

Comisión Interamericana del Atún Tropical
Inter-American Tropical Tuna Commission



Harvest Control Rules

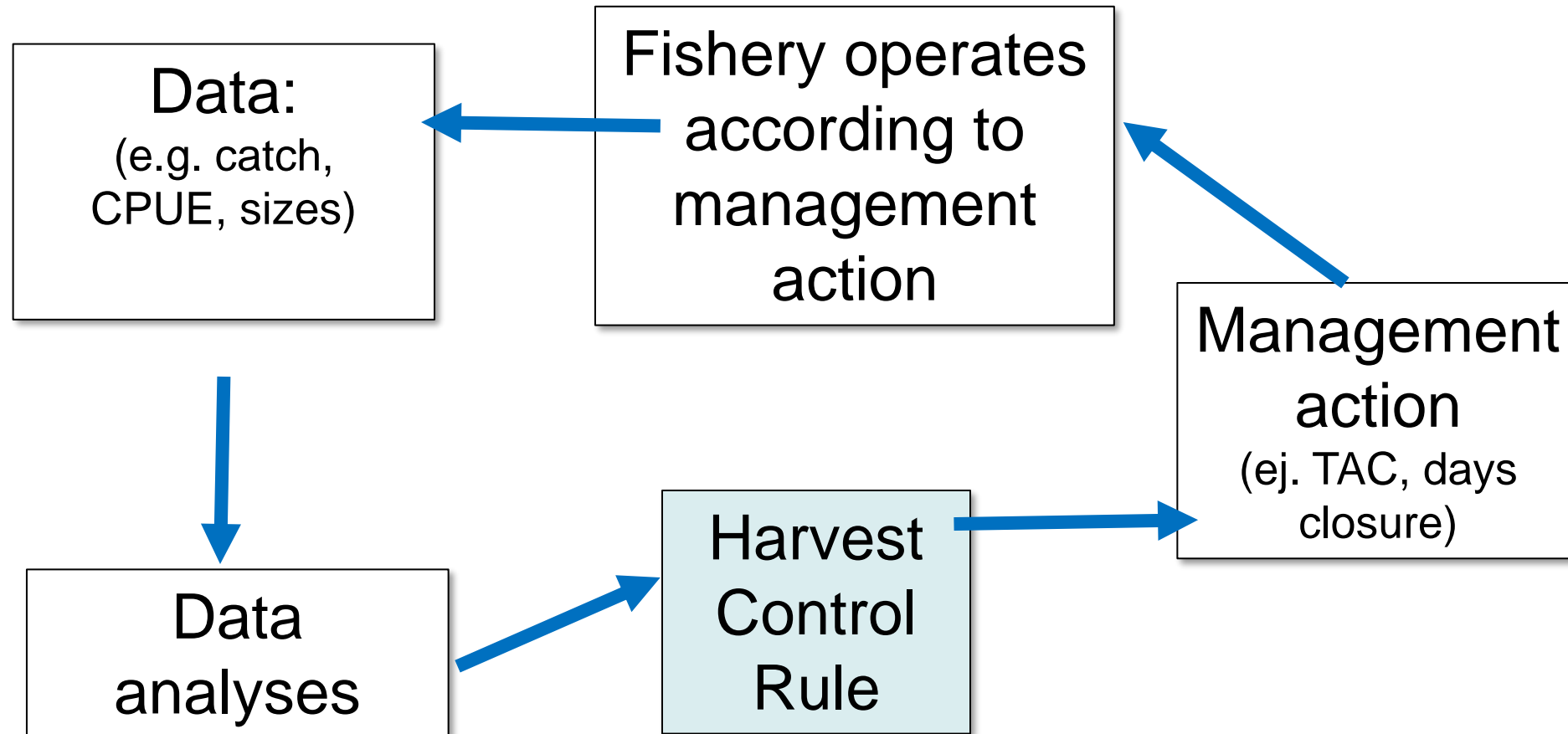
3rd IATTC Tropical Tuna MSE Workshop, *by videoconference*, December 08-09, 2022



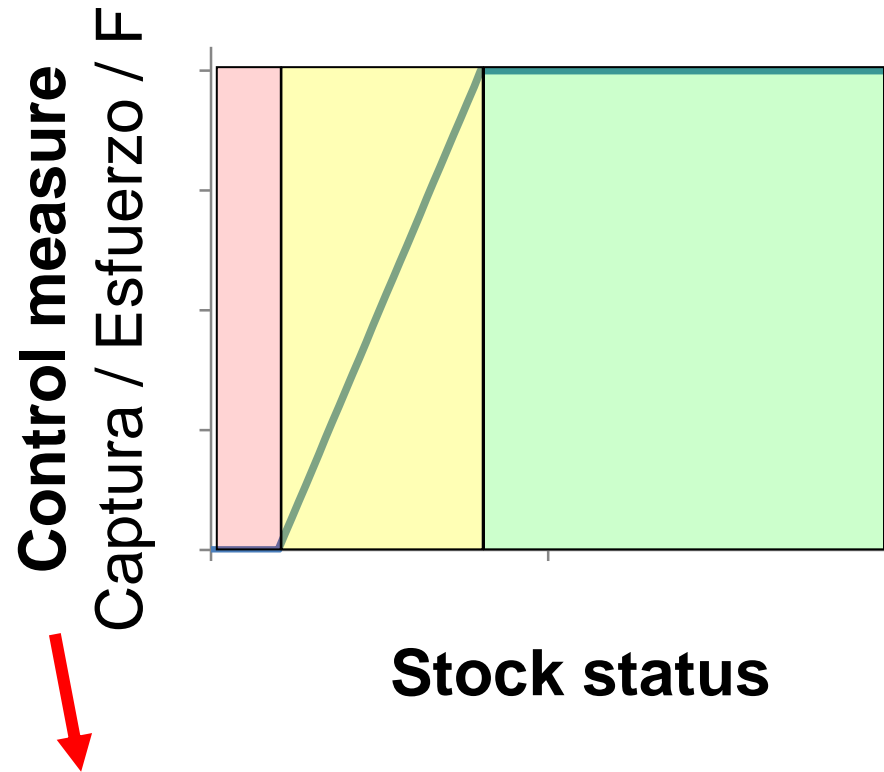
Harvest Control Rules (HCR)

- **Pre-agreed** management actions to changes in the stock and/or environmental, economic factors relative to **reference points, or trends** in stock indicators.
- Operationalize **management objectives**
- Increase management decisions **transparency**
- Framework to implement harvest strategies using decision making based on science.

Harvest Control Rule Cycle



Harvest Control Rule elements



- **Control measure, tactics:**

- Regulations available to apply the strategy

Control measures / Tactics

Input Controls – regulate fishing effort

- number and size of fishing vessels
- length of fishing season
- spatial closures

Output Controls – regulate catch

- total allowed catch (TAC)
- transferable quotas (ITQ)
- Quota allocation by gear/fleet

Control measures / Tactics

Why **Output Controls**?

- Better adherence to allowed catch
- Reduce (not always) the “race for fish”

Challenges of **Output Controls**

- Incentivize catch misreporting
- Less robust to assessment errors
- More difficult and costly to monitor

Type of control measures in tuna RFMOs

INPUTS (fishing)



OUTPUTS (catch)



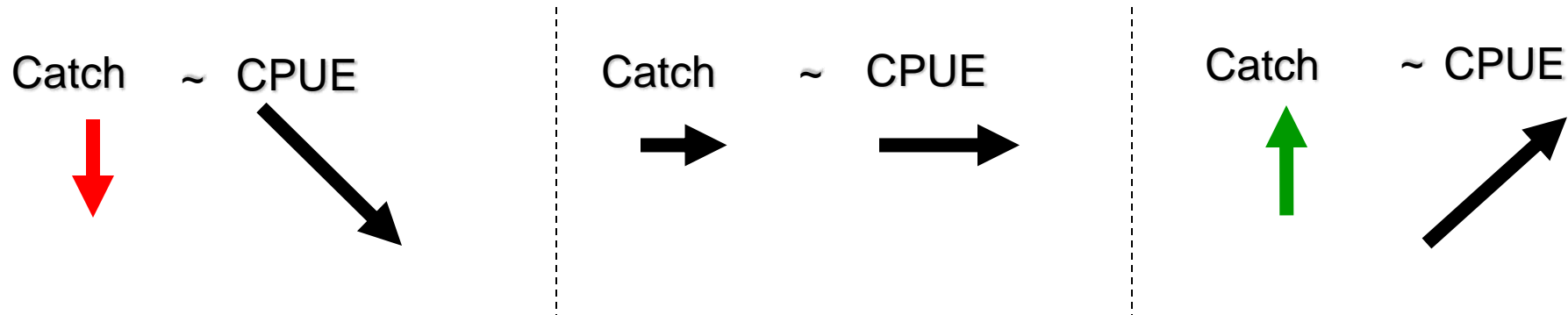
Types of Harvest Control Rules (HCR)

- **Constant**
- **Empirical Rule**
 - Minimum treatment of data
 - Easy to compute, explain and understand
 - Care required to minimize responses to noisy data
- **Model-based Rule**
 - Based on models of varied complexity (e.g. assessments)

Empirical Harvest Control Rules

- Based on monitoring and feedback
- Simple rule, even when evaluation of its performance uses complex computer simulations (such as MSE)

