A theoretical Blue Shark Management Strategy Evaluation for North Pacific

Global BSH MSE Workshop
Rome, Italy – October 2025

Breakout Session Part 2

Blue Shark Case Study: Base Case

Stock Overview: N Pacific Blue Shark

- *Provide a brief summary on the fishery dynamics predicted by the SS3 model e.g., historical trend in spawning biomass, catch (discards), fishing mortality, SB/SBMSY, F/FMSY*

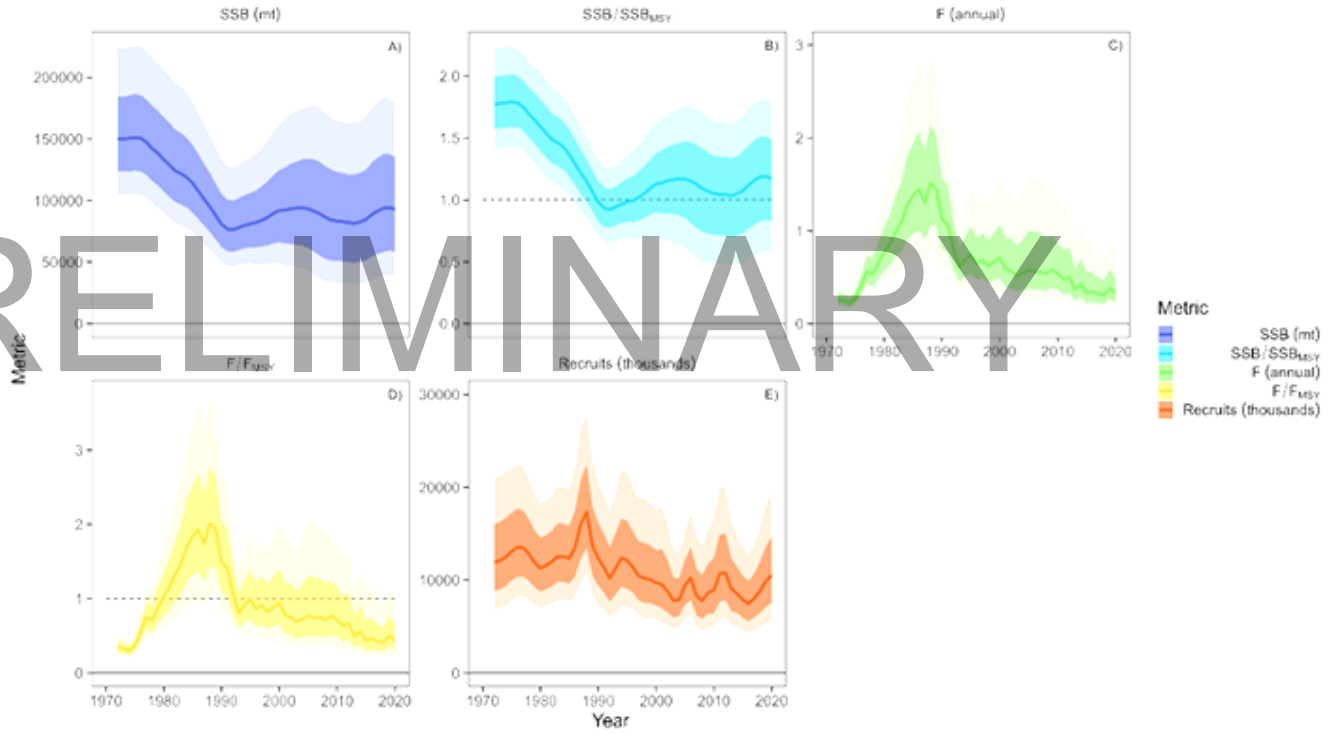


Figure 3E. Results of the SS3 stock assessment model ensemble: (upper left) estimated female spawning stock biomass (SSB; metric tons) relative to MSY level (horizontal broken line); (upper middle) estimated fishing mortality (sum of F's across all fishing fleets) relative to MSY level (horizontal broken line); (upper right) estimated female SSB; (lower left) estimated fishing mortality (sum of F's across all fishing fleets); (lower middle) estimated age-0 recruits. Light and dark shaded areas of all figures denote 80 and 50% percentiles around the median estimate, respectively.

Candidate N Pacific Management Procedures

- *Candidate Management Procedures evaluated in MSE*

FMSYref - A reference FMSY method that fishes at FMSY

'mynewEMP', 'EMP_3', 'EMP_4', 'EMP_5', 'EMP_6', were created by adjusting the the *Ind_fac*, which changes the multiplier on the *current catch/index* to indicate the future catch.

Multipliers of **1, 1.5, 2, 2.5, & 3** were used with the assumption that the current ratio of index to target (Bmsy) is 1.5. Calibration over last 10 years

- The main properties of the CMPs that are considered in are related to scaling the catch amount by the current assumed ratio of catch to index can check the responsiveness of the MP to the change in target catch

Performance Metrics

- *PMs used to summarize the performance of the CMPs are the following.*

Status - Probability of being in the Kobe green quadrant
Safety - Probability of SB>0.4SBMSY
P100 - Probability of SB>SBMSY
PNOF - Probability of F<FMSY
Catch_ST - Average catch in first 10 years
Catch_LT - Average catch in last 10 years
SLC - sum of log catches
MLC - mean length of catches (last 10 years)

Breakout Session Part 3

Alternative OMs: Reference and Robustness

N Pacific Alternative OMs

Key uncertainties: Natural mortality, scale of catch

	Considered Values				
M	0.8M	1.25M	Base		
Catch	0.8*Catch	1.25*Catch	Base		

N Pacific Alternative OMs (continued)

