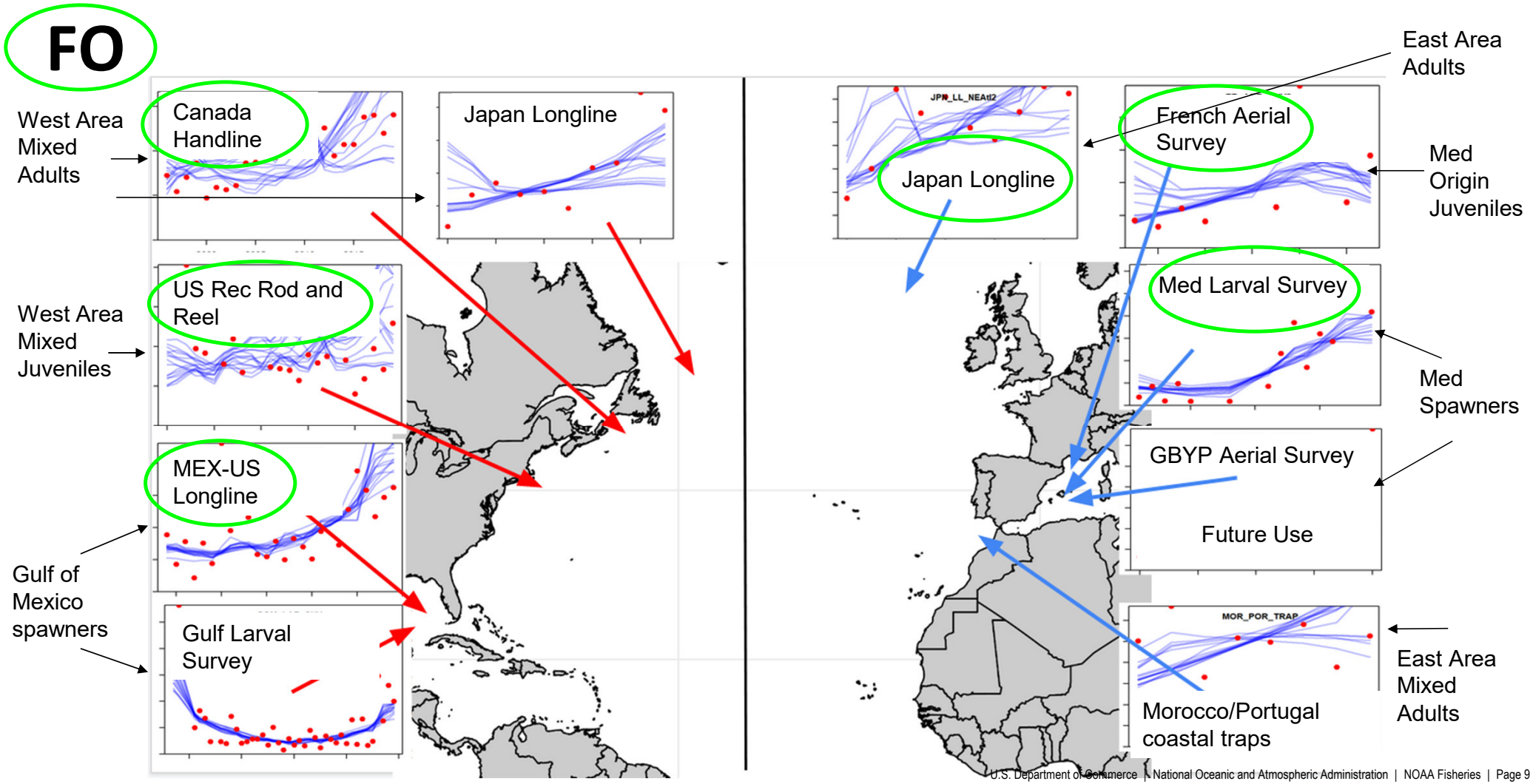
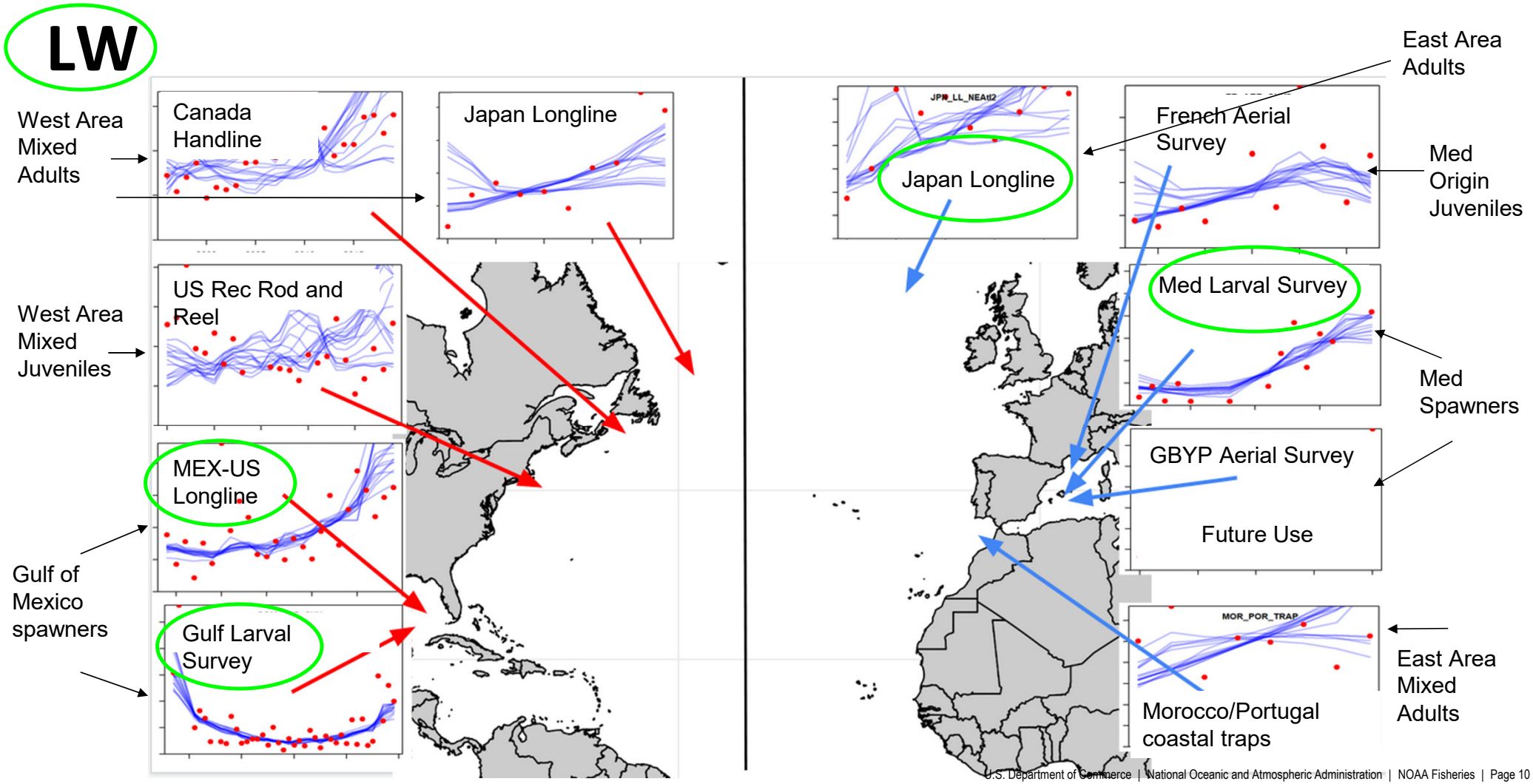
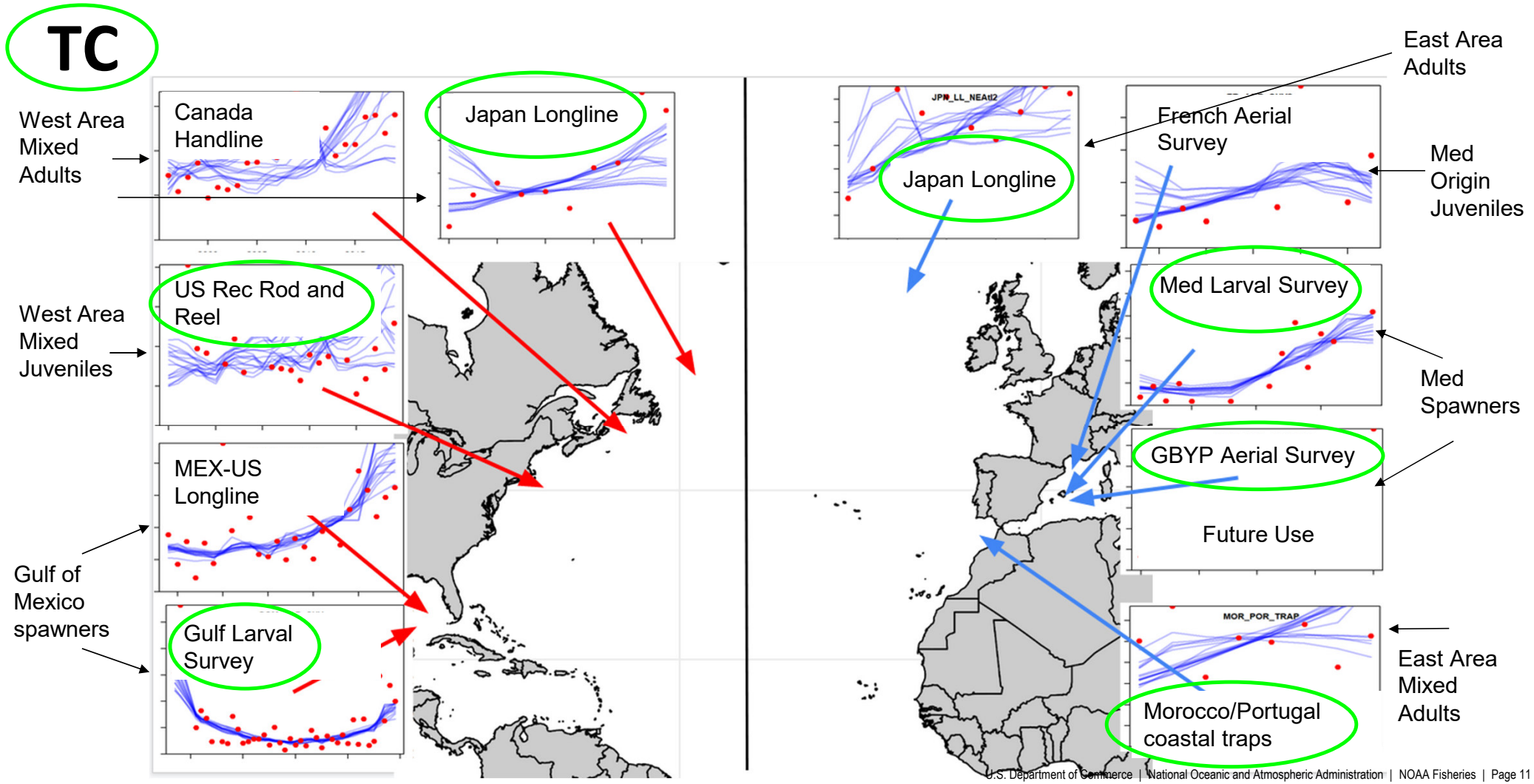


