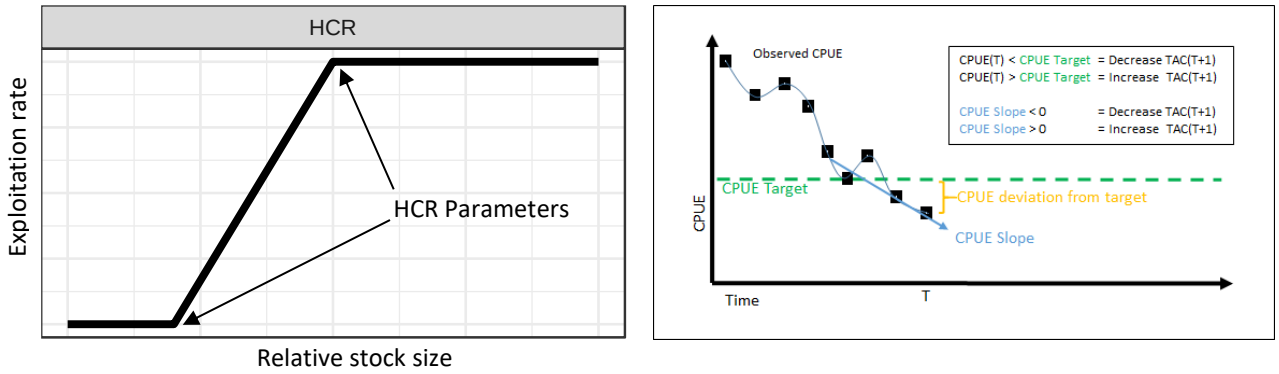
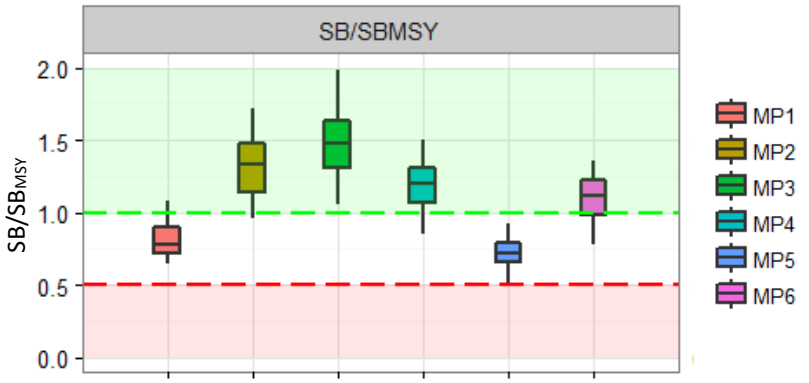
PRESENTATION OF MANAGEMENT STRATEGY EVALUATION RESULTS

Figure 1. Harvest Control Rule (HCR)



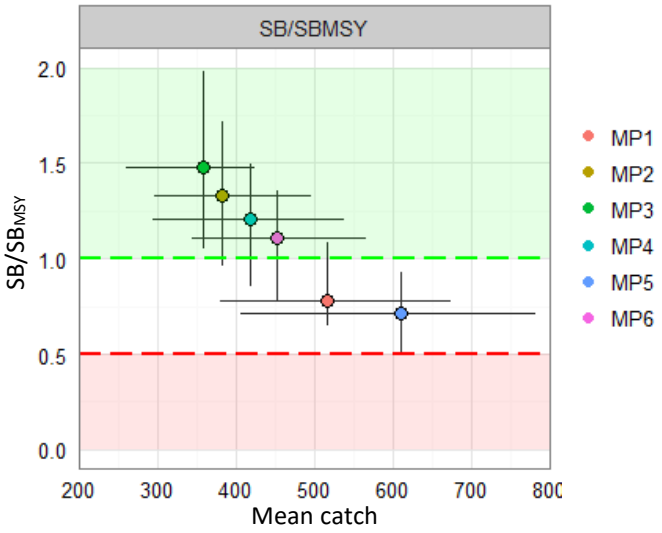
Examples of two different types of harvest control rules: Biomass-based HCR relating exploitation rate to relative stock size (left), and cpue-based HCR relating observed cpue to a target level cpue. (right).