TOTAL NUMBER OF OMs

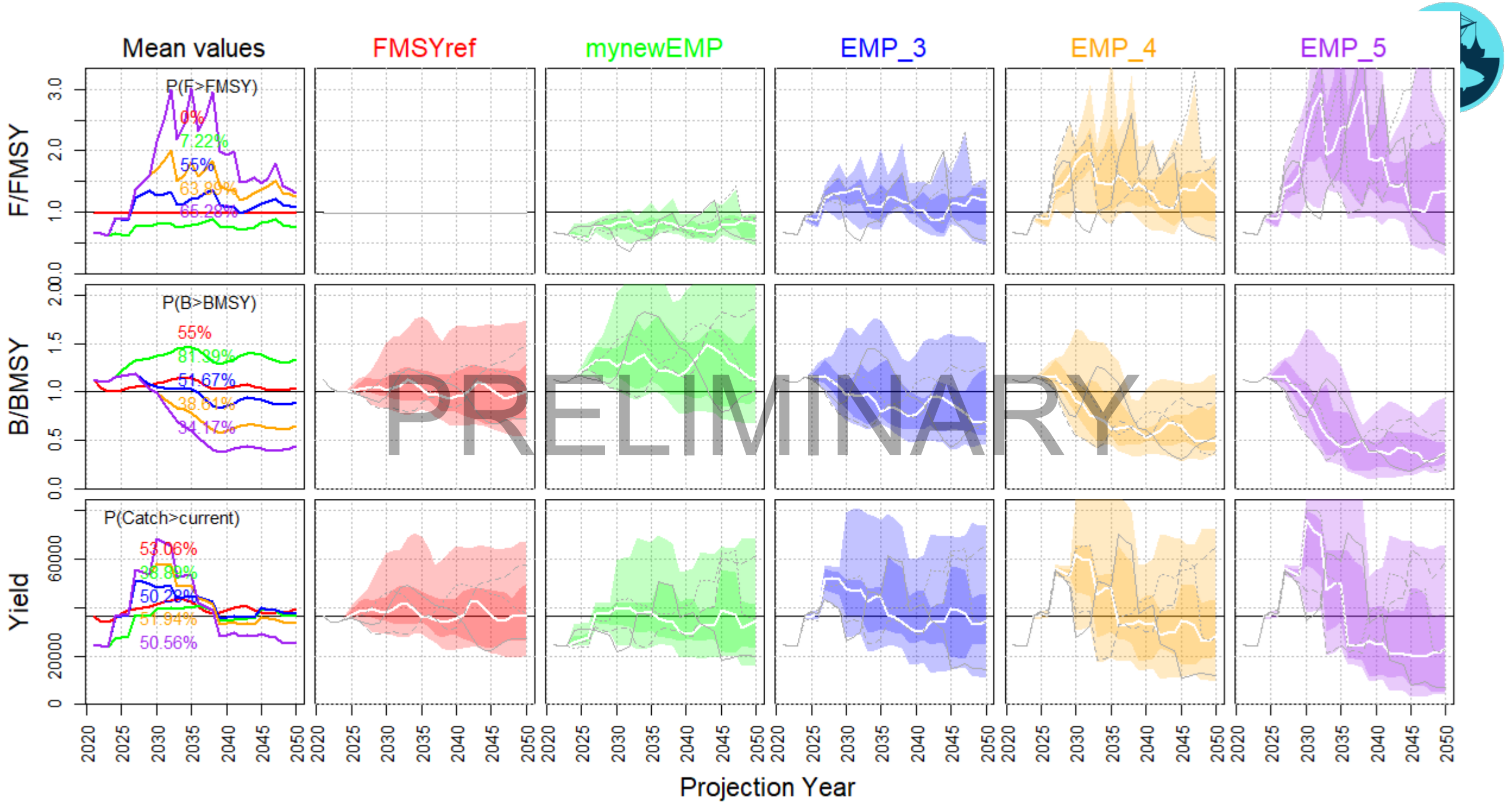
5

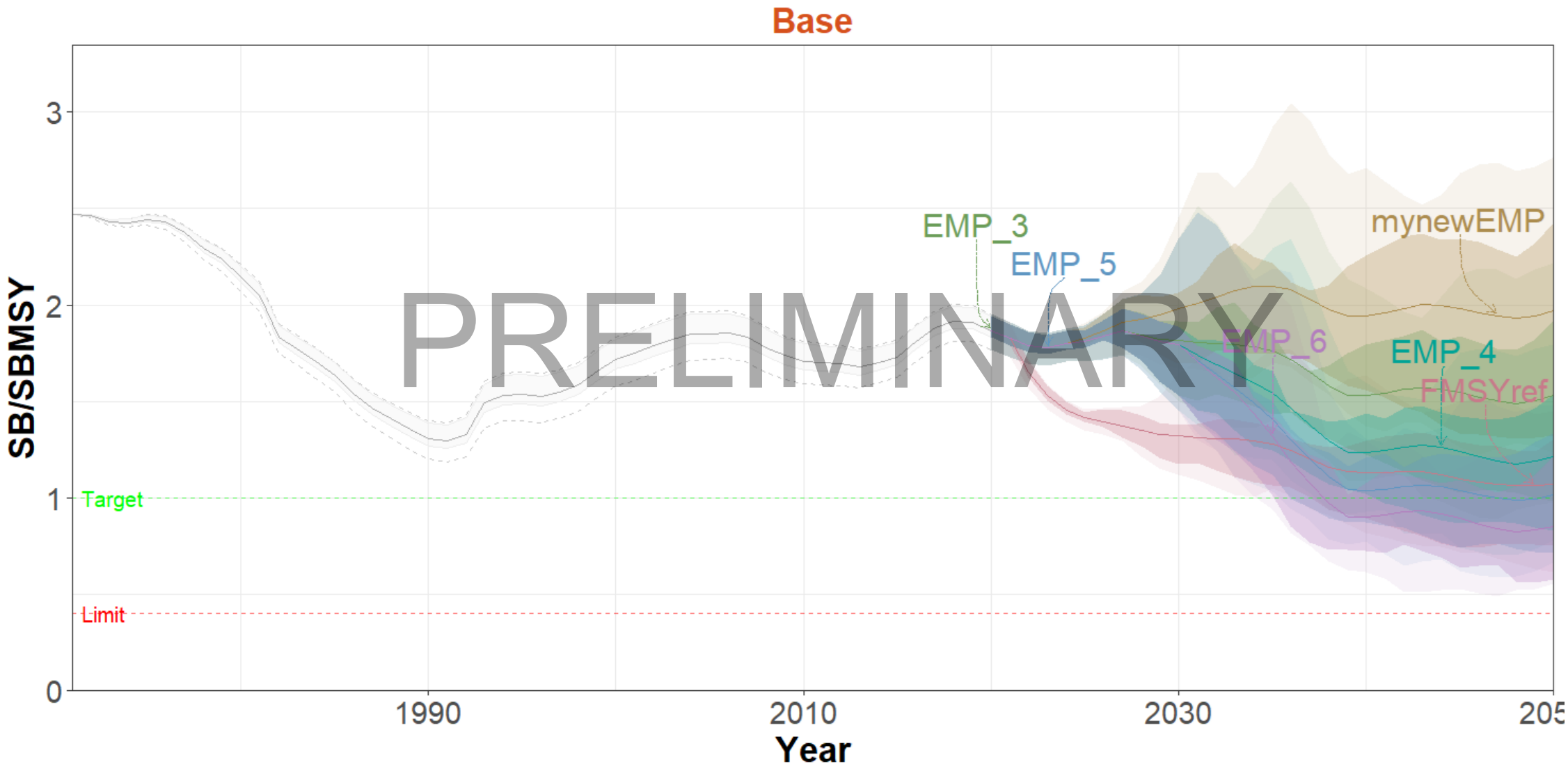
Reference set OMs

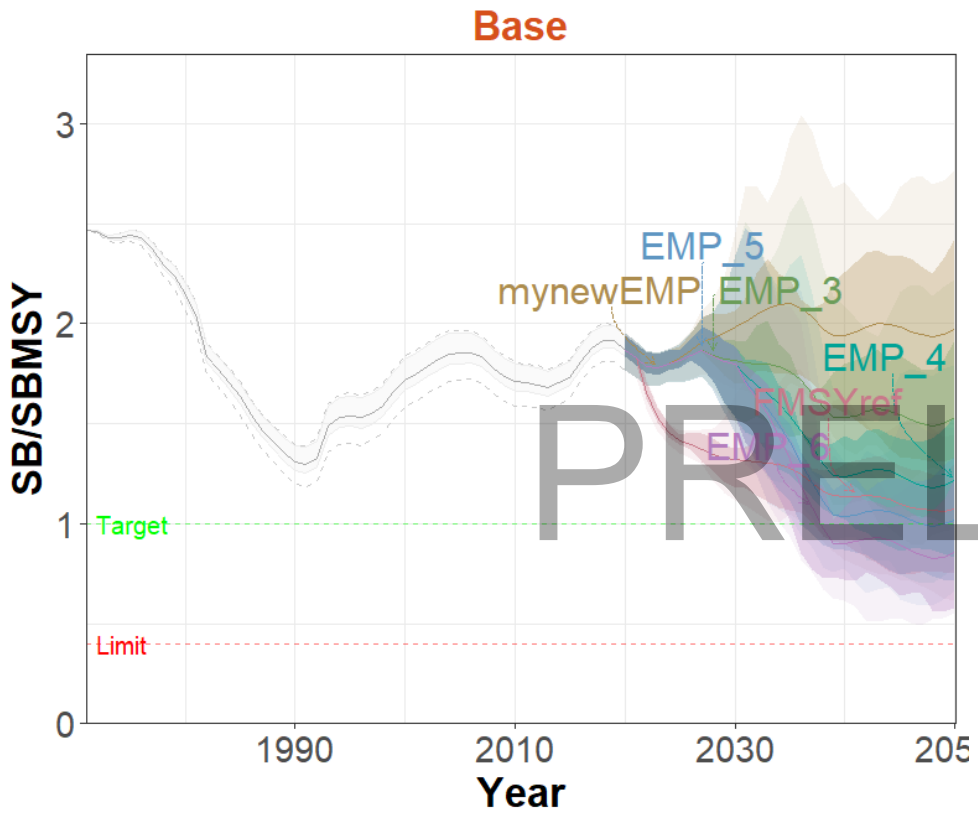
	M	Catch
OM1	base	base
OM2	0.8*base	1.25*base
OM3	0.8*base	0.8*base
OM4	1.25*base	1.25*base
OM5	1.25*base	0.8*base

