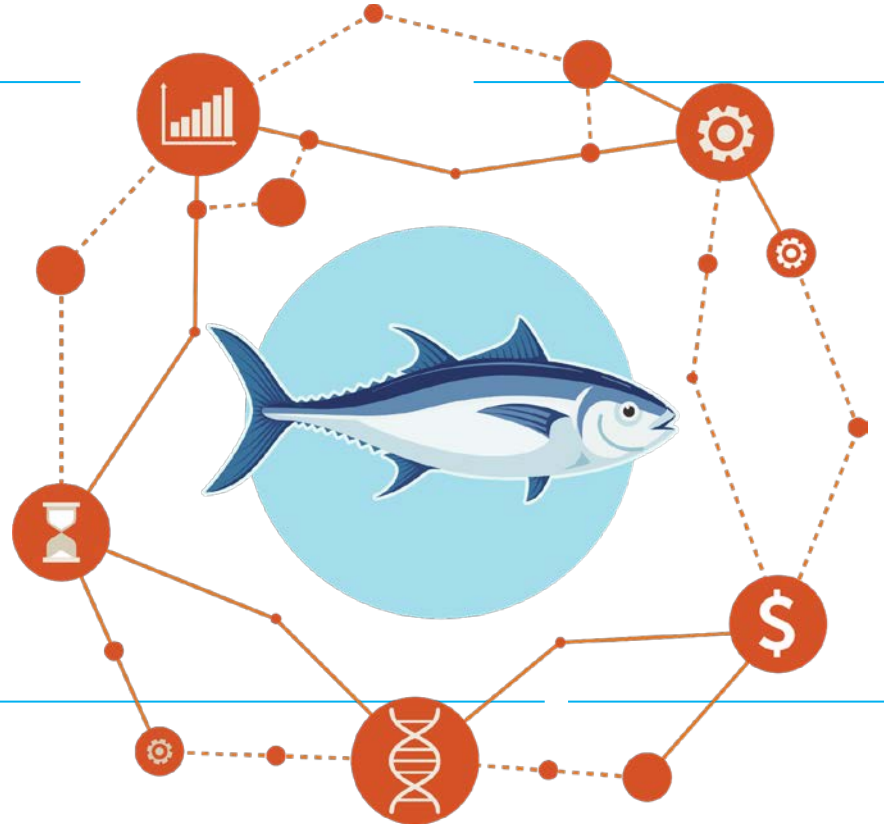


BFT Management Strategy Evaluation (MSE)

Part 1: 14 July 2022

References

1. BFT MSE summary: Background & Structure
2. BFT MSE summary: Results, Decisions & Next Steps
3. Splash Page: https://iccat.github.io/abft-mse/

Outline (numbered according to PA2 agenda)

4. Update on BFT-MSE framework and CMPs by SCRS
   a. Additional requested statistics
      i. PrpOF - proportion of simulation years above U_{MSY} for projection years 1-30
      ii. AvUrel - average U/U_{MSY} for projection years 1-30
      iii. Revised AvgBr - now average SSB/SSB_{MSY} for years 11-30 (was 1-30)
   b. SCRS Responses to feedback provided at the Intersessional Meeting of PA2 (1-3 Mar 2022)
      i. Evaluation of 3-year TAC setting for selected CMPs
      ii. "Phase-in" of +20/-10% allowable TAC change for the first 2 CMP applications
      iii. Revised quilt plots and summary table of CMPs
5. Candidate management procedure performance, refinement, and selection
   a. Finalized development tuning
   b. Complete set of CMPs
   c. Illustration of performance tuning options

Outline (numbered according to PA2 agenda)

6. Key Decisions
    a) Decision point 1 (PA2 Agenda Item 6.a): 2-year vs. 3-year management cycle and symmetric stability
    b) Decision point 2 (PA2 Agenda Item 6.b*)*: Incorporation of ‘phase-in’ as default
    c) Decision point 3 (PA2 Agenda Item 6.c): Culling of CMPs that fail thresholds defined at May PA2 meeting
    d) Decision point 4: Culling of lowest performing CMPs

Outline (numbered according to PA2 agenda)

7. Feedback and guidance on additional changes to CMPs by PA2 to the SCRS

- Preferences on yield path
  - Recent high abundance is expected to result in increased catches (both in the East and the West) in the short term, followed by a decline. Should the possibility of reducing the size of the peak of this pulse in TACs to spread it over a longer period be investigated?
- Index selection for CMPs
  - Number of indices: Some CMPs use all 10 of the approved indices to set TACs, while others use as few as 2 per management area (**Figure 1**).
- Performance tuning
  - SCRS will discuss the process of performance tuning to achieve higher yield performance while meeting minimum safety and status objectives.

Outline (numbered according to PA2 agenda)

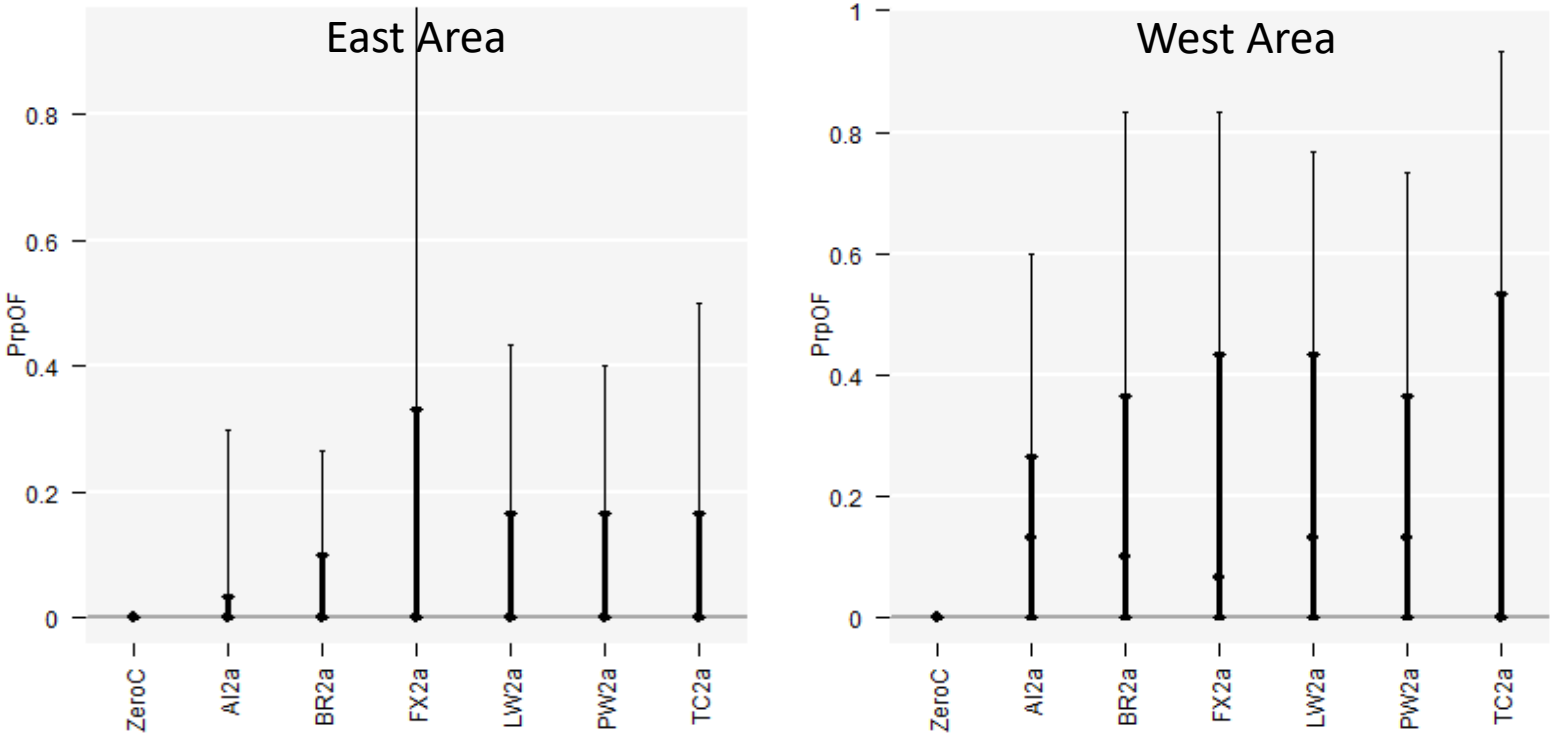
8. Process for obtaining feedback from CPCs of their stakeholder preferences relative to CMP decisions (see also Next steps below)

- How may the SCRS assist in CPC-planned stakeholder outreach?

