



Food and Agriculture Organization
of the United Nations



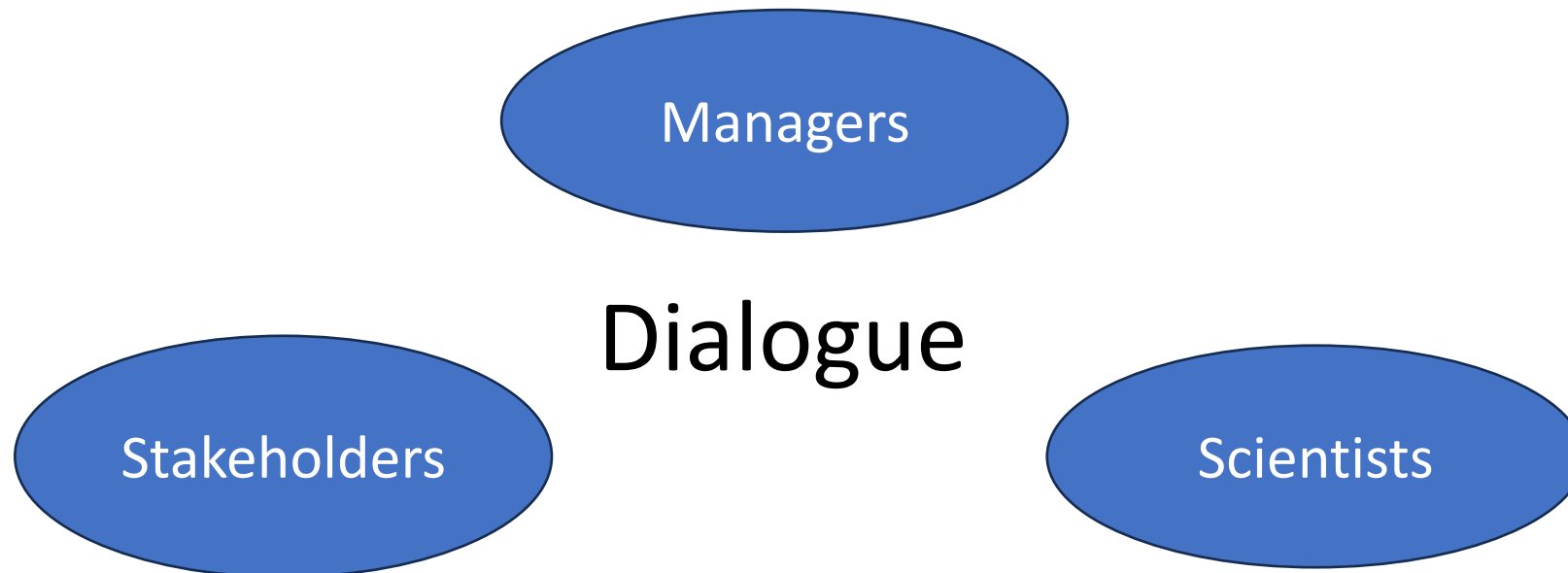
ITEM 5. INTRODUCTION TO MSE AND PRESENTATION OF MSE RESULTS

Simply.... Management Procedure (MP) is

“a pre-defined rule to set a TAC ”

Simply.... MSE is

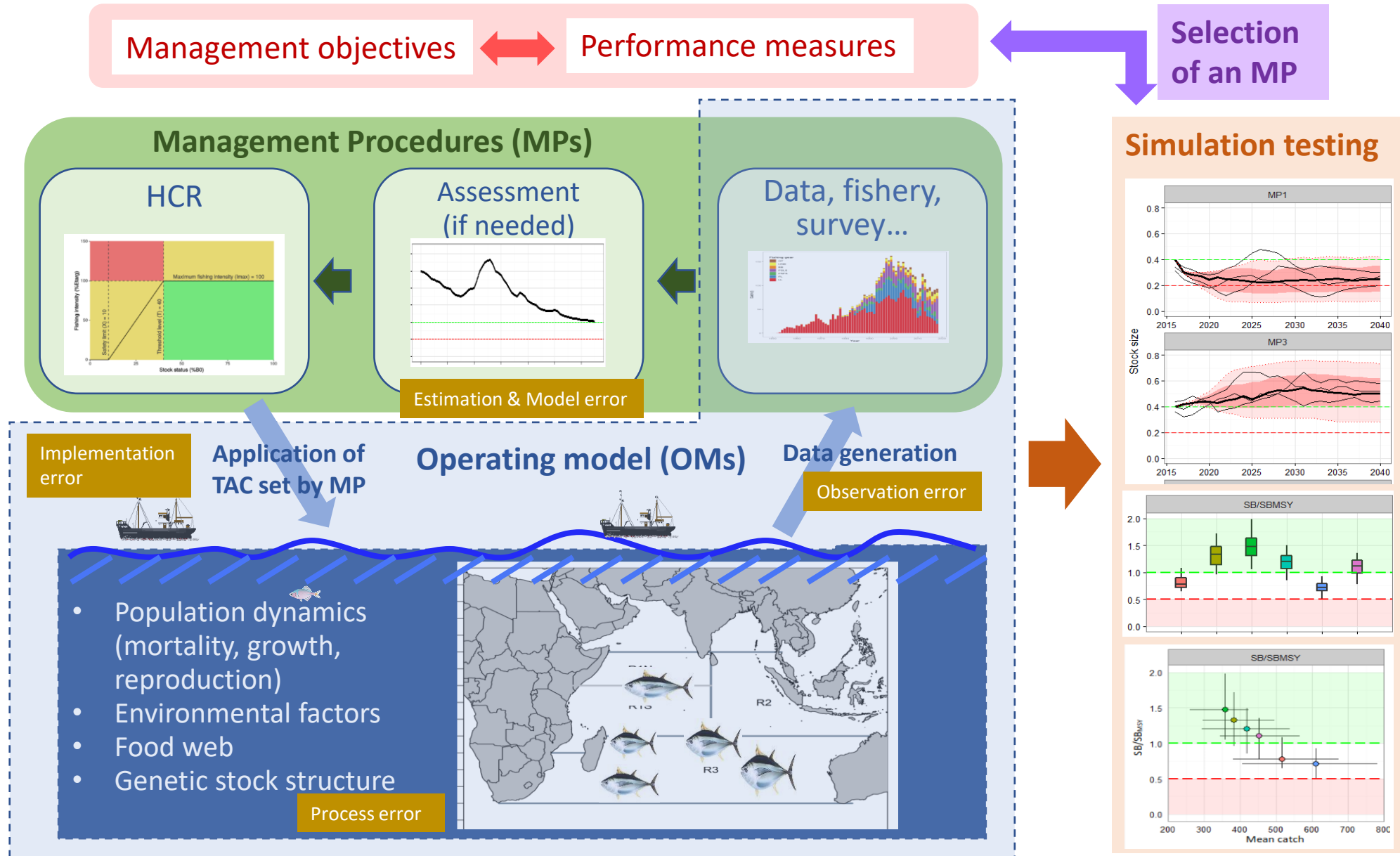
“an evaluation process of candidate management procedures for achieving stated management objectives through stochastic simulations” (DS Butterworth)