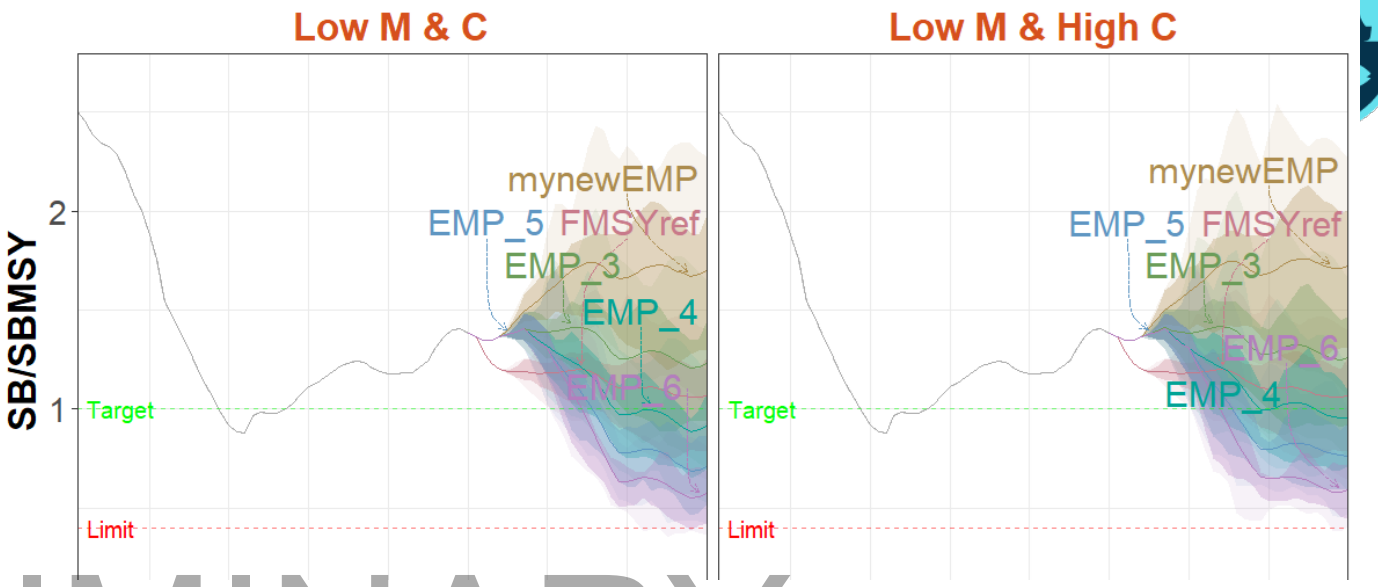
Visualizing Results

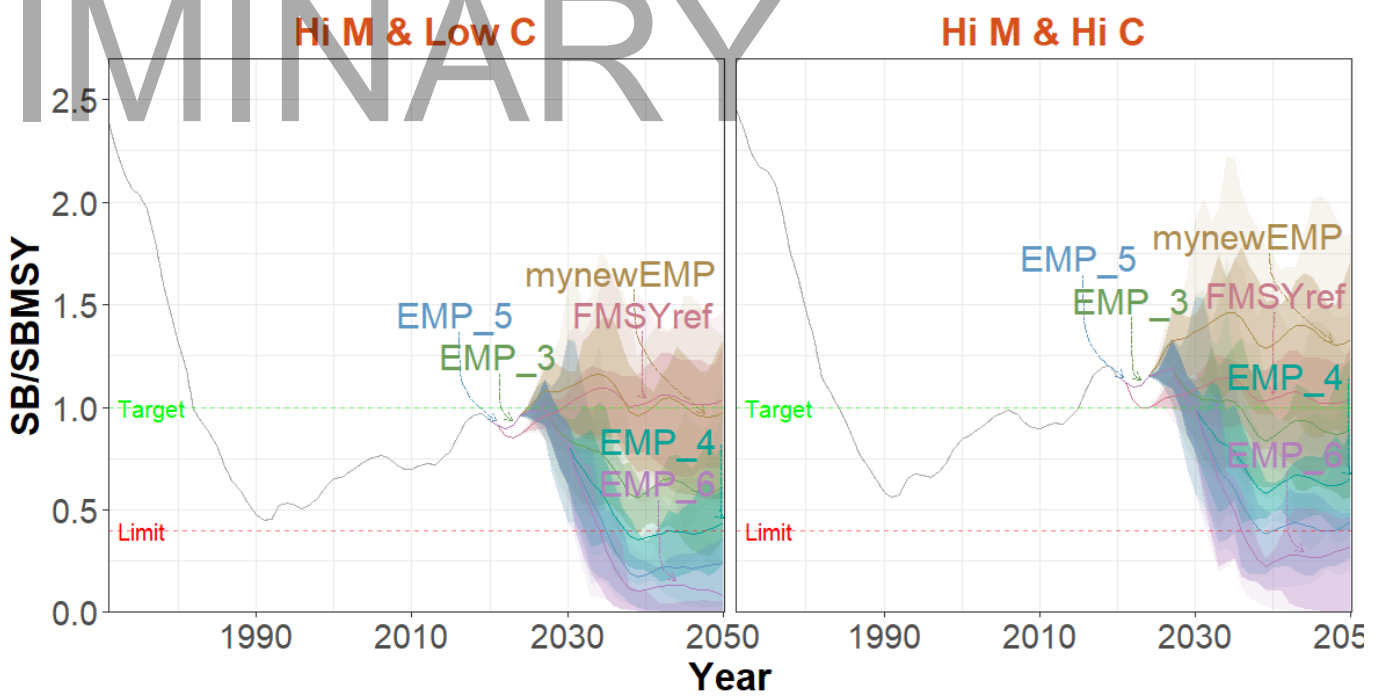
Slick Breakout Session

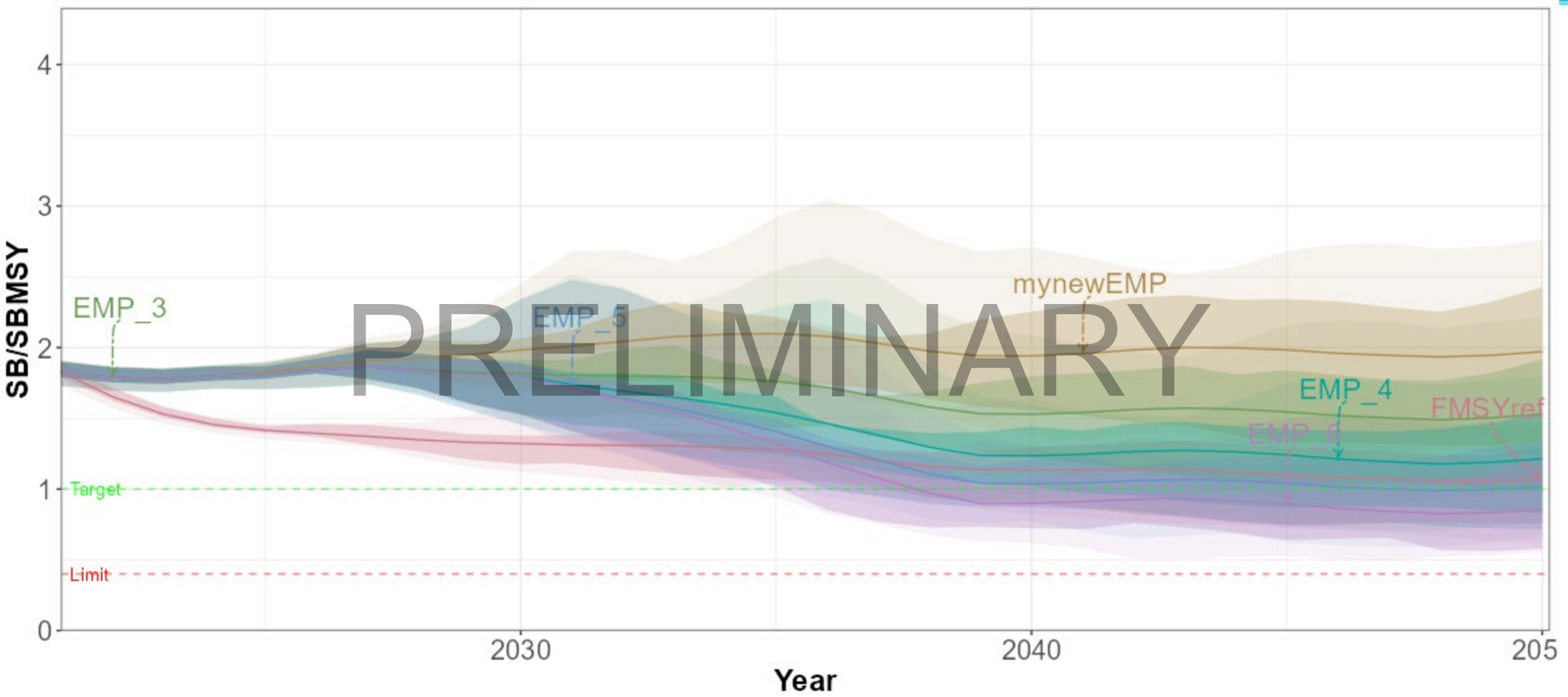

Mean values
FMSYref
mynewEMP
EMP_3
EMP_4
EMP_5
F/FMSY
P(F>FMSY)
0%
7.22%
55%
63.89%
66.28%
B/BMSY
P(B>BMSY)
55%
81.39%
51.67%
38.61%
34.17%
Yield
P(Catch>current)
53.06%
38.89%
50.28%
51.94%
50.56%
PRELIMINARY
Projection Year


Base
SB/SBMSY
3
2
1
0
Target
Limit
EMP_3
EMP_5
EMP_6
EMP_4
mynewEMP
FMSYref
PRELIMINARY
1990
2010
2030
205
Year