Indices of Abundance (red points) and OM fits (blue lines)



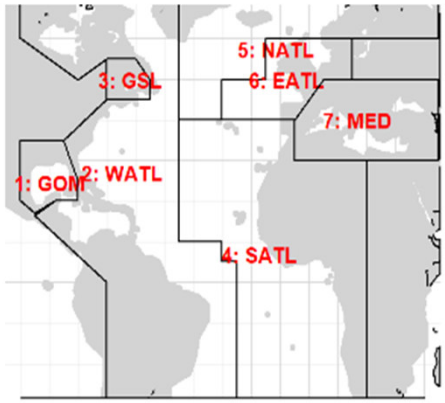
Indices of Abundance (red points) and OM fits (blue lines)



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

Rule for West area TAC

Rule for East area TAC



West TAC

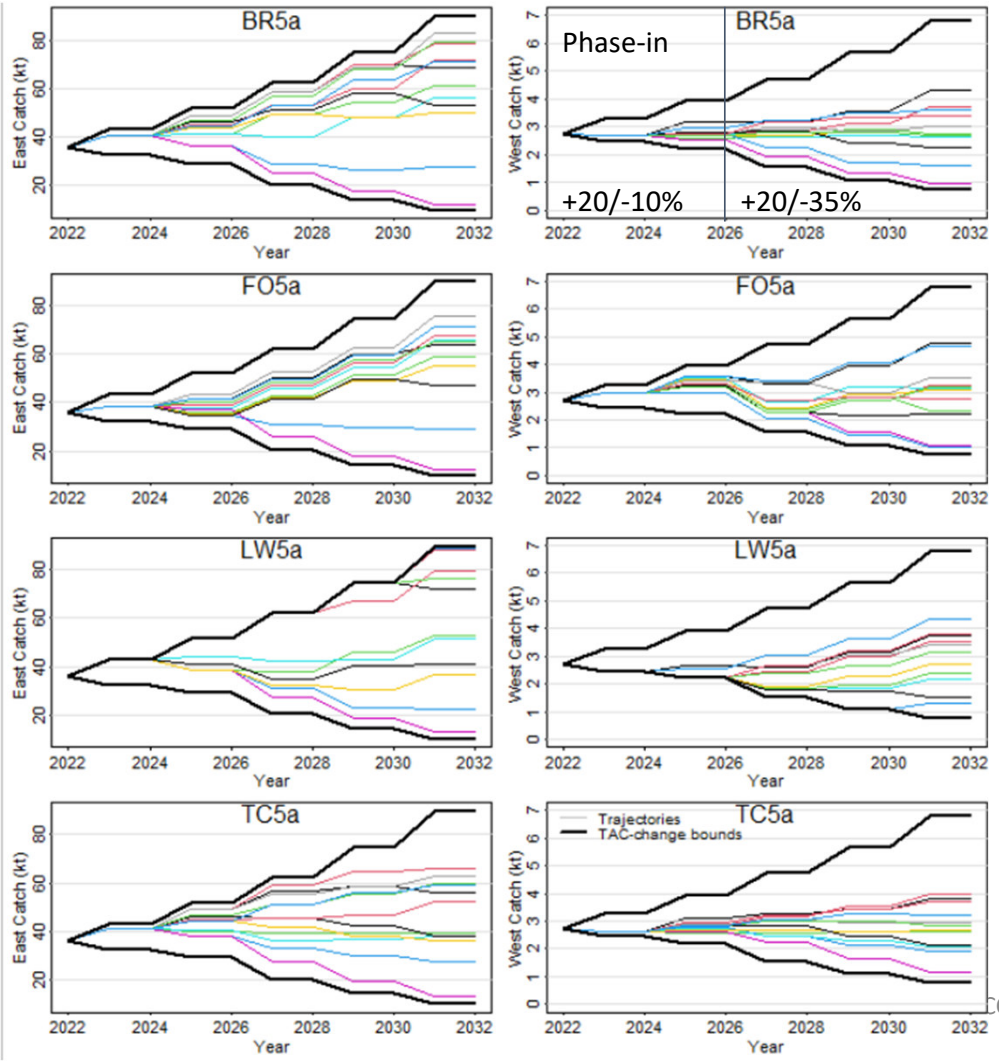
East TAC

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 two cycles for a 2-yr setting or 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

Break for questions on Candidate Management Procedures

2. Key performance statistics and their interpretation

Performance Statistics for this MSE

(Used to evaluate achievement of management objectives)

Management Objectives (MOs)

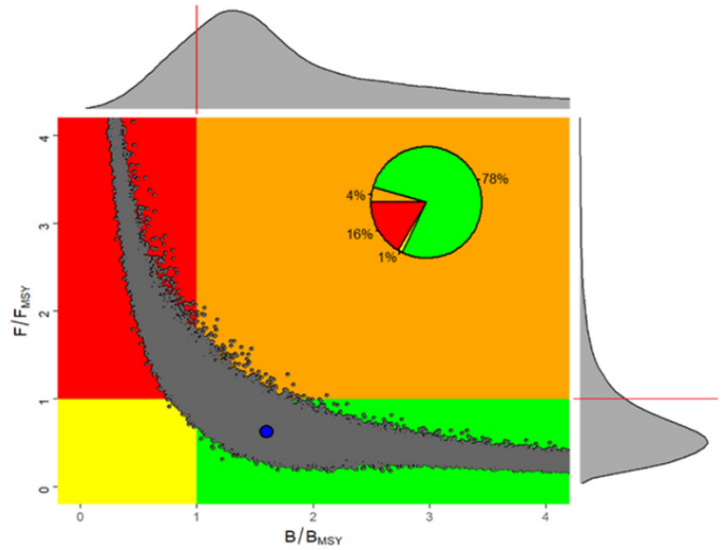
Status: The stock should have a greater than [**60 to 70**]% probability of occurring in the green quadrant of the Kobe matrix

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≥SSBMSY & U < UMSY) of the Kobe plot in year 30 of the projection period (PGK).



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

*B_{lim} defined for the purposes of this MSE and it not used as a hard trigger in any management procedure.

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.

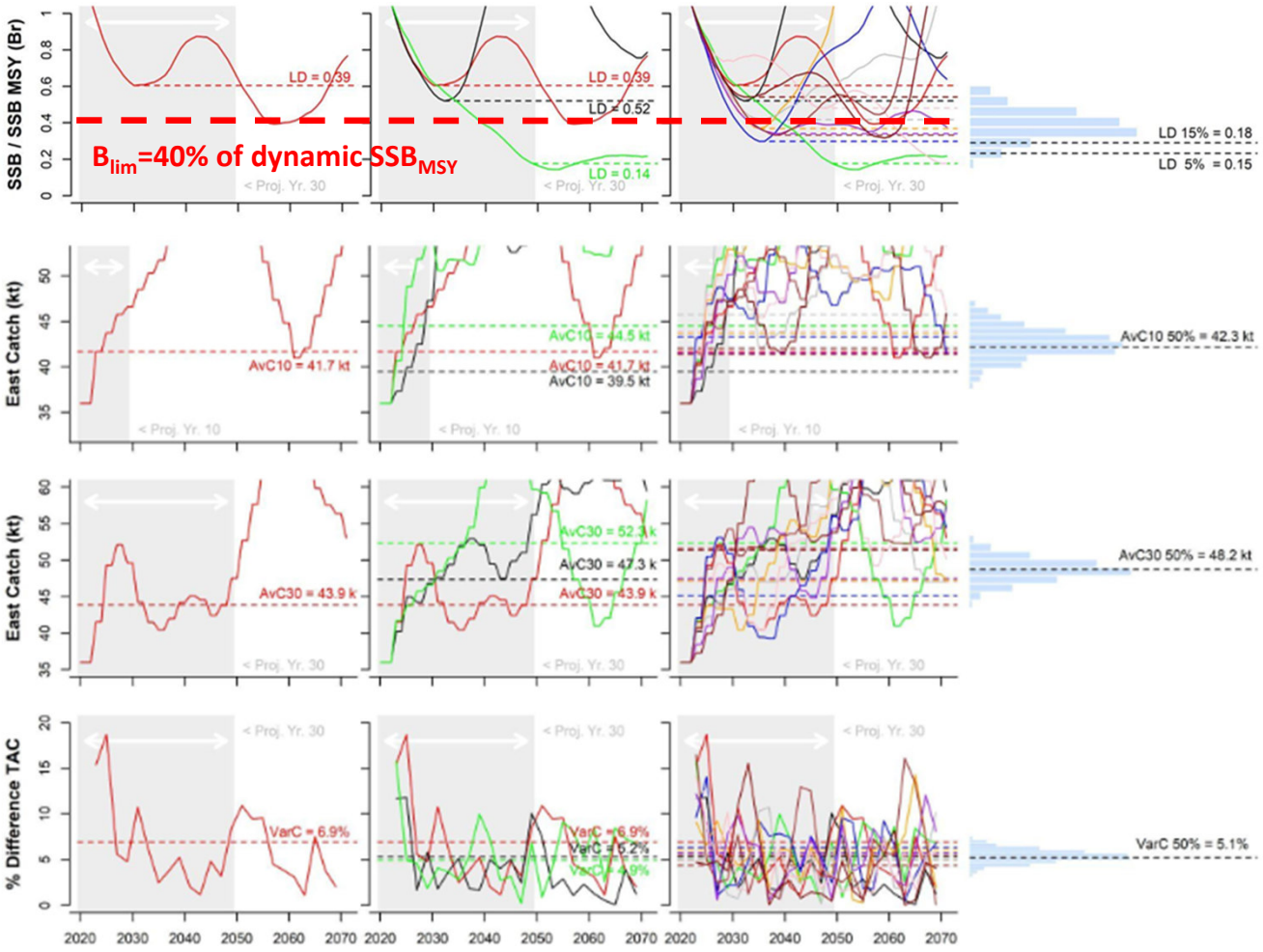
Performance Statistics for this MSE

- 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)
- 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 this 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

Break for questions on questions on Performance statistics for this MSE

3. Decision points before Panel 2

Decision Points before Panel 2 (14 October)

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**- or **3**-yr 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.

