



**NOAA  
FISHERIES**

# A brief introduction on how Management Strategy Evaluation can address some key challenges before the Council



ICCAT CICTA CICAA

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Management Council  
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