MSE IN NUTSHELL (TECHNICALLY)

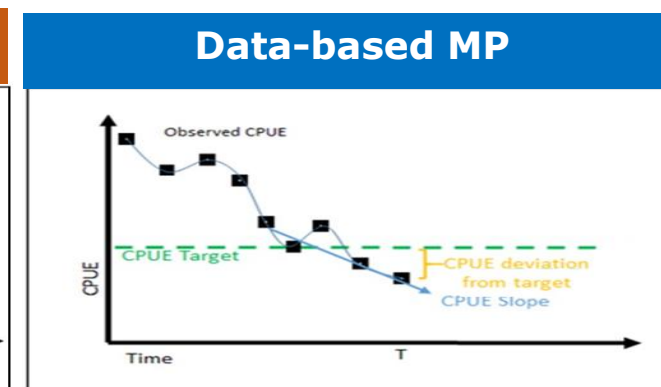
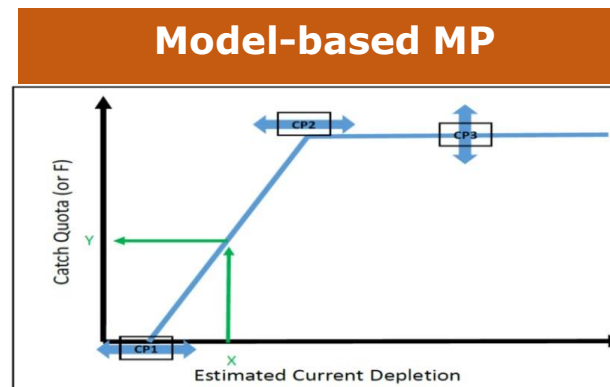
MSE Process

1. Identification of **Management objectives** and **performance indicators**
2. Development of **Management Procedures (MPs)**
3. Development of **Operating Models (OMs)**
4. **Simulation testing** of MPs with the OMs
5. **Selection of an MP** based on simulation performance
6. **Implementation** of the MP



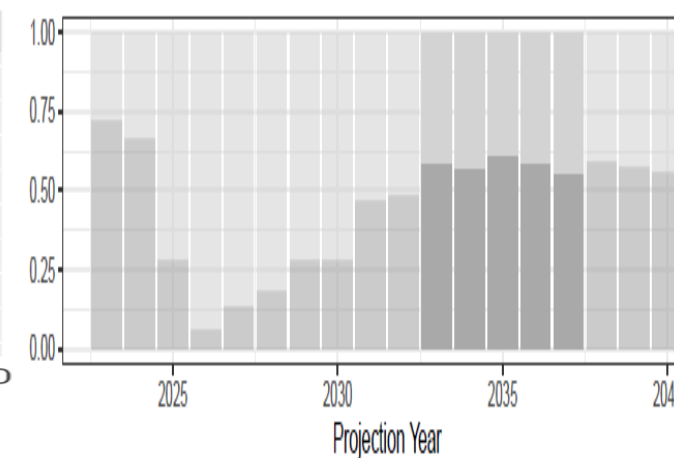
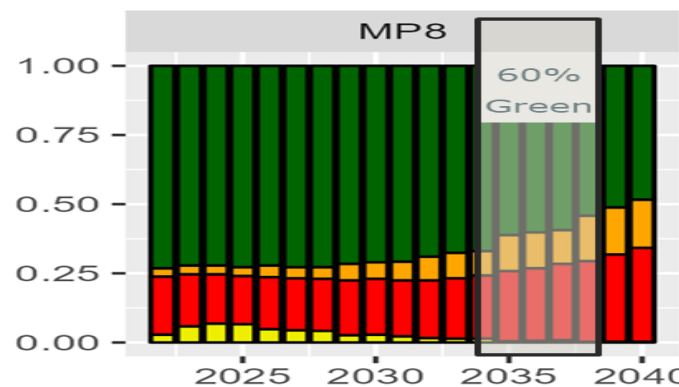
● Type of management procedures (MPs)

- Model-based (Assessment & Harvest Control Rule(HCR))
- Data-based (CPUE trend or CPUE-based HCR)