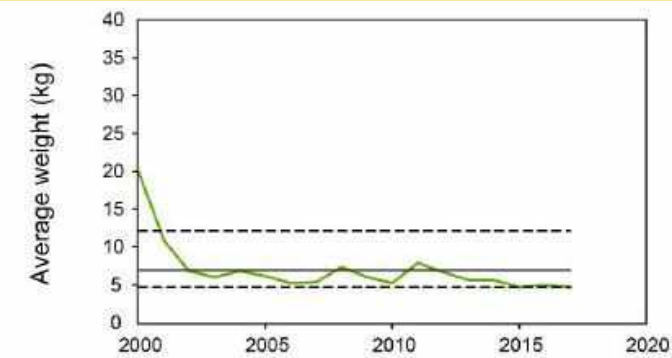
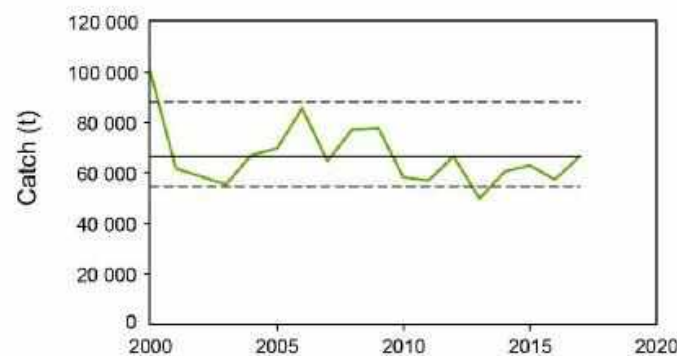
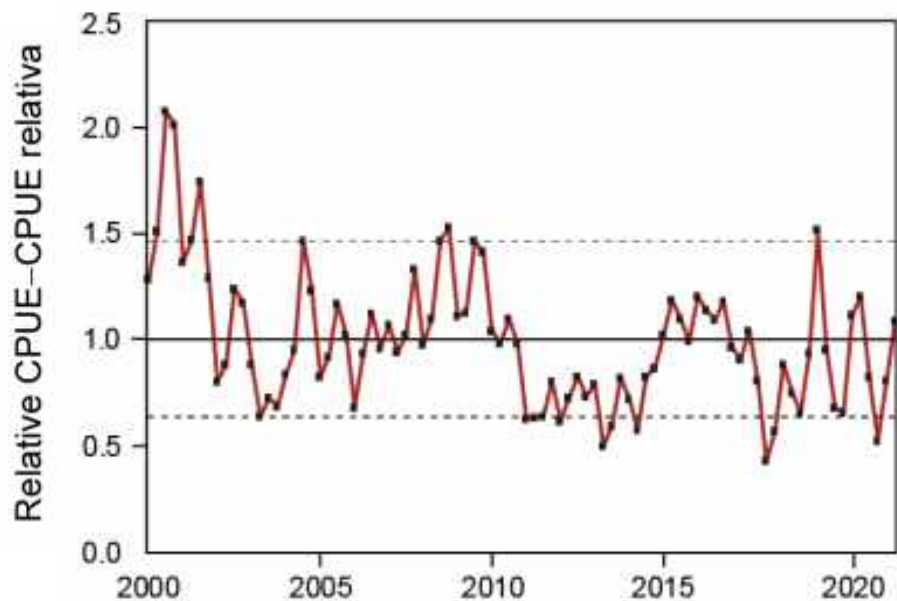
Example: adjust catch using CPUE trends