Figure 2. Boxplot comparing performance of Management Procedures (MPs)



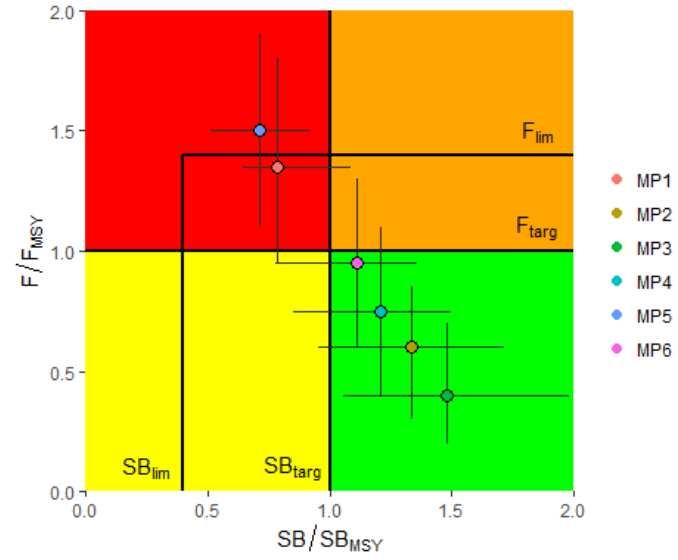
This example boxplot compares the performance of 6 MPs against SB/SB_{MSY}. Each data point represents the median over the last 20 years of the projection period as the horizontal line, 25th - 75th percentiles as coloured bars, and 5th -95th percentiles as thin lines. Limit and target reference points are indicated by red and green dashed lines respectively.

Figure 3. Trade-off plot comparing performance of Management Procedures (MPs)



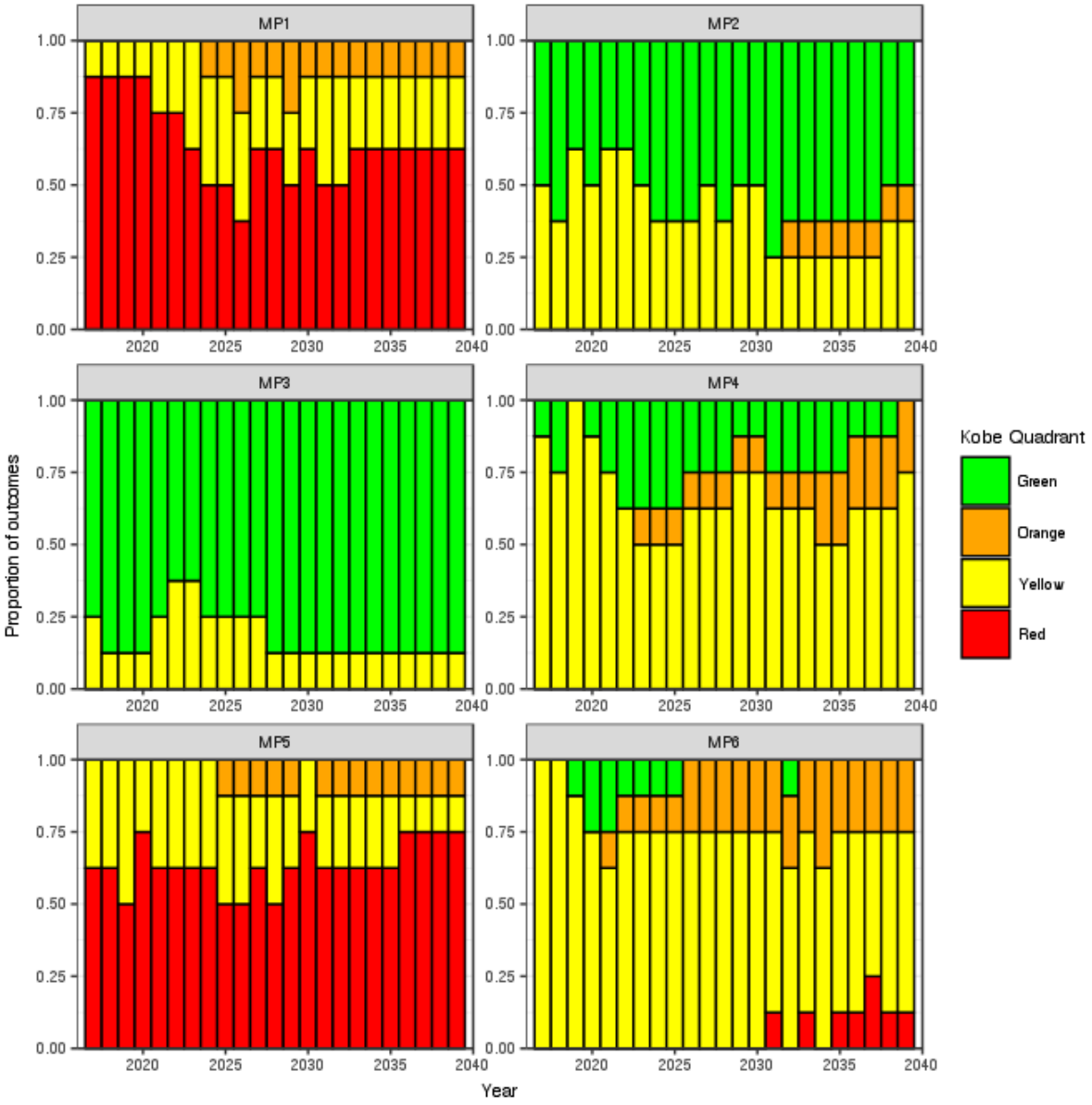
This example trade-off plot indicates the trade-offs in performance of 6 management procedures (MPs) between catch and SB/SB_{MSY}. Each data point represents the median over the last 20 years of the projection period and the errors bars represent 5th and 95th percentiles. Limit and target reference points are indicated by red and green dashed lines respectively.