● Tuning criteria

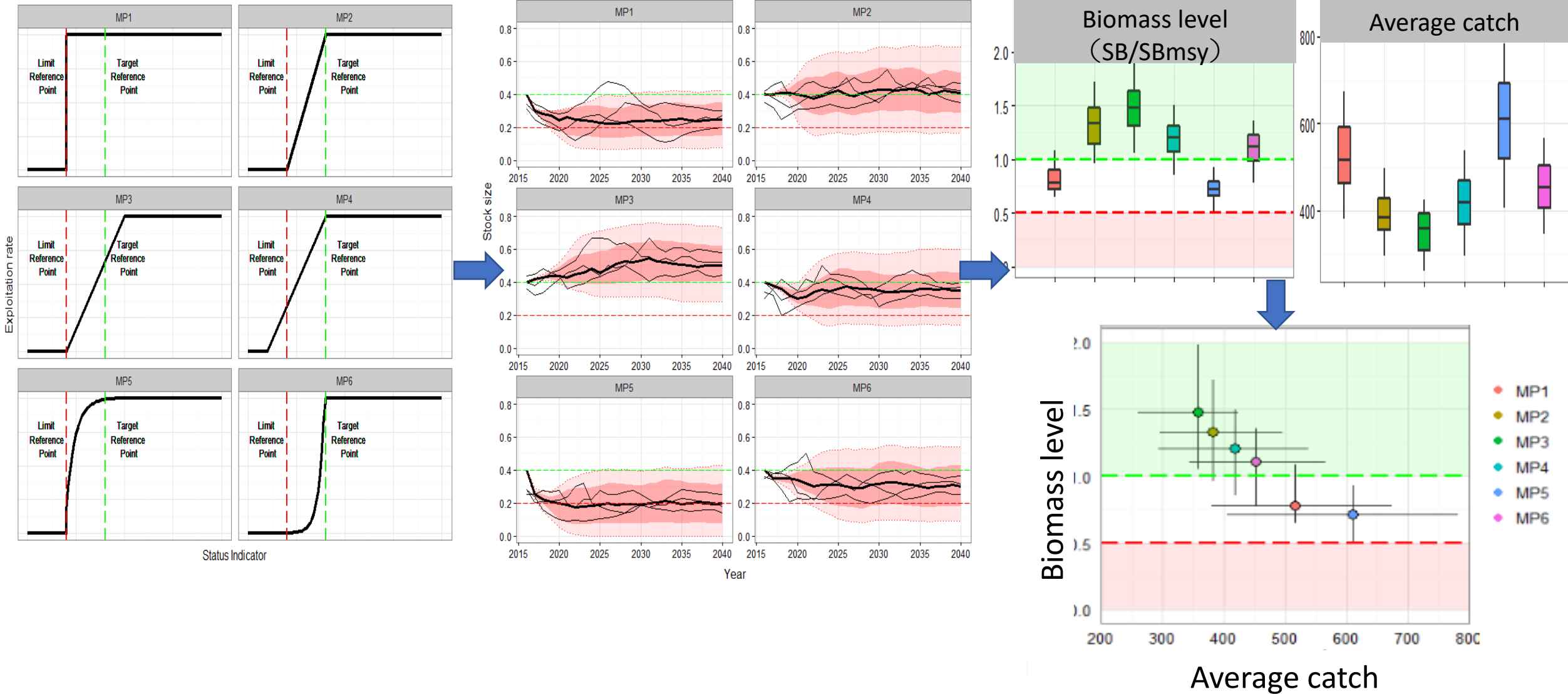
- Tuning a parameter of MPs associated with the management goals
- Kobe green quadrant probability (50, 60 and 70%) etc. in a certain window