Displaying Results: Quilt Plots

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

Includes the top 5 performance statistics:

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

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

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

Yield:

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

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

	West				
CMP	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*dynamic SSBmsy), to satisfy PA2 requirement

West CMP	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

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.

Understanding ranking CMPs - Tot column

CMP	West					East					Tot
	PGK (Mean)	AvC10 (50%)	AvC30 (50%)	VarC (50%)	LD (15%)	PGK (Mean)	AvC10 (50%)	AvC30 (50%)	VarC (50%)	LD (15%)	
BR5a	0.6	2.77	2.43	8.81	0.42	0.6	51.97	41.42	15.6	0.45	0.32
FO5a	0.61	2.89	2.59	14.86	0.4	0.6	46.88	37.19	16.68	0.45	0.54
TC5a	0.6	2.67	2.4	7.51	0.4	0.6	41.07	36.18	10.01	0.41	0.58
LW5a	0.6	2.41	2.25	16.52	0.48	0.6	43.96	36.33	18.35	0.45	0.64

Calculating Tot:

1. Scale each column according to its minimum and maximum, giving a rank order from 0 (best) to 1 (worst)
2. Weight columns according to the default weighting
3. Obtain an average for West and East
4. Take the average across East and West

Tot: Lower is better, should be interpreted as rank 1 -4.

Decision point 1: Operational management objective for Safety: **LD*10%** or **15%** probability of being below B_{lim} (40% of dynamic SSB_{MSY}) in years 11-30 of projections.

Strategic considerations:

- A 15% probability ("risk") of breaching the limit reference point (B_{lim}) means higher risk to the stock than 10%.
- B_{lim} is used here solely for the MSE to evaluate CMP performance and does not function as a hard 'trigger' that would require a management response, such as closing the fishery.
- Obtaining a $LD^*_{10\%}$ above the LRP is challenging to achieve for the western stock simply due to a fair number (~10%) of operating models starting close to B_{lim}. This was the rationale for using years 11-30 to calculate LD*.
- SCRS recommends considering the decision point 2 related to PGK as a more straightforward means of addressing precautionary fishing intensity.

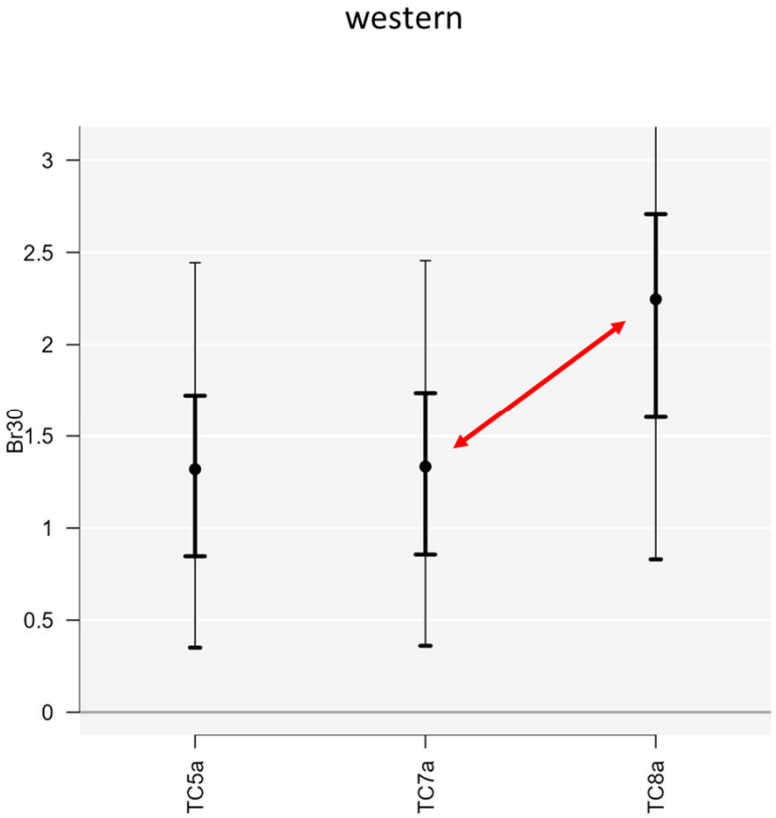
East

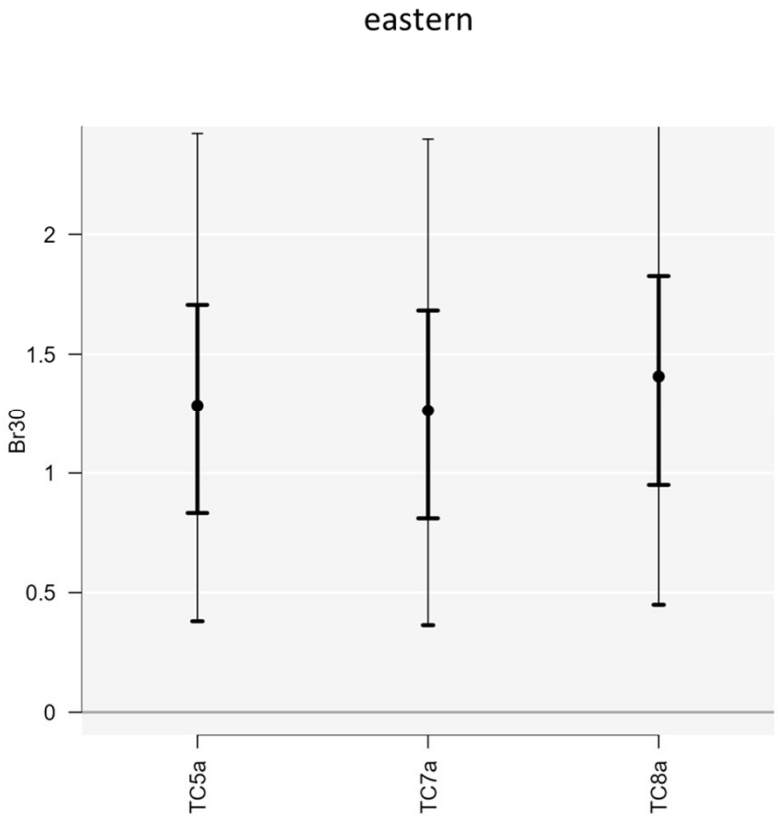
CMP	Tuning	Variant	LD*10	LD*15	PGK	AvC10 (t)	AvC30 (t)	VarC
TC7a	LD*15	2-yr, -30%	0.33	0.4	59%	41,780	36,790	10.1%
TC8a	LD*10	2-yr, -30%	0.4	0.47	67%	38,480	34,300	9.6%

West

CMP	Tuning	Variant	LD*10	LD*15	PGK	AvC10 (t)	AvC30 (t)	VarC
TC7a	LD*15	2-yr, -30%	0.26	0.4	61%	2,630	2,360	7.5%
TC8a	LD*10	2-yr, -30%	0.39	0.55	92%	1,240	710	12.8%

Decision point 1: **LD*10%** vs. **LD*15%**



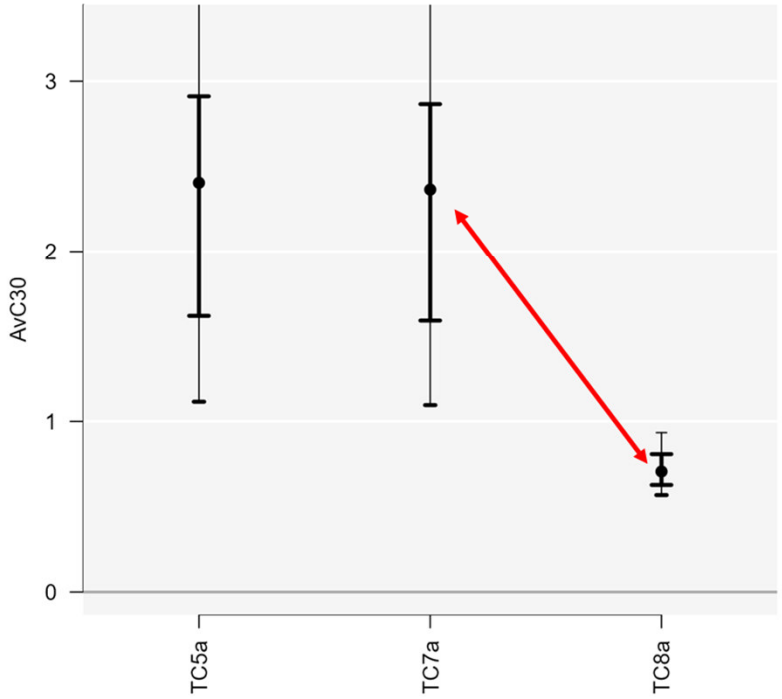


LD*10% has biomass improvements, especially for the western stock

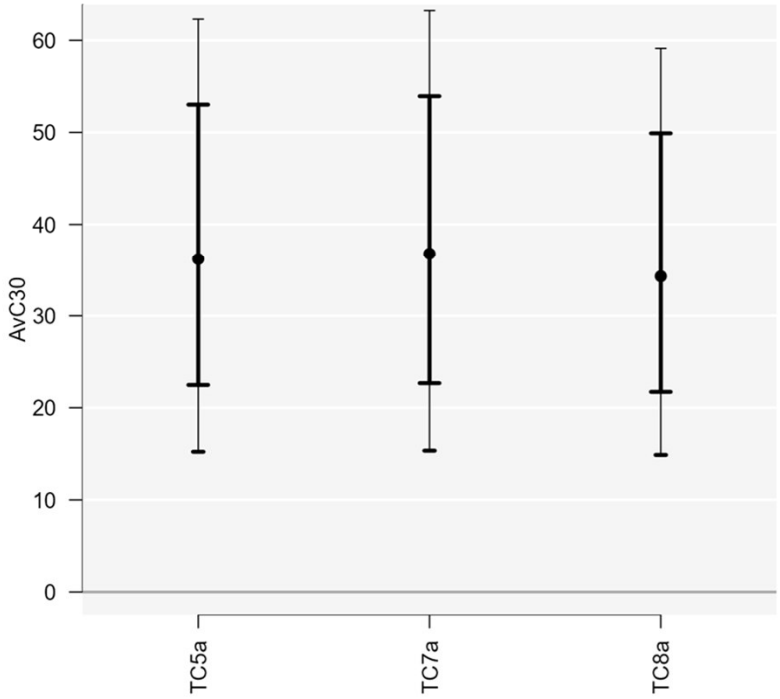
Tuning: 5 is PGK60, 7 is LD*15, 8 is LD*10

Decision point 1: **LD*10%** vs. **LD*15%**

West



East



LD*10% has major impact on yield for the western stock

Tuning: 5 is PGK60, 7 is LD*15, 8 is LD*10

Decision point 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).