Additional requested performance statistics

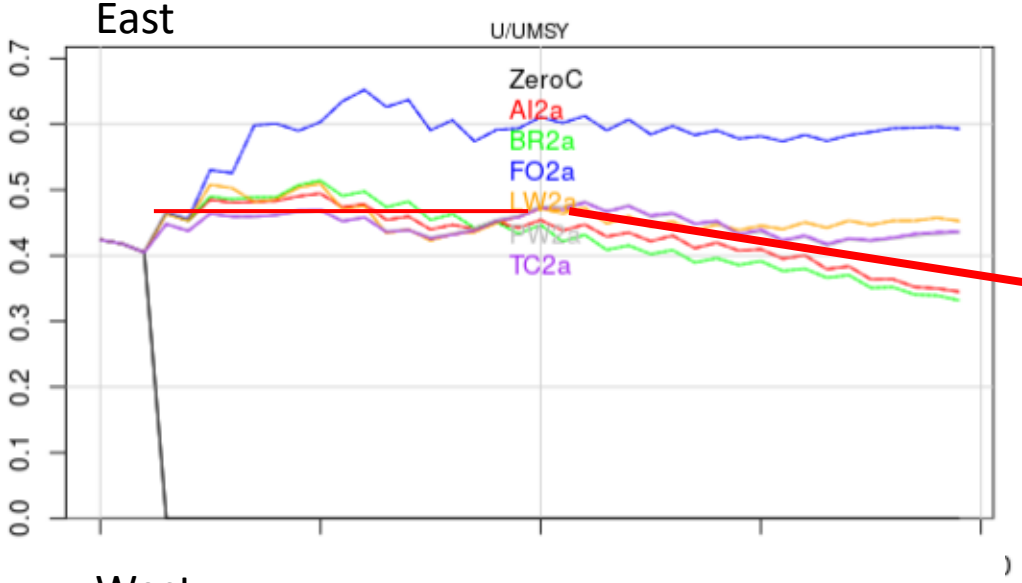
- **PrpOF** - proportion of simulation years above U_{MSY} for projection years 1-30
- **AvUrel** - average U/U_{MSY} for projection years 1-30
- **Revised AvgBr** - now average B/B_{MSY} for years 11-30 (was 1-30)

PrpOF

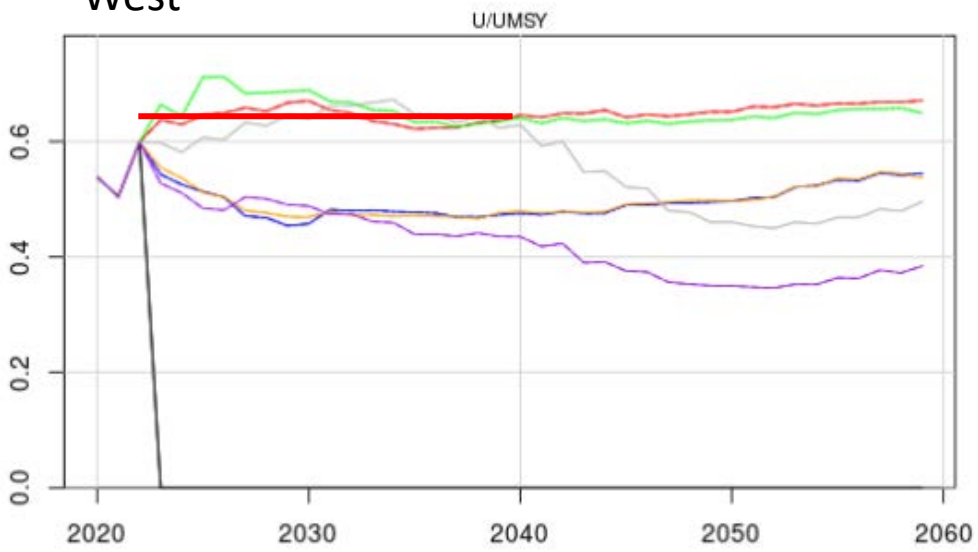


U/U_{MSY} for projection years 1-30 (across all OMs)

East

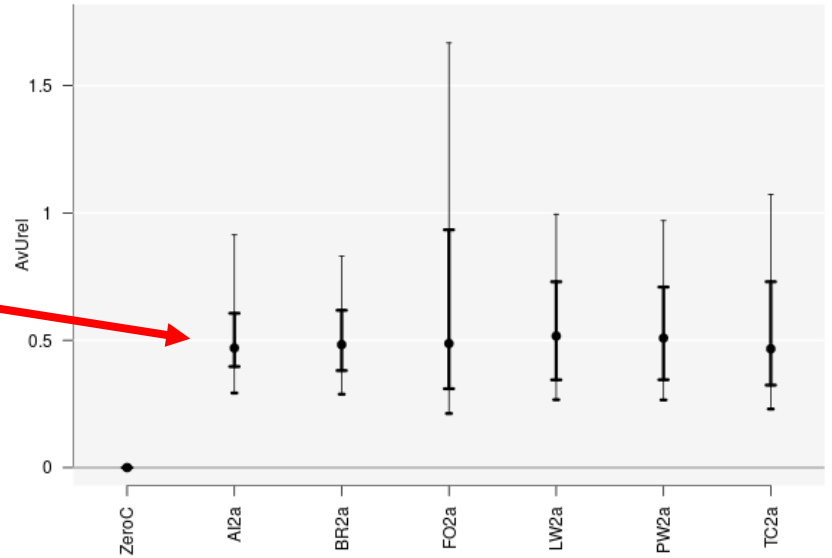


West



AvUrel - average U/U_{MSY} for projection years 1-30

East Area



West Area

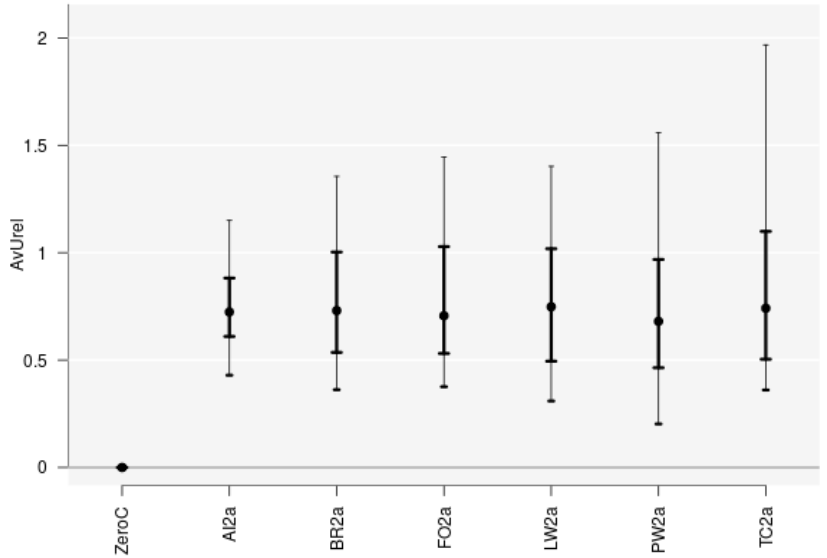


Table 2. Table of Operational Management Objectives and Performance Statistics.

