Indian Ocean Albacore Tuna Management Procedures Evaluation: Status Report.*

IOTC Technical Committee on Management Procedures – 18-19 May 2018

IOTC-2018-TCMP02-INF09

Summary of MSE work status

- An evaluation of Management Procedures (MPs) for Indian Ocean albacore tuna is being carried out. The analysis attempts to simulation-test a full MP, consisting on data collection, an agreed evaluation of stock status, and a decision rule.
- The base case Operating Model (OM) for albacore is being developed by the Working Party on Methods (WPM) with input from the Working Party on Temperate Tuna (WPTmT). The current base case has yet to be fully reviewed by either WP.
- Two types of MPs are being evaluated and presented here. They mainly differ in the method used to assess stock status: trends in the main CPUE series, or a surplus production stock assessment. Both depend on the availability of an index of abundance generated in a similar manner to what is currently being used by WPTmT for the albacore stock assessment. One of them also requires good estimates of total catches from all fleets.
- Further work on this MSE exercise will require resources to be made available for an external peer review. Resources for development, albeit limited by available staff time, are being provided by the European Commission's DG MARE and DG JRC.

Selection of MPs according to guidance from TCMP01 (2017)

The tuning objective refers to a key management objective that the MPs can achieve precisely (e.g. achieving $SB \geq SB_{MSY}$ with a 50% probability by 2024). The tuning objective normally relates to a desirable biomass (in terms of the risk of exceeding reference points and/or a rebuilding timeframe), and has a very strong influence on the obtainable yield (because biomass risk and attainable catch are closely related). Tuning ensures that candidate MPs are identical with respect to this high priority objective, making it easier to select among MPs on the basis of performance with respect to secondary management objectives (e.g. yield and catch stability). Ideally the Commission will have narrowed down the tuning objectives to 1 or 2 before selection.

The TCMP 2017 defined 4 interim tuning objectives for exploration:

- TB1: Pr(mean(SB(2019:2038)>=SB(MSY)) = 0.5. Average SB over the period 2019-2038 exceeds SB MSY in exactly 50% of the simulations).
- TB2: Pr(Kobe green zone 2019:2038) = 0.5. The stock status is in the Kobe green quadrant over the period 2019-2038 exactly 50% of the time (averaged over all simulations).
- TB3: Pr(Kobe green zone 2019:2038) = 0.6. The stock status is in the Kobe green quadrant over the period 2019-2038 exactly 60% of the time (averaged over all simulations).
- TB4: Pr(Kobe green zone 2019:2038) = 0.7. The stock status is in the Kobe green quadrant over the period 2019-2038 exactly 70% of the time (averaged over all simulations).

TCMP01 (2017) further recognized the desirability of other MP constraints:

- Total Allowable Catch (TAC) to be set every 3 years (and held constant between settings)
- A maximum of 15% change to the TAC (increase or decrease) relative to the previous TAC

*Iago MOSQUEIRA. European Commission, DG Joint Research Centre, Directorate D - Sustainable Resources, Unit D.02 Water and Marine Resources, Via E. Fermi 2749, 21027 Ispra VA, Italy. <iago.mosqueira@ec.europa.eu>

Evaluated Management Procedures

"M" class (model-based) MPs

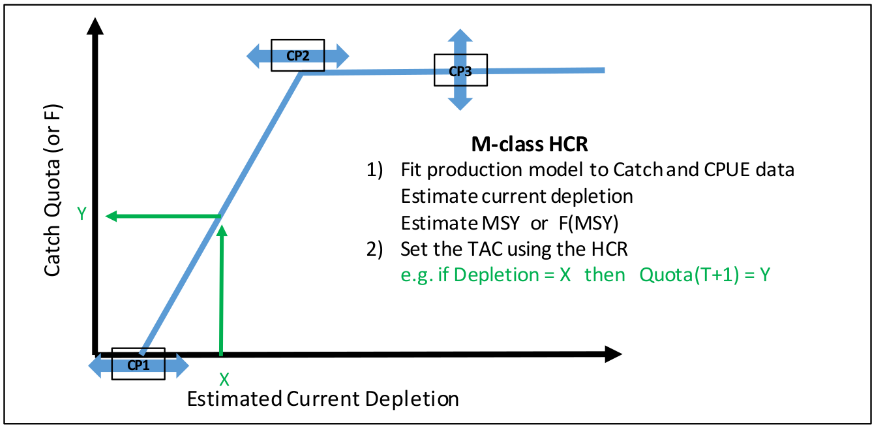


Figure 1: The model-based (M-class) MPs involve two steps: 1) fitting a simple surplus production model, and 2) applying a Harvest Control Rule (HCR) to the model estimates. The individual M-class MPs differ in terms of the Control Parameters (CP1-CP3) that define the shape of the HCR. In the examples presented here, a grid of possible values for the three parameters was created and the MP run for all of them. Those runs closest to the objectives, and according the limits chosen, were selected.