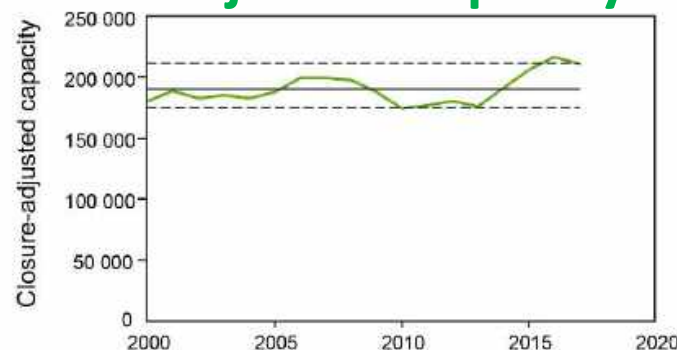
Indicators EPO Bigeye tuna



Standardized Japanese longline CPUE index



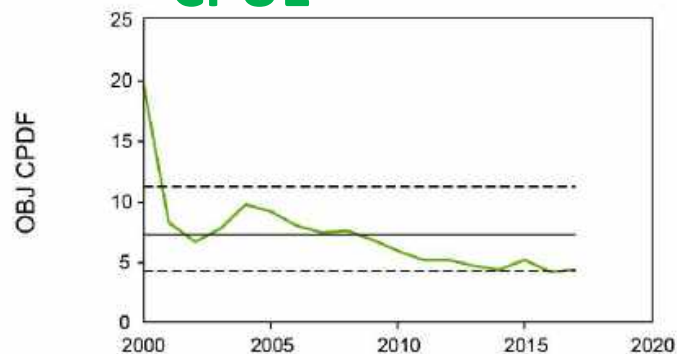
adjusted-capacity



number of sets



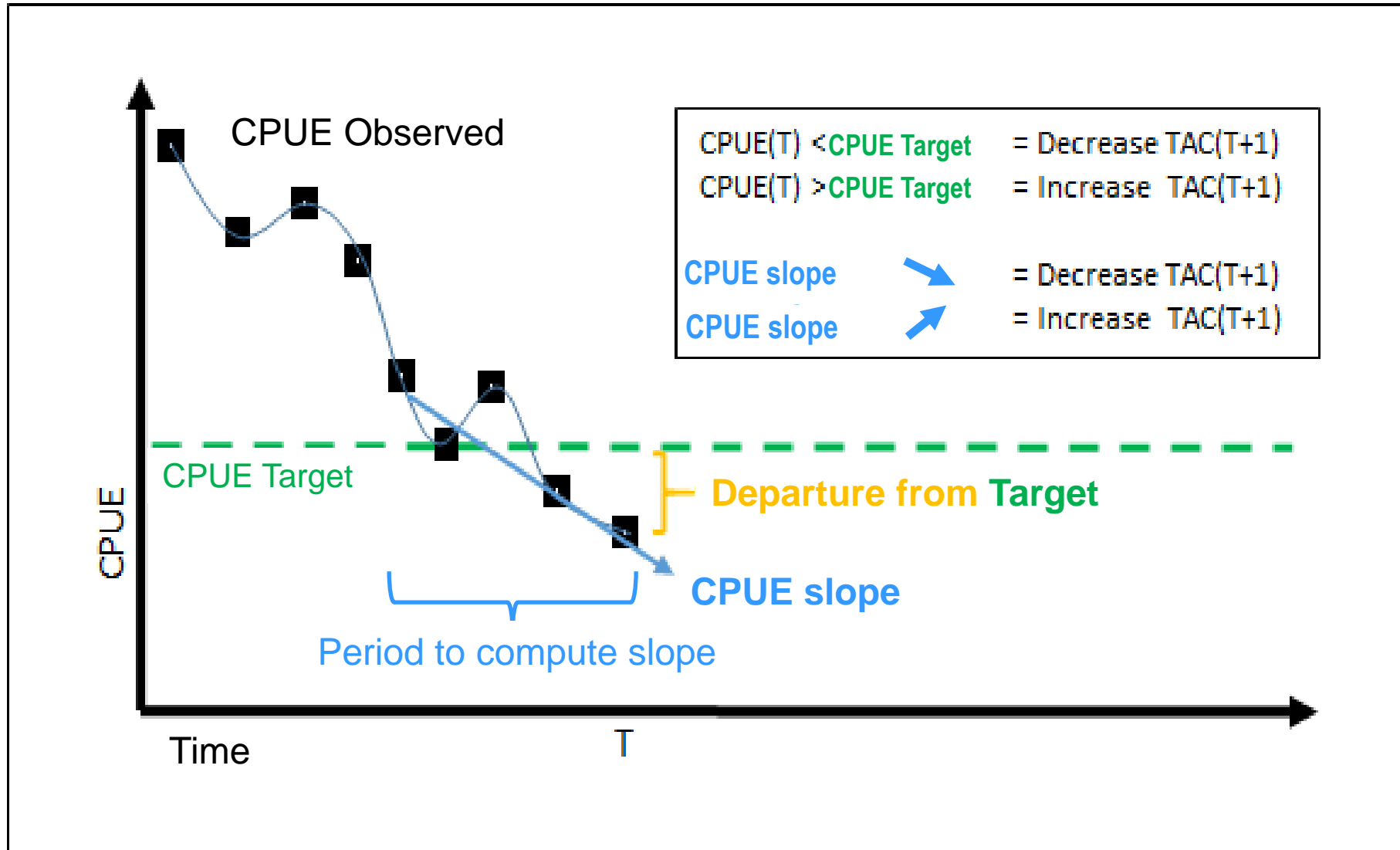
CPUE



days fished

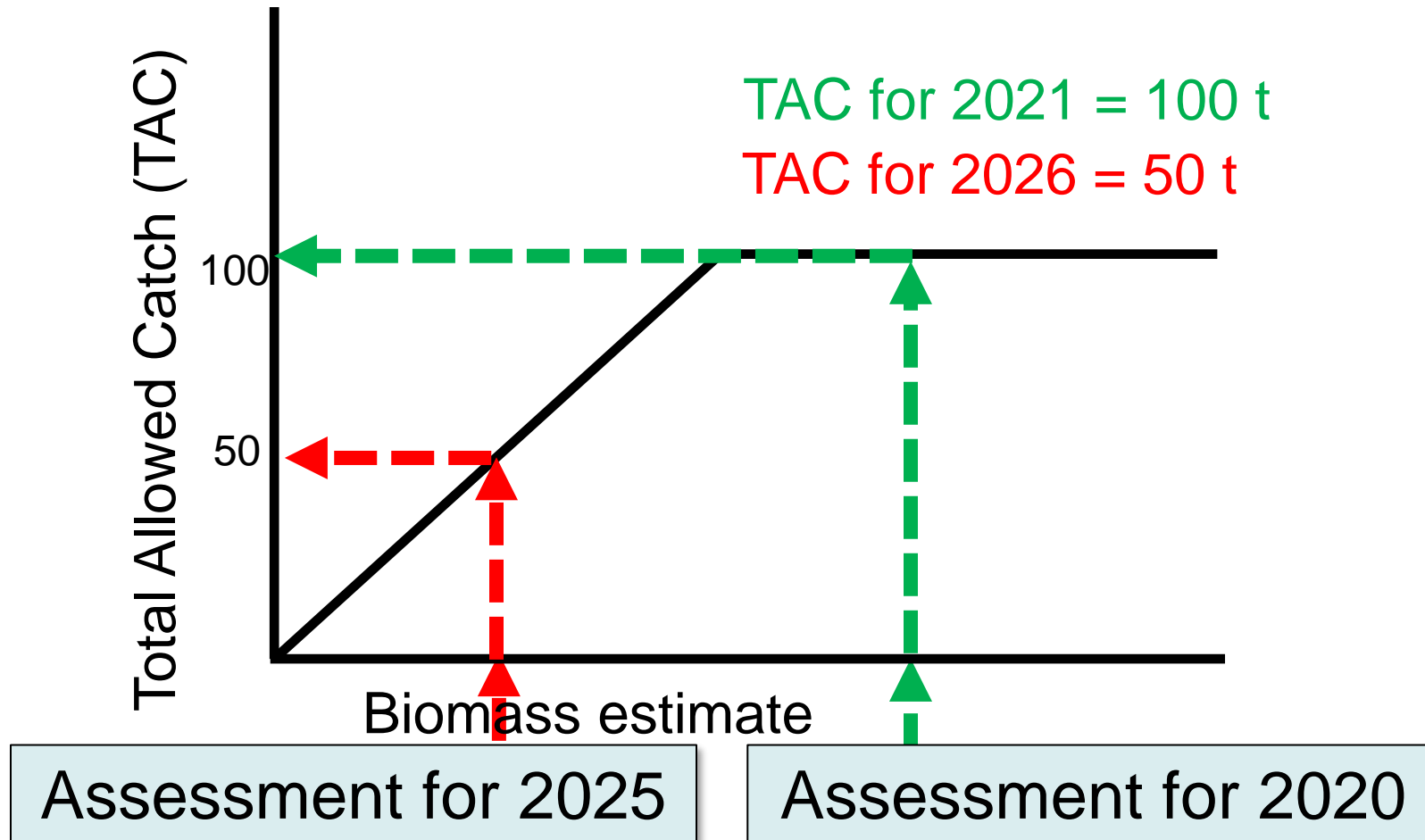


Empirical Rule example

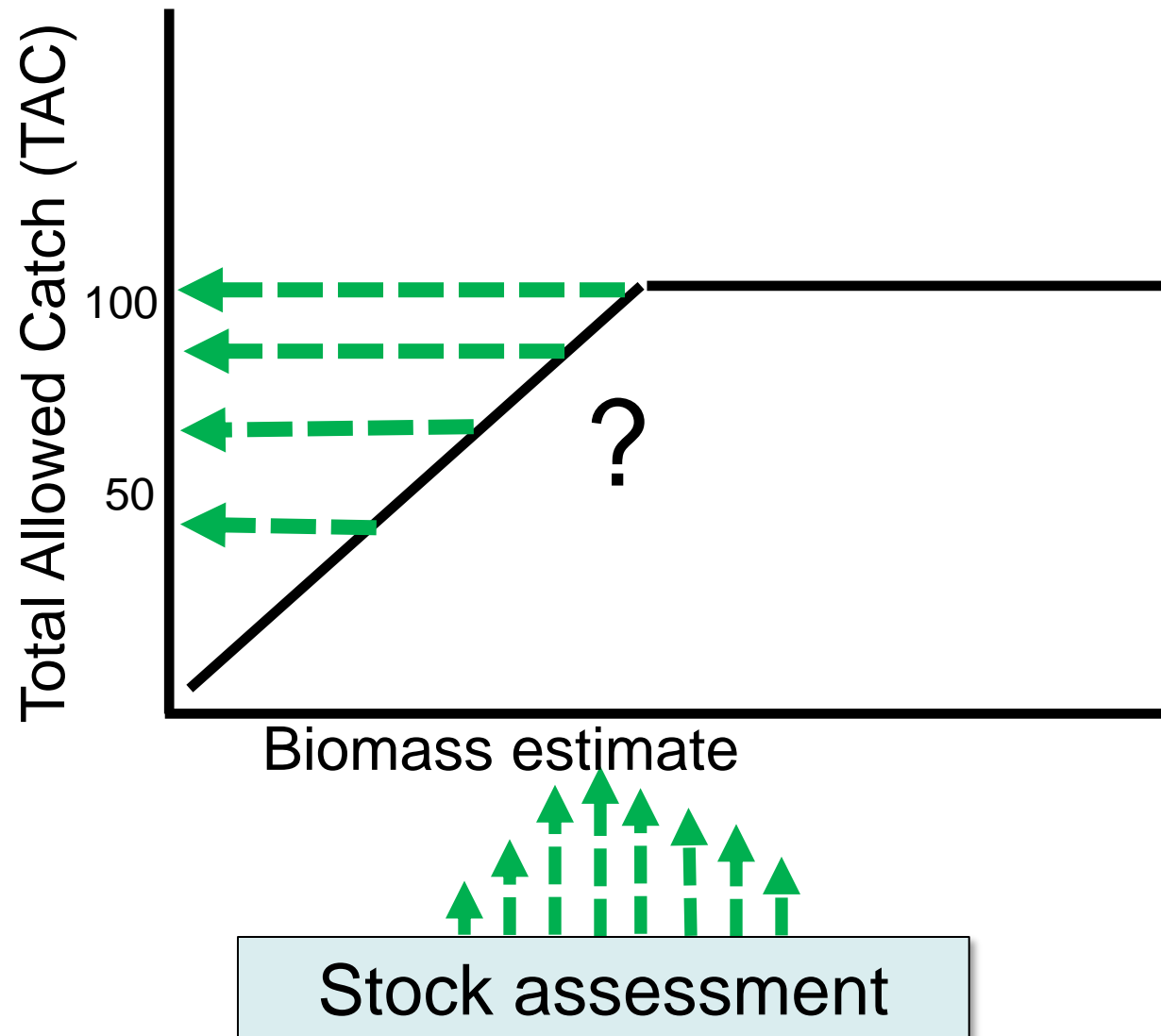


Model-based Control Rule

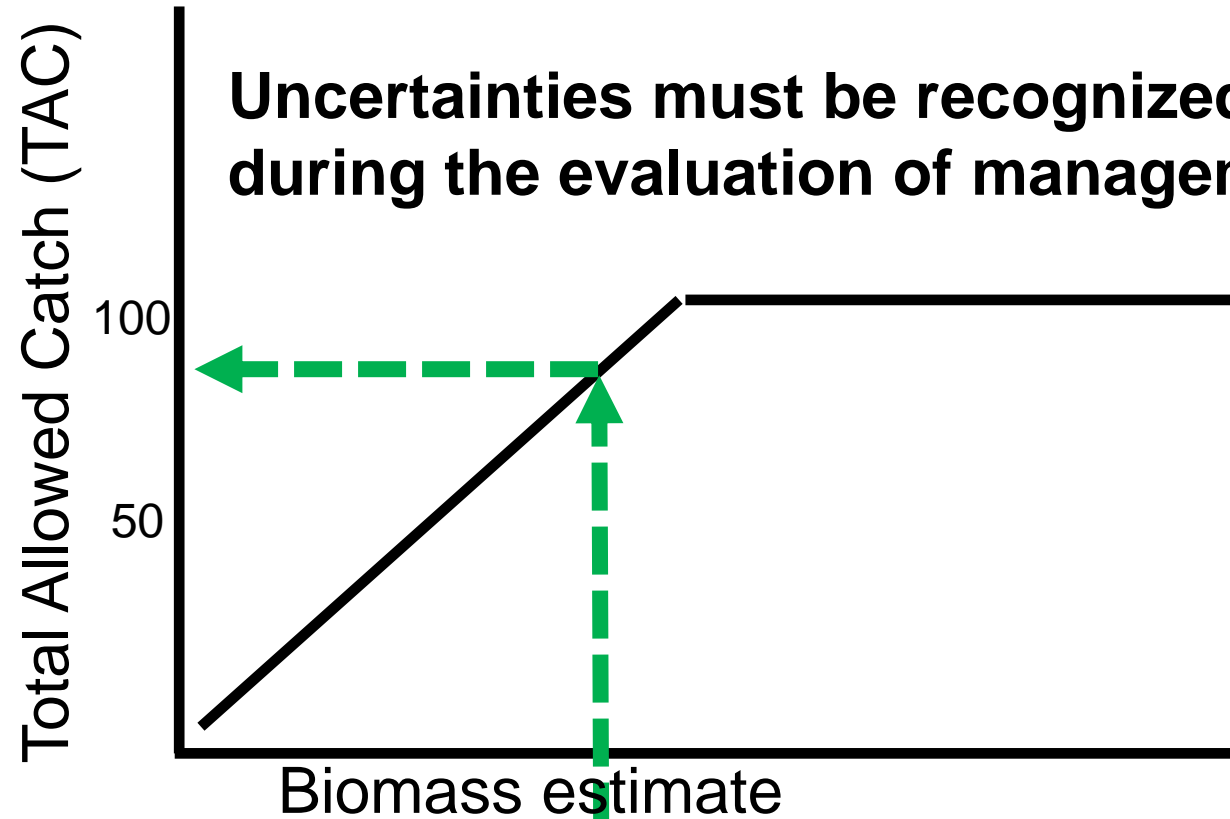
- 1) Fit a pre-specified stock assessment
- 2) Use the HCR to determine next year's TAC