Management Objectives (Res. 18-03) + May 2022 PA2 guidance	Primary Performance Statistics (Tuning Objective & Quilt 1)	Secondary Performance Statistics (Quilt 2)
Status The stock should have a greater than [60]% probability of occurring in the green quadrant of the Kobe matrix. (To be evaluated at intermediate points between zero and 30 years, and at the end of the 30-year period.)	Br30 – Br [i.e., biomass ratio, or spawning stock biomass (SSB) relative to dynamic SSBMSY[3]] after 30 years. PGK: probability of being in the Kobe green quadrant (i.e., SSB>dSSBMSY and U<UMSY[4]) in year 30.	AvgBr – Average Br over projection years 11-30. Br20 – Br after 20 years. POF – Probability of overfishing (U>UMSY) after 30 projected years. PNRK - Probability of not being in the red Kobe quadrant (SSB > SSBMSY or U < UMSY) after 30 projected years. OFT – Overfished Trend, SSB trend if Br30<1. PrpOF – Proportion $U > U_{MSY}$ (i.e., probability of overfishing in projection years 1-30). (See presentation. Not currently in quilt plot.) AvUrel – mean U/U_{MSY} in projection years 1-30. (See presentation. Not currently in quilt plot.) U/UMSY – exploitation rate (U) in biomass divided by exploitation rate at MSY. (Shown as a trajectory in the presentation rather than in a quilt plot)
Safety There should be no more than a [15]% probability of the stock falling below BLIM at any point during the years 11-30 of the projection period.	LD* – Lowest depletion (i.e., SSB relative to dynamic SSB_{MSY}) over years 11-30 in the projection period. LD* value is evaluated relative to SCRS-proposed B_{LIM} (40% of dynamic SSB_{MSY}).[5] LD5%, LD10% and LD15% will all be evaluated, with the latter in Quilt 1 and the former 2 in Quilt 2.	
Yield Maximize overall catch levels.	AvC10 – Median TAC (t) over years 1-10. AvC30 – Median TAC (t) over years 1-30.	C1 – TAC in first 2 years of MP (i.e., 2023-24). AvC20 – Median TAC (t) over years 1-20.
Stability Any change in TAC between management periods should be no more than a 20% increase or a [20][30]% decrease, except during the application of the MP in the first two management periods, where any TAC change shall not exceed a 20% increase or a 10% decrease.	VarC – Variation in TAC (%) between 2-year management cycles.	

Decision point 1: Evaluation of 3-year TAC setting for BR CMPs ‘performance tuned’ to LD*15%

			East						West					
CMP	Mgmt Cycle	Stability	Br30 50% tile	Br30 5% tile	LD*15	LD*10	Difference in AvC30 (kt)	VarC	Br30 50% tile	Br30 5% tile	LD*15	LD*10	Difference in AvC30 (kt)	VarC
BR5a	2-year	+20/-30	1.03	0.24	0.4	0.31	-	19.7	1.07	0.41	0.4	0.32	-	13.56
BR5c	3-year	+20/-30	1.1	0.20	0.4	0.28	-1.81	20.1	1.15	0.37	0.4	0.29	-0.11	15.12
BR5d	3-year	+20/-35	1.13	0.31	0.4	0.34	-2.37	20.9	1.17	0.42	0.4	0.31	-0.08	15.33

Subscript a indicates 2-year management cycle

Subscript c indicates 3-year management cycle

TAKE HOME: Performance was only slightly inferior and practical considerations (stability, reduced administrative burden) may support a 3-year management cycle

Decision point 2: “Phase-in” of +20/-10% allowable TAC change for the first 2 CMP applications across 5 CMPs tested

East CMP	C1 (50%)	AvC10 (50%)	AvC30 (50%)	VarC (50%)	LD (5%)	LD (15%)	PGK (Mean)
AI2a	32.27	41.16	37.62	16.17	0.42	0.65	0.71
AI2b	**32.4**	**44.04**	**37.71**	**16.49**	**0.36**	**0.55**	**0.7**
BR2a	43.2	40.9	32.65	16.56	0.49	0.66	0.78
BR2b	**43.2**	**40.81**	**32.47**	**16.51**	**0.42**	**0.61**	**0.78**
LW2a	43.2	34.63	30.27	17.21	0.44	0.6	0.72
LW2b	**43.2**	**34.46**	**30.19**	**17.2**	**0.39**	**0.56**	**0.72**
PW2a	41.14	35.36	29.93	13.27	0.43	0.6	0.74
PW2b	**40.76**	**34.82**	**29.59**	**13.24**	**0.4**	**0.57**	**0.75**
TC2a	37.26	33.43	29.21	8.18	0.37	0.54	0.73
TC2b	**38.39**	**35.58**	**30.97**	**8.38**	**0.32**	**0.49**	**0.68**

West CMP	C1 (50%)	AvC10 (50%)	AvC30 (50%)	VarC (50%)	LD (5%)	LD (15%)	PGK (Mean)
AI2a	2.82	3.03	2.77	16.43	0.32	0.53	0.58
AI2b	**2.82**	**3.05**	**2.75**	**16.36**	**0.25**	**0.48**	**0.58**
BR2a	2.71	3.02	2.72	12.61	0.28	0.49	0.63
BR2b	**2.71**	**3**	**2.69**	**12.57**	**0.22**	**0.47**	**0.63**
LW2a	2.53	2.68	2.56	15.63	0.28	0.5	0.59
LW2b	**2.51**	**2.7**	**2.54**	**15.82**	**0.22**	**0.48**	**0.6**
PW2a	2.42	2.37	2.29	17.11	0.28	0.45	0.67
PW2b	**2.45**	**2.48**	**2.3**	**17.42**	**0.21**	**0.41**	**0.67**
TC2a	2.68	2.83	2.64	6.71	0.18	0.4	0.61
TC2b	**2.73**	**2.95**	**2.74**	**6.85**	**0.16**	**0.38**	**0.58**

Subscript a indicates no phase-in

Subscript b indicates +20/-10% allowable TAC change phase-in for the first 2 management cycles

Take Home: The phase-in made little difference to long-term biomass (risk) or yield outcomes, and thus is confirmed as a viable approach

Symmetric TAC change +20/-20

- Stability alternative
  - o symmetrical stability provision: +20/-20% allowable TAC change from one cycle to the next (in contrast to the default structure, which allows 20% TAC increases and 30% TAC decreases).
    - slower to implement necessary TAC decreases
    - lower yield
    - lower biomass performance

			East					West				
Variant	Mgmt Cycle	Stability	Br30	LD*15	LD*10	AvC30	VarC	Br30	LD*15	LD*10	AvC30	VarC
BR2a	2-year	+20/-30	1.5	0.66	0.58	32.65	16.56	1.25	0.49	0.38	2.72	12.61
BR2g	2-year	+20/-20	1.49	0.55	0.46	32.38	14.53	1.24	0.46	0.32	2.71	12.15

Comparative performance for variations of the BR CMP. Performance of BR2g (+20/-20 stability) has slightly lower yields (AvC30) compared to BR2a (+20/-30 stability), as well as poorer conservation (Br30) performance.