Candidate MP Performance

Time Series Plots - Biomass

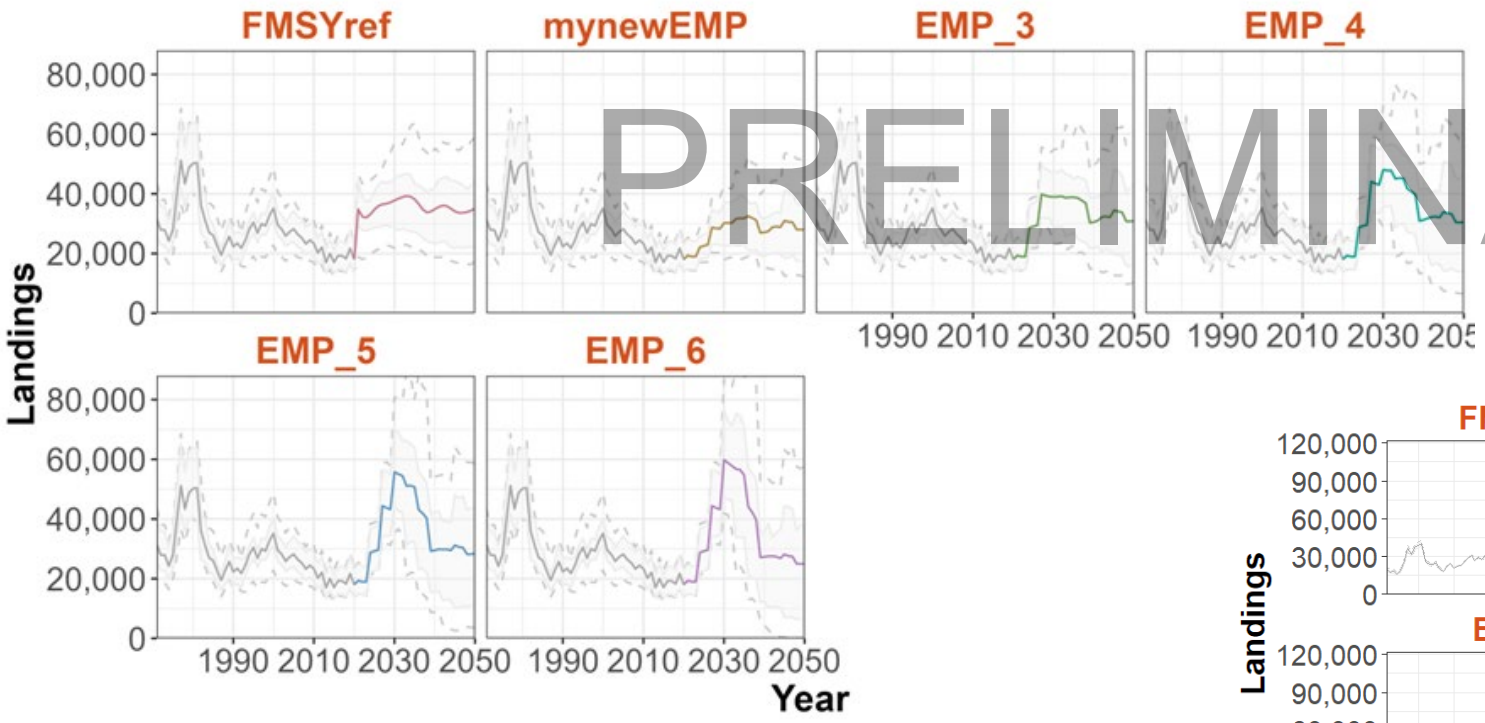
Mean values
LRP 40%BMSY, TRP = BMSY

SUMMARY OF RESULTS

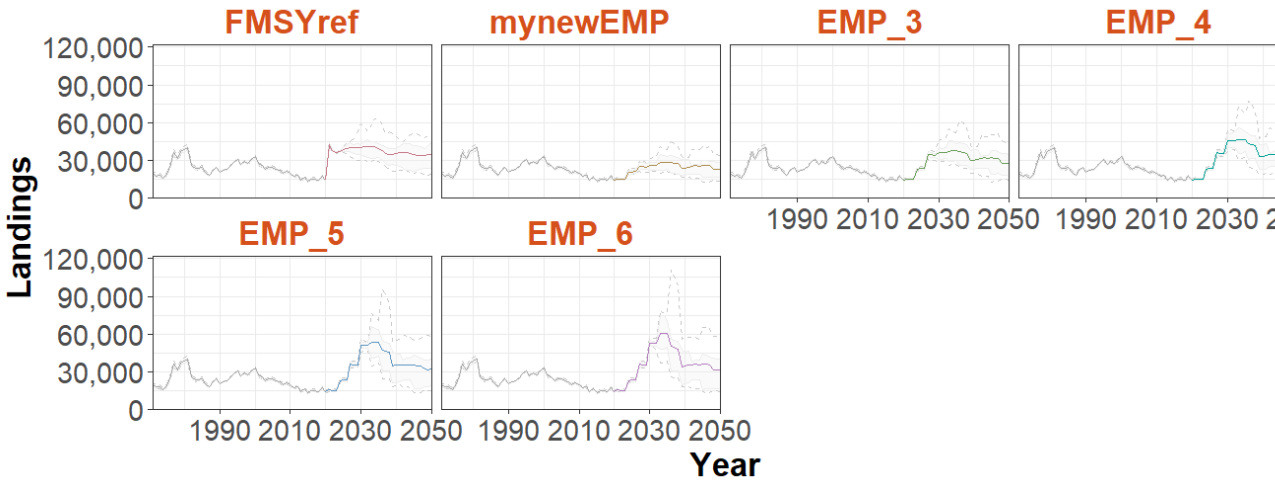
Landings Are Similar, but more variable with all OM's

Note Y axis scale differences

All OM's



Base Case OM.



Candidate MP Performance

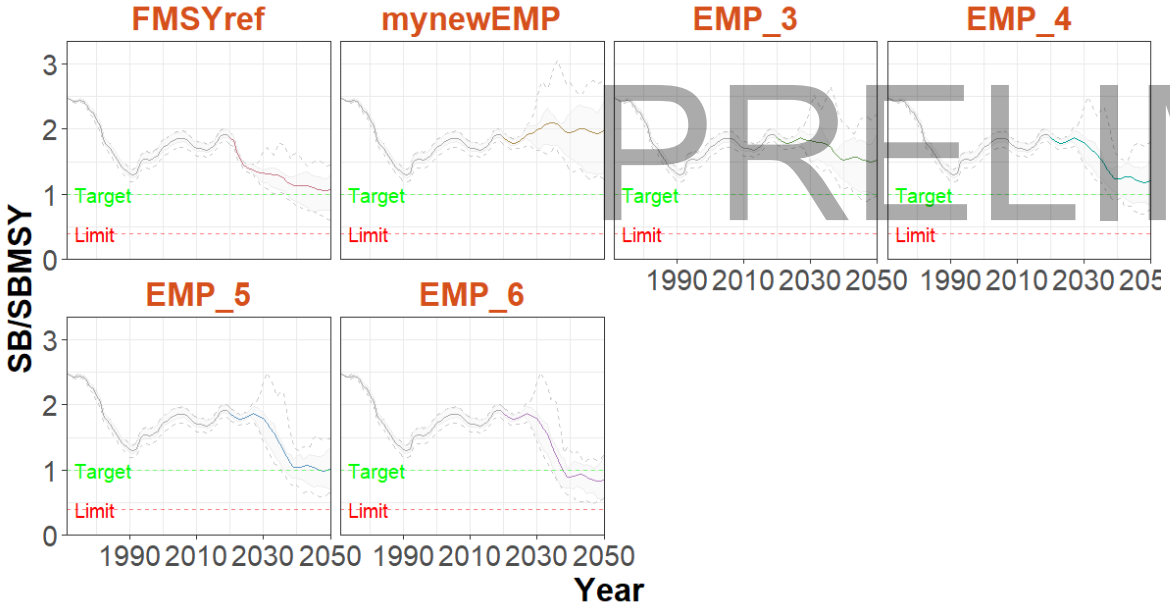
Time Series Plots - Yield

[add any necessary supplemental info: (e.g., Median values over 20-year projection (2020-2040))]