Figure 4. Kobe plot comparing Management Procedures (MPs) against B_{MSY} and F_{MSY} reference points



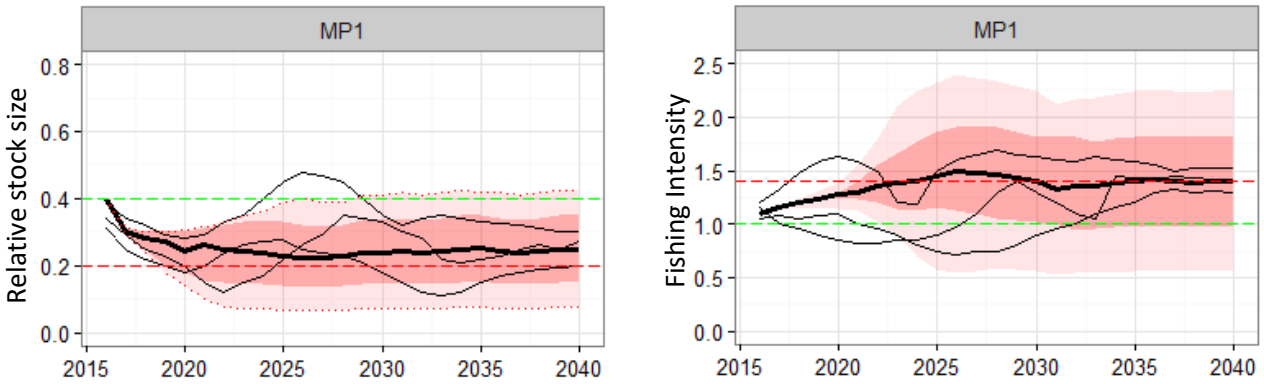
This example Kobe plot compares 6 management procedures (MPs) against performance measures for SB/SB_{MSY} and F/F_{MSY}. Each data point represents the median in the final year of the projection period and the error bars represent the 95th percentiles. Target (SB_{targ} and F_{targ}) and limit (SB_{lim} and F_{lim}) reference points are indicated by black lines.

Figure 5. Plot comparing Management Procedures (MPs) against proportion of runs in each of the Kobe quadrants over-time



This example plot compares six management procedures (MPs) against proportion of runs in each of the Kobe quadrants (green, orange, yellow and red) in each projection year over from 2016 to 2040.

Figure 4. Time series projections for the performance of Management Procedures (MPs)



These example time series plots indicate the performance of 1 MP against the stock size (left) and fishing intensity (right) performance measures projected over the years 2016-2040. The median is represented by the bold black lines, a dark ribbon shades the 25th - 75th percentile region and a light ribbon shades the 10th - 90th percentile region. Three additional thin black lines show individual realizations.

Table 1. Summary table of performance of Management Procedures (MPs). Performance of 6 MPs against 5 performance measures averaged over the last 20 years of the projection period. Shading indicates the relative performance for each MP (dark = better, light = worse).

Management Procedure	**Performance Measure**				
	SB/SB_{MSY}	Probability(Green)	Probability(SB>limit)	Mean Catch	Catch variability
MP1	0.78	0.05	0.84	516	0.16
MP2	1.33	0.94	0.96	383	0.28
MP3	1.48	0.96	1	358	0.3
MP4	1.21	0.84	0.93	419	0.22
MP5	0.72	0	0.71	611	0.1
MP6	1.11	0.61	0.91	452	0.21

Table 2a. Hypothetical example of MSE outputs comparing the performance of 6 management procedures (MPs) against all IOTC performance measures for in the first projection year.