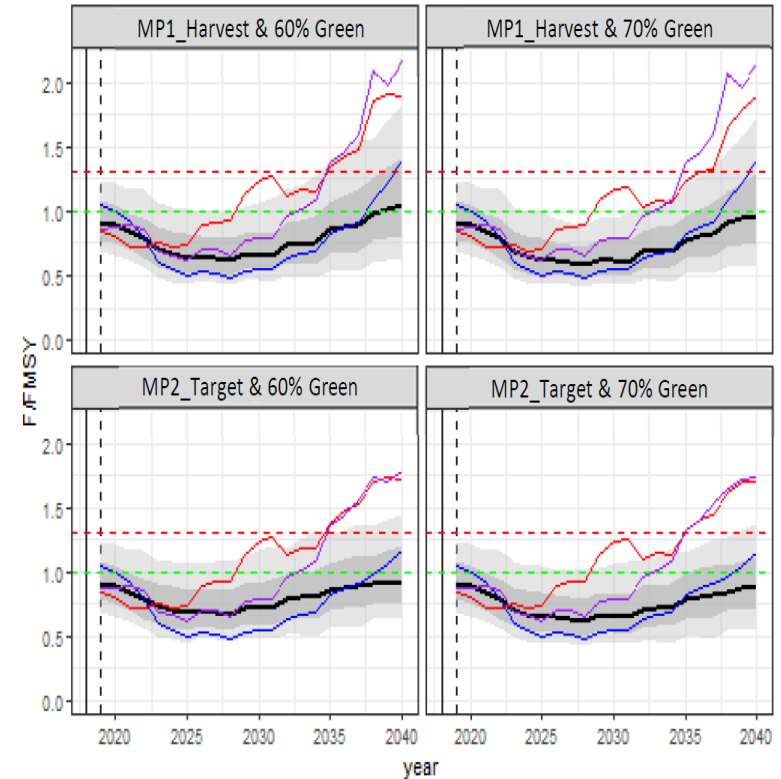
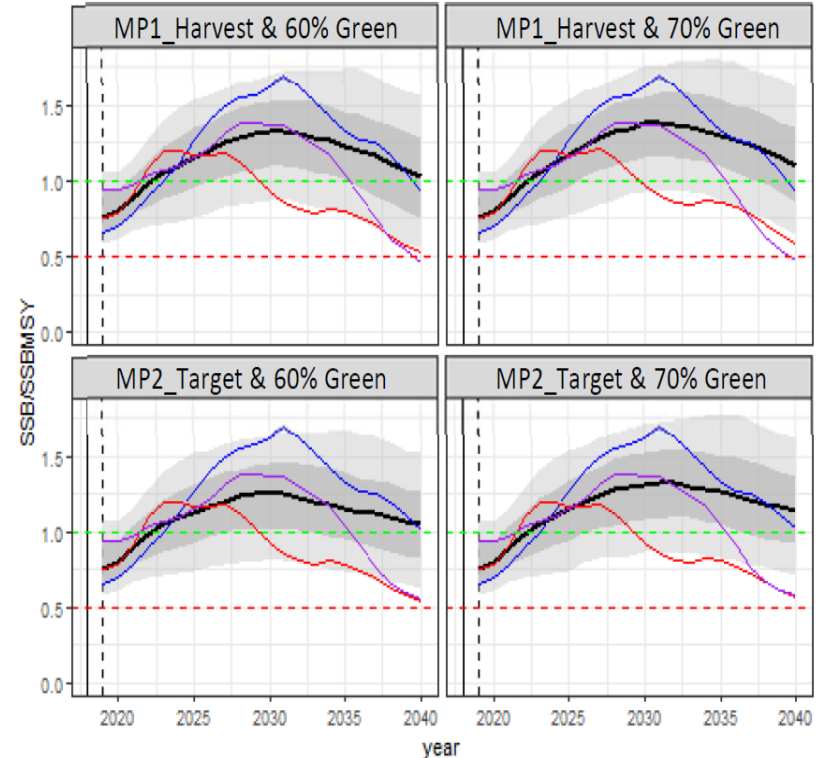
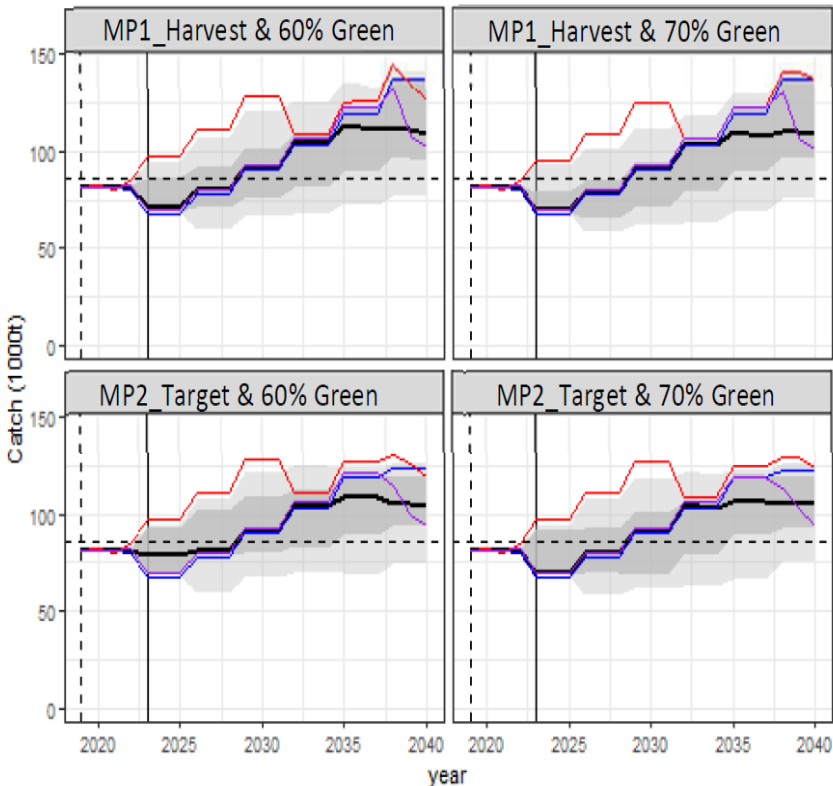
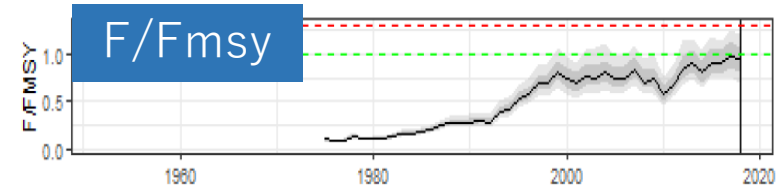
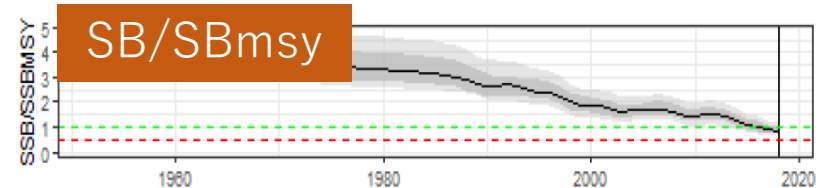


● Other important elements

- Constraints (maximum change in TAC): symmetric or asymmetric (upwards/downward)
- Time lag: 2-3 yrs (“data-lag” + “implementation lag”)
- Robustness scenarios (implementation error, recruitment failure etc.)
- Regular check for Exceptional Circumstances

Conduct **comprehensive simulation** to evaluate the performance of MPs using OMs