Stock Assessment Uncertainty

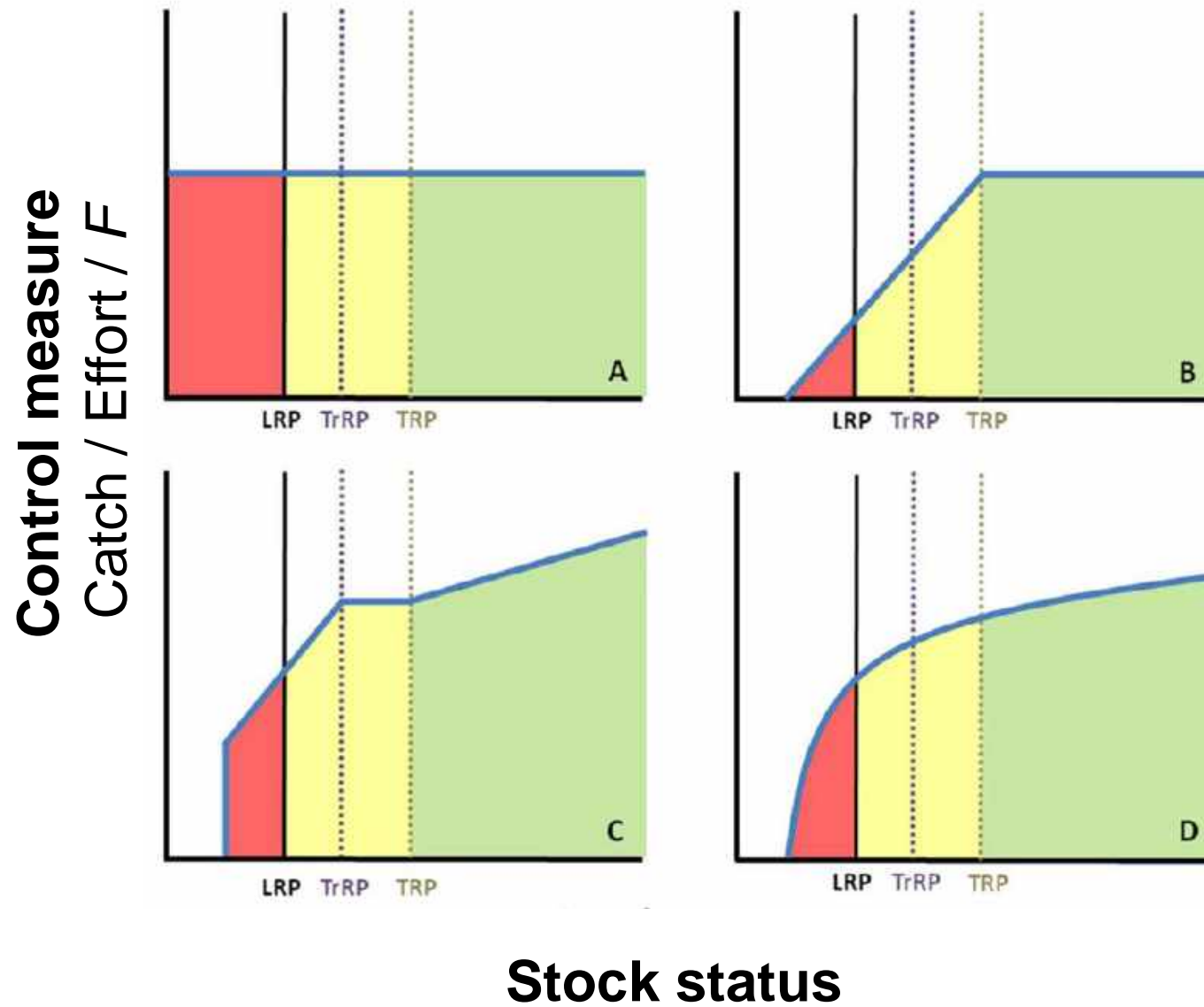


HCR must provide unique action



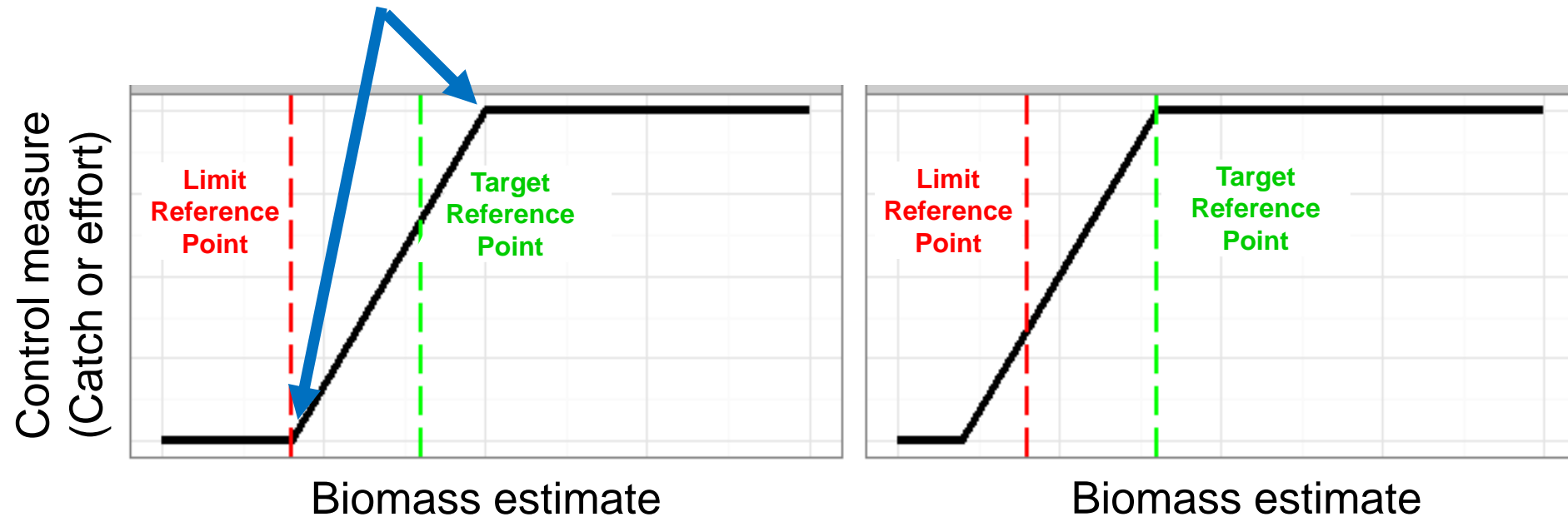
Stock assessment

HCR and Reference Points



HCR, control parameters and Reference Points

Control parameters (trigger reference points)



- Harvest Control Rules (HCR) can have arbitrary control parameters
- Formal Reference Points (**limit**, **target**) can be used to evaluate the performance of the HCR (but they do not need to be part of the HCR...)

IATTC Harvest Control Rule Implementation

- Limited entry for new purse-sein vessels
- Fishing Capacity should remain constant (but has increased over time)
- Recommendations of IATTC Scientific Staff to implement Harvest Control Rule using a time closure of the fishery (vessels can choose among two periods)
- Duration of closure calculated using an F multiplier from the stock assessments of YFT and BET, adjusted given changes in fleet capacity.

IATTC Harvest Control Rule Implementation

- “Corralito”: spatial closure (Sep. 29 to Oct. 29)
- Equivalent to 3 closure days for all EPO (SAC-05-16).