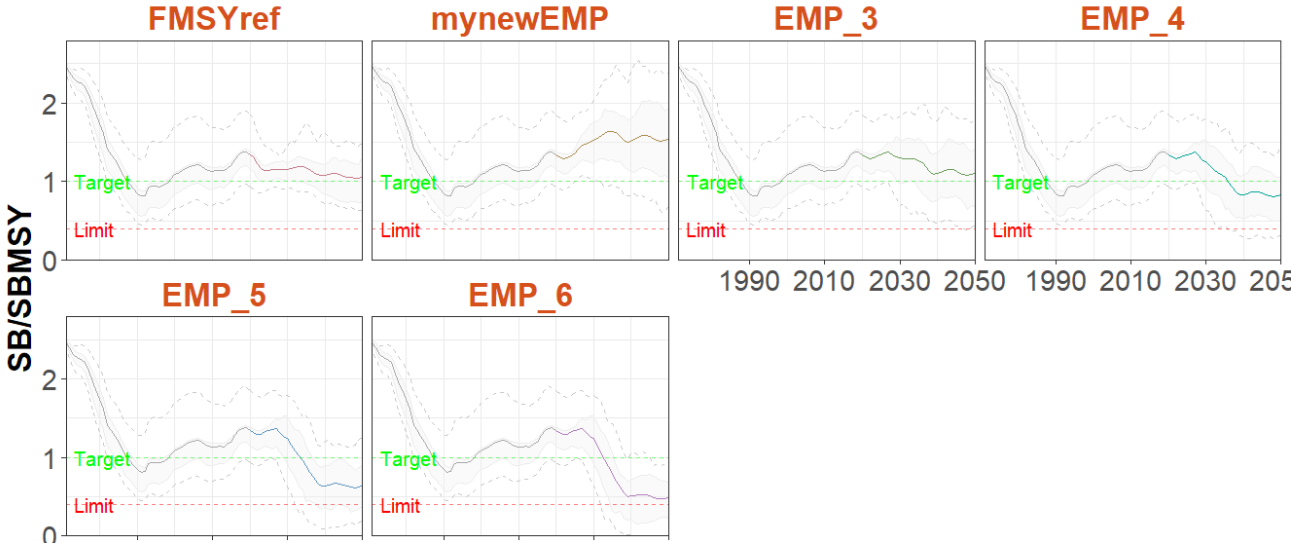
SUMMARY OF RESULTS

The combination of All OM's result in a overall more depleted stock showing that the range of the structural uncertainty results in a more depleted stock