"D" class (data-based) MPs

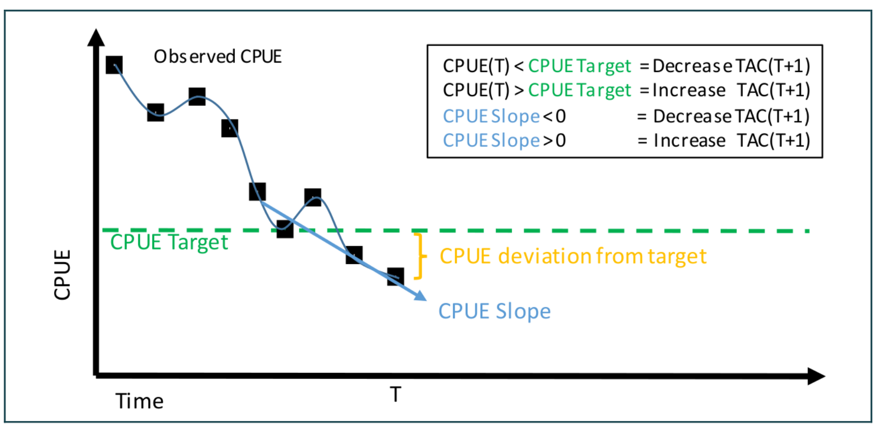


Figure 2: The data-based (D-class) MPs attempt to manage the fishery to achieve a target value of (standardized longline) CPUE. The next TAC is increased relative to the current TAC if current CPUE is above the target CPUE and the CPUE trend is increasing. Conversely, the next TAC is decreased relative to the current TAC if current CPUE is below the target CPUE and the CPUE trend is decreasing. If the CPUE location relative to the target and CPUE slope are in opposite directions, the TAC change could be in either direction, depending on the magnitude of these indicators, and the associated control parameters. Control parameters include: 1) the number of years in the CPUE slope calculation, 2) responsiveness to CPUE target deviation, 3) responsiveness to CPUE slope and 4) the CPUE target.

Management Procedures Labels

The first three characters of the candidate MP name correspond to the tuning objective and the final letter designates the model class, e.g. TB1.M: tuning = TB1 (above), model-based MP (below). Commonly, the tuning objective is more important than the MP type in determining management performance.

Results

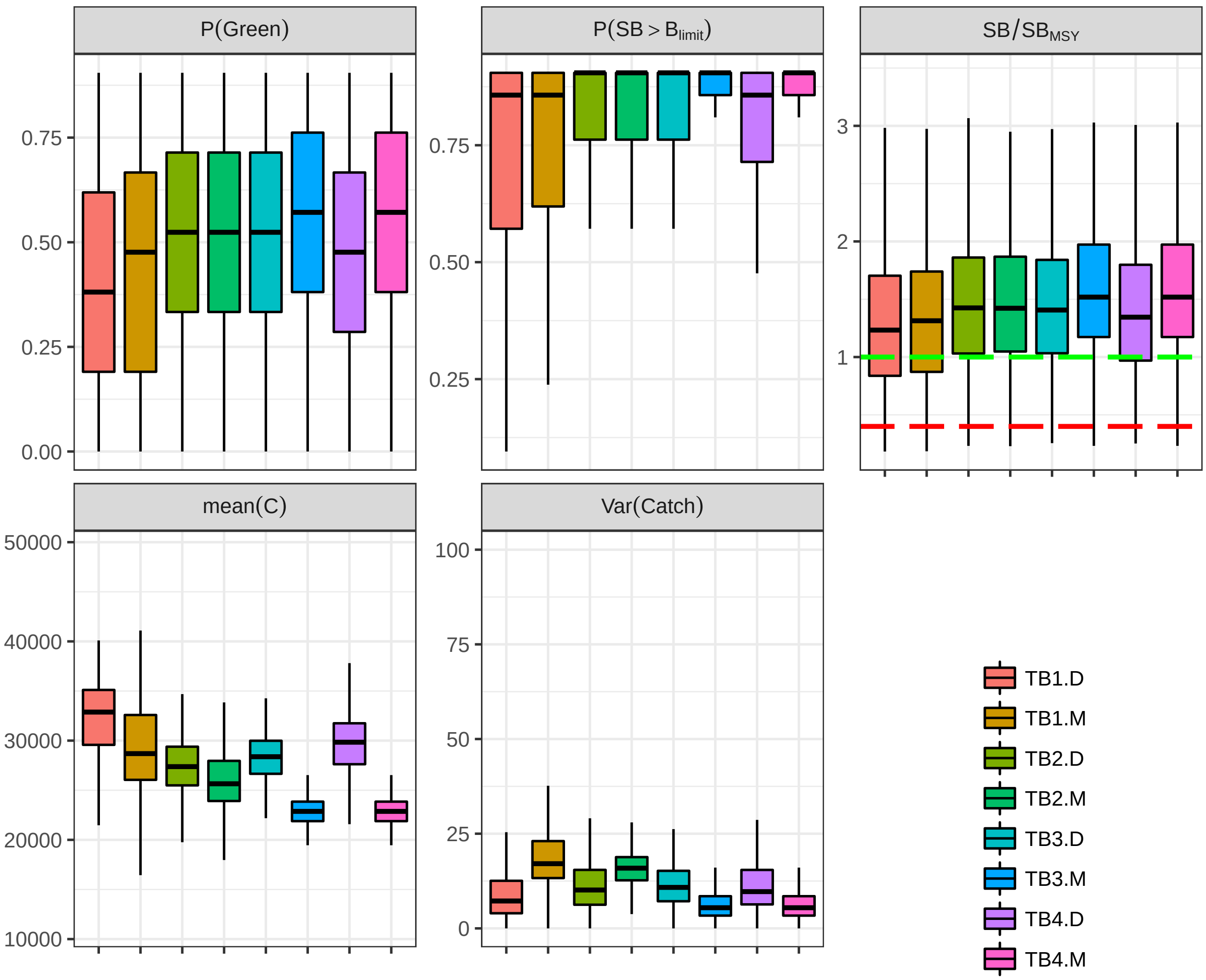


Figure 3: Comparison across MPs with respect to five key performance indicators averaged along the 2018-2038 period. Horizontal line is the median value, boxes show the 25th-50th percentiles, while thin lines present thew 10th-90th percentiles. Red and green dashed lines in the first panel show the interim limit and target reference points, respectively.