Figure 1. Closure area

IATTC Harvest Control Rule Implementation

- Longline catch quotas by CPC (no clear mechanism to



Other measures in place

- Fishing on FADs
- Total retention



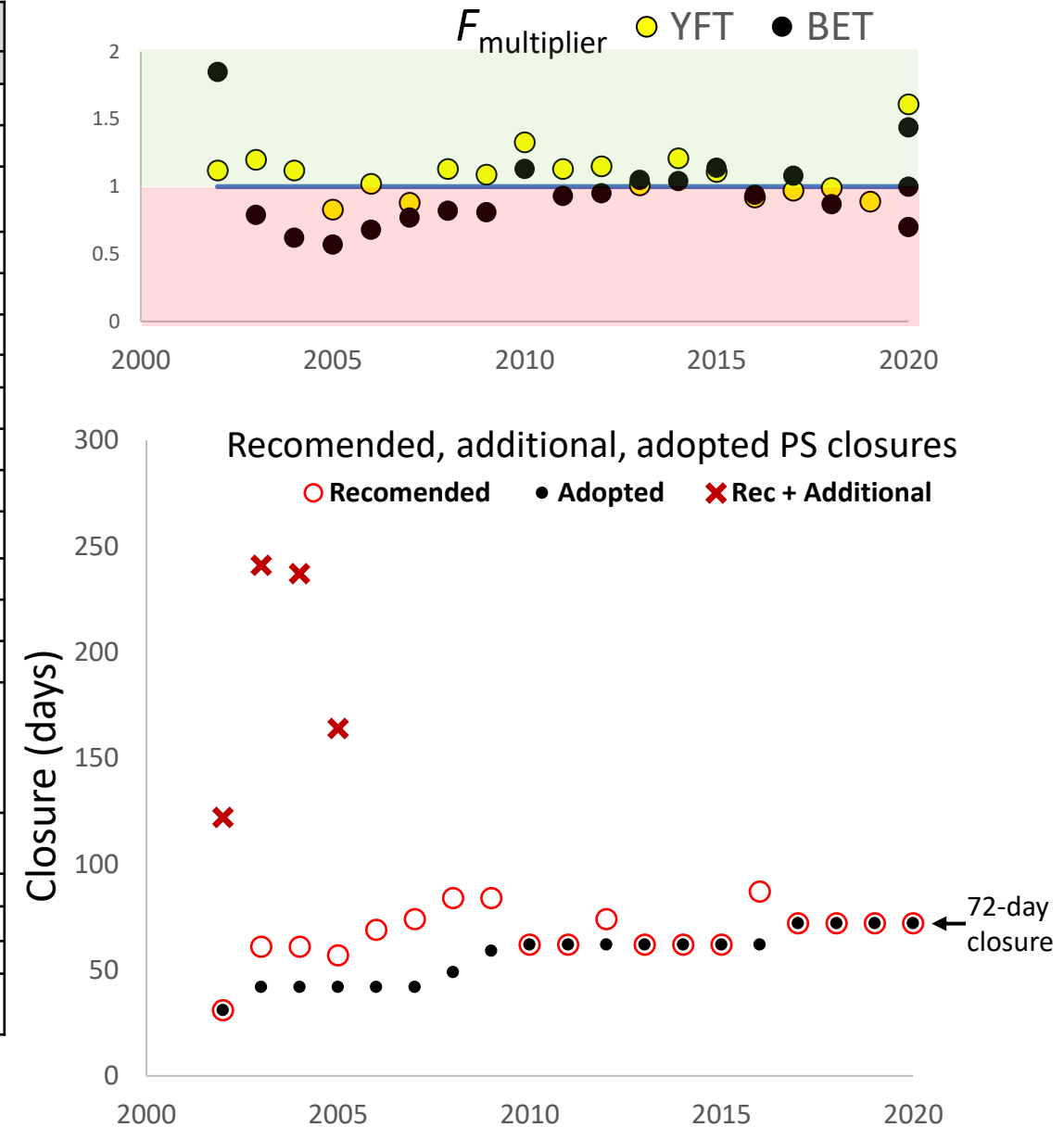
Other measures not adopted, or adopted but abandoned

Some examples only, list is not complete

- Combination of temporal and large spatial purse-seine closures (e.g. 2003, 2004)
- Individual vessel limits on purse seine BET catches (e.g. 2003)
- Additional closure days for the floating object fishery catching BET (e.g. 2006)
- Purse-seine catch limits (adopted, then back to closures 5 months later, 2017)
- Limits on the number of floating object and unassociated sets (2018, 2019)
- Limits on the number of floating object sets + ind. vessel daily active FADs (2020)

HCR implementation at IATTC

Year	Resolution	F multiplier		Closure (days)	
		YFT	BET	Recommended	Implemented
2002	C-02-04	1.12	1.85	31	31
2003	C-03-12	1.2	0.79	61 + add. measures ^[1]	42
2004	C-04-09	1.12	0.62	61 ^[2] + add. measures ^[3]	42
2005	C-04-09	0.83	0.57	61 + add. measures ^[3]	42
2006	C-04-09	1.02	0.68	61 + add. measures ^[4]	42
2007	C-06-02	0.88	0.77	74	42
2008	None	1.13	0.82	84	49
2009	C-09-01	1.09	0.81	84	59
2010	C-10-01	1.33	1.13	62	62
2011	C-11-01	1.13	0.93	62	62
2012	C-12-01	1.15	0.95	62-74 ^[5]	62
2013	C-13-01	1.01	1.05	62	62
2014	C-13-01	1.21	1.04	62	62
2015	C-13-01	1.11	1.14	62	62
2016	C-17-01	1.02 (0.92) ^[6]	1.05 (0.94) ^[6]	87	62 + OBJ DEL catch limits ^[7] , amended to 72 days OBJ, UNA and 62 DEL
2017	C-17-02	1.03 (0.97) ^[8]	1.15 (1.08) ^[8]	72	72
2018	C-17-02	0.99	0.87 ^[9]	72+ add. measures ^[12]	72
2019	C-17-02	0.89 ^[10]	No assessment	72+ add. measures ^[12]	72
2020	C-20-06	1.61	0.7 / 1 / 1.44 ^[11]	72+ add. measures ^[12]	72
2021	C-21-04	No assessment	No assessment	72+ add. measures ^[12]	72+ BET IVL



^[9] ^[10] Assessments determined not reliable for providing advice

^[11] Computed from pessimistic, overall and optimistic models from BET risk analysis

^[12] Limits on the number of OBJ and/or unassociated sets and vessel limits

HCR and management strategies in IATTC

RESOLUTION C-16-02

HARVEST CONTROL RULES FOR TROPICAL TUNAS (YELLOWFIN, BIGEYE, AND SKIPJACK)

C-16-02 has a harvest control rule (HCR) with **target**, **limit reference points**. **But:**

- HCR has not been fully evaluated using simulation
- No alternative HCR which could be better (e.g., more robust to uncertainty) has been considered yet
- HCR does not specify what management actions are to be implemented
- HCR does not have a mechanism calculating magnitude of management actions
- Probabilities around targets are not specified
- Including a consultative process is desirable

C-16-02 has elements of a management strategy, but it is not fully specified



Harvest Control Rule development

- Harvest control rules (including their component biological reference points) should be developed in the management planning stage with the **involvement of all stakeholders**
- The success of HCRs is generally enhanced by involvement of stakeholders in the definition of the problem, including assumptions, and as it **facilitates trust and policy “buy in”**

Harvest Control Rule development

- Tropical Tuna Harvest Control Rules ([Resolution C-16-02](#))

“...comprehensive management strategy evaluation (MSE) is necessary to evaluate the HCR (...) and alternatives (...) to allow the Commission to adopt a permanent HCR.”

- To evaluate the current HCR (C-16-02), we need to **further specify it** (paraphrasing it):

Purse-seine

- a. Management measures, such as closures, which can be established for multiple years, shall attempt to prevent the fishing mortality rate (F) from exceeding the best estimate of F_{MSY} for the species that requires the strictest management.
- b. If the probability that F will exceed the limit reference point (F_{LIMIT}) is greater than 10%, as soon as is practical management measures shall be established that have a probability of at least 50% of reducing F to the target level (F_{MSY}) or less, and a probability of less than 10% that F will exceed F_{LIMIT} .
- c. If the probability that spawning biomass (S) is below the limit reference point (S_{LIMIT}) is greater than 10%, as soon as is practical management measures shall be established that have a probability of at least 50% of restoring S to the target level (dynamic S_{MSY}) or greater, and a probability of less than 10% that S will descend to below S_{LIMIT} in a period of two generations of the stock or five years, whichever is greater.

Other gears

- d. Management measures shall be as consistent as possible with those for the purse-seine fishery, while taking account of the impact of those fisheries on the species compared with that of purse-seine fishery.

Harvest Control Rule development

- ***CLARIFYING POINTS OF CURRENT HCR***

- **Management measures**

- **Purse seine**

- Days of closure? Catch limits? Limits on number of sets?
- Global purse seine measures or by type of set (NOA, DEL, OBJ)?
- Global tropical tuna measures or by species?
- Others?

- **Longline**

- Catch limits, other?
- Consistency with other gears and accounting impact on the stocks compared other gears?

Harvest Control Rule development

- ***CLARIFYING POINTS OF CURRENT HCR***
- **Time span of management action and HCR, time of application**
 - It has varied from multiple years (e.g. 3-year cycle) to 1 year or less
 - How many years should the management action apply to? Adjustments in between?
 - “as soon as is practical”, measures following HCR or with lags?

Harvest Control Rule development

- **CLARIFYING POINTS OF CURRENT HCR**
- Evaluation of Risk and nature of Reference Points
 - Dynamic targets F_{MSY} and B_{MSY}
 - Equilibrium limits for F and B (not to be exceeded, 10% probability)

Harvest Control Rules for BET MSE

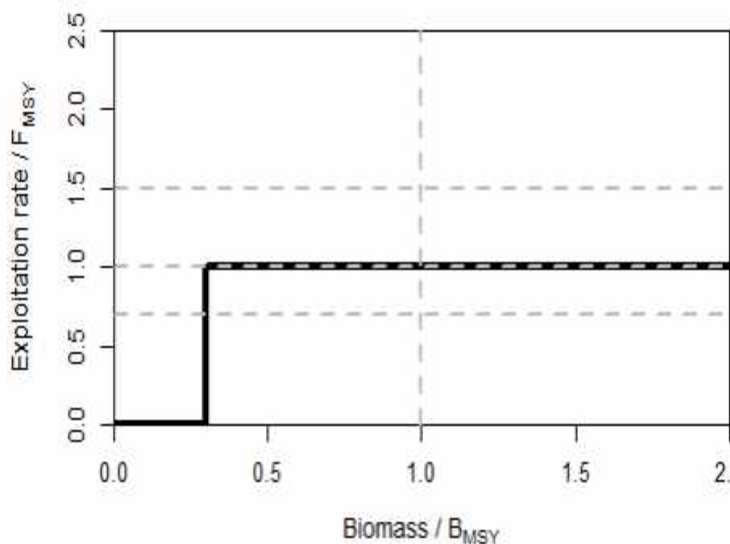
- Tropical Tuna Harvest Control Rules ([Resolution C-16-02](#))

"...comprehensive management strategy evaluation (MSE) is necessary to evaluate the HCR (...) and alternatives (...) to allow the Commission to adopt a permanent HCR."