Base Case



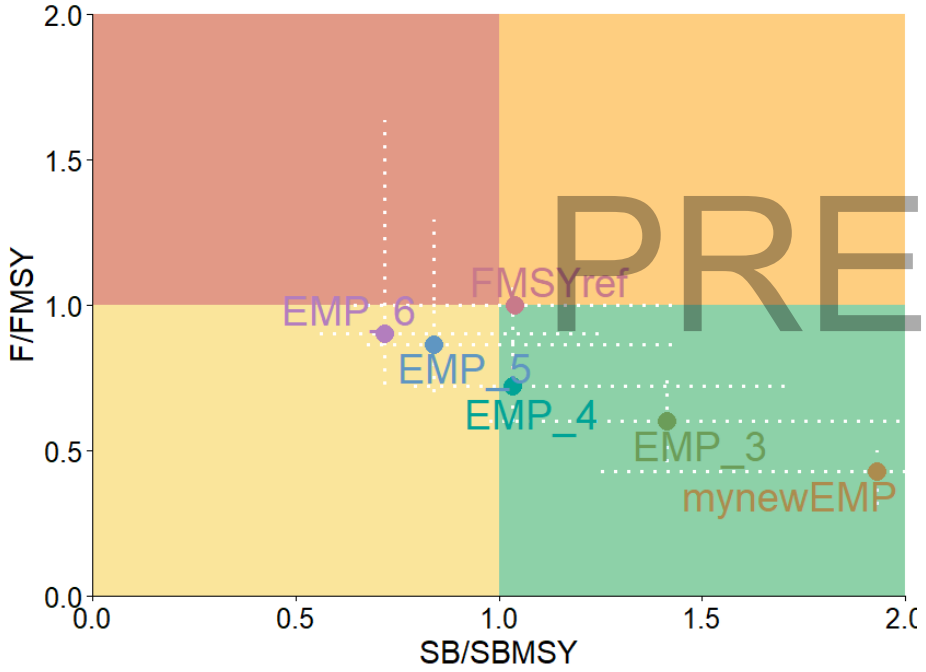
All OM's



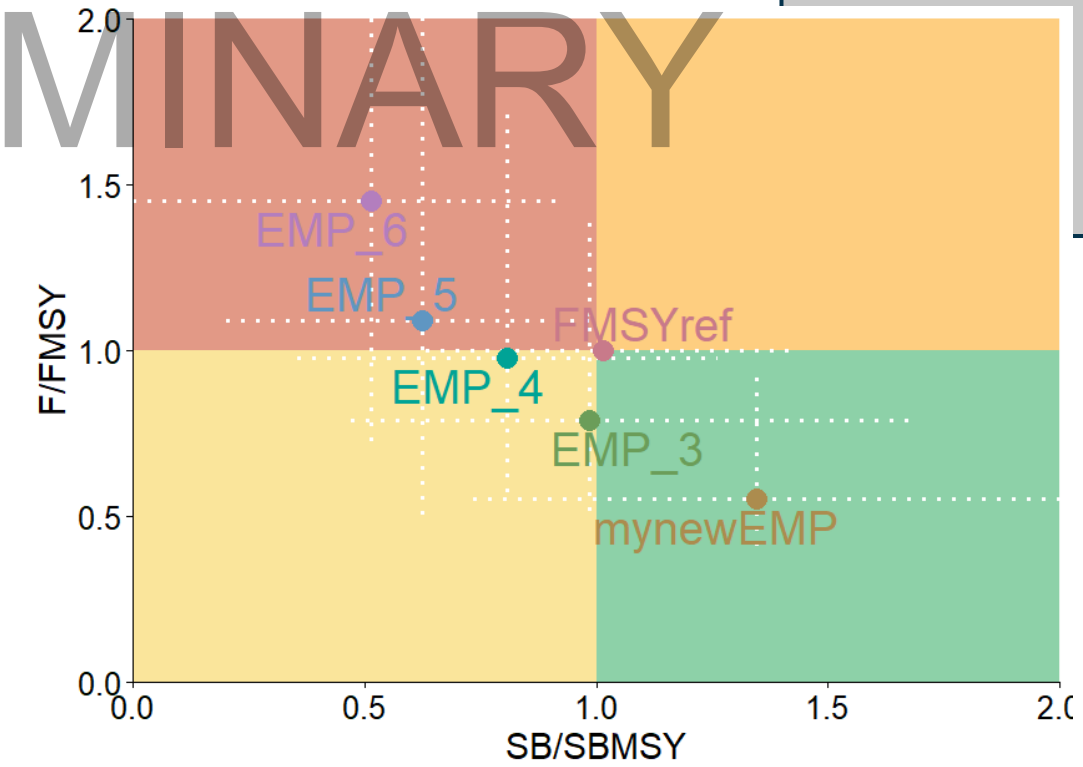
Candidate MP Performance

Kobe Plot

Base Case OM



All Oms (1:5)



SUMMARY OF RESULTS

Including variability in Catch and Natural mortality shifts the stock status to more depleted, with higher influence of fishing.

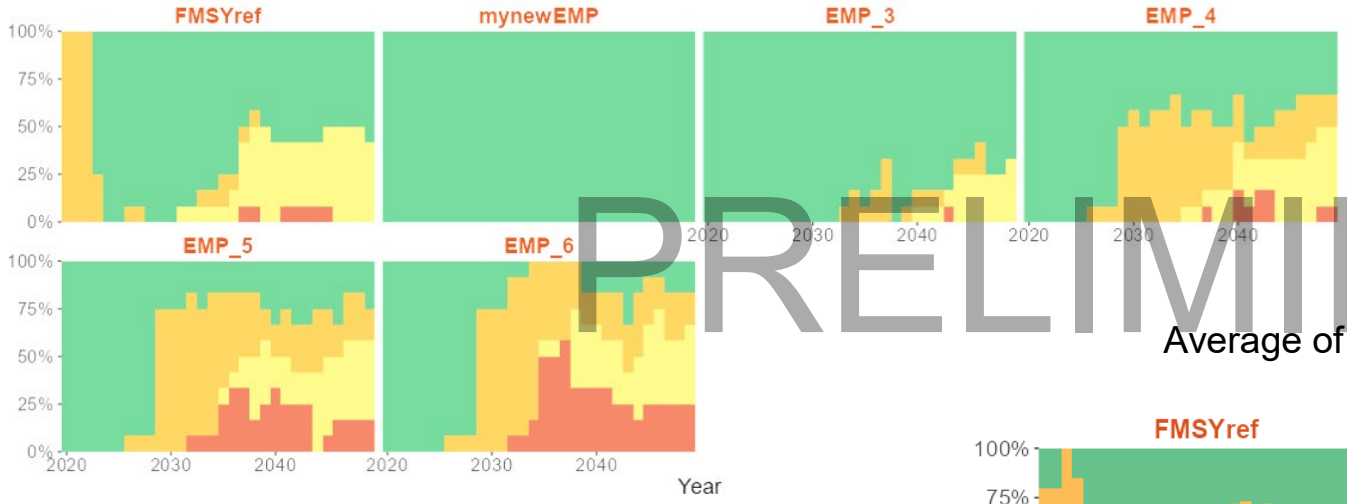
Candidate MP Performance

SUMMARY OF RESULTS

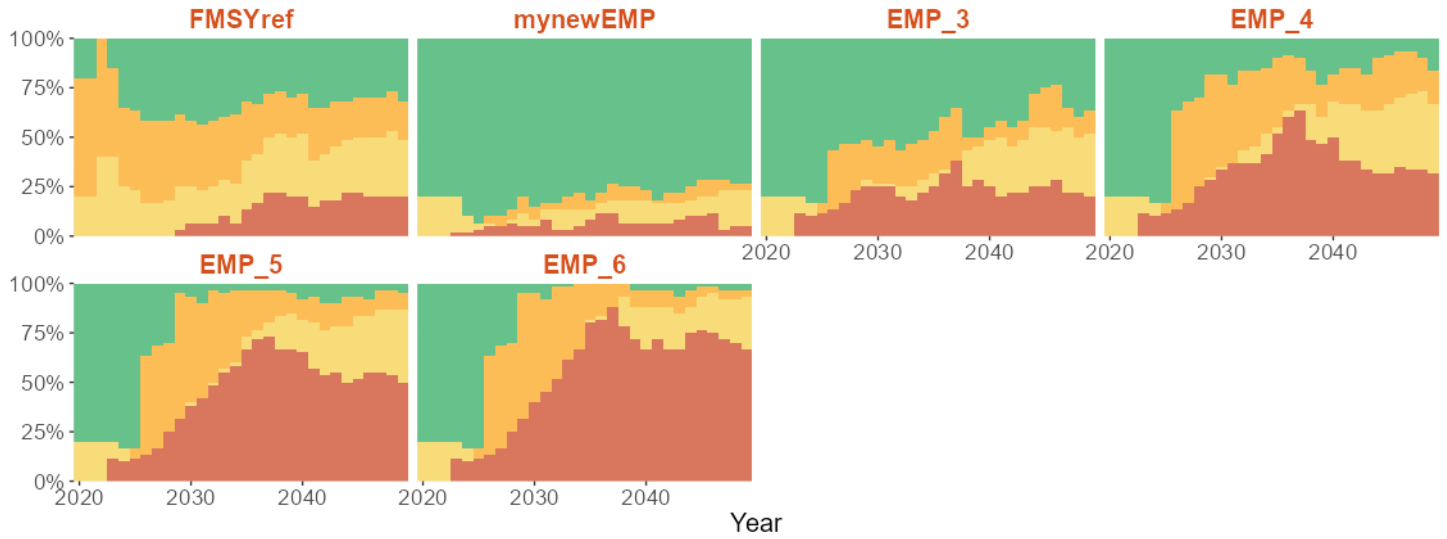
[insert summary of key takeaways]

Kobe Time Plot

Base Case OM



Average of OM 1:5



Candidate MP Performance

SUMMARY OF RESULTS

[insert summary of key takeaways]

Quilt Table

All OM's

SLC = sum of log catch
MLC = Mean Length of Catch

MP	Status	Safety	P100	PNOF	Catch_ST	Catch_LT	SLC	MLC
FMSYref	0.783	1.000	0.783	0.847	39,400	35,100	315	144
mynewEMP	1.000	1.000	1.000	1.000	21,000	24,900	301	148
EMP_3	0.883	1.000	0.933	0.947	25,700	30,700	307	147
EMP_4	0.597	1.000	0.850	0.714	27,100	33,600	310	145
EMP_5	0.458	1.000	0.747	0.594	27,600	34,400	311	144
EMP_6	0.386	0.994	0.683	0.528	27,800	34,700	312	143