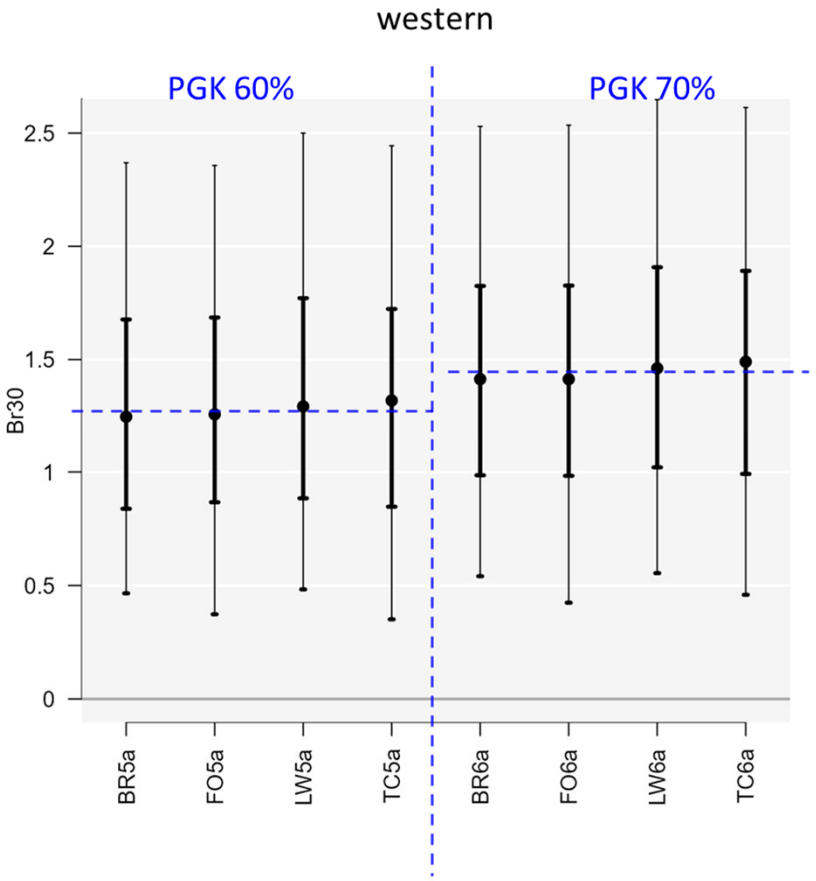
Strategic considerations:

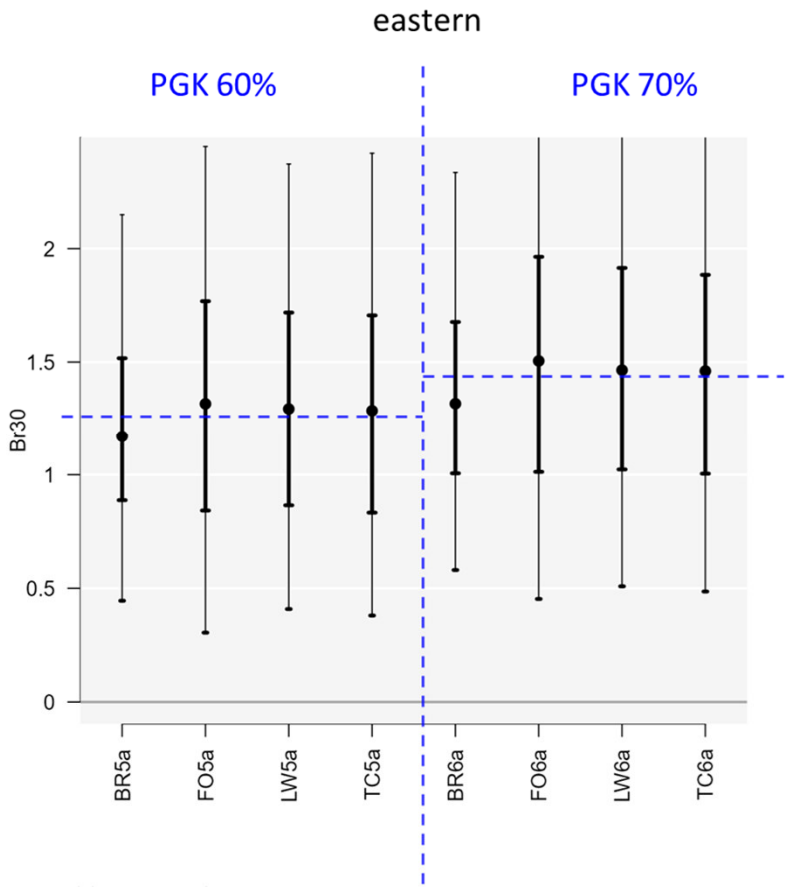
- PGK of 60% has heavier fishing pressure and entails a higher probability of overfishing and/or being overfished, relative to PGK 70%, which has lower fishing pressure.

	West				East			
	AvC10 (50%)	AvC30 (50%)	VarC (50%)	LD* (15%)	AvC10 (50%)	AvC30 (50%)	VarC (50%)	LD* (15%)
PGK 60%	2.60	2.40	12.63	0.42	45.49	37.92	16.19	0.40
PGK 70%	2.37	2.15	12.44	0.45	40.27	33.94	15.57	0.48
% difference	-8.9%	-10.2%	-1.5%	6.9%	-11.5%	-10.5%	-3.8%	18.0%

*Results are averaged across 2 and 3 year management cycles for all CMPs

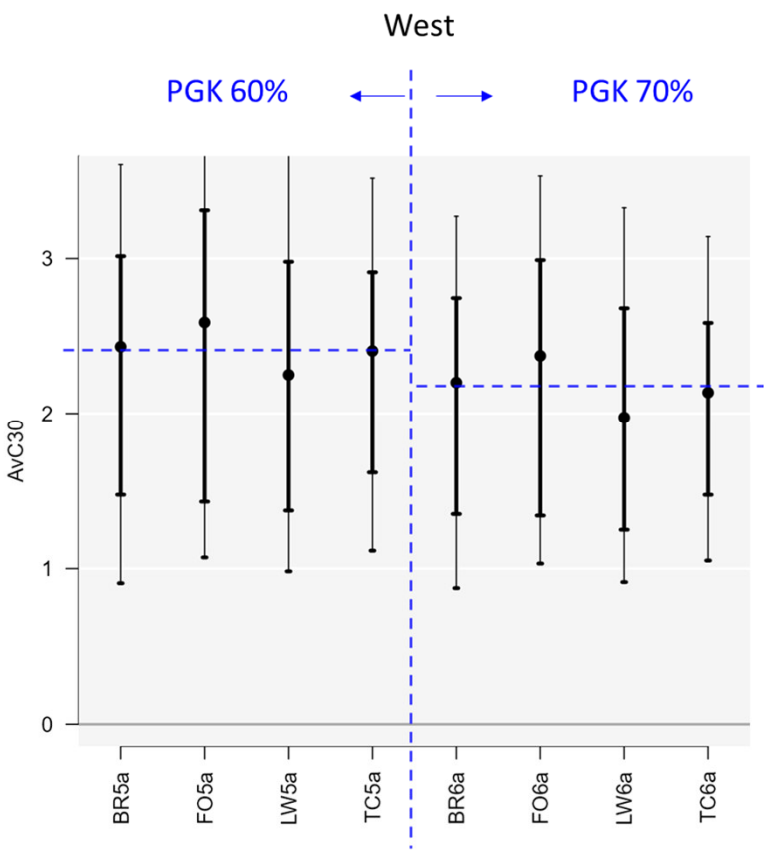
Decision point 2: PGK60 vs. PGK70, Biomass

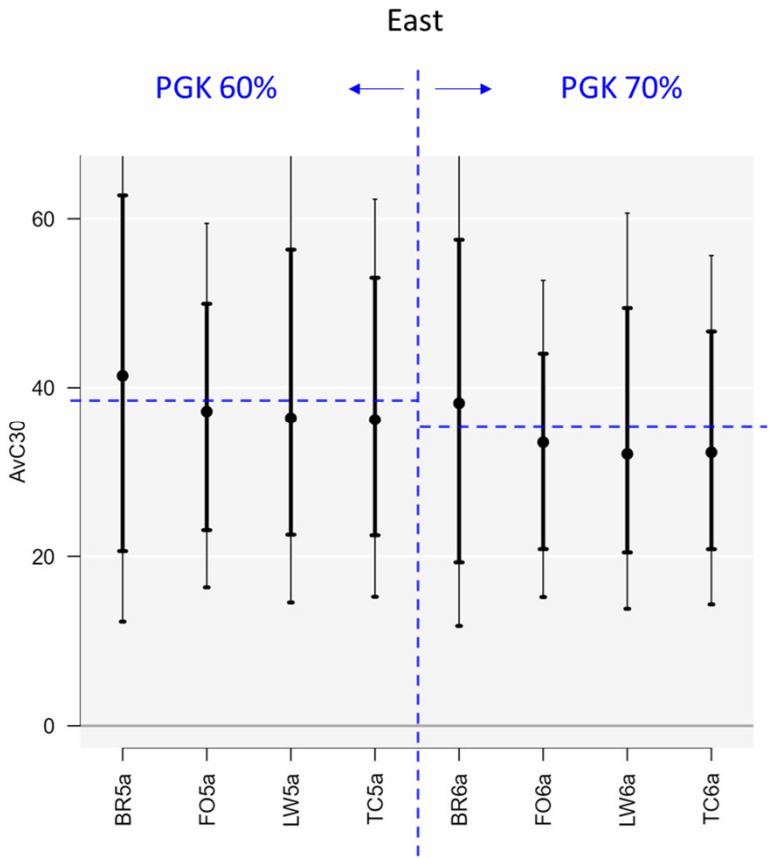




PGK70 has better biomass performance than PGK60

Decision point 2: PGK60 vs. PGK70, Yield





PGK60% has higher yield than PGK70%

Decision point 2: PGK60 vs. PGK70

Table 7. Relative performance results for the four CMPs for PGK60% vs. PGK70%. Ranking is based on the Tot column in the primary quilt plots.