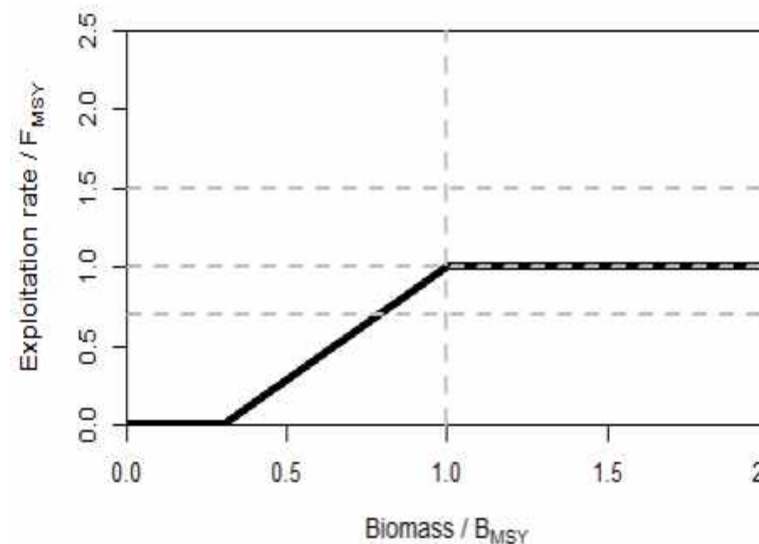
ALTERNATIVE HCRs

- 1) Empirical HCR based on standardized Japanese longline index of abundance
- 2) Model based HCR, based on surplus production model (ASPM, Pella-Tomlison)

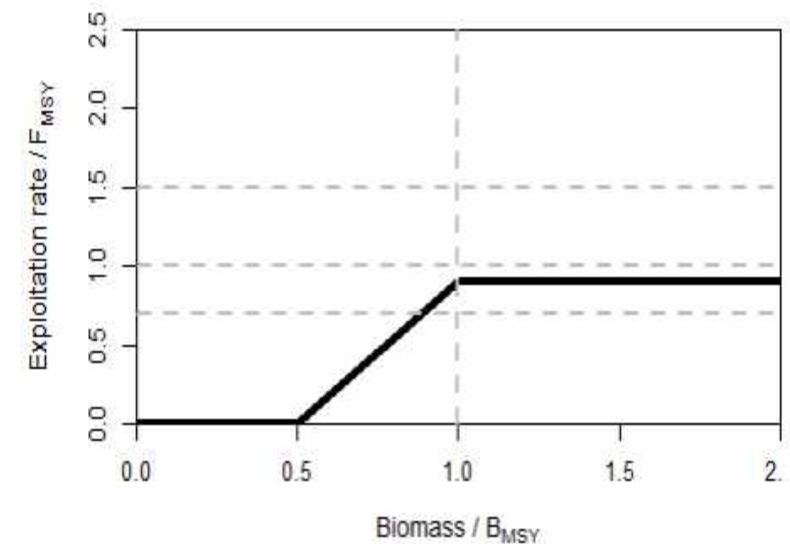
HCR 1 IATTC-like



HCR 2 Moderate



HCR 3 Conservative



Harvest Control Rules for BET MSE

- Applied on a 3-year cycle
- Effort controls (days of closure) for surface fleets, Catch limits for longline fleets
- Data inputs for HCR:
 - Empirical HCR: standardized Japanese longline index of abundance
 - Model-based HCR: standardized Japanese longline index of abundance and total catches

CIAT IATTC

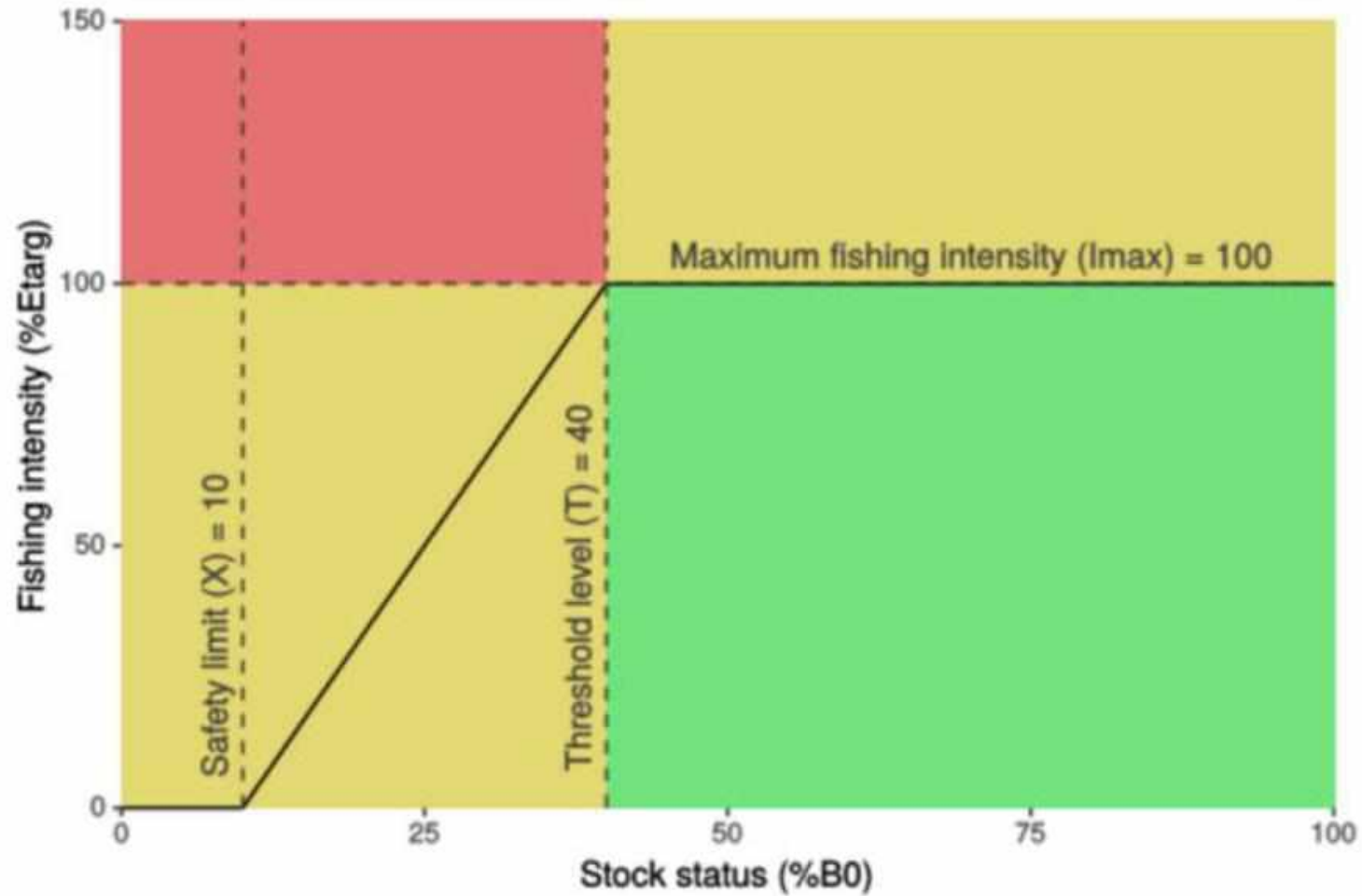


Questions?

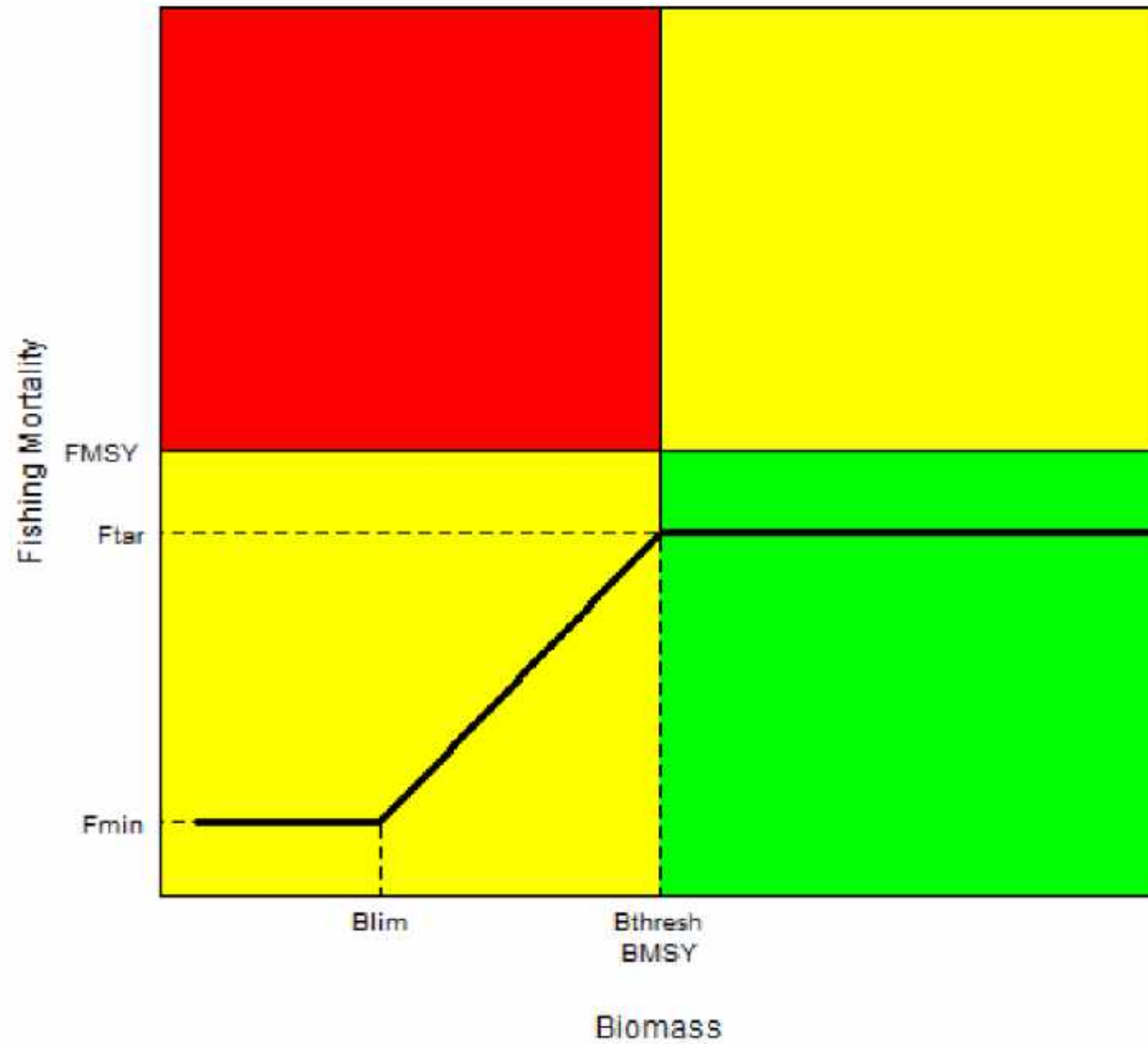
Tropical tuna reference points, Harvest Control Rules, tuna RFMOs