Take Home: Performance of BR2g (+20/-20 stability) has slightly lower yields (AvC30) compared to BR2a (+20/-30 stability), as well as poorer conservation (LD*) performance.

c) Decision point 3 Culling of CMPs that fail thresholds as defined at May PA2 meeting

- For +20/-30 stability, ordered according to statistic weighting from May.
- Lowest depletion, LD* (>15% probability of falling below B_{LIM}, i.e., 40% of dynamic SSB_{MSY})

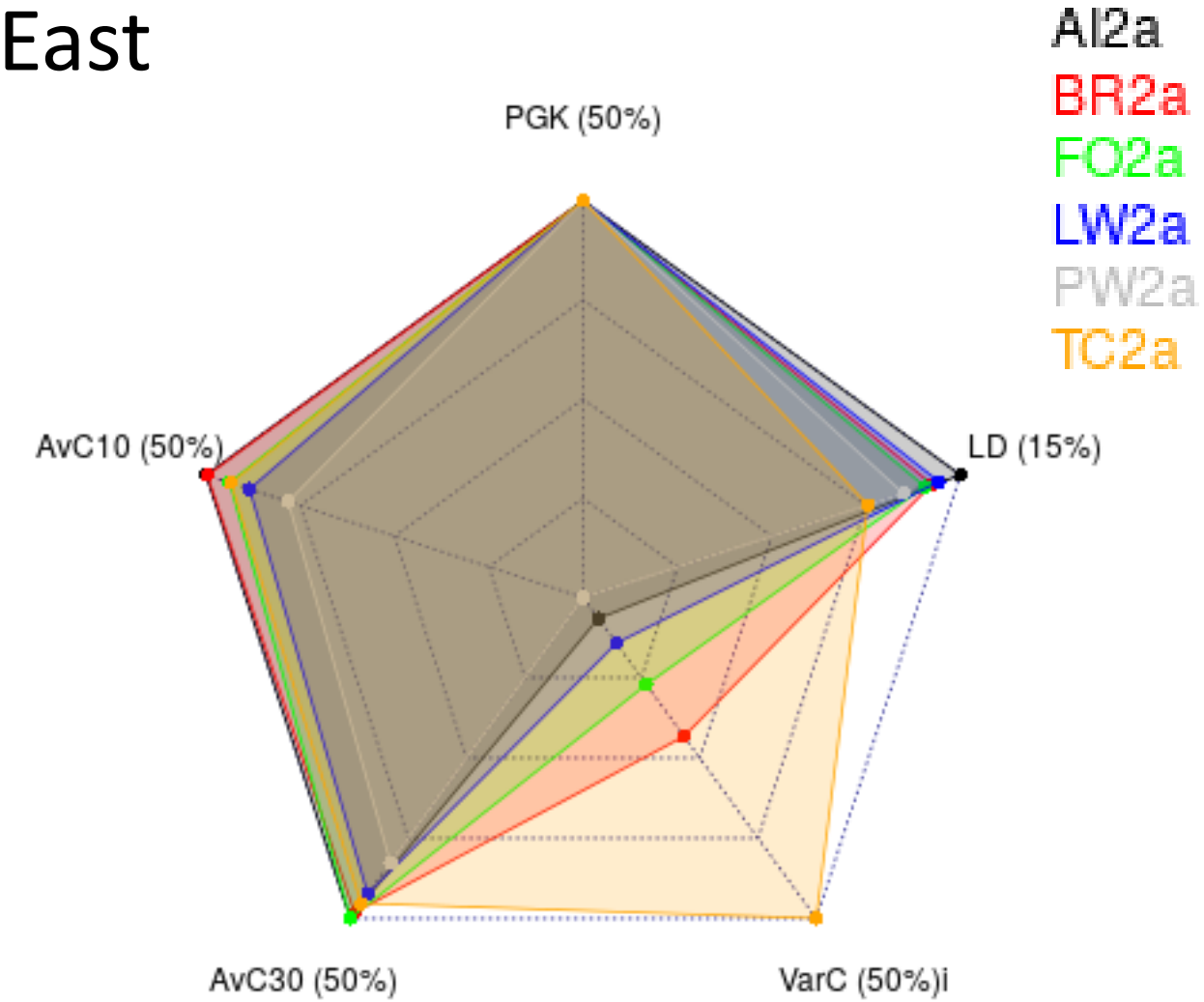
  Two CMPs (i.e., EA and TN) were withdrawn by their developers due to difficulties in meeting this.
- 60% pGreen (i.e., probability of being in the green quadrant of the Kobe matrix in year 30).

  All 6 CMPs meet or nearly meet this for the default tuning level (median Br30 of 1.25 for the western stock and 1.50 for the eastern).

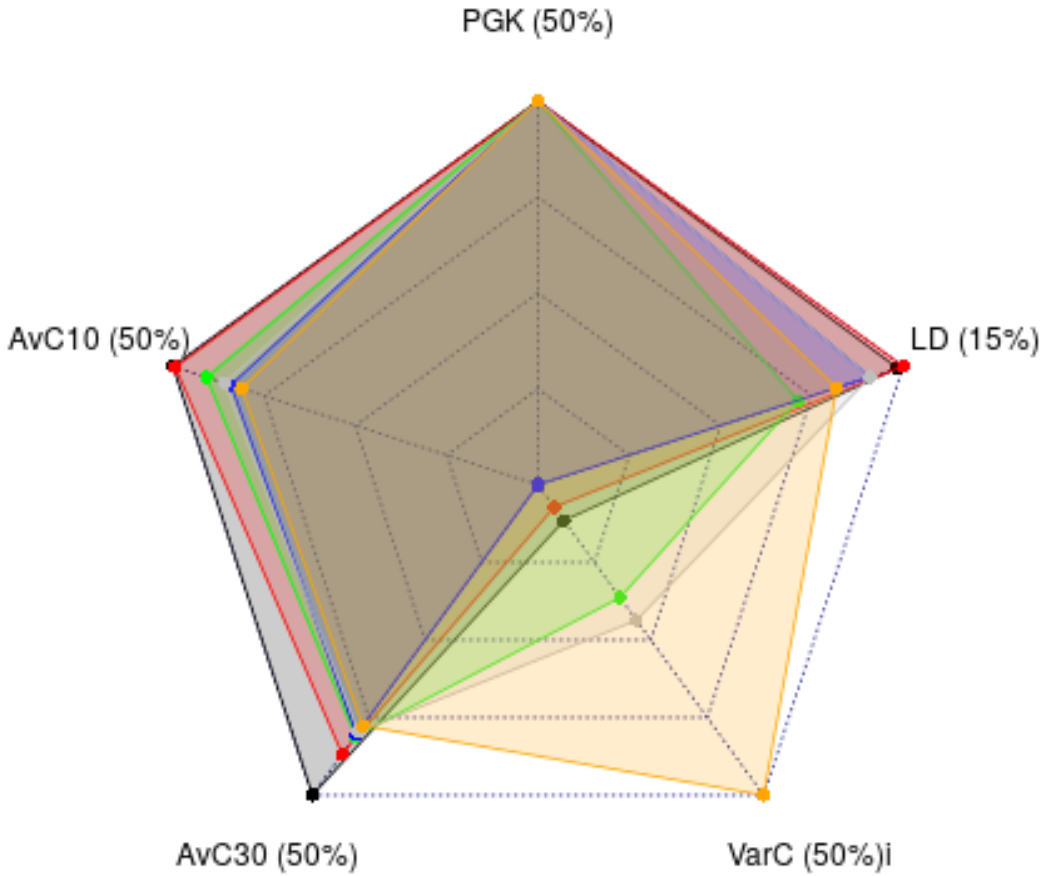
CMP	West					East					Tot	# indices
	PGK (Mean)	AvC10 (50%)	AvC30 (50%)	VarC (50%)	LD (15%)	PGK (Mean)	AvC10 (50%)	AvC30 (50%)	VarC (50%)	LD (15%)		
BR2a	0.63	3.02	2.72	12.61	0.49	0.78	40.9	32.65	16.56	0.66	0.26	10
AI2a	0.58	3.03	2.77	16.43	0.53	0.71	41.16	37.62	16.17	0.65	0.27	10
TC2a	0.61	2.83	2.64	6.71	0.4	0.73	33.43	29.21	8.18	0.54	0.48	7
FO2a	0.62	2.84	2.77	14.29	0.48	0.64	37.37	30.46	13.93	0.47	0.53	6
LW2a	0.59	2.68	2.56	15.63	0.5	0.72	34.63	30.27	17.21	0.6	0.58	4
PW2a	0.67	2.37	2.29	17.11	0.45	0.74	35.36	29.93	13.27	0.6	0.71	4