Rank	PGK=60%	PGK=70%
1	BR	BR
2	FO	TC
3	TC	FO
4	LW	LW

The first and last ranked CMPs are the same for PGK60% and PGK70%,

Second and third ranked switch places between the two PGK tunings.

Decision point 3: Management cycle length, **2**- or **3**-year TAC setting intervals.

Strategic considerations:

- The 3-yr cycle CMPs are slightly slower to react to signals to change the TAC. As a result, the changes in TAC need to be larger in the 3-yr cycle and this is seen in larger VarC statistics.
- Yields are slightly lower with a 3-yr management cycle, with more pronounced reductions in near-term TACs (AvC10) compared to long-term TACs (AvC30).
- If a 3-yr cycle is chosen with PGK=60% no CMPs meet LD*15% with the default stability (+20/-30%)

Decision point 3: Management cycle length, **2**- or **3**-year TAC setting intervals

‘a’ (2-years) vs ‘b’ (3 years) within tuning level (70%) for a given CMP

CMP	Type	Tuning	Variant	West					East				
				PGK (Mean)	AvC10 (50%)	AvC30 (50%)	VarC (50%)	LD (15%)	PGK (Mean)	AvC10 (50%)	AvC30 (50%)	VarC (50%)	LD (15%)
BR6a	BR	6	a	0.71	2.57	2.2	8.21	0.45	0.7	46.49	38.13	14.63	0.51
BR6b	BR	6	b	0.7	2.55	2.18	9.75	0.43	0.7	43.27	37.2	17.14	0.44
FO6a	FO	6	a	0.71	2.66	2.37	15.03	0.41	0.7	42.71	33.46	16.45	0.52
FO6b	FO	6	b	0.71	2.43	2.3	17.27	0.42	0.7	43.08	34.46	19.13	0.46
LW6a	LW	6	a	0.7	2.04	1.97	16.5	0.5	0.7	36.41	32.08	17.68	0.51
LW6b	LW	6	b	0.7	2.02	1.97	17.42	0.47	0.7	37.94	32.22	19.08	0.44
TC6a	TC	6	a	0.71	2.37	2.13	7.09	0.45	0.7	36.33	32.27	9.41	0.49
TC6b	TC	6	b	0.71	2.33	2.1	8.22	0.43	0.71	35.89	31.69	11.05	0.43

*Results are for tuning level 6 (70% PGK)

Decision point 3: Management cycle length, **2**- or **3**-year TAC setting intervals

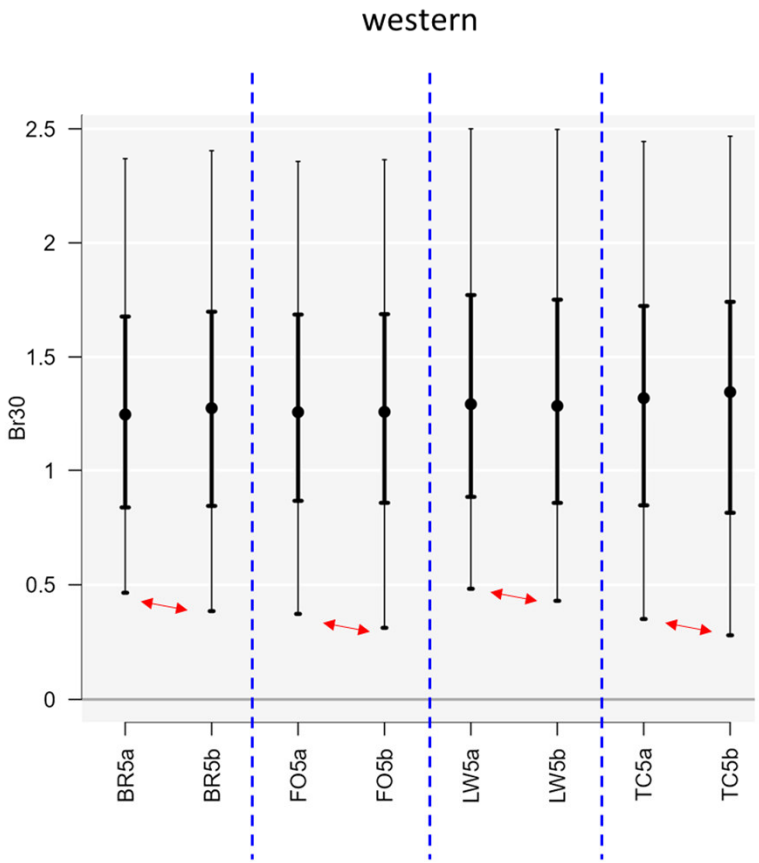
'a' (2-years) vs 'b' (3 years) within tuning level (60%) for a given CMP

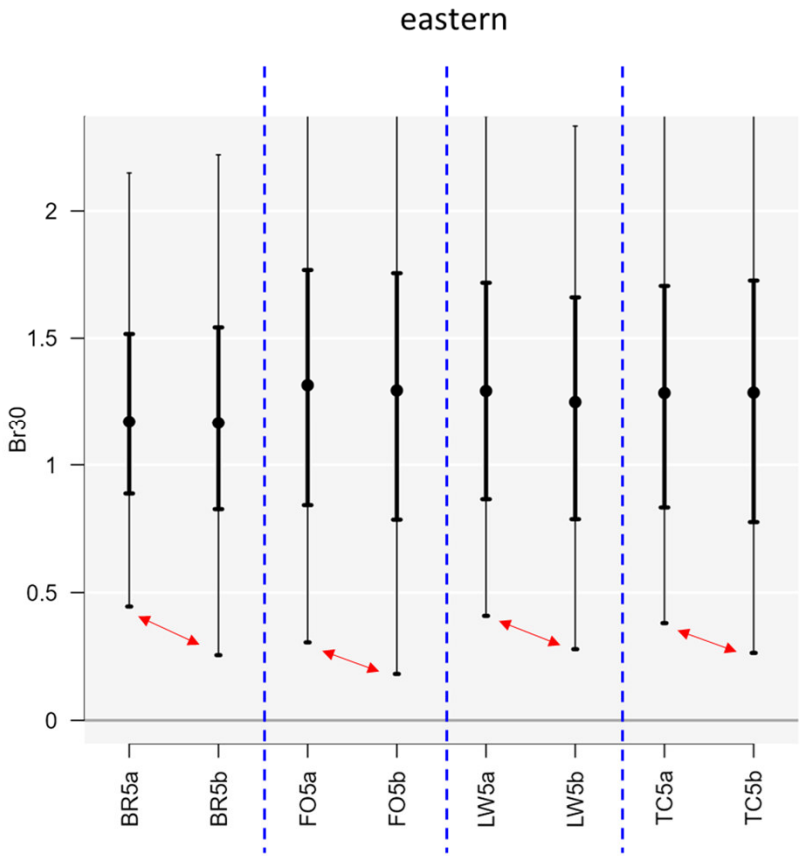
CMP	Type	Tuning	Variant	West					East				
				PGK (Mean)	AvC10 (50%)	AvC30 (50%)	VarC (50%)	LD (15%)	PGK (Mean)	AvC10 (50%)	AvC30 (50%)	VarC (50%)	LD (15%)
BR5a	BR	5	a	0.6	2.77	2.43	8.81	0.42	0.6	51.97	41.42	15.6	0.45
BR5b	BR	5	b	0.6	2.7	2.4	10.37	0.4	0.6	47.75	41.17	17.96	0.38
FO5a	FO	5	a	0.61	2.89	2.59	14.86	0.4	0.6	46.88	37.19	16.68	0.45
FO5b	FO	5	b	0.61	2.59	2.51	17.12	0.4	0.6	47.15	38.29	19.35	0.37
LW5a	LW	5	a	0.6	2.41	2.25	16.52	0.48	0.6	43.96	36.33	18.35	0.45
LW5b	LW	5	b	0.6	2.21	2.22	17.34	0.46	0.6	45.02	37.04	19.72	0.37
TC5a	TC	5	a	0.6	2.67	2.4	7.51	0.4	0.6	41.07	36.18	10.01	0.41
TC5b	TC	5	b	0.61	2.59	2.38	8.49	0.37	0.6	40.12	35.76	11.84	0.34

If a 3-yr cycle is chosen with PGK=60%, no CMPs meet LD*15%

*Results are for tuning level 5 (60% PGK)

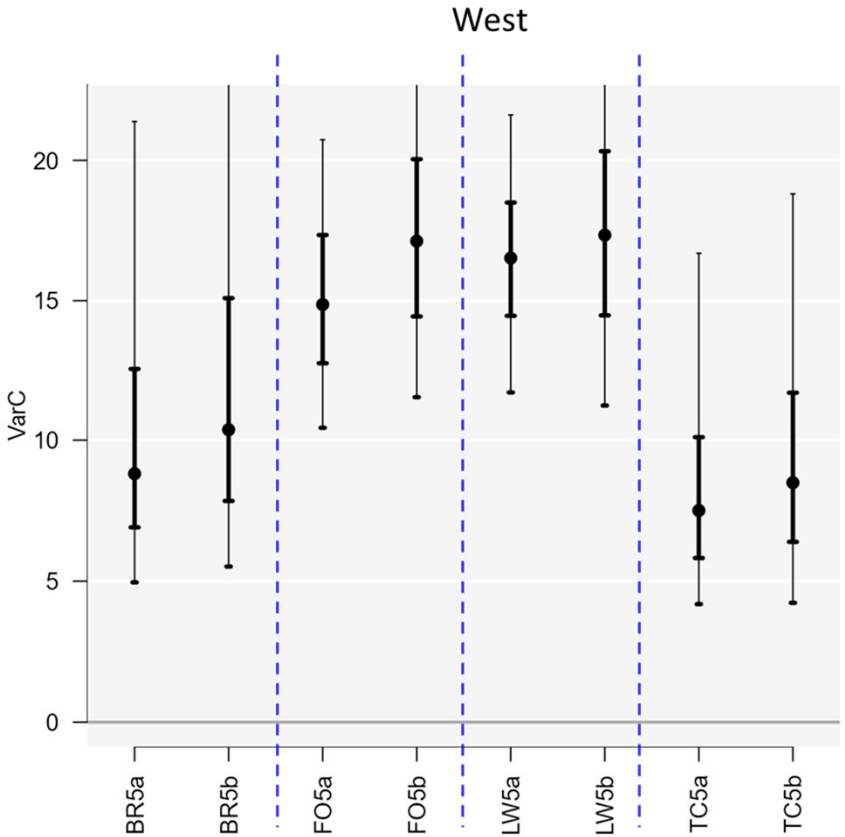
Decision point 3: **2**- vs. **3**-year TAC setting intervals, Biomass