Status : maximize stock status		1 year					
		MP1	MP2	MP3	MP4	MP5	MP6
1. Mean spawner biomass relative to pristine	SB/SB_0	0.5	0.8	0.9	0.7	0.4	0.6
2. Minimum spawner biomass relative to pristine	SB/SB_0	0.3	0.6	0.6	0.5	0.2	0.4
3. Mean spawner biomass relative to SB_{MSY}	SB/SB_{MSY}	0.8	1.3	1.4	1.2	0.7	1.1
4. Mean fishing mortality relative to target	F/F_{tar}	1.4	0.6	0.4	0.8	1.5	0.9
5. Mean fishing mortality relative to F_{MSY}	F/F_{MSY}	1.4	0.6	0.4	0.8	1.5	0.9
6. Probability of being in Kobe green quadrant	SB,F	0.5	0.9	1	0.8	0.3	0.7
7. Probability of being in Kobe red quadrant	SB,F	0.3	0.1	0	0.1	0.5	0.2
Safety : maximize the probability of remaining above low stock status (i.e. minimize risk)							
8. Probability of spawner biomass being above 20% of SB_0	SB	0.8	0.9	0.9	0.8	0.7	0.8
9. Probability of spawner biomass being above B_{Lim}	SB	0.8	1.0	1.0	0.9	0.7	0.9
Yield : maximize catches across regions and gears							
10. Mean catch (1'000 t)	C	520	390	350	430	600	460
11. Mean catch by region and/or gear (1'000 t)	C	250	200	180	210	310	220
12. Mean catch relative to MSY	C/MSY	1.1	0.7	0.6	0.8	1.2	0.9
Abundance: maximize catch rates to enhance fishery profitability							
13. Mean catch rates (by region and gear) (for fisheries with meaningful catch-effort relationship)	I	3.2	3.8	3.9	2.7	2.5	2.6
Stability: maximize stability in catches to reduce commercial uncertainty							
14. Mean absolute proportional change in catch	C	0.2	0.3	0.3	0.2	0.1	0.2
15. % Catch co-efficient of variation	C	20	25	24	18	12	21
16. Probability of shutdown	C	0.01	0.01	0.01	0.01	0.01	0.01

Table 2b. Hypothetical example of MSE outputs comparing the performance of 6 management procedures (MPs) against all IOTC performance measures for a 5-year projection period.

Status : maximize stock status		5 years					
		MP1	MP2	MP3	MP4	MP5	MP6
1. Mean spawner biomass relative to pristine	SB/SB_0	0.5	0.8	1.0	0.7	0.4	0.6
2. Minimum spawner biomass relative to pristine	SB/SB_0	0.3	0.5	0.6	0.5	0.2	0.4
3. Mean spawner biomass relative to SB_{MSY}	SB/SB_{MSY}	0.9	1.2	1.3	1.1	0.7	1.2
4. Mean fishing mortality relative to target	F/F_{tar}	1.4	0.6	0.4	0.8	1.5	0.9
5. Mean fishing mortality relative to F_{MSY}	F/F_{MSY}	1.5	0.5	0.4	0.8	1.6	0.9
6. Probability of being in Kobe green quadrant	SB,F	0.5	0.9	0.9	0.8	0.3	0.7
7. Probability of being in Kobe red quadrant	SB,F	0.3	0.1	0.0	0.1	0.5	0.2
Safety : maximize the probability of remaining above low stock status (i.e. minimize risk)							
8. Probability of spawner biomass being above 20% of SB_0	SB	0.8	0.8	0.9	0.8	0.7	0.8
9. Probability of spawner biomass being above B_{Lim}	SB	0.8	1.0	1.0	0.9	0.7	0.8
Yield : maximize catches across regions and gears							
10. Mean catch (1'000 t)	C	551	417	378	434	600	460
11. Mean catch by region and/or gear (1'000 t)	C	248	194	176	229	335	218
12. Mean catch relative to MSY	C/MSY	1.2	0.6	0.6	0.8	1.3	1.0
Abundance: maximize catch rates to enhance fishery profitability							
13. Mean catch rates (by region and gear) (for fisheries with meaningful catch-effort relationship)	I	3.0	3.8	4.0	2.6	2.3	2.8
Stability: maximize stability in catches to reduce commercial uncertainty							
14. Mean absolute proportional change in catch	C	0.2	0.3	0.3	0.2	0.1	0.2
15. % Catch co-efficient of variation	C	19.4	27.3	26.2	17.6	11.5	21.0
16. Probability of shutdown	C	0.01	0.01	0.01	0.01	0.01	0.01

Table 2c. Hypothetical example of MSE outputs comparing the performance of 6 management procedures (MPs) against all IOTC performance measures for a 10-year projection period.