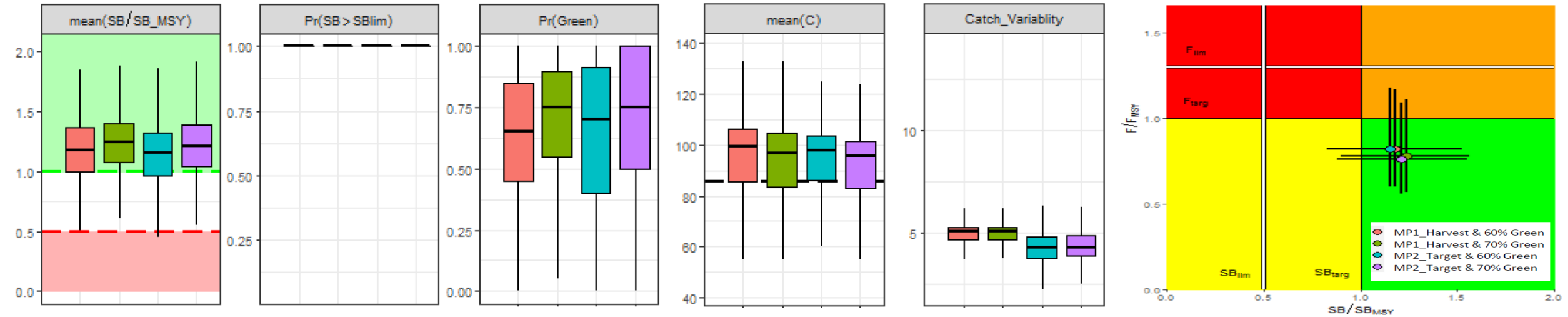


- MP1: higher ave catch, higher variation
- MP2_60%: Initial catch reduction seems low

Stochastic variation at the end in MP1 tends to be slightly larger than that in MP2

Stochastic variation in MP1 tends to be slightly larger than that in MP2

EXAMPLE OF BIGEYE MSE (DISCUSSED AND ADOPTED IN 2022)

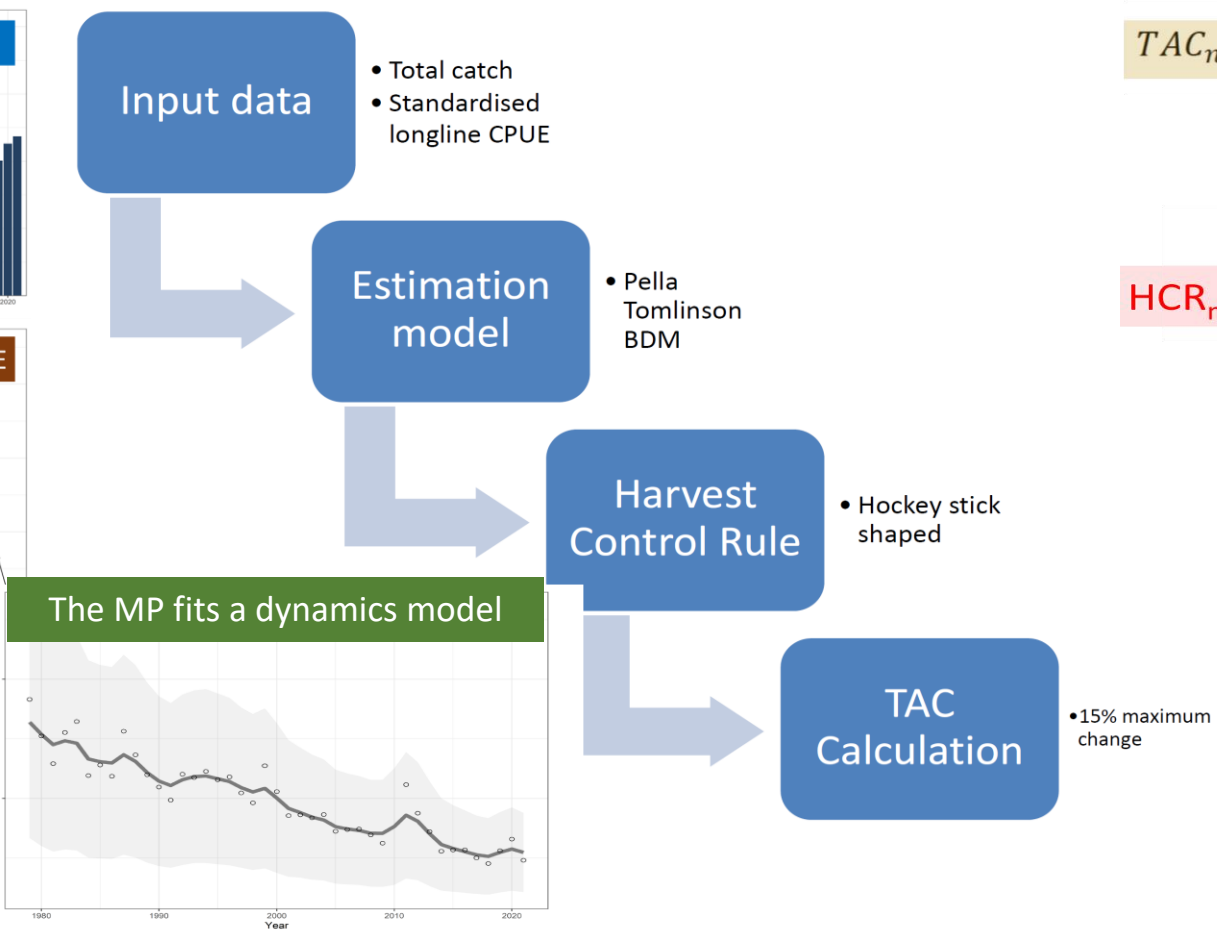
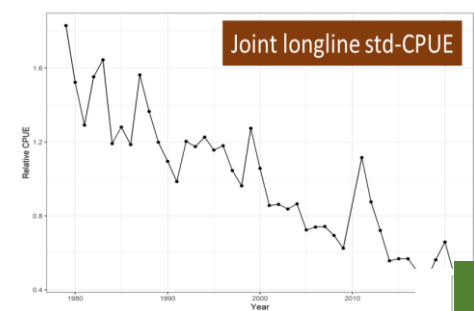
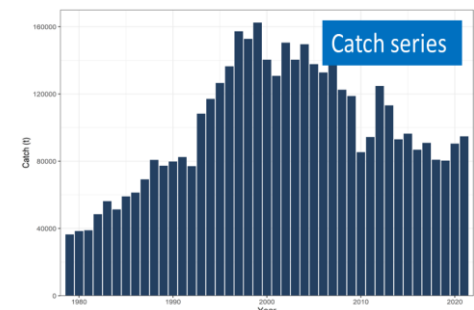
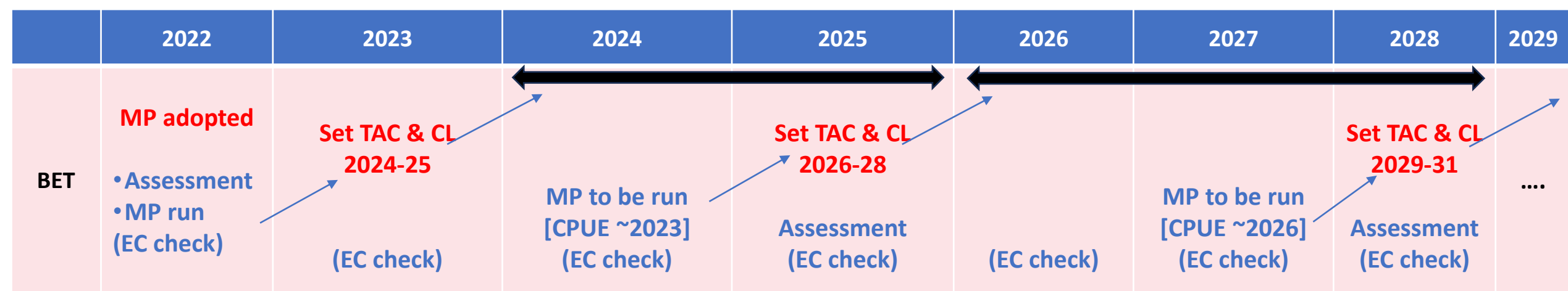