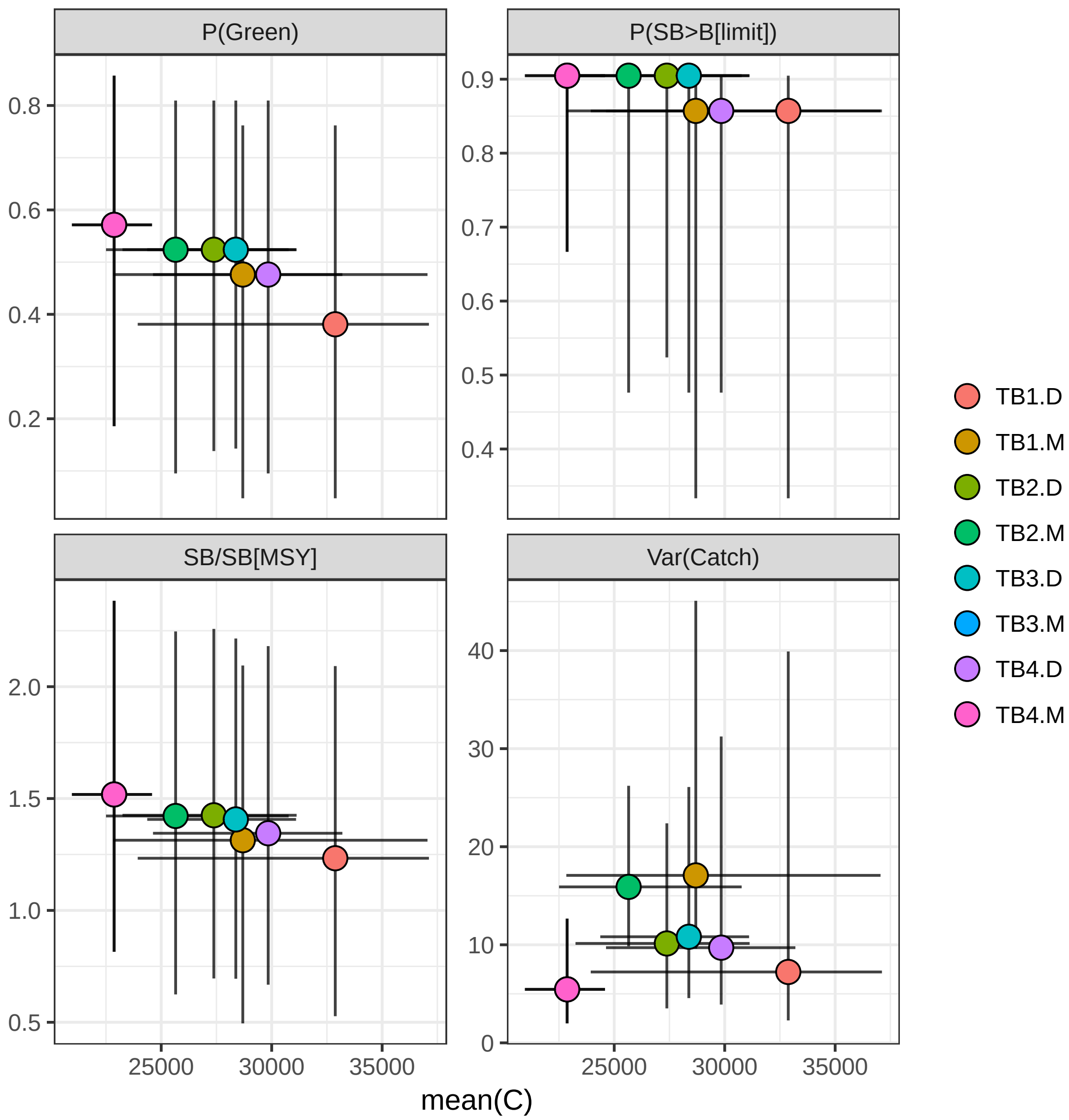


Figure 4: Comparison of trade-offs across multiple MPs for four key performance measures against mean catch over the 2019-2038 period. Circles point to the median value, while lines represent the 10th-90th percentiles. Red and green dashed lines show the interim limit and target reference points, respectively.

Table 1: Summarized performance of candidate MPs with respect to key indicators, averaged over the 2019-2038 period.

	MP	SB/SB_{MSY}	P(Green)	P(SB>B[limit])	mean(C)	Var(Catch)
1	TB1.D	1.23 (0.527-2.09)	0.41	0.73	32.88 (23.936-37.12)	14
2	TB1.M	1.31 (0.495-2.09)	0.44	0.74	28.69 (22.831-37.05)	22
3	TB2.D	1.43 (0.696-2.26)	0.5	0.8	27.38 (23.248-31.13)	13
4	TB2.M	1.42 (0.625-2.25)	0.5	0.79	25.65 (22.502-30.77)	18
5	TB3.D	1.41 (0.695-2.22)	0.5	0.79	28.38 (24.367-31.10)	14
6	TB3.M	1.52 (0.815-2.38)	0.55	0.83	22.87 (20.957-24.58)	7.7
7	TB4.D	1.34 (0.668-2.18)	0.47	0.78	29.84 (24.629-33.20)	14
8	TB4.M	1.52 (0.815-2.38)	0.55	0.83	22.87 (20.957-24.58)	7.7