Spider/Radar plots

East



West



Secondary quilt plots West (+20/-30 stability)

CMP	West									
	C1 (50%)	AvC20 (50%)	AvgBr (50%)	Br20 (50%)	Br30 (5%)	LD (5%)	LD (10%)	POF (Mean)	PNRK (Mean)	OFT (P>0)
BR2a	2.71	2.73	1.34	1.31	0.54	0.28	0.38	0.22	0.83	0.86
AI2a	2.82	2.83	1.35	1.31	0.63	0.32	0.42	0.26	0.87	0.87
TC2a	2.68	2.59	1.42	1.41	0.35	0.18	0.27	0.28	0.78	0.86
FO2a	2.41	2.78	1.38	1.35	0.48	0.3	0.38	0.26	0.81	0.85
LW2a	2.53	2.56	1.34	1.3	0.49	0.28	0.38	0.26	0.81	0.84
PW2a	2.42	2.27	1.23	1.18	0.49	0.28	0.38	0.09	0.95	0.94

Secondary quilt plots East (+20/-30 stability)

CMP	East									
	C1 (50%)	AvC20 (50%)	AvgBr (50%)	Br20 (50%)	Br30 (5%)	LD (5%)	LD (10%)	POF (Mean)	PNRK (Mean)	OFT (P>0)
BR2a	43.2	34.05	1.49	1.45	0.73	0.49	0.58	0.03	0.99	0.96
Al2a	32.27	40.51	1.53	1.51	0.47	0.42	0.55	0.11	0.9	0.86
TC2a	37.26	28.84	1.59	1.58	0.52	0.37	0.47	0.07	0.94	0.9
FO2a	43.2	29.83	1.52	1.5	0.3	0.25	0.37	0.21	0.81	0.84
LW2a	43.2	30.14	1.52	1.5	0.55	0.44	0.53	0.08	0.95	0.92
PW2a	41.14	30.2	1.53	1.5	0.57	0.43	0.52	0.06	0.97	0.93

Table 1. Table of Candidate Management Procedures (CMPs).

CMP	Indices used		Detailed description	Strengths/Weaknesses	References
	EAST	WEST			
FO	FR AER SUV2 JPN LL NEAtl2 W-MED LAR SUV	US RR 66-144, CAN SWNS RR US-MEX GOM PLL	Uses an estimated F0.1 applied to an estimate of biomass to provide TAC advice. The F0.1 estimate is based on the relative abundance of young, medium and old fish for each area (which is informed from the areas indices noted on the left). Estimated biomass for each area is derived from an index from that area and a period of reference years.	Strengths: - performs well across several indicators. - uses indices that represent various age class to calculate TAC.	SCRS/2020/144 SCRS/2021/122
AI	All	All	An artificial neural network is trained on simulated projected data for all indices (from both sides of the ocean) and a management value V, that is the true simulated vulnerable biomass in each area multiplied by a harvest control rule. Once trained, the neural network can predict V using new index data (simulated or real). Area-specific TAC is then calculated as a constant fraction of V.	Strengths: - performs well across several indicators. - uses all indices. Weaknesses: - lacks a clear relationship between index values and TAC, due to machine learning component. - struggles to achieve LD and PGK.	SCRS/2021/028
BR	All	All	TACs are set based on relative harvest rates (with some slight initial time dependence) for a reference year (2018) applied to the 2-year moving average of a combined master abundance index for each of the West and East areas. These master indices are weighted averages across the indices available for the area based on their variances and to achieve smoother TAC trends over time.	Strengths: - strong performance, across most indicators. - uses all indices.	SCRS/2021/121 SCRS/2021/152 SCRS/2022/082 SCRS/2022/126
LW	W-MED LAR SUV JPN LL NEAtl2	GOM LAR SUV MEXUS_LL	LW uses a 3-yr average of catch divided by relative SSB to estimate a constant harvest rate metric. All 4 indices on the left are used for the West area to account for stock mixing; Med larval and JPN East LL are used for the East area.	Strengths: - performs well across several indicators. Weaknesses: - has struggled to achieve some of PA2 identified thresholds for PGK.	SCRS/2021/127
PW	W-MED LAR SUV JPN LL NEAtl2	GOM LAR SUV MEXUS_LL	Similar to LW, PW uses indices in the East and the West (as specified on the left) to achieve a constant exploitation rate. It adjusts Western TAC according to Eastern indices under the assumption that Western TACs are supported by Eastern mixing.	Strengths: - performs well across several indicators. Weaknesses: - poor stability and yield.	SCRS/2021/155 SCRS/2022/078
TC	MOR POR TRAP JPN LL NEAtl2 W-MED LAR SUV GBYP AER SUV BAR	US RR 66-144 JPN_LL_West2 GOM_LAR_SUV	Two fishery indices for each area (West: JPN_LL_West2, US_RR_66_144. East: JPN_LL_NEAtl2, MOR_POR_TRAP) and three stock-specific fishery independent indices (West: GOM_LAR_SUV. East: MED_LAR_SUV, GBYP_AER_SUV_BAR) are used to predict area biomass assuming a fixed rate of stock mixing (e.g., a fixed fraction of the Eastern stock enters the West area). The TAC is calculated for each area by multiplying the predicted area biomass by a constant harvest rate.	Strengths: - highest stability Weaknesses: - increased stability causes somewhat lower biomass and yield performance.	SCRS/2020/150 SCRS/2020/165

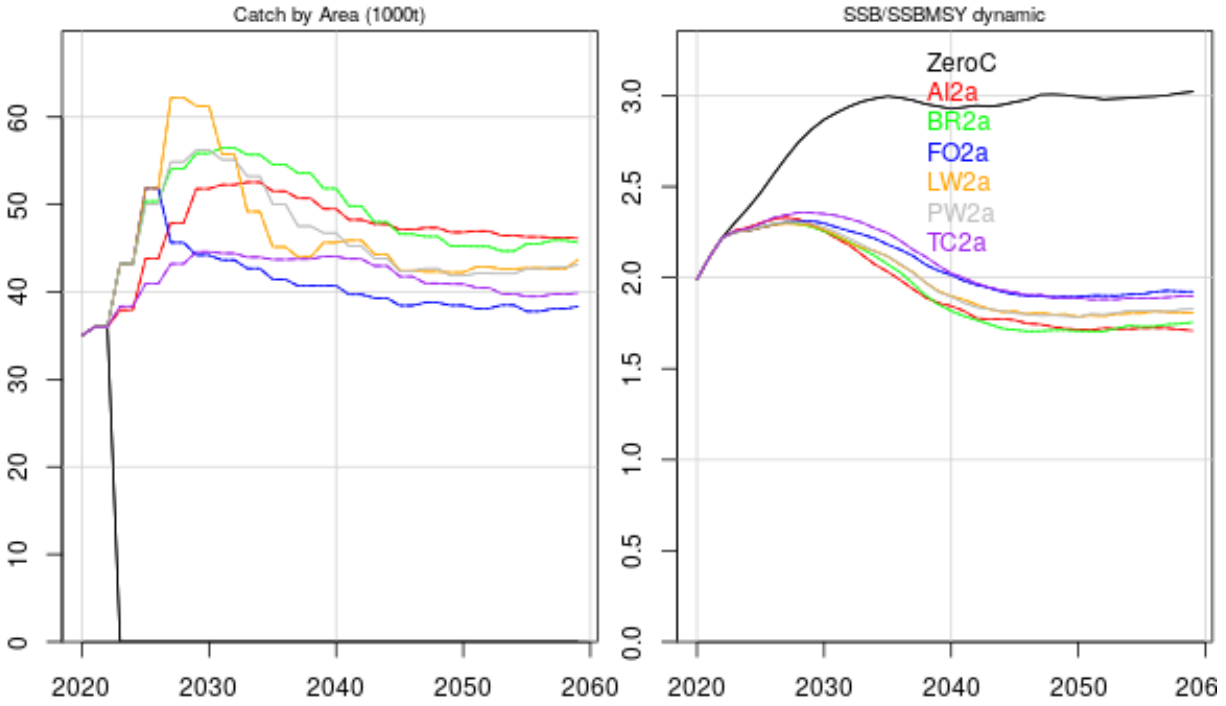
7. Feedback and guidance on additional changes to CMPs by PA2 to the SCRS