- MP1_Harvest & 60% Green
- MP1_Harvest & 70% Green
- MP2_Target & 60% Green
- MP2_Target & 70% Green

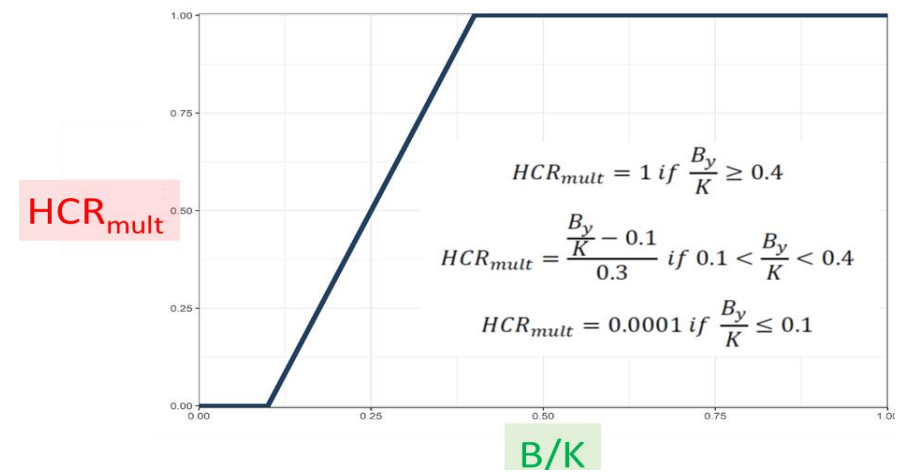
MP	Performance Measure				
	SB/SB _{MSY}	Prob(Green)	Prob(SB>limit)	Mean Catch (t)	Catch Variability (%)
MP1_Harvest 60% Green	1.18 (1.00-1.36)	0.63	0.97	99.3 (85.6-106.1)	5.06
MP2_Target 60% Green	1.15 (0.96-1.32)	0.63	0.97	97.7 (86.0-103.6)	4.23
MP1_Harvest 70% Green	1.24 (1.07-1.40)	0.69	0.98	96.6 (83.7-104.6)	5.08
MP2_Target 70% Green	1.21 (1.04-1.39)	0.69	0.98	95.8 (82.8-101.6)	4.28

Management procedure

2. The adopted management procedure for bigeye tuna known as MP1 Harvest is described in Annex I (MP).
3. Consistent with the adopted management objectives of the Commission, the management procedure is designed to achieve:
 - a) a 60% probability that the bigeye tuna spawning stock biomass achieves the target reference point of SB_{MSY}^1 by 2034-2038;
 - b) the bigeye tuna spawning stock biomass avoids breaching the interim limit reference point specified in Resolution 15/10 with a high probability;and operates with the following constraint:
 - c) the maximum increase or decrease in the TAC shall be 15% relative to the previous TAC.

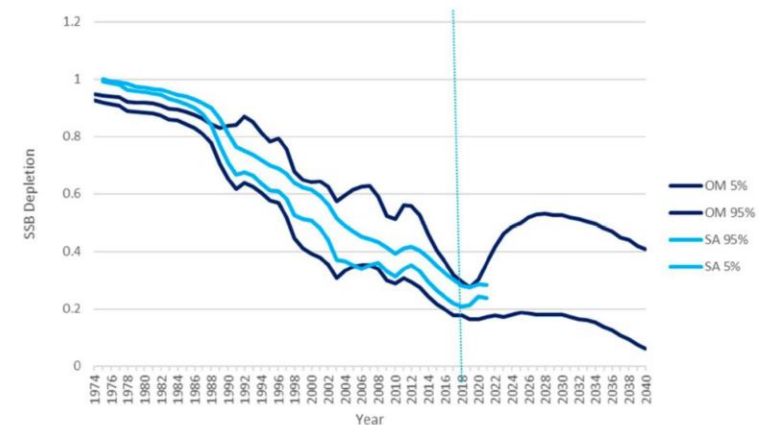


$$TAC_{new} = B_y(1 - \exp(-F_{mult} \times HCR_{mult} \times F_{MSY\ ratio}))$$



$TAC_{new} = 68,404 \text{ t}$
 (>15% lower than 2021 catch of 94,803 t)
Recommended TAC (endorsed by SC)
= 80,583 t (15% below 2021 catch)