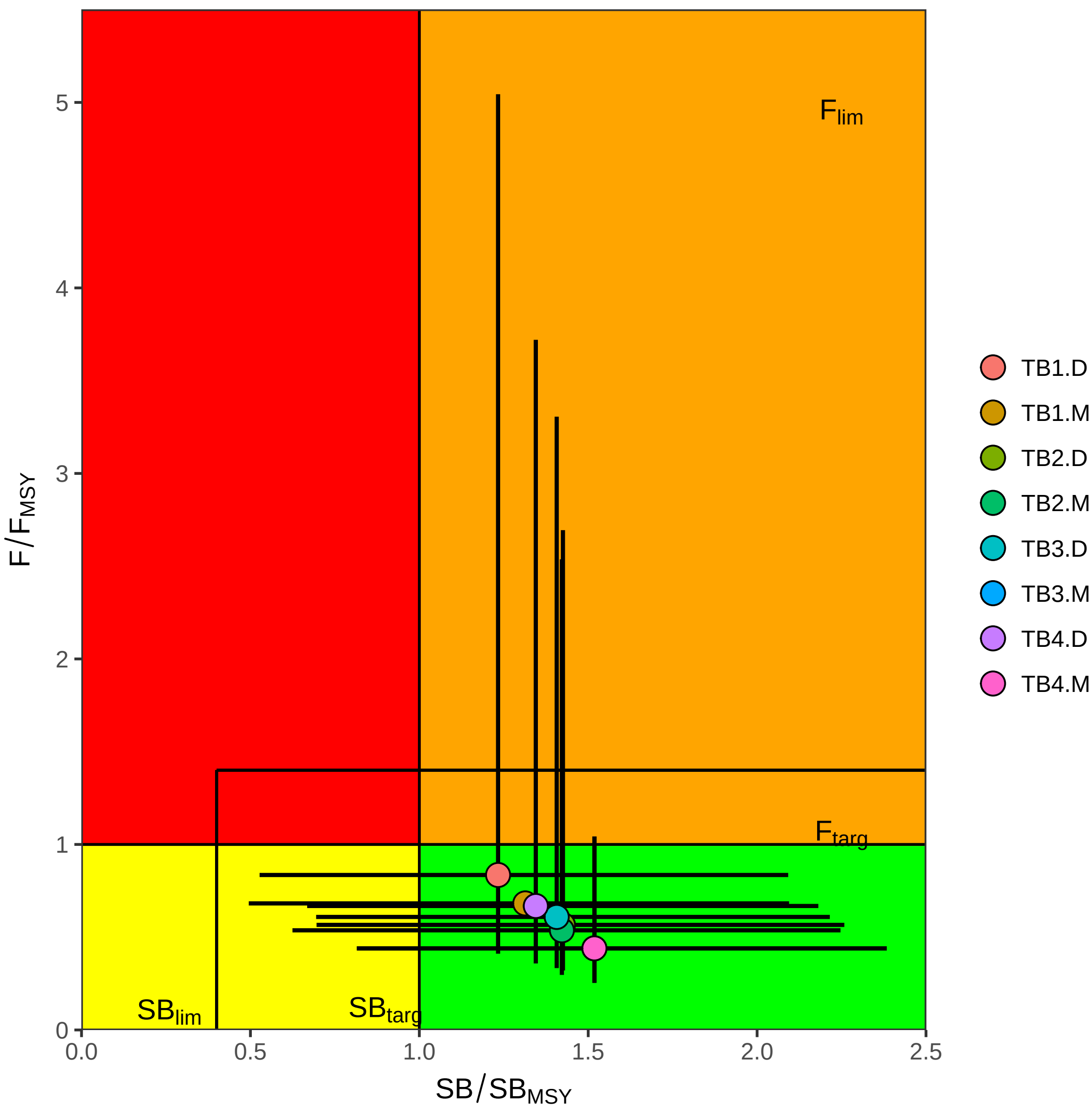


Figure 5: Kobe plot comparing candidate MPs for performance along the two Kobe axis and for the 2019-2038 period. Circles represent the median values while thin lines show the 10th-90th percentiles.