- Preferences on yield path
  - Recent high abundance is expected to result in increased catches (both in the East and the West) in the short term, followed by a decline. Should the possibility of reducing the size of the peak of this pulse in TACs to spread it over a longer period be investigated?
- Index selection for CMPs
  - Number of indices: Some CMPs use all 10 of the approved indices to set TACs, while others use as few as 2 per management area (**Figure 1**).
- Performance tuning
  - The SCRS will discuss the process of performance tuning to achieve higher yield performance while meeting minimum safety and status objectives.

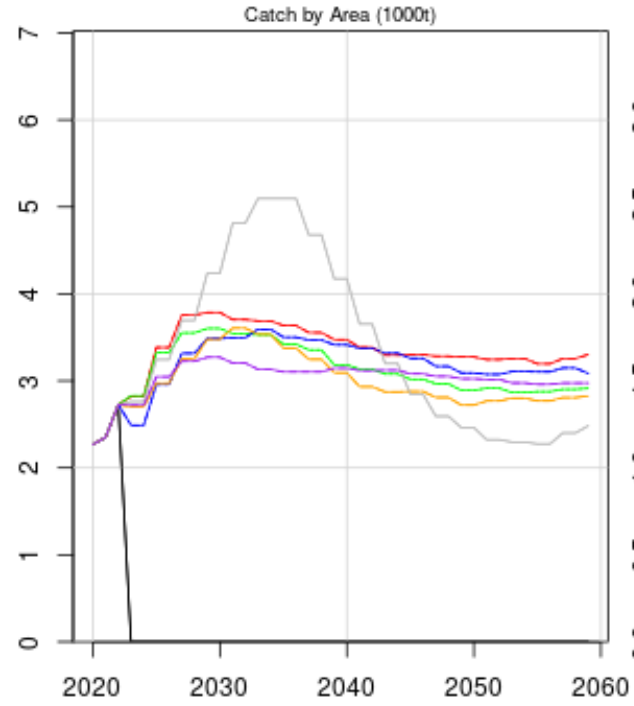
Yield path preferences

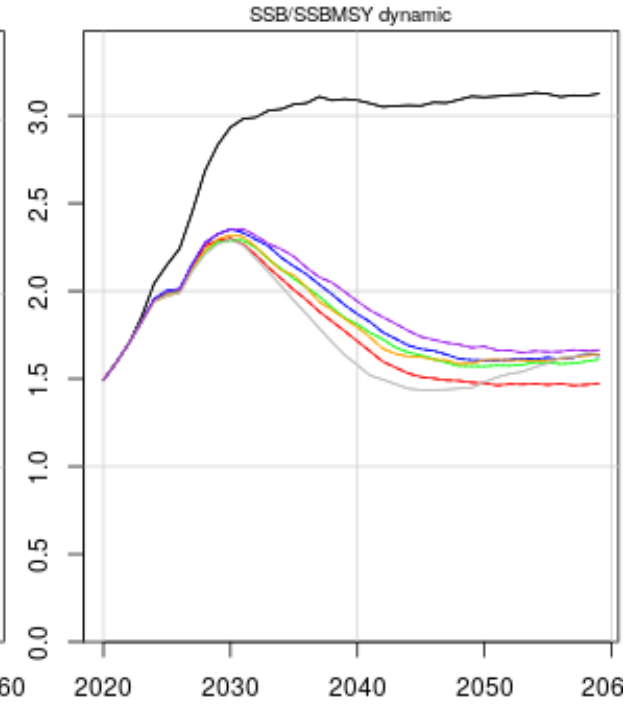
Recruitment Scenario 1 (high recruitment East/High status in West)