Element	RFMO	CCSBT	IATTC	ICCAT	IOTC	WCPFC
LRP		None	$F_{0.5R0}$ and $B_{0.5R0}$ with steepness of 0.75. Relates to a depletion of $0.077B_0$. (interim limits)	N. Atlantic swordfish: $0.4 B_{MSY}$ (interim limit)	Tropical tunas: $0.4 B_{MSY}$ ($0.5 B_{MSY}$ for BET) (interim limits) and $1.4 * F_{MSY}$ $1.3 * F_{MSY}$ SKJ $0.2SSB_0$ and F $0.2 * SSB_0$	Tropical tunas and S. Pacific albacore: $0.2 SB_{F=0}$ ($0.2B_0$) evaluated using recent recruitment levels
TRP		Interim 30%TRO achieved with 50% probability by 2035	B_{MSY} and F_{MSY}	"Green" quadrant of Kobe plot seems a target zone, but no specific TRP adopted.	Tropical tunas, albacore B_{MSY} and F_{MSY}	None for BET nor YFT Skipjack $0.5B_{F=0}$
HCR		Empirical (gene-tagging, CPUE and Close-Kin Mark Recapture indices)	Model-based: Reduce F to F_{MSY} if it exceeds this value. If 10% or greater of exceeding the limit	None	Model-based for SKJ None for BET and YFT	None

IOTC HCR for skipjack (IOTC Res. 16/02).



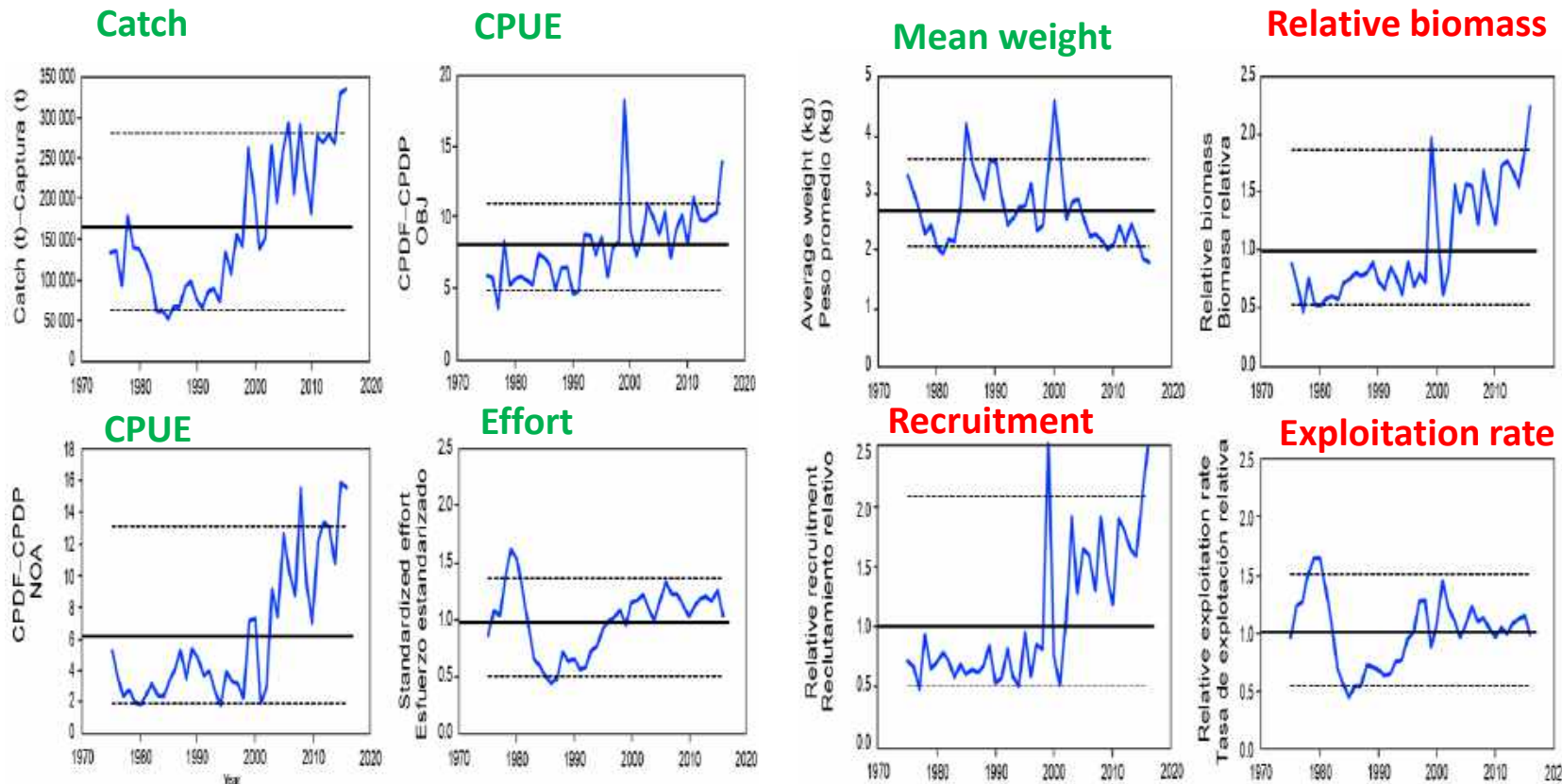
Harvest Control Rule adopted for North Atlantic albacore



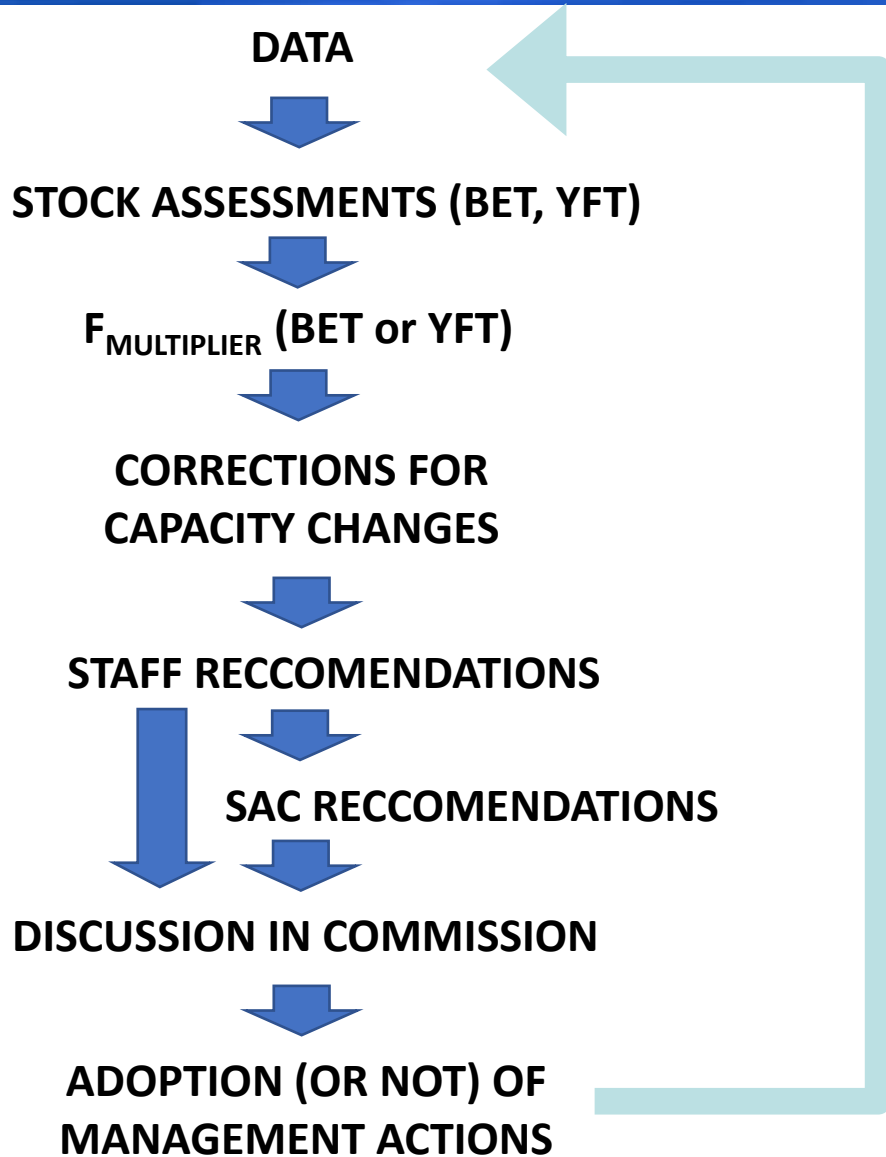
Indicators EPO Skipjack tuna

Based on **data** or **simple model** population estimates

- **Data** (catch, effort, CPUE, mean weight)
- **Simple model estimates** (biomass, recruitment and exploitation rate)