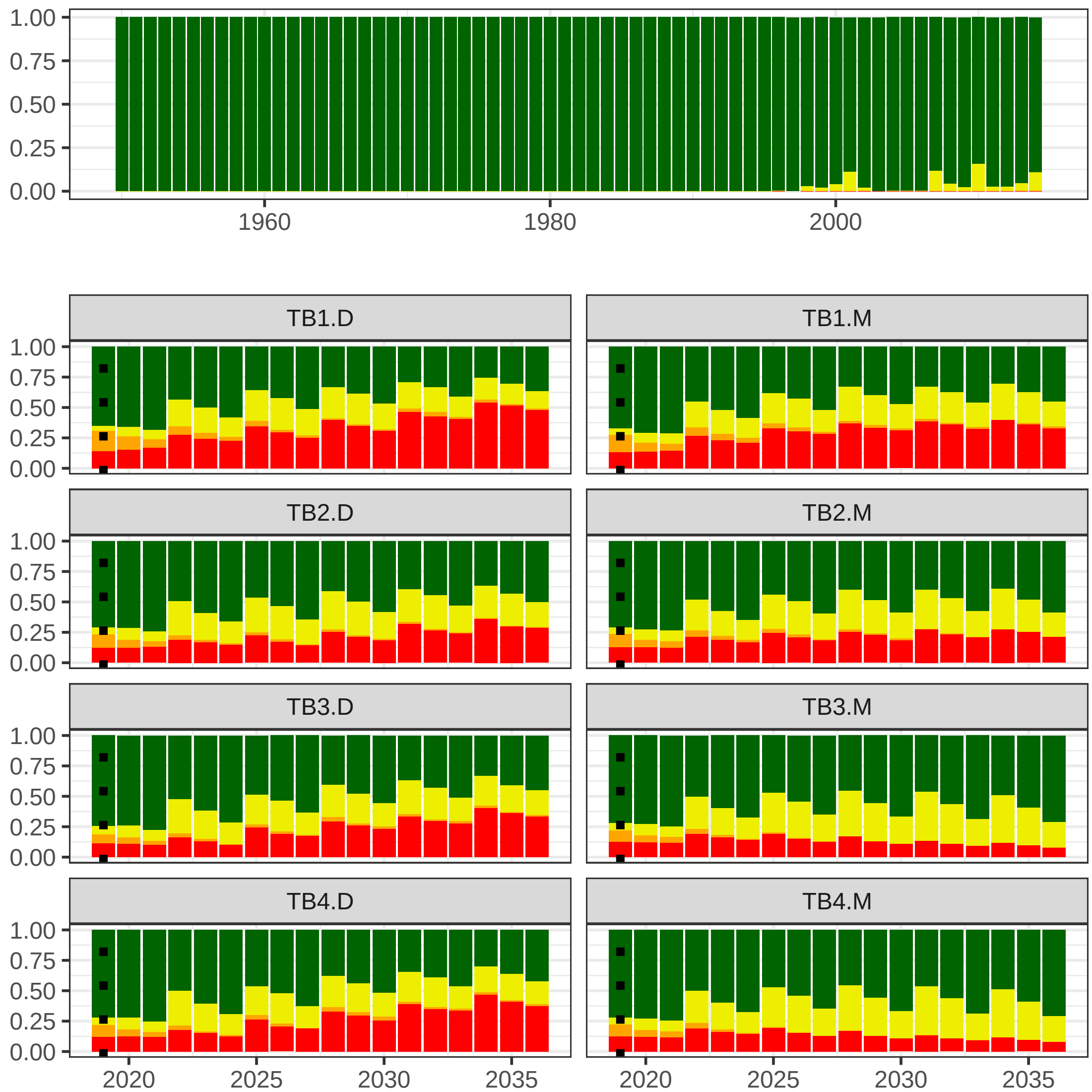
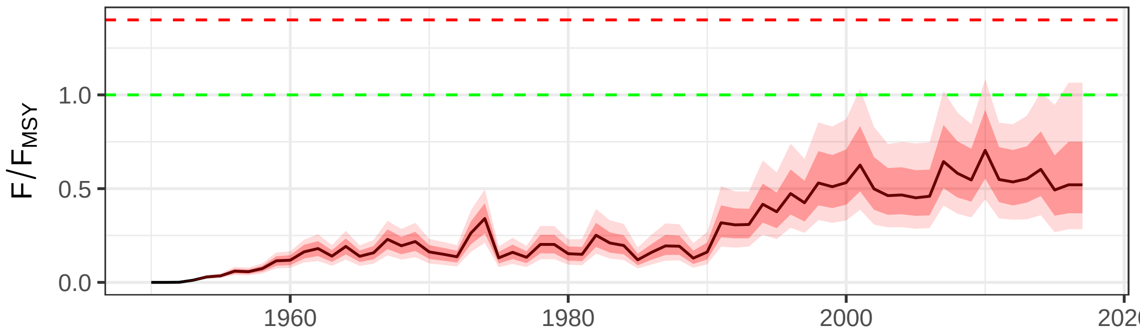
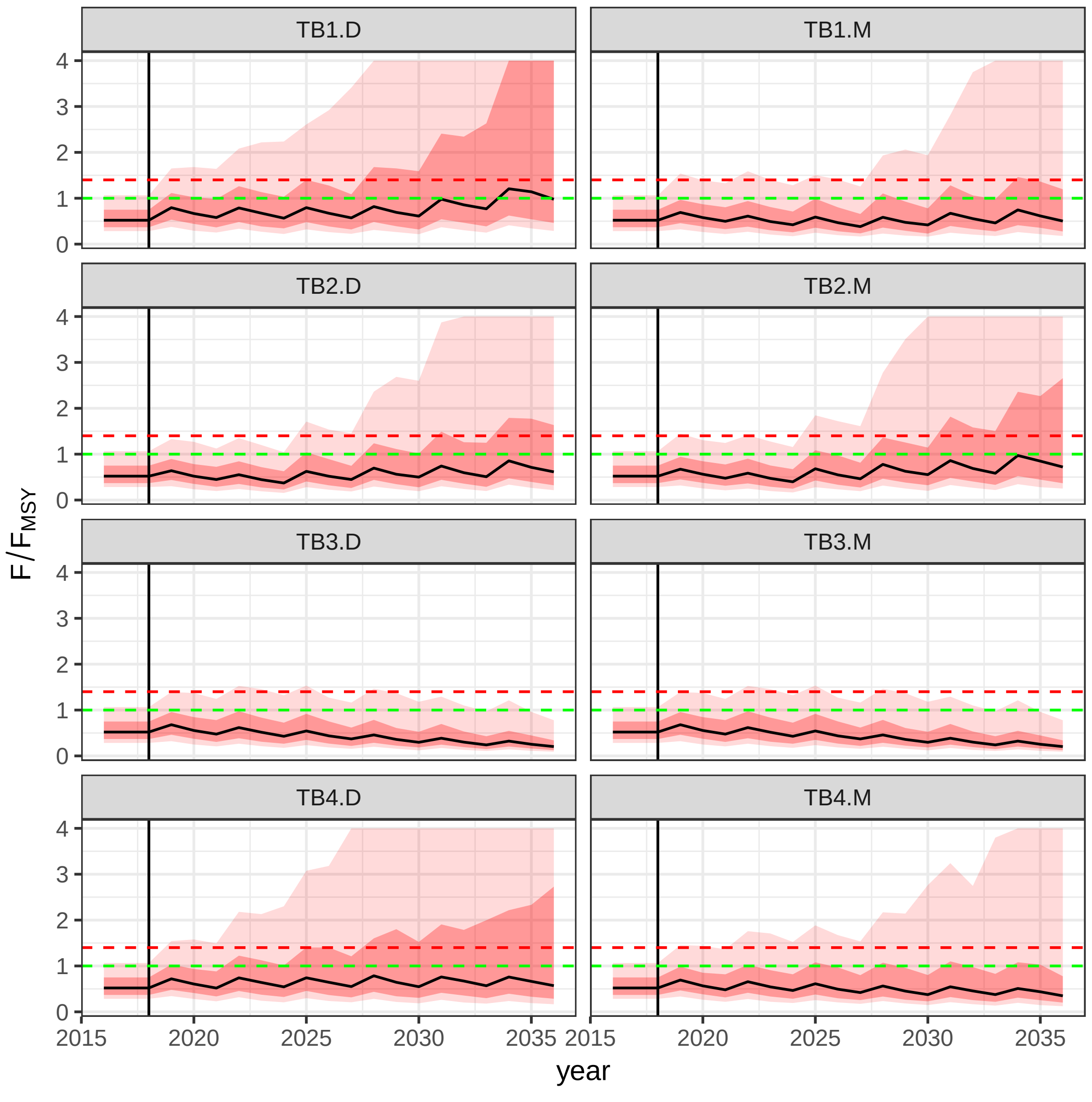