Eastern Stock



Western Stock

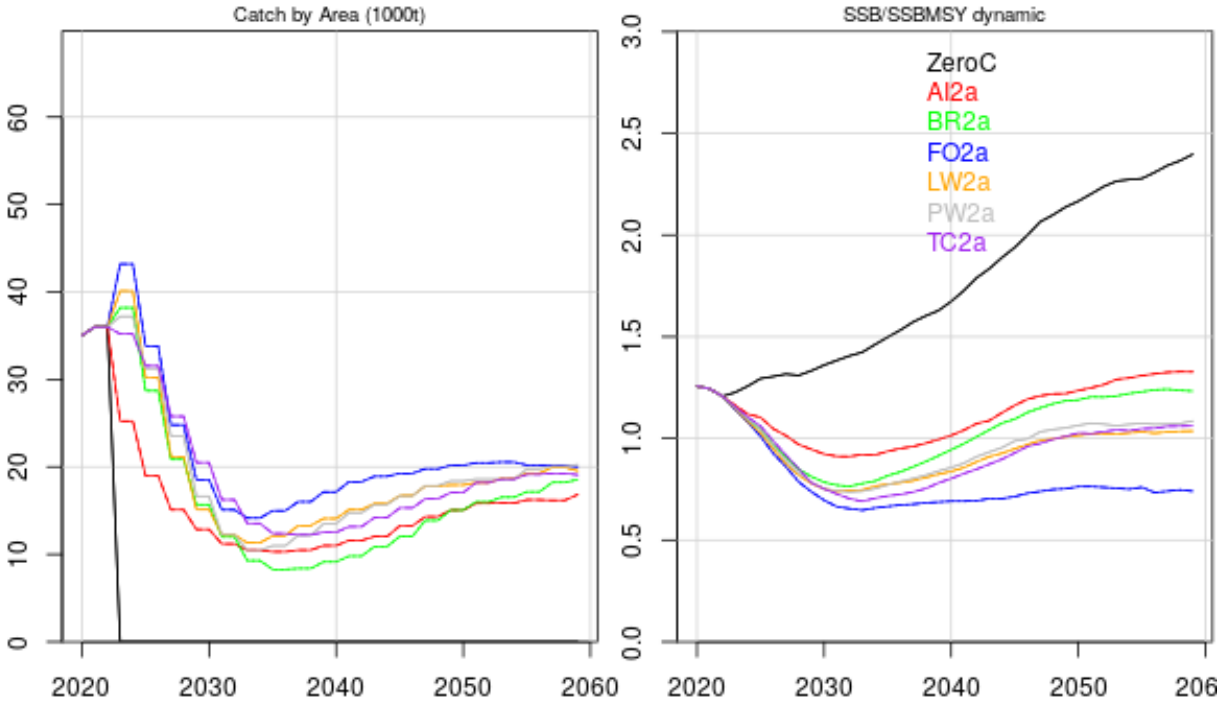




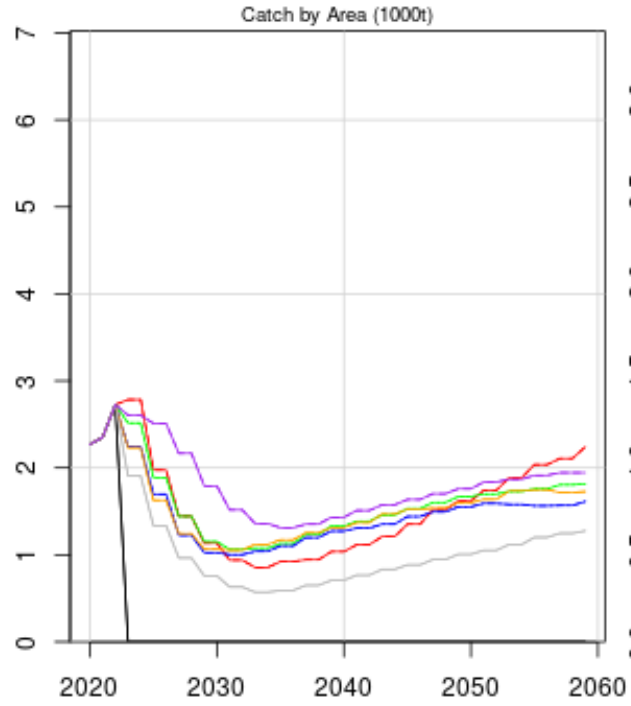
Yield path preferences

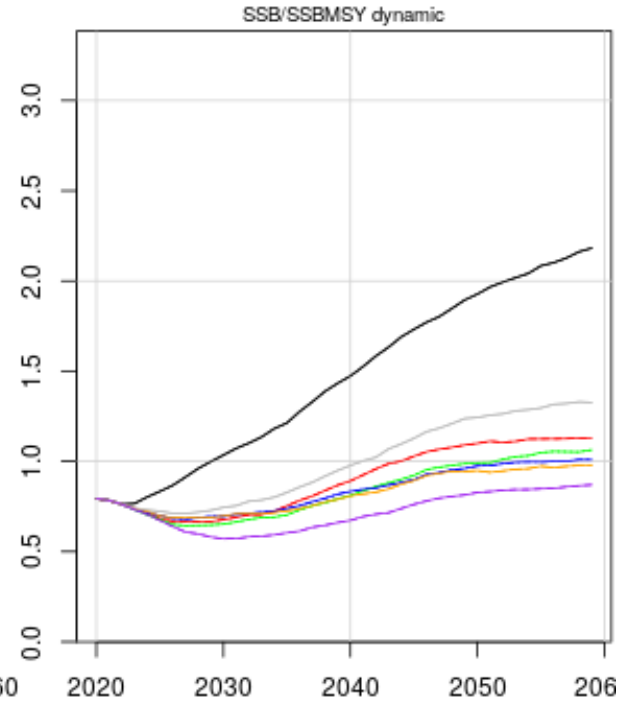
Recruitment Scenario 2 (low recruitment in East and West)

Eastern Stock



Western Stock

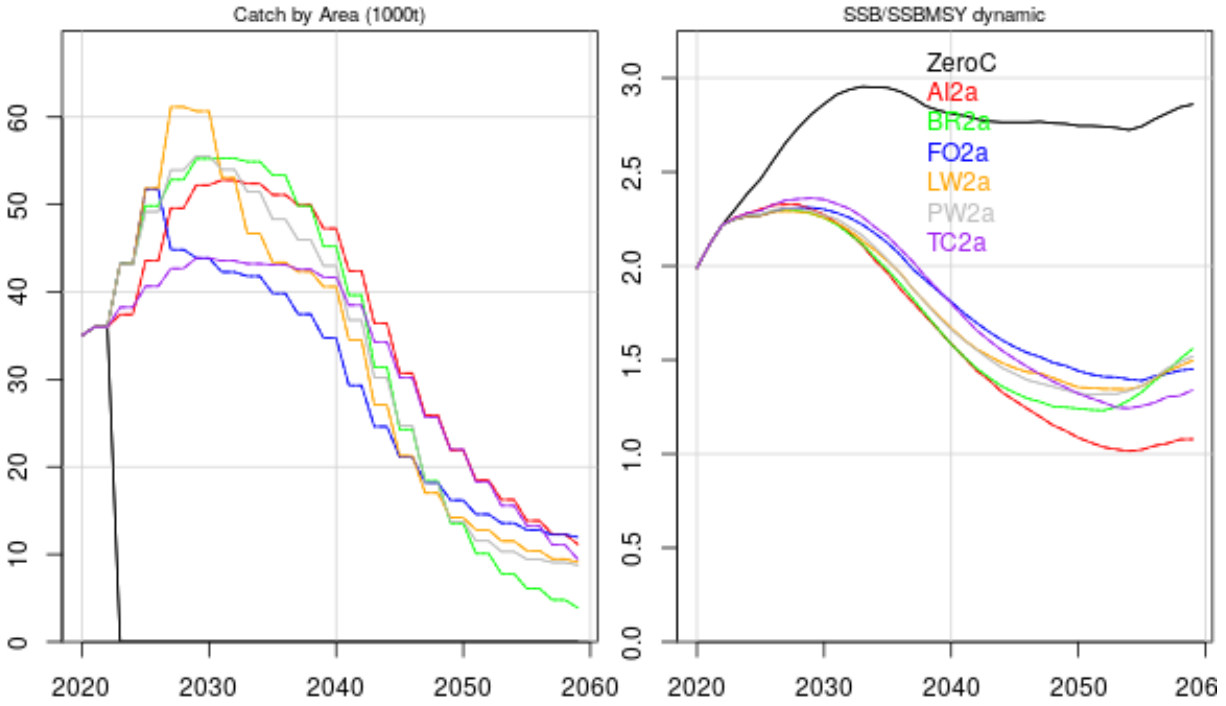




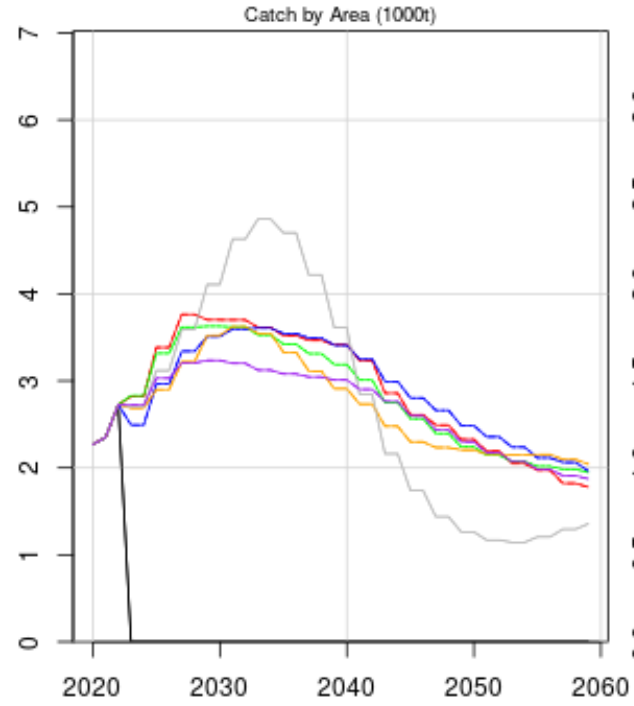
Yield path preferences

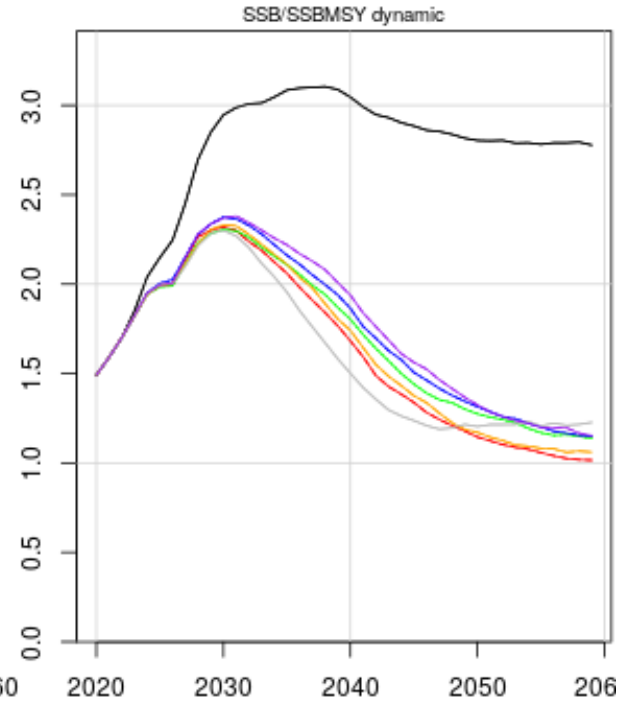
Recruitment Scenario 3 (future regime shift)