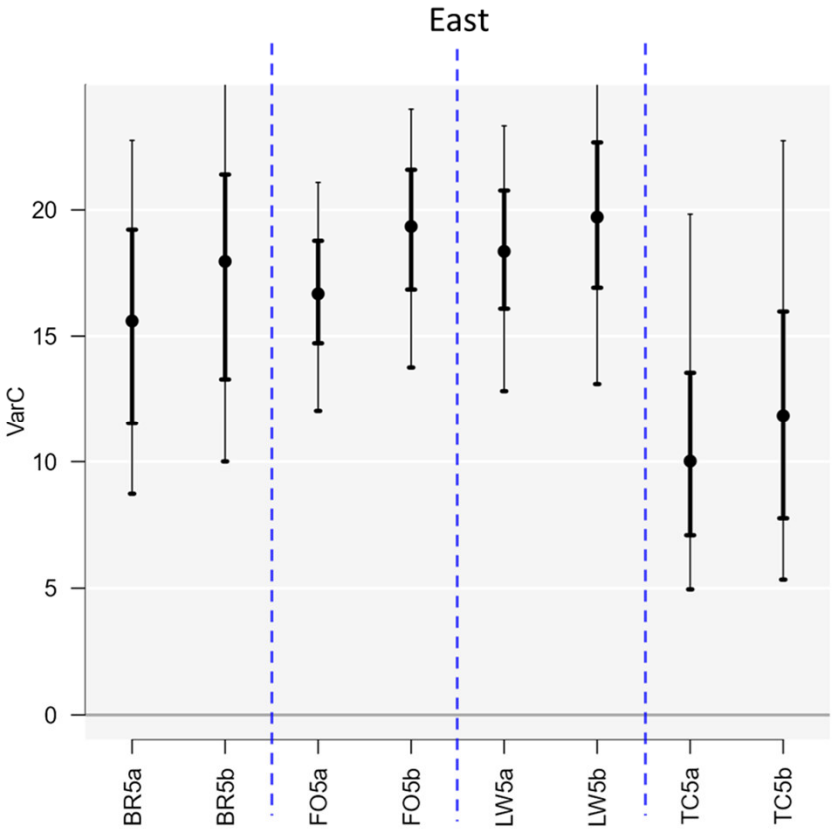




2-year cycles have better tail biomass performance than 3-year cycles, especially for eastern stock

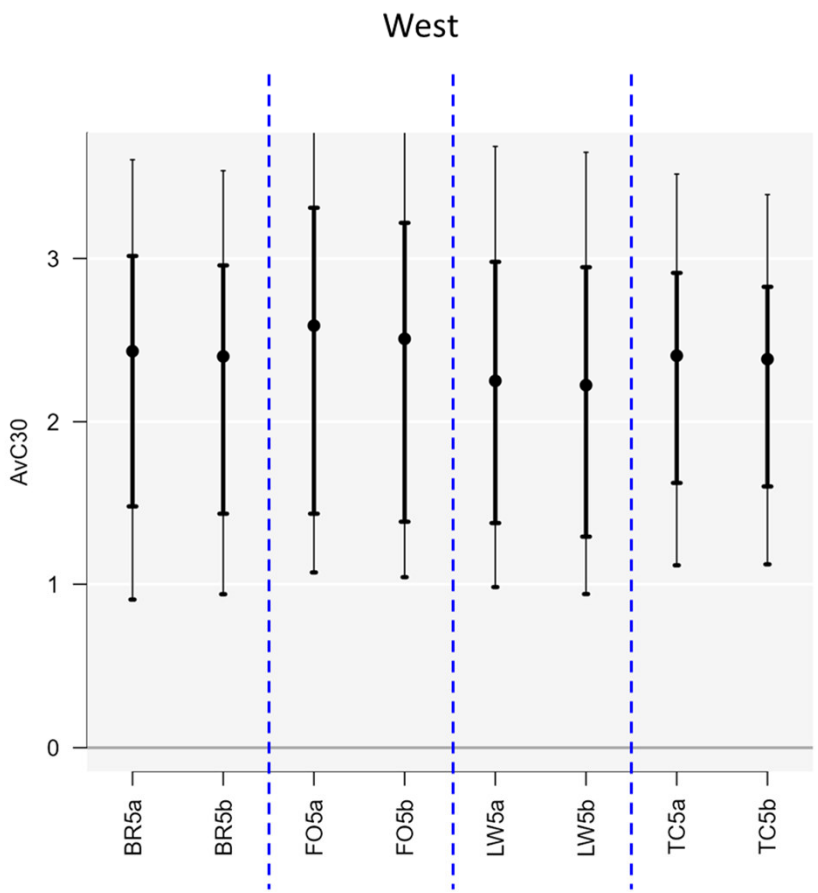
Decision point 3: **2**- vs. **3**-year TAC setting intervals, Stability

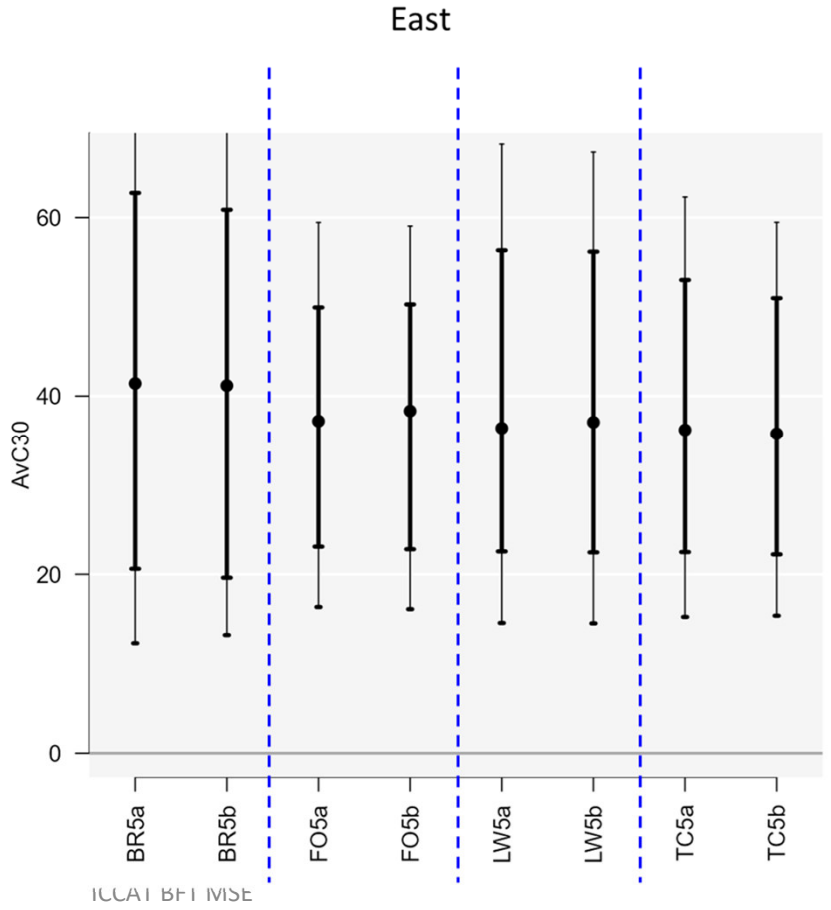




3-year cycles have larger variability to compensate for fewer changes

Decision point 3: **2**- vs. **3**-year TAC setting intervals, Yield





Cycle length has little impact on yield

Decision point 3: Management cycle length: **2**- or **3**-year TAC setting intervals.

	2-yr variants	3-yr variants
1	BR	BR
2	FO	FO
3	TC	TC
4	LW	LW

Rank order of CMPs is retained

*Results are averaged across CMP tuning levels (PGK60 and 70%)

Decision point 3: Management cycle length: **2**- or **3**-yr TAC setting.

Performance averaged across 4 CMPs and PGK 60% and 70% for 2 and 3-yr management cycles, with the default stability of +20%/-30%.

	West				East			
mgmt cycle (yrs)	AvC10 (50%)	AvC30 (50%)	VarC (50%)	LD* (15%)	AvC10 (50%)	AvC30 (50%)	VarC (50%)	LD* (15%)
2	2.55	2.29	11.82	0.44	43.23	35.88	14.85	0.47
3	2.43	2.26	13.25	0.42	42.53	35.98	16.91	0.40
% difference	-4.7%	-1.5%	12.1%	-3.7%	-1.6%	0.3%	13.9%	-14.8%

Decision point 4: Operational management objective for Stability: Following the phase-in period, limitations on TAC change between management cycles of +20%/-30% or +20%/-35%.

Strategic considerations:

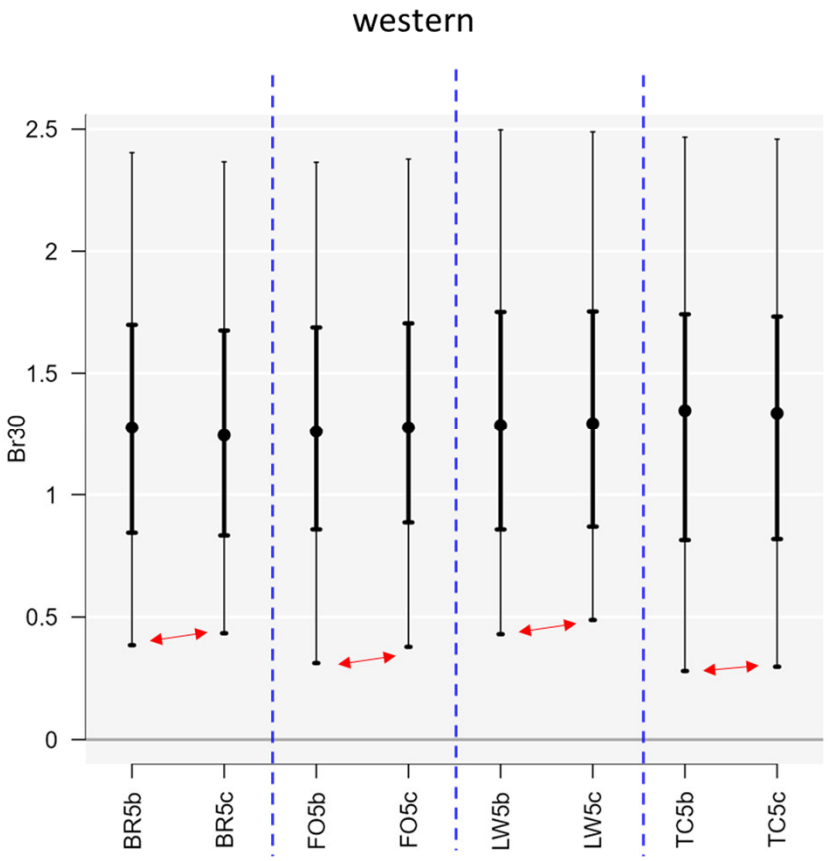
- CMPs used a default stability provision to limit TAC changes to 20% increases and 30% decreases between management cycles, following the initial phase-in period.
- This asymmetry (as compared to +20%/-20%) has proven critical to enable CMPs to respond to stock declines
- All CMPs were unable to achieve the minimum threshold $LD^*_{15\%}$=0.40 in variants using 3-yr management cycles and tuning to PGK60%
- Should Panel 2 choose a 3-yr management cycle and 60% PGK, **+20/-35%** is required to meet the $LD^*_{15\%}$ threshold. Even then, this threshold can only be met only by BR and FO.