Candidate MP Performance

SUMMARY OF RESULTS

[insert summary of key takeaways]

Quilt Table

SLC = sum of log catch
MLC = Mean Length of Catch

High M

MP	Status	Safety	P100	PNOF	Catch_ST	Catch_LT	SLC	MLC
FMSYref	0.511	1.000	0.471	1.000	29,400	31,200	308	144
mynewEMP	0.510	0.994	0.617	0.747	25,000	30,000	305	145
EMP_3	0.167	0.914	0.336	0.367	30,700	28,800	306	142
EMP_4	0.125	0.765	0.254	0.321	32,300	24,600	303	140
EMP_5	0.115	0.607	0.215	0.276	33,000	18,700	292	128
EMP_6	0.114	0.532	0.203	0.218	33,300	12,900	278	140

Low M

MP	Status	Safety	P100	PNOF	Catch_ST	Catch_LT	SLC	MLC
FMSYref	0.747	1.000	0.736	0.000	38,700	38,000	315	144
mynewEMP	0.990	1.000	0.990	0.999	24,600	30,200	306	147
EMP_3	0.696	1.000	0.843	0.808	31,800	36,500	312	145
EMP_4	0.319	1.000	0.660	0.449	35,100	38,600	314	144
EMP_5	0.246	0.996	0.525	0.357	36,200	38,100	315	142
EMP_6	0.231	0.944	0.457	0.310	36,800	36,600	315	141

Candidate MP Performance

SUMMARY OF RESULTS

[insert summary of key takeaways]

Quilt Table

SLC = sum of log catch
MLC = Mean Length of Catch

High Catch

MP	Status	Safety	P100	PNOF	Catch_ST	Catch_LT	SLC	MLC
FMSYref	0.686	1.000	0.643	0.500	42,500	42,700	319	144
mynewEMP	0.878	1.000	0.903	0.962	30,300	36,700	312	146
EMP_3	0.492	0.992	0.682	0.629	38,600	41,000	317	144
EMP_4	0.271	0.953	0.524	0.415	41,700	40,500	318	142
EMP_5	0.228	0.842	0.440	0.365	42,800	36,900	316	141
EMP_6	0.217	0.771	0.390	0.299	43,500	31,600	310	136

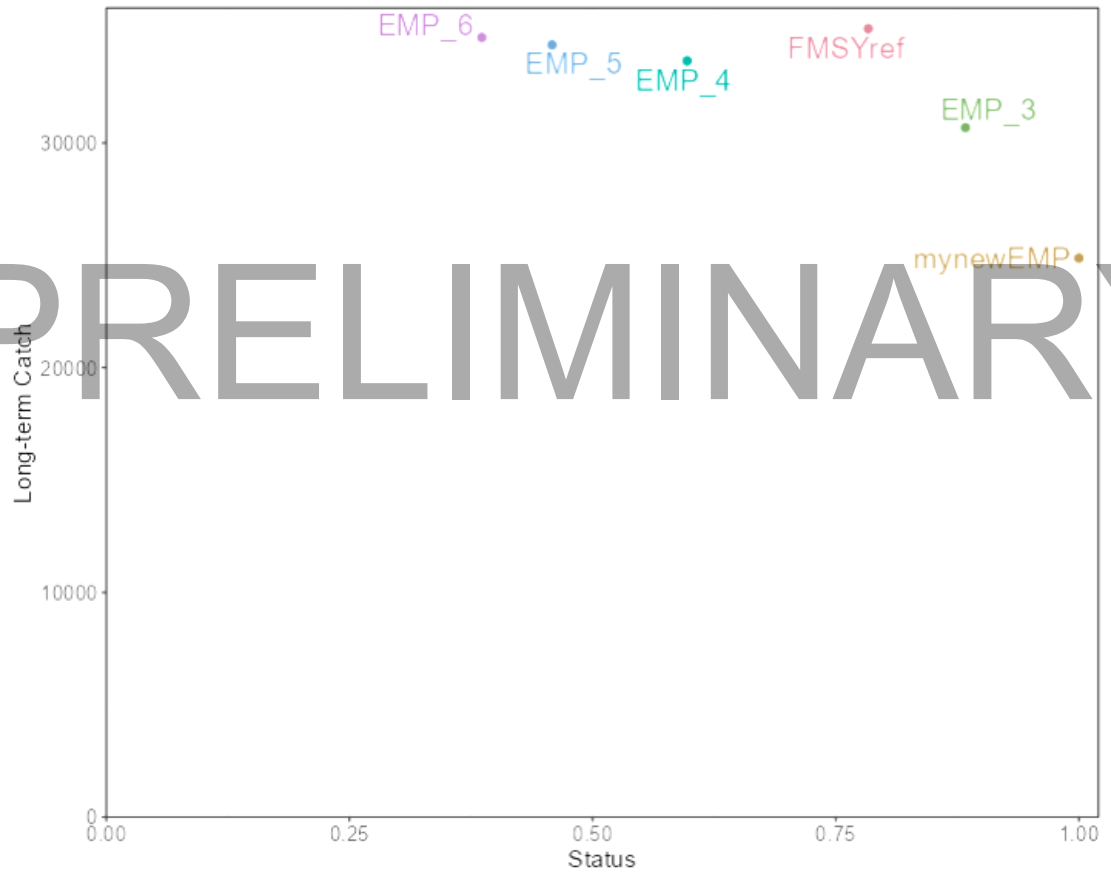
Low Catch

MP	Status	Safety	P100	PNOF	Catch_ST	Catch_LT	SLC	MLC
FMSYref	0.572	1.000	0.564	0.500	25,500	26,600	304	144
mynewEMP	0.622	0.994	0.704	0.783	19,300	23,400	298	146
EMP_3	0.371	0.922	0.497	0.546	24,000	24,400	301	143
EMP_4	0.174	0.812	0.390	0.354	25,600	22,700	300	140
EMP_5	0.133	0.761	0.300	0.268	26,300	20,000	292	130
EMP_6	0.128	0.706	0.269	0.229	26,700	17,900	284	146

Candidate MP Performance

Trade-off Plot

Status vs long-term catch



SUMMARY OF RESULTS

[insert summary of key takeaways]

Key Results and Considerations

Structural uncertainty for this stock indicated that if considered, all MPs would do 'worse'.

- *Need to refine OM's, critically evaluate the indices of abundance.*

Draft Workplan

NP BSH MSE Draft Project Plan_BSH MSE Workshop Oct 25.docx - Google Docs

PRELIMINARY

Questions from the group?