- Need “regular monitoring” for MP implementation
- Need safeguard for “Exceptional Circumstances”
 - New information: out of range of previous knowledge (e.g. stock status, fishing operations, dynamics, biology)
 - Input data for MP: missing (no longer available), historically changed etc.
 - Inconsistency between TAC recommended and actual catch
 - Rare events, when the fishery system falls outside of the scope of the simulation testing, (e.g. large IUU catches identified, recruitment failure)



GUIDELINES FOR THE PROVISIONS OF EXCEPTIONAL CIRCUMSTANCES FOR IOTC SPECIES MPs

[This is a living document with generic guidelines that could apply for any MP adopted and implemented by the IOTC.]

When a Management Procedure (MP) is adopted, a set of checks are essential to ensure that unexpected events do not result in MP advice that is risky for the stock and fisheries. These checks are part of these guidelines that provide a structure for providing management advice when there are concerns about implementing an MP. The guidelines provide a scientific process for developing appropriate management responses to exceptional circumstances and, hence, provide transparency in TAC decision making by the Commission.

Exceptional circumstances are defined in the IOTC as “... circumstances (primarily related to future monitoring data falling outside the range covered by Management Strategy Evaluation (MSE) simulation testing) where overriding of the output from a Management Procedure should be considered...”. Exceptional circumstance can include:

- New knowledge about the stock, population dynamics or biology
- Changes in fisheries or fishing operations
- Changes to input data to the MP, or missing data, or
- Inconsistent implementation of the MP advice (e.g. total catch is greater than the Total Allowable Catch (TAC)).

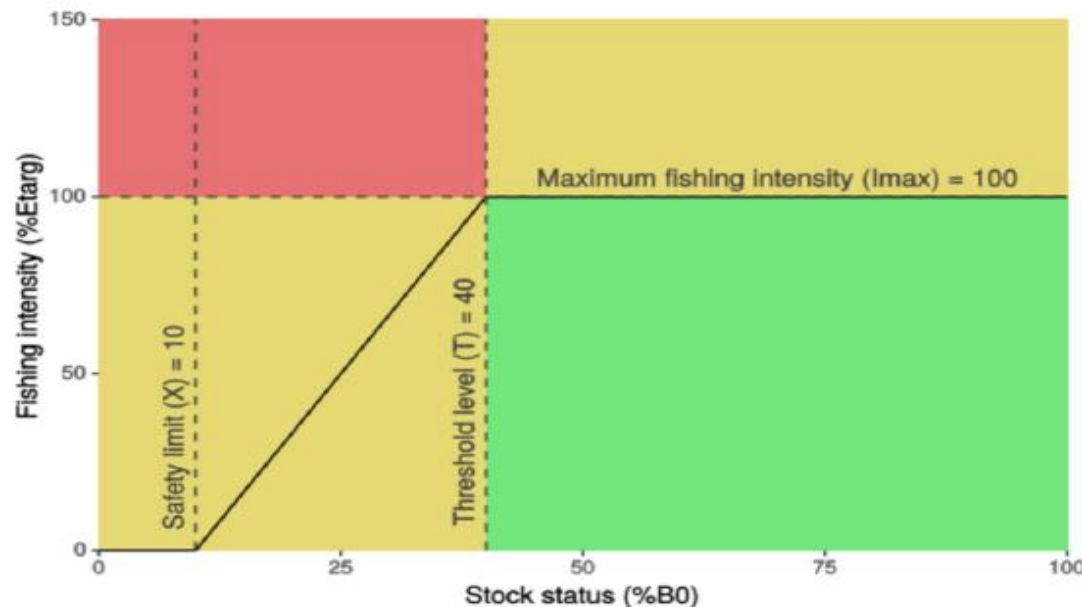
For more details
“Appendix 6A of the 2021 SC report”

HARVEST CONTROL RULE FOR SKIPJACK TUNA

Resolution 16/02 On **Harvest Control Rules** for skipjack tuna in the IOTC area of competence (Superseded by **21/03**)

- a) The estimate of current spawning stock biomass (B_{curr});
- b) The estimate of the unfished spawning stock biomass (B_0);
- c) The estimate of the equilibrium exploitation rate (E_{targ}) associated with sustaining the stock at B_{targ} .

From stock assessment
(external to HCR)