Status : maximize stock status		10 years					
		MP1	MP2	MP3	MP4	MP5	MP6
1. Mean spawner biomass relative to pristine	SB/SB_0	0.5	0.8	0.9	0.7	0.4	0.6
2. Minimum spawner biomass relative to pristine	SB/SB_0	0.3	0.6	0.6	0.5	0.2	0.4
3. Mean spawner biomass relative to SB_{MSY}	SB/SB_{MSY}	0.8	1.3	1.4	1.2	0.7	1.1
4. Mean fishing mortality relative to target	F/F_{tar}	1.4	0.6	0.4	0.8	1.5	0.9
5. Mean fishing mortality relative to F_{MSY}	F/F_{MSY}	1.4	0.6	0.4	0.8	1.5	0.9
6. Probability of being in Kobe green quadrant	SB,F	0.5	0.9	1	0.8	0.3	0.7
7. Probability of being in Kobe red quadrant	SB,F	0.3	0.1	0	0.1	0.5	0.2
Safety : maximize the probability of remaining above low stock status (i.e. minimize risk)							
8. Probability of spawner biomass being above 20% of SB_0	SB	0.8	0.9	0.9	0.8	0.7	0.8
9. Probability of spawner biomass being above B_{Lim}	SB	0.8	1.0	1.0	0.9	0.7	0.9
Yield : maximize catches across regions and gears							
10. Mean catch (1'000 t)	C	520	390	350	430	600	460
11. Mean catch by region and/or gear (1'000 t)	C	250	200	180	210	310	220
12. Mean catch relative to MSY	C/MSY	1.1	0.7	0.6	0.8	1.2	0.9
Abundance: maximize catch rates to enhance fishery profitability							
13. Mean catch rates (by region and gear) (for fisheries with meaningful catch-effort relationship)	I	3.2	3.8	3.9	2.7	2.5	2.6
Stability: maximize stability in catches to reduce commercial uncertainty							
14. Mean absolute proportional change in catch	C	0.2	0.3	0.3	0.2	0.1	0.2
15. % Catch co-efficient of variation	C	20	25	24	18	12	21
16. Probability of shutdown	C	0.01	0.01	0.01	0.01	0.01	0.01

Table 2d. Hypothetical example of MSE outputs comparing the performance of 6 management procedures (MPs) against all IOTC performance measures for a 20-year projection period.

Status : maximize stock status		20 years					
		MP1	MP2	MP3	MP4	MP5	MP6
1. Mean spawner biomass relative to pristine	SB/SB_0	0.5	0.8	1.0	0.7	0.4	0.6
2. Minimum spawner biomass relative to pristine	SB/SB_0	0.3	0.5	0.6	0.5	0.2	0.4
3. Mean spawner biomass relative to SB_{MSY}	SB/SB_{MSY}	0.9	1.2	1.3	1.1	0.7	1.2
4. Mean fishing mortality relative to target	F/F_{tar}	1.4	0.6	0.4	0.8	1.5	0.9
5. Mean fishing mortality relative to F_{MSY}	F/F_{MSY}	1.5	0.5	0.4	0.8	1.6	0.9
6. Probability of being in Kobe green quadrant	SB,F	0.5	0.9	0.9	0.8	0.3	0.7
7. Probability of being in Kobe red quadrant	SB,F	0.3	0.1	0.0	0.1	0.5	0.2
Safety : maximize the probability of remaining above low stock status (i.e. minimize risk)							
8. Probability of spawner biomass being above 20% of SB_0	SB	0.8	0.8	0.9	0.8	0.7	0.8
9. Probability of spawner biomass being above B_{Lim}	SB	0.8	1.0	1.0	0.9	0.7	0.8
Yield : maximize catches across regions and gears							
10. Mean catch (1'000 t)	C	551	417	378	434	600	460
11. Mean catch by region and/or gear (1'000 t)	C	248	194	176	229	335	218
12. Mean catch relative to MSY	C/MSY	1.2	0.6	0.6	0.8	1.3	1.0
Abundance: maximize catch rates to enhance fishery profitability							
13. Mean catch rates (by region and gear) (for fisheries with meaningful catch-effort relationship)	I	3.0	3.8	4.0	2.6	2.3	2.8
Stability: maximize stability in catches to reduce commercial uncertainty							
14. Mean absolute proportional change in catch	C	0.2	0.3	0.3	0.2	0.1	0.2
15. % Catch co-efficient of variation	C	19.4	27.3	26.2	17.6	11.5	21.0
16. Probability of shutdown	C	0.01	0.01	0.01	0.01	0.01	0.01