Tropical Tuna management in the IATTC



Tropical Tuna management in the IATTC

DATA



STOCK ASSESSMENTS (BET, YFT)



1. Problems with the BET assessment (2018)
2. Problems with the YFT assessment (2019)



$F_{\text{MULTIPLIER}}$ (BET or YFT)



CORRECTIONS FOR
CAPACITY CHANGES



STAFF RECCOMENDATIONS



SAC RECCOMENDATIONS



DISCUSSION IN COMMISSION



ADOPTION (OR NOT) OF
MANAGEMENT ACTIONS

Tropical Tuna management in the IATTC

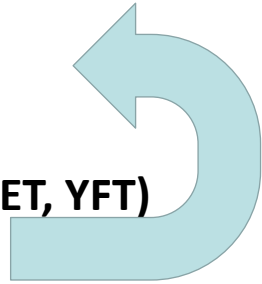
DATA



STOCK ASSESSMENTS (BET, YFT)



$F_{\text{MULTIPLIER}}$ (BET or YFT)



1. Problems with the BET assessment (2018)
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CORRECTIONS FOR
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DISCUSSION IN COMMISSION



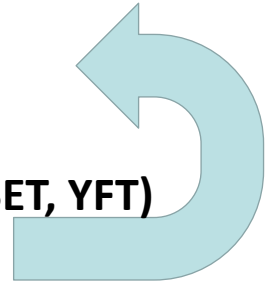
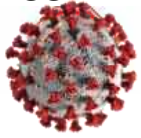
ADOPTION (OR NOT) OF
MANAGEMENT ACTIONS

IATTC Tropical Tuna management since 2020

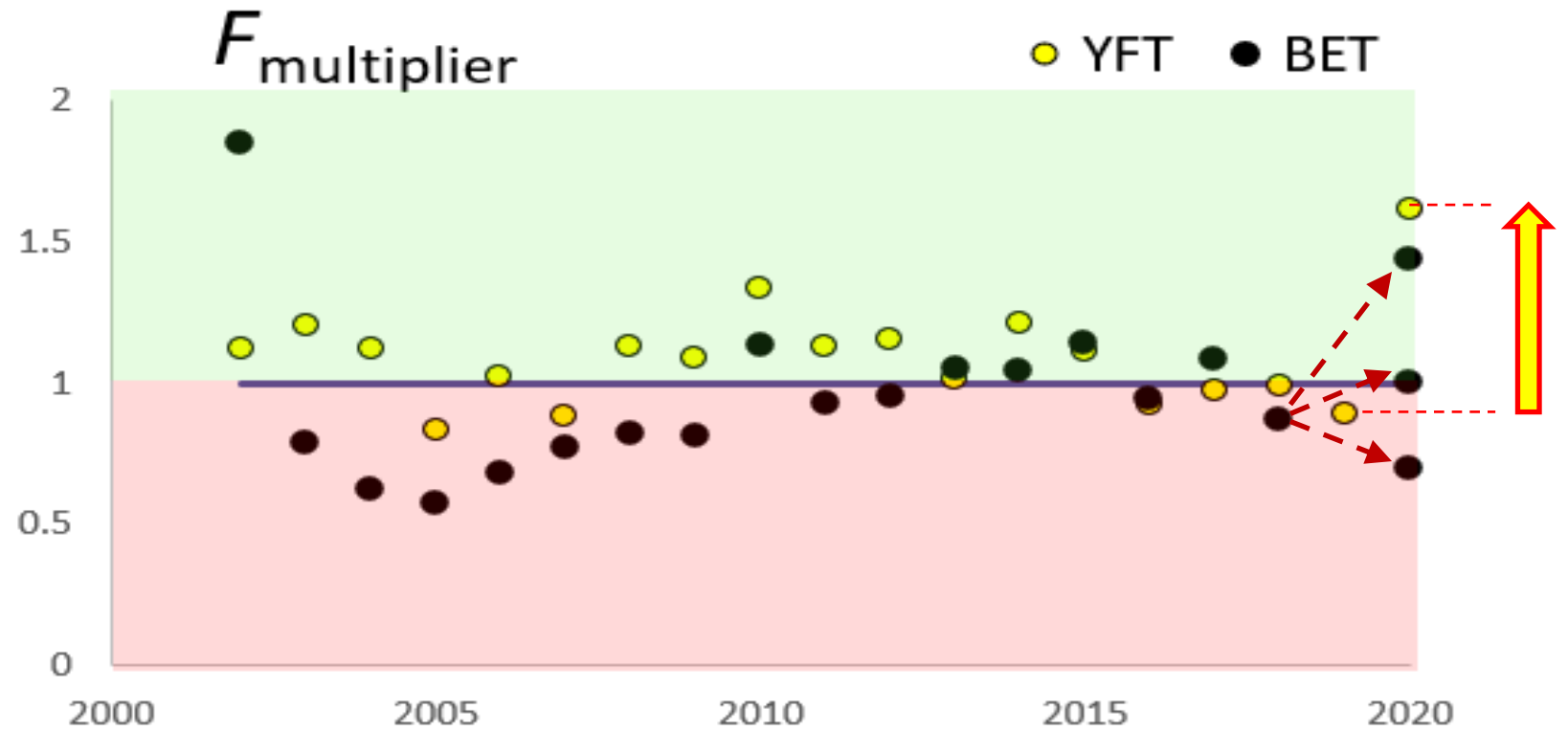
DATA



STOCK ASSESSMENTS (BET, YFT)



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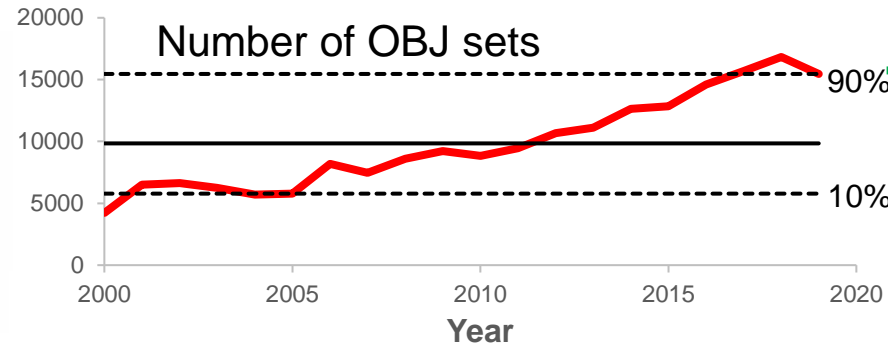
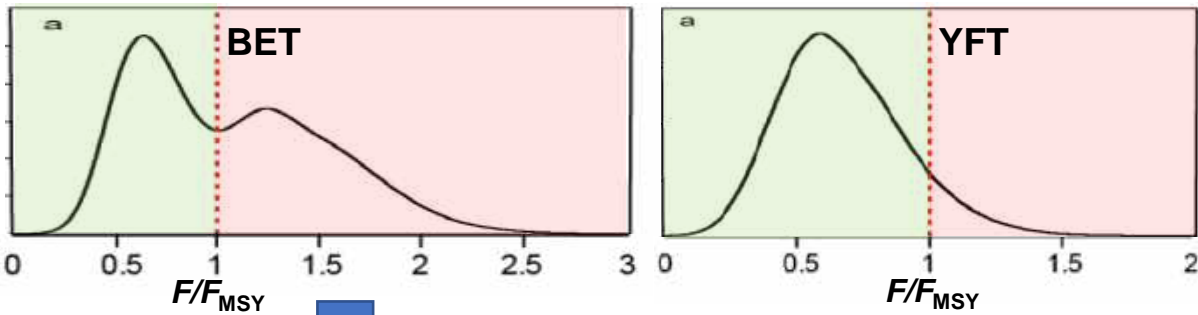


IATTC Tropical Tuna management since 2020

DATA



MULTI-MODEL STOCK ASSESSMENTS (2020)



CORRECTIONS FOR CAPACITY CHANGES



STAFF RECCOMENDATIONS

~~INCLUDING PRECAUTIONARY LIMIT ON OBJ # of SETS~~



SAC RECCOMENDATIONS



DISCUSSION IN COMMISSION



~~ADOPTION (OR NOT) OF MANAGEMENT ACTIONS~~



ADOPTION (OR NOT) OF MANAGEMENT ACTIONS

2022-2024 MANAGEMENT CYCLE
(72 days PS closure + BET IVL)



Control measures / Tactics

Why **Input Controls**?

- Simple and inexpensive to implement
- Easy to monitor
- More robust to assessment errors
- Mixed fisheries where it is difficult to monitor all species.

Challenges with **Input Controls**

- Incentivize a “race for fish”
- Difficult to limit all sources of fishing effort
- Fishing effort can re-distribute or change
- Tend to exceed the allowable catch