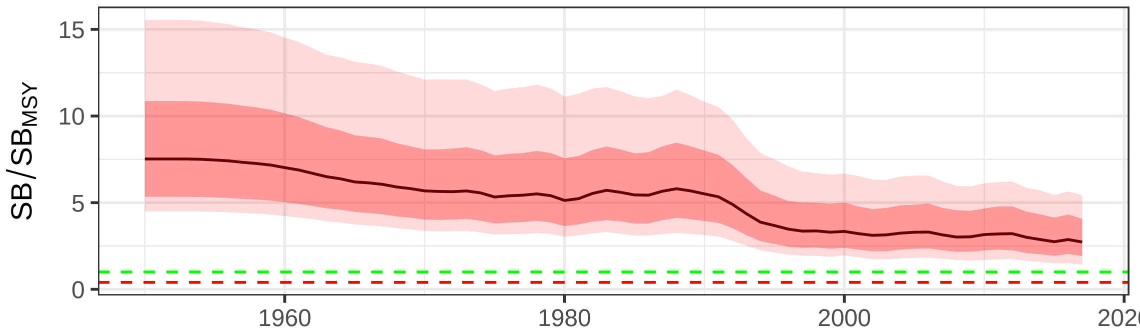
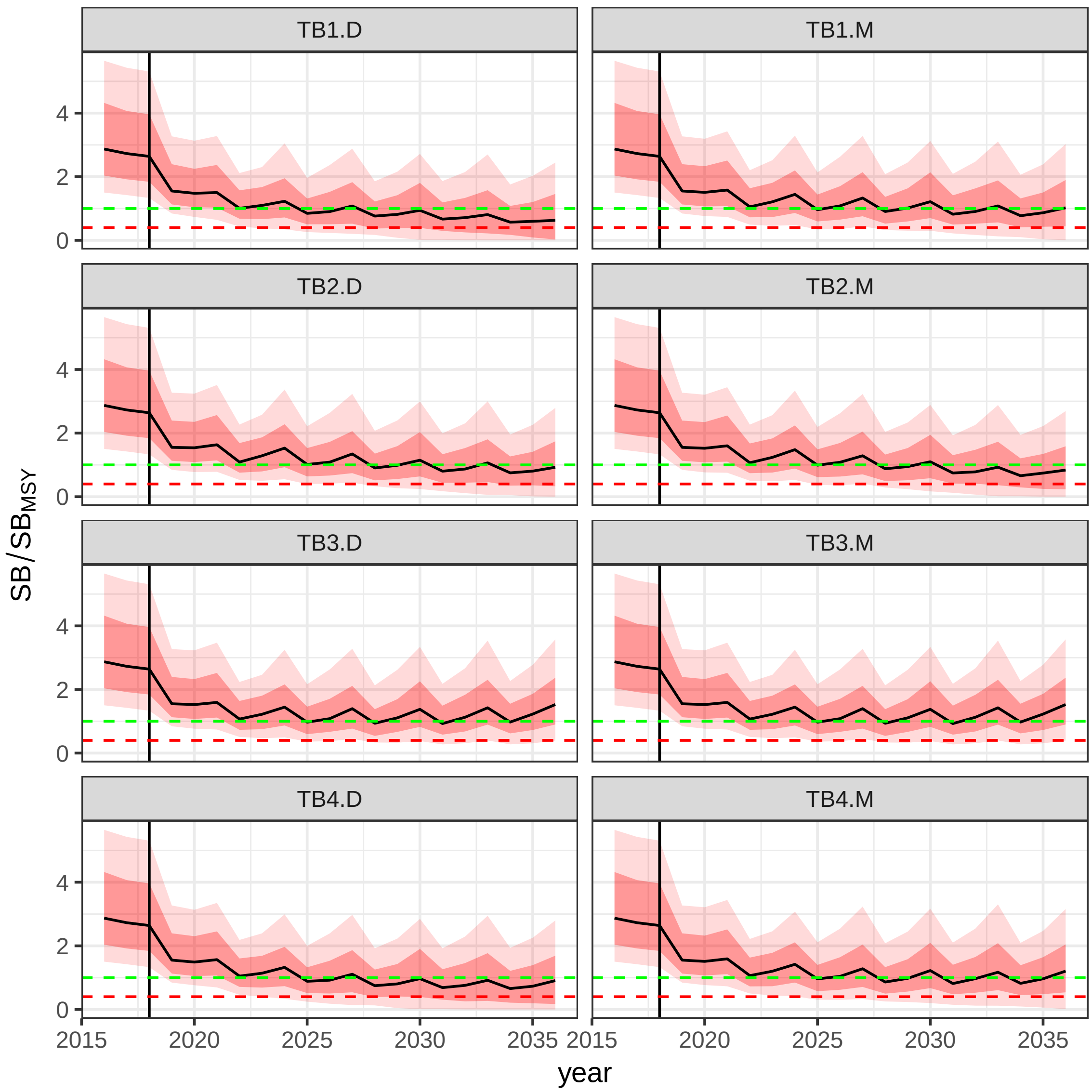