Eastern Stock

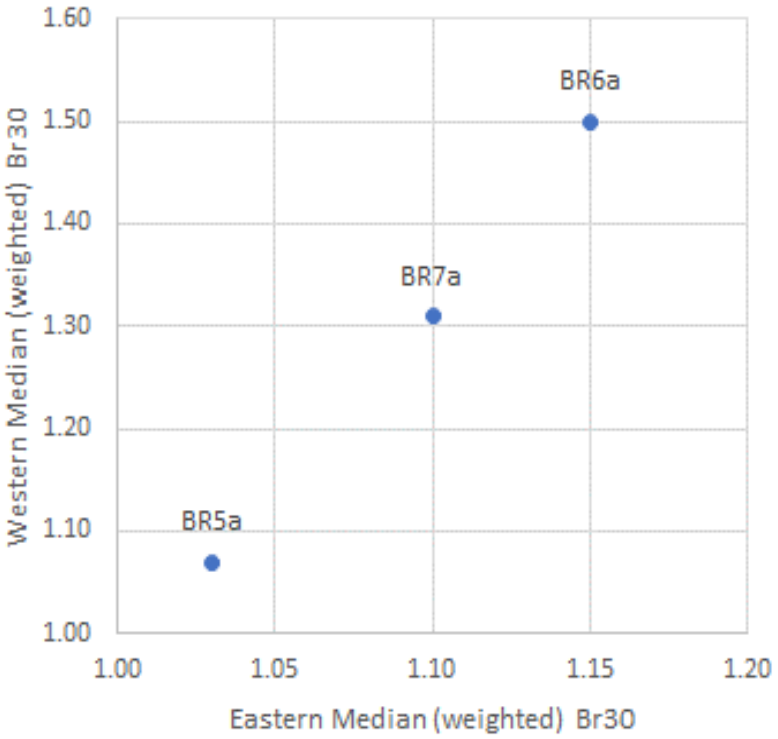


Western Stock





- Performance tuning
  - The SCRS will discuss the process of performance tuning to achieve higher yield performance while meeting minimum safety and status objectives.



Performance tuning means dialing up the fishing intensity to achieve higher yield, while satisfying safety and status thresholds.

Akin to tuning a race car for speed, while keeping it on the track.

BR CMP has been initially ‘performance’ tuned to LD*15%, 10% and 5%. Results are still preliminary but also do not currently meet PGK at 60% across the tunings.

8. Process for obtaining feedback from CPCs of their stakeholder preferences relative to CMP decisions (see also Next steps below)

- How may the SCRS assist in CPC-planned stakeholder outreach?
- Ambassador meetings
  - Late July?
  - Late September or early October

Next steps

After the 14 July Panel 2 meeting, there is one remaining meeting of Panel 2 to take place before the Commission Plenary, scheduled for 14 October 2022. This will follow the September meetings of the SCRS Bluefin MSE Technical Subgroup, Bluefin Species Group, and SCRS Plenary meeting. The Bluefin Species Group also hopes to convene additional Ambassador meetings (tentatively, in late July and early October) in English, French and Spanish, and some summary materials are available in Arabic.

Next Steps (yellow are Panel 2/Commission meetings)

Date		Meeting (hybrid)	Objectives
2022	September 5-8	SCRS BFT MSE Technical Group meeting (Madrid)	• CMP developers to present updated results. • BFTSG to provide feedback. • CMP developers to present revised results, incorporating feedback. • BFTSG to cull the CMPs to a maximum of three.
	September 20-21	SCRS BFT Species Group (Madrid)	• BFTSG to review and endorse final CMP results. • BFTSG to select one final CMP, with multiple tuning levels, for presentation to the SCRS.
	September 26-30	SCRS Plenary (Madrid)	• SCRS to review and endorse final CMP results. • SCRS to select one final CMP, with multiple tuning levels, for presentation to Panel 2.
	October 14 (or 2 days?)	4th Panel 2 meeting BFT MSE (Madrid)	• SCRS to present final CMPs, with all final specifications, for review. • Panel 2 to select a CMP to recommend for Commission adoption.
	November 14-21	Annual Commission meeting (Portugal)	• Commission to adopt a fully specified MP, including final operational management objectives.

Decisions:

1. Decision point 1: **2-year vs. 3-year management cycle and symmetric stability (+20/-20 or asymmetric (+20/-30; +20/-35)**
2. Decision point 2: **Incorporation of 'phase-in' as default (+20/-10 for first two TACs)**
3. Decision point 3 (PA2 Agenda Item 6.c): Culling of CMPs that fail thresholds defined at May PA2 meeting **(no decision needed)**
4. Decision point 4: Culling of lowest performing CMPs **(no decision needed)**

Preferences/Feedback:

1. Preferences on yield path

   Recent high abundance is expected to result in increased catches (both in the East and the West) in the short term, followed by a decline. Should the possibility of reducing the size of the peak of this pulse in TACs to spread it over a longer period be investigated?

2. Index selection for CMPs

   Number of indices: Some CMPs use all 10 of the approved indices to set TACs, while others use as few as 2 per management area.

3. Performance tuning

   SCRS will discuss the process of performance tuning to achieve higher yield performance while meeting minimum safety and status objectives.

Relative weighting of key performance statistics (from May 9-10 meeting)

Examples of weighting schemes	Status PGK (mean)	Yield AvC10 (50%)	Yield AvC30 (50%)	Stability VarC (50%)	Safety LD* (%TBD)
Default: Equal across yield, stability, and safety	0	0.5	0.5	1	1
Sensitivity 1: Double weighting of safety	0	0.25	0.25	0.5	1
Sensitivity 2: Double weighting of yield	0	1	1	1	1

PGK: Probability of Green Kobe ($SSB > SSB_{MSY}$ & $U < U_{MSY}$) after 30 projected years
AvC10: Mean catches over first 10 projected years
AvC20: Mean catches over first 20 projected years
VarC: Average annual variation in catches

New results

				East					West				
Variant	Mgmt Cycle	Stability	phase in	Br30 50% tile	LD*15	LD*10	AvC30	VarC	Br30 50% tile	LD*15	LD*10	AvC30	VarC
BR2a	2-year	+20/-30	no	1.5	0.66	0.58	32.65	16.56	1.25	0.49	0.38	2.72	12.61
BR2g	2-year	+20/-20	no	1.49	0.55	0.46	32.38	14.53	1.24	0.46	0.32	2.71	12.15
BR2c	3-year	+20/-30	no	1.47	0.52	0.44	32.88	18.29	1.23	0.45	0.31	2.72	14.57
BR2d	3-year	+20/-35	no	1.5	0.58	0.5	32.35	19.14	1.25	0.46	0.33	2.71	14.64
BR2i	3-year	+20/-20	no	1.47	0.39	0.27	31.57	15.21	1.27	0.38	0.25	2.65	13.44
BR2j	3-year	+20/-35	+20/-10; 2 TACs	1.48	0.47	0.38	32.4	18.77	1.24	0.4	0.25	2.7	14.54
BR2k	3-year	+20/-35	+20/-10; 1 TAC	1.5	0.58	0.5	32.35	19.14	1.25	0.46	0.32	2.71	14.64