$$SB_{2022} = 1,143 \text{ (1000t)}$$

$$SB_0 = 2,177 \text{ (1000t)}$$

$$SB_{2022}/SB_0 = 0.53 > 0.40$$

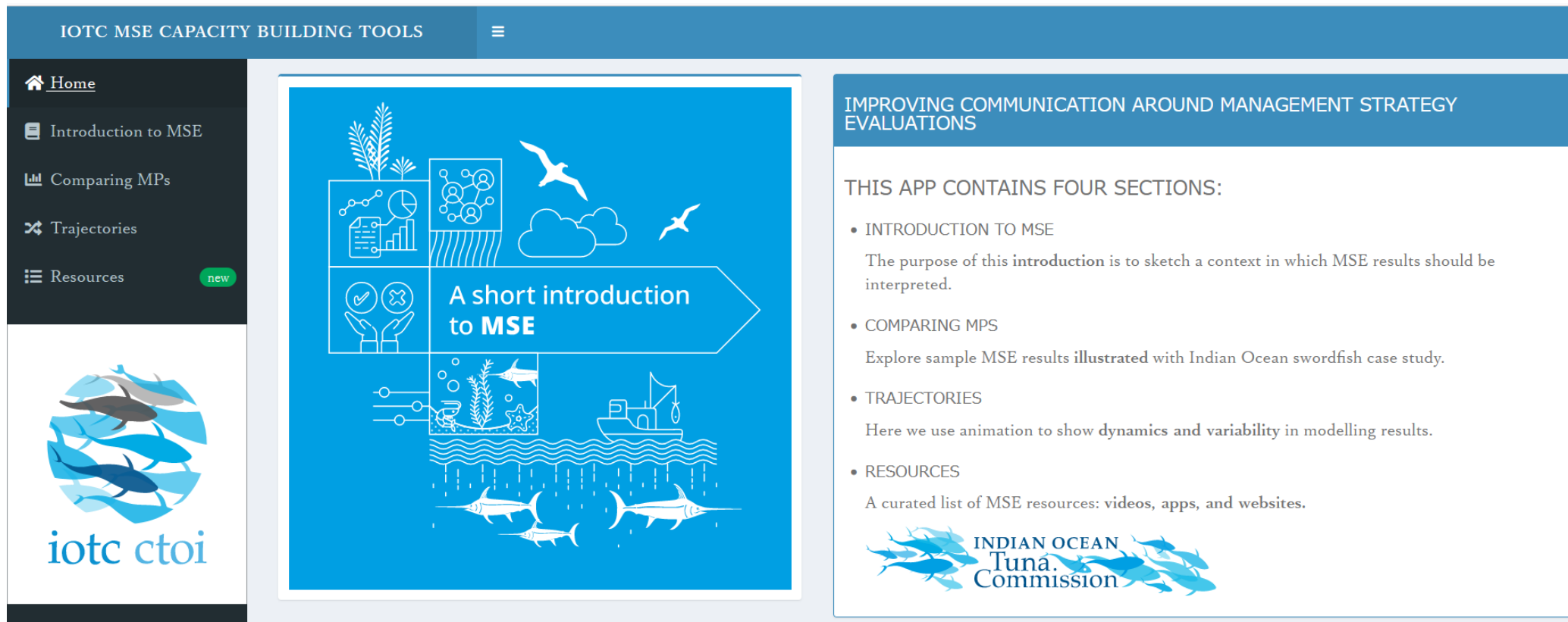
$$E_{targ} \text{ (Exploitation rate for 40\%SB}_0\text{)} = 0.55$$

HCR

$$\begin{aligned}
 \text{Catch limit} &= E_{targ} * SB_{2022} \\
 &= 0.55 * 1,143 = 629 \text{ (1000t)}
 \end{aligned}$$

ACHIEVEMENT AND PROGRESS ON MSE IN THE IOTC

	Yellowfin	Bigeye ★	Skipjack ★ ?		Swordfish ★ ?	Albacore
Stock status	2021	2022	2023		2023	2022
Existing HCR/MP		22/03 (MP) 23/04 (Catch limits)	16/02 & 21/02 (HCR)	Prop H	Prop G	
Tuning criterion	Prob(SB _{20XX} ≥ SB _{msy}) = 0.5 for 20XX=2029, 2034	Prob(Kobe Green) =50%, 60%, 70%		Prob(B<B40% & E<E40%) =50%, 60%, 70%	Prob(Kobe Green) =50%, 60%, 70%	Prob(Kobe Green) =50%, 60%, 70%
MP type		<ul style="list-style-type: none"> Data-based Model-based (MP1-Harvest MP2-Target) 	HCR (Inputs from SS3 assessment)	<ul style="list-style-type: none"> Two Data-based Model-based 	<ul style="list-style-type: none"> Two data-based One model-based 	<ul style="list-style-type: none"> Data-based Model-based
Constraints etc.		15% maximum change	30% max change C _{max} =900,000 (t)	<ul style="list-style-type: none"> Symmetric 15% max change Asymmetric 15%(up)-10%(down) 	Asymmetric 15% (upward) - 10% (downward)	
Progress in MSE (EC: exceptional circumstances)	Pending results of new assessment in 2024	Under peer-review process. Regular monitoring for EC		Close to finalizing the selection of an MP from 12 CMPs (= 3*2*2)	Close to finalizing the selection of an MP from 6 CMPs (= 3*2)	In Progress (new OM conditioning approach was agreed)



The screenshot shows the IOTC MSE Capacity Building Tools app interface. At the top, there is a header with the text "IOTC MSE CAPACITY BUILDING TOOLS" and a hamburger menu icon. On the left, there is a dark sidebar with navigation options: "Home", "Introduction to MSE", "Comparing MPs", "Trajectories", and "Resources" (marked with a "new" badge). The main content area features a large blue graphic with the text "A short introduction to MSE" and various icons representing science, management, and marine resources. To the right of the graphic, there is a section titled "IMPROVING COMMUNICATION AROUND MANAGEMENT STRATEGY EVALUATIONS" which lists the app's sections: "INTRODUCTION TO MSE", "COMPARING MPS", "TRAJECTORIES", and "RESOURCES". At the bottom right, there is a logo for the "INDIAN OCEAN Tuna Commission".

IOTC MSE CAPACITY BUILDING TOOLS

Home

Introduction to MSE

Comparing MPs

Trajectories

Resources **new**

A short introduction to MSE

IMPROVING COMMUNICATION AROUND MANAGEMENT STRATEGY EVALUATIONS

THIS APP CONTAINS FOUR SECTIONS:

- INTRODUCTION TO MSE
The purpose of this introduction is to sketch a context in which MSE results should be interpreted.
- COMPARING MPS
Explore sample MSE results illustrated with Indian Ocean swordfish case study.
- TRAJECTORIES
Here we use animation to show dynamics and variability in modelling results.
- RESOURCES
A curated list of MSE resources: videos, apps, and websites.

INDIAN OCEAN Tuna Commission

https://pl202.shinyapps.io/IOTC_MSE/