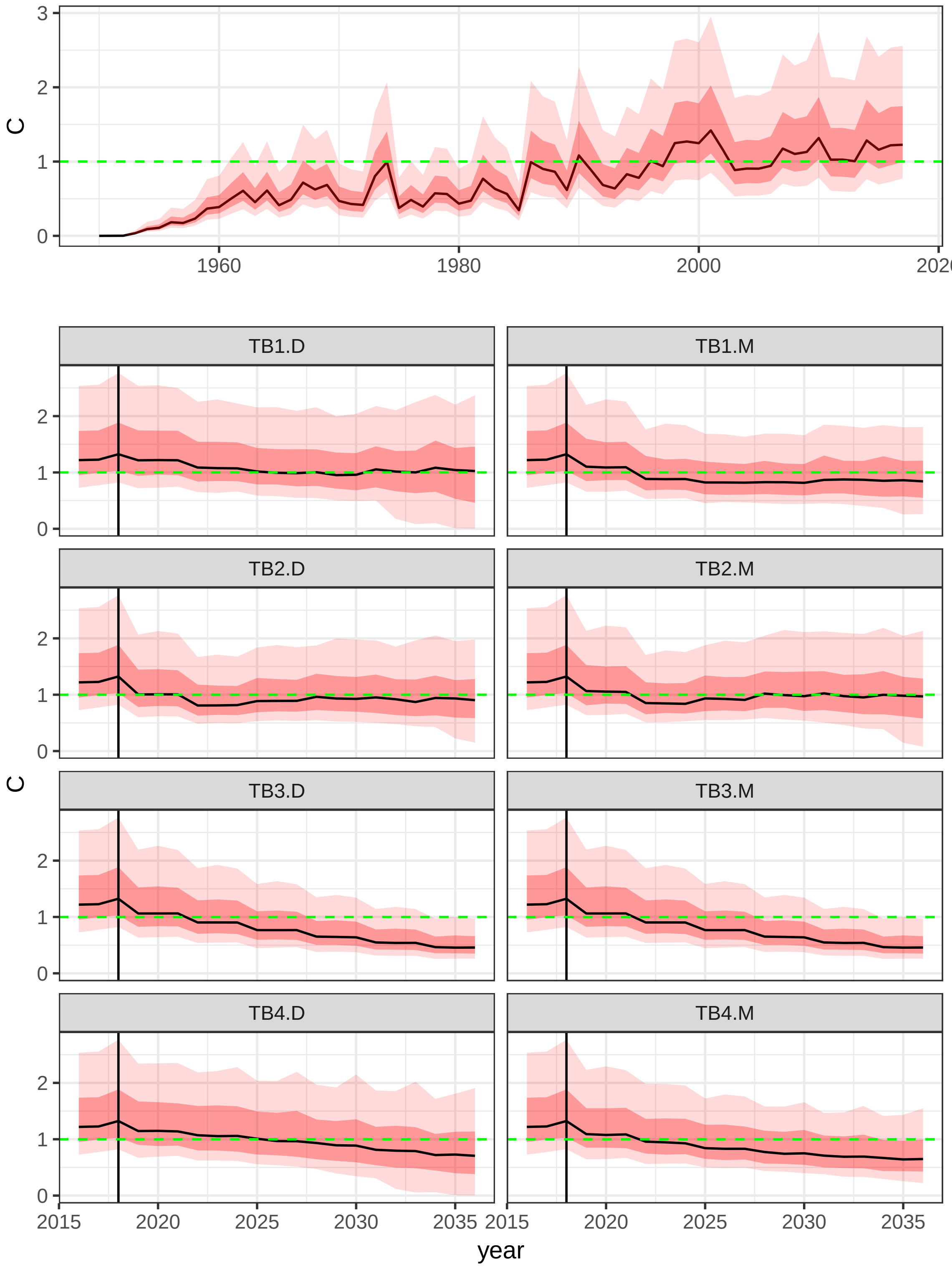
Figure 6: Proportion of simulations in each of the Kobe quadrants over time for each of the candidate MPs, starting in the first year of application of the MP, 2019.