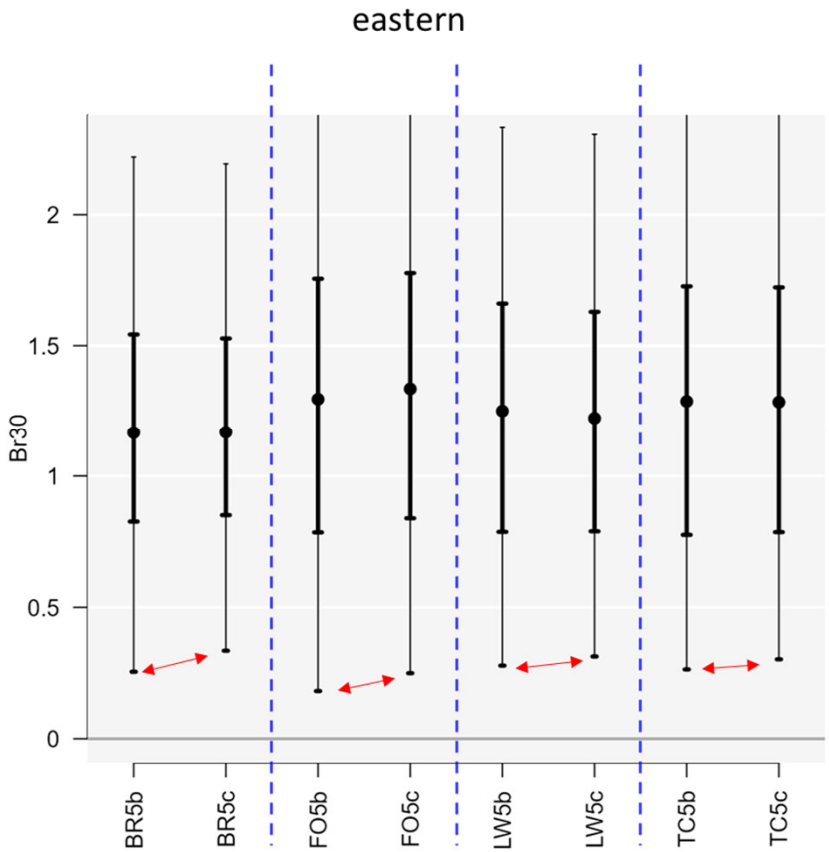
Decision point 4: Compare 'b' (+20%/-30%) with 'c' (+20%/-35%) stability for PGK60% and 3-year management cycle

				West					East				
CMP	Type	Tuning	Variant	PGK (Mean)	AvC10 (50%)	AvC30 (50%)	VarC (50%)	LD (15%)	PGK (Mean)	AvC10 (50%)	AvC30 (50%)	VarC (50%)	LD (15%)
BR5c	BR	5	c	0.6	2.74	2.46	10.49	0.4	0.6	48.37	41.28	18.65	0.41
BR5b	BR	5	b	0.6	2.7	2.4	10.37	0.4	0.6	47.75	41.17	17.96	0.38
FO5c	FO	5	c	0.62	2.59	2.51	17.41	0.42	0.62	47.15	37.75	19.85	0.41
FO5b	FO	5	b	0.61	2.59	2.51	17.12	0.4	0.6	47.15	38.29	19.35	0.37
LW5c	LW	5	c	0.6	2.22	2.22	17.74	0.47	0.6	47.09	37.88	20.25	0.39
LW5b	LW	5	b	0.6	2.21	2.22	17.34	0.46	0.6	45.02	37.04	19.72	0.37
TC5c	TC	5	c	0.6	2.6	2.39	8.53	0.37	0.6	40.4	36.01	11.9	0.35
TC5b	TC	5	b	0.61	2.59	2.38	8.49	0.37	0.6	40.12	35.76	11.84	0.34

- Only tuning level 5 (60% PGK) is necessary to consider here as it is the only one that needs the -35%
- 'b' is the default +20%/-30%, 'c' is +20%/-35%, both for 3-year management cycles.
- Values of $LD^*_{15\%}$ below the B_{lim} (0.4) are denoted in red. Only BR and FO can satisfy LD*15 threshold with PGK=60% and 3-year management cycle.

Decision point 4: +20%/-30% or +20%/-35%, Biomass





-35% allows small improvement in tail performance compared to -30%

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

Quilt plot 1 for 16 top performing CMP variants, with +20/-35% used for 3-yr, 60%PGK

				West					East					
order	CMP	Tuning	Variant	PGK	AvC10 (kt)	AvC30 (kt)	VarC	LD (15%)	PGK	AvC10 (kt)	AvC30 (kt)	VarC	LD (15%)	Tot
1	BR	PGK60%	2-yr	71%	2.57	2.2	8.21	0.45	70%	46.49	38.13	14.63	0.51	0.31
2	BR	PGK60%	2-yr	60%	2.77	2.43	8.81	0.42	60%	51.97	41.42	15.6	0.45	0.32
3	TC	PGK70%	2-yr	71%	2.37	2.13	7.09	0.45	70%	36.33	32.27	9.41	0.49	0.36
4	TC	PGK60%	2-yr	60%	2.67	2.4	7.51	0.4	60%	41.07	36.18	10.01	0.41	0.39
5	BR	PGK60%	3-yr, -35%	60%	2.74	2.46	10.49	0.4	60%	48.37	41.28	18.65	0.41	0.48
6	BR	PGK70%	3-yr	70%	2.55	2.18	9.75	0.43	70%	43.27	37.2	17.14	0.44	0.49
7	FO	PGK60%	2-yr	61%	2.89	2.59	14.86	0.4	60%	46.88	37.19	16.68	0.45	0.49
8	TC	PGK70%	3-yr	71%	2.33	2.1	8.22	0.43	71%	35.89	31.69	11.05	0.43	0.5
9	FO	PGK70%	2-yr	71%	2.66	2.37	15.03	0.41	70%	42.71	33.46	16.45	0.52	0.52
10	LW	PGK60%	2-yr	60%	2.41	2.25	16.52	0.48	60%	43.96	36.33	18.35	0.45	0.55
11	TC	PGK60%	3-yr, -35%	60%	2.6	2.39	8.53	0.37	60%	40.4	36.01	11.9	0.35	0.55
12	LW	PGK70%	2-yr	70%	2.04	1.97	16.5	0.5	70%	36.41	32.08	17.68	0.51	0.61
13	FO	PGK60%	3-yr, -35%	62%	2.59	2.51	17.41	0.42	62%	47.15	37.75	19.85	0.41	0.62
14	FO	PGK70%	3-yr	71%	2.43	2.3	17.27	0.42	70%	43.08	34.46	19.13	0.46	0.66
15	LW	PGK60%	3-yr, -35%	60%	2.22	2.22	17.74	0.47	60%	47.09	37.88	20.25	0.39	0.66
16	LW	PGK70%	3-yr	70%	2.02	1.97	17.42	0.47	70%	37.94	32.22	19.08	0.44	0.74

CMPs in red did not meet LD*15%

Displaying Results: Quilt Plot #2

- Includes 10 additional performance statistics:
  - **Safety:**
    - LD* (5%): 5%tile of lowest depletion over years 11-30
    - LD* (10%) 10%tile of lowest depletion over years 11-30,
  - **Status:**
    - Br20: Depletion (SSB relative to dynamic SSB_{MSY}) in projection year 20 (50%)
    - AvgBr: SSB relative to dynamic SSB_{MSY} over projection years 11-30 (50%)
    - Br30: Depletion (SSB relative to dynamic SSB_{MSY}) in projection year 30 (5%)
    - POF: Probability of Overfishing ($U > U_{MSY}$) after 30 projected years (mean)
    - PNRK: Probability of not Red Kobe ($SSB \geq SSB_{MSY}$ or $U < U_{MSY}$) after 30 projected years (mean)
    - OFT: Overfished trend, SSB trend over projection years 31 - 35 when Br30 < 1
  - **Stability:** None
  - **Yield:**
    - C1: catch in the first year of CMP application (actual value in kt)
    - AvC20: average catch (kt) over years 1-20 (50%tile)
- CMPs are ordered the same as in Quilt Plot #1

Decision point 5: Management procedure: **FO**, **BR**, **LW** 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%

Decision point 5: Management procedure: **FO**, **BR**, **LW** or **TC**
Quilt Plot #2 - West

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	2.69	2.38	1.5	1.47	0.54	0.2	0.3	0.09	0.94	0.92
2	BR	PGK60%	2-yr	2.69	2.46	1.37	1.33	0.46	0.2	0.29	0.18	0.86	0.85
3	TC	PGK70%	2-yr	2.5	2.23	1.56	1.57	0.46	0.21	0.3	0.12	0.91	0.92
4	TC	PGK60%	2-yr	2.65	2.53	1.44	1.43	0.35	0.17	0.26	0.24	0.81	0.87
5	BR	PGK60%	3-yr, -35%	2.69	2.64	1.4	1.37	0.43	0.19	0.27	0.18	0.87	0.83
6	FO	PGK70%	3-yr	2.96	2.81	1.37	1.31	0.37	0.16	0.25	0.19	0.86	0.88
7	BR	PGK60%	2-yr	2.69	2.11	1.53	1.51	0.46	0.18	0.28	0.09	0.94	0.92
8	TC	PGK70%	3-yr	2.46	2.2	1.59	1.6	0.4	0.18	0.28	0.11	0.92	0.93
9	FO	PGK70%	2-yr	2.96	2.55	1.48	1.45	0.42	0.16	0.25	0.08	0.94	0.93
10	LW	PGK60%	2-yr	2.45	2.39	1.41	1.37	0.48	0.22	0.32	0.21	0.85	0.86
11	TC	PGK60%	3-yr, -35%	2.62	2.5	1.46	1.45	0.3	0.14	0.23	0.22	0.83	0.87
12	LW	PGK70%	2-yr	2.45	2.07	1.56	1.54	0.55	0.23	0.33	0.12	0.93	0.92
13	FO	PGK60%	3-yr, -35%	2.96	2.68	1.4	1.36	0.38	0.18	0.27	0.17	0.87	0.88
14	FO	PGK70%	3-yr	2.96	2.44	1.5	1.47	0.38	0.15	0.25	0.08	0.94	0.93
15	LW	PGK60%	3-yr, -35%	2.45	2.36	1.44	1.4	0.49	0.22	0.32	0.21	0.85	0.84
16	LW	PGK70%	3-yr	2.45	2.06	1.57	1.56	0.49	0.21	0.3	0.12	0.93	0.91

CMPs are ordered based on Primary Quilt Tot column
Red outlined CMPs do not meet the LD*15%

CMPs and their variants and their short (C1) and medium (AvC10) yields and variability in yield (VarC).

EAST

CMP	LD	PGK	Cycle	Stability	C1	AvC10	VarC	Note
BR	15	60	2	+20/-30	40,570	51,970	15.6	
			3	+20/-30	40,570	47,750	17.96	LD=0.38
				+20/-35	40,570	48,370	18.65	
		70	2	+20/-30	40,570	46,490	14.63	
			3	+20/-30	40,570	43,270	17.14	
TC	15	60	2	+20/-30	41,280	41,070	10.01	
			3	+20/-30	40,780	40,120	11.84	LD=0.34
				+20/-35	40,940	40,400	11.9	LD=0.35
		70	2	+20/-30	38,910	36,330	9.41	
			3	+20/-30	38,290	35,890	11.05	
FO	15	60	2	+20/-30	38,290	46,880	16.68	
			3	+20/-30	38,290	47,150	19.35	LD=0.37
				+20/-35	38,290	47,150	19.85	
		70	2	+20/-30	38,290	42,710	16.45	
			3	+20/-30	38,290	43,080	19.13	
LW	15	60	2	+20/-30	43,200	43,960	18.35	
			3	+20/-30	43,200	45,020	19.72	LD=0.37
				+20/-35	43,200	47,090	20.25	LD=0.39
		70	2	+20/-30	43,200	36,410	17.68	
			3	+20/-30	43,200	37,940	19.08	

WEST

CMP	LD	PGK	Cycle	Stability	C1	AvC10	VarC	Note
BR	15	60	2	+20/-30	2,690	2,770	8.81	
			3	+20/-30	2,690	2,700	10.37	
				+20/-35	2,690	2,740	10.49	
		70	2	+20/-30	2,690	2,570	8.21	
			3	+20/-30	2,690	2,550	9.75	
TC	15	60	2	+20/-30	2,650	2,670	7.51	
			3	+20/-30	2,620	2,590	8.49	LD=0.37
				+20/-35	2,620	2,600	8.53	LD=0.37
		70	2	+20/-30	2,500	2,370	7.09	
			3	+20/-30	2,460	2,330	8.22	
FO	15	60	2	+20/-30	2,960	2,890	14.86	
			3	+20/-30	2,960	2,590	17.12	
				+20/-35	2,960	2,590	17.41	
		70	2	+20/-30	2,960	2,660	15.03	
			3	+20/-30	2,960	2,430	17.27	
LW	15	60	2	+20/-30	2,450	2,410	16.52	
			3	+20/-30	2,450	2,210	17.34	
				+20/-35	2,450	2,220	17.74	
		70	2	+20/-30	2,450	2,040	16.5	
			3	+20/-30	2,450	2,020	17.42	

CMPs that do not satisfy LD*15 are denoted in red shading.

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

Relative performance is generally conserved across all CMP types. The exception is that TC performs better than FO under PGK=70%, while FO outperforms TC under all other variants.* Note that not all CMPs averaged here meet LD*15%.

Ranking	All variants	2-yr	3-yr	PGK=60%	PGK=70%
1	BR*	BR	BR*	BR	BR
2	FO*	FO	FO*	FO	TC
3	TC*	TC	TC*	TC*	FO
4	LW*	LW	LW*	LW	LW

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

Relative performance is generally conserved for both East and West, except that FO and TC trade places. Note that not all CMPs averaged here meet LD*15%.

	East					West				
	All variants	2-yr	3-yr	PGK=60 %	PGK=70 %	All variants	2-yr	3-yr	PGK=60 %	PGK=70 %
1	BR	BR	BR	BR	BR	BR	BR	BR	BR	BR
2	FO	FO	FO	FO	FO	TC	TC	TC	TC	TC
3	TC	TC	TC	LW	TC	FO	FO	FO	FO	FO
4	LW	LW	LW	TC	LW	LW	LW	LW	LW	LW

Decision point 6: Timeframe for review of Management Procedure

The SCRS recommends that regular reviews of the MP be conducted to consider new data and methods, and to potentially recondition the MSE.

The inter-review period must be an integral multiple of the management (TAC-setting) cycle duration (2 or 3 yrs) to ensure that the two processes remain in synchrony.

The SCRS recommends that the MP be reviewed every 6 years, i.e. completed in 2028 for the first time, which would be compatible with either of these two cycle durations, as well as with scientific considerations.

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		

All of the above are specified (for Northern Albacore) in ICCAT Rec 21-04

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.

Decisions, revisited

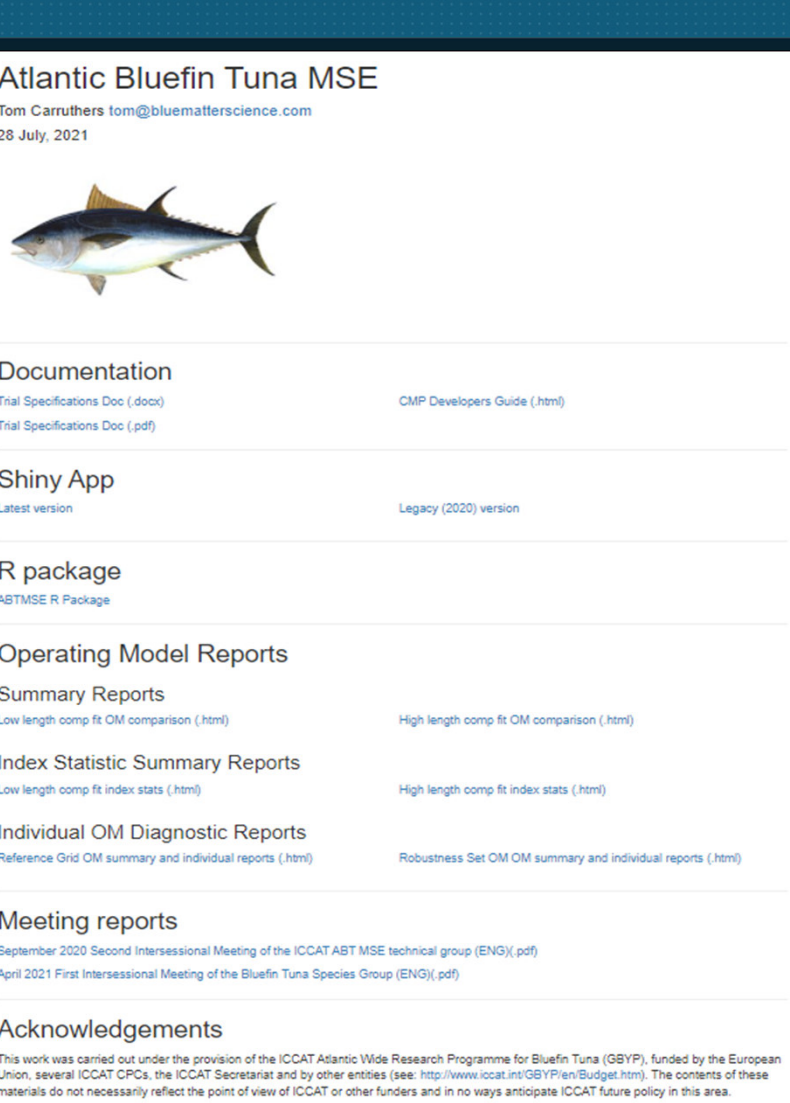
1. Operational management objective for Safety: LD*10% of LD*15% [No CMPs meet LD*10, SCRS recommends using decision point 2 for added precaution, if desired.]
2. Operational management objective for Stock Status: **60%** or **70%** PGK. [This is the most influential decision on the yield vs. status tradeoff.]
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**, **LW** or **TC**. [SCRS is of the opinion that any of the CMPs meet PA2 objectives and represent robust management procedures.]
6. Timeframe for review of Management Procedure [~6 years, round multiple of either 2 or 3-yr TAC settings]

Next steps

- 14 October: 4th Panel 2 intersessional meeting
  - 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

Other Resources

Splash Page: https://iccat.github.io/abft-mse/ (Eng only)



Atlantic Bluefin Tuna MSE

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28 July, 2021

Documentation

Trial Specifications Doc (.docx)

Trial Specifications Doc (.pdf)

CMP Developers Guide (.html)

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 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

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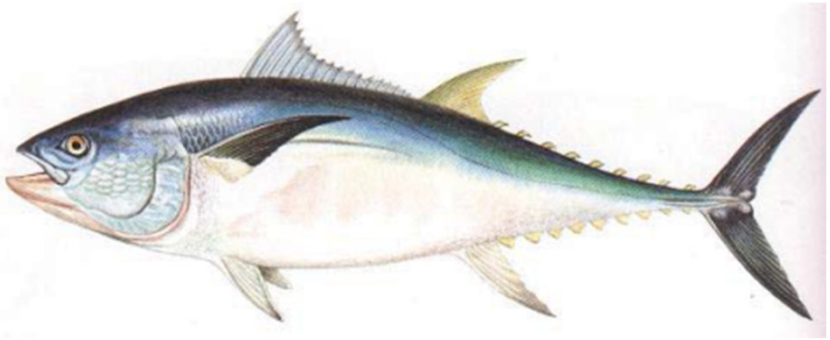
Extra material



Decision point additional slides