F/F_MSY
1.0
0.5
0.0
1960
1980
2000
2020


TB1.D
TB1.M
TB2.D
TB2.M
TB3.D
TB3.M
TB4.D
TB4.M
F/F_MSY
4
3
2
1
0
2015
2020
2025
2030
2035
year


SB/SBMSY
15
10
5
0
1960
1980
2000
2020


TB1.D
TB1.M
TB2.D
TB2.M
TB3.D
TB3.M
TB4.D
TB4.M
SB/SBMSY
4
2
0
2015
2020
2025
2030
2035
year


C
0
1
2
3
1960
1980
2000
2020
TB1.D
TB1.M
TB2.D
TB2.M
TB3.D
TB3.M
TB4.D
TB4.M
2015
2020
2025
2030
2035
year

Indicator		5 years TB1.D	TB1.M	TB2.D	TB2.M	TB3.D	TB3.M	TB4.D	TB4.M
Catch variability	Var(Catch)	23.13	36.93	25.46	24.83	27.51	23.48	23.63	23.48
Mean absolute proportional change in catch	mean(deltaC)	0.97	0.98	0.94	0.95	0.93	0.94	0.94	0.94
Mean catch over years	mean(C)	35.61	34.51	31.89	32.42	29.96	31.54	31.08	31.54
Mean catch rate	mean(CR)	0.34	0.34	0.35	0.35	0.35	0.35	0.35	0.35
Mean fishing mortality relative to FMSY	F/F[MSY]	0.70	0.66	0.60	0.60	0.54	0.59	0.58	0.59
Mean fishing mortality relative to target	F/F[target]	0.70	0.66	0.60	0.60	0.54	0.59	0.58	0.59
Mean proportion of MSY	C/MSY	1.38	1.33	1.23	1.25	1.15	1.21	1.19	1.21
Mean spawner biomass relative to unfished	SB/SB[0]	0.34	0.34	0.35	0.35	0.35	0.35	0.35	0.35
Mean spawnwer biomass relative to SBMSY	SB/SB[MSY]	1.73	1.75	1.77	1.77	1.79	1.78	1.79	1.78
Minimum spawner biomass relative to unfished	min(SB/SB[0]	0.16	0.16	0.17	0.17	0.17	0.17	0.17	0.17
Probability of SB greater or equal to SBMSY	P(SB>=SB[MSY])	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17
Probability of being in Kobe green quadrant	P(Green)	0.67	0.67	0.83	0.67	0.83	0.83	0.83	0.83
Probability of being in Kobe red quadrant	P(Red)	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Probability of fishery shutdown	P(shutdown)	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Probability that spawner biomass is above 0.20 unfished	P(SB>0.20SB0)	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0.83
Probability that spawner biomass is above Blim	P(SB>B[limit])	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00

		10 years							
Indicator		TB1.D	TB1.M	TB2.D	TB2.M	TB3.D	TB3.M	TB4.D	TB4.M
Catch variability	Var(Catch)	10.76	20.30	18.76	18.14	20.11	11.90	19.95	11.90
Mean absolute proportional change in catch	mean(deltaC)	0.99	1.00	0.98	0.97	0.98	0.95	0.99	0.95
Mean catch over years	mean(C)	33.32	32.11	28.69	29.14	28.45	27.73	29.54	27.73
Mean catch rate	mean(CR)	0.28	0.29	0.30	0.30	0.31	0.31	0.31	0.31
Mean fishing mortality relative to FMSY	F/F[MSY]	0.71	0.67	0.57	0.58	0.55	0.53	0.59	0.53
Mean fishing mortality relative to target	F/F[target]	0.71	0.67	0.57	0.58	0.55	0.53	0.59	0.53
Mean proportion of MSY	C/MSY	1.28	1.25	1.11	1.13	1.10	1.06	1.14	1.06
Mean spawner biomass relative to unfished	SB/SB[0]	0.28	0.29	0.30	0.30	0.31	0.31	0.31	0.31
Mean spawnwer biomass relative to SBMSY	SB/SB[MSY]	1.46	1.52	1.58	1.56	1.61	1.59	1.58	1.59
Minimum spawner biomass relative to unfished	min(SB/SB[0]	0.11	0.11	0.12	0.12	0.13	0.13	0.12	0.13
Probability of SB greater or equal to SBMSY	P(SB>=SB[MSY])	0.36	0.36	0.27	0.36	0.27	0.27	0.27	0.27
Probability of being in Kobe green quadrant	P(Green)	0.55	0.64	0.64	0.64	0.64	0.64	0.64	0.64
Probability of being in Kobe red quadrant	P(Red)	0.09	0.09	<0.001	<0.001	<0.001	<0.001	0.09	<0.001
Probability of fishery shutdown	P(shutdown)	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Probability that spawner biomass is above 0.20 unfished	P(SB>0.20SB0)	0.64	0.64	0.73	0.73	0.73	0.73	0.73	0.73
Probability that spawner biomass is above Blim	P(SB>B[limit])	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00

		20 years							
Indicator		TB1.D	TB1.M	TB2.D	TB2.M	TB3.D	TB3.M	TB4.D	TB4.M
Catch variability	Var(Catch)	7.23	17.08	10.14	15.91	10.82	5.46	9.70	5.46
Mean absolute proportional change in catch	mean(deltaC)	1.01	1.02	1.01	0.99	1.01	0.95	1.01	0.95
Mean catch over years	mean(C)	32.88	28.69	27.38	25.65	28.38	22.87	29.84	22.87
Mean catch rate	mean(CR)	0.23	0.25	0.27	0.27	0.27	0.29	0.26	0.29
Mean fishing mortality relative to FMSY	F/F[MSY]	0.84	0.68	0.57	0.54	0.61	0.44	0.67	0.44
Mean fishing mortality relative to target	F/F[target]	0.84	0.68	0.57	0.54	0.61	0.44	0.67	0.44
Mean proportion of MSY	C/MSY	1.25	1.13	1.05	1.01	1.08	0.88	1.14	0.88
Mean spawner biomass relative to unfished	SB/SB[0]	0.23	0.25	0.27	0.27	0.27	0.29	0.26	0.29
Mean spawnwer biomass relative to SBMSY	SB/SB[MSY]	1.23	1.31	1.43	1.42	1.41	1.52	1.34	1.52
Minimum spawner biomass relative to unfished	min(SB/SB[0]	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Probability of SB greater or equal to SBMSY	P(SB>=SB[MSY])	0.53	0.47	0.42	0.39	0.42	0.37	0.45	0.37
Probability of being in Kobe green quadrant	P(Green)	0.38	0.48	0.52	0.52	0.52	0.57	0.48	0.57
Probability of being in Kobe red quadrant	P(Red)	0.19	0.10	0.05	0.05	0.07	<0.001	0.10	<0.001
Probability of fishery shutdown	P(shutdown)	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Probability that spawner biomass is above 0.20 unfished	P(SB>0.20SB0)	0.43	0.48	0.57	0.57	0.57	0.62	0.52	0.62
Probability that spawner biomass is above Blim	P(SB>B[limit])	0.86	0.86	0.90	0.90	0.90	0.90	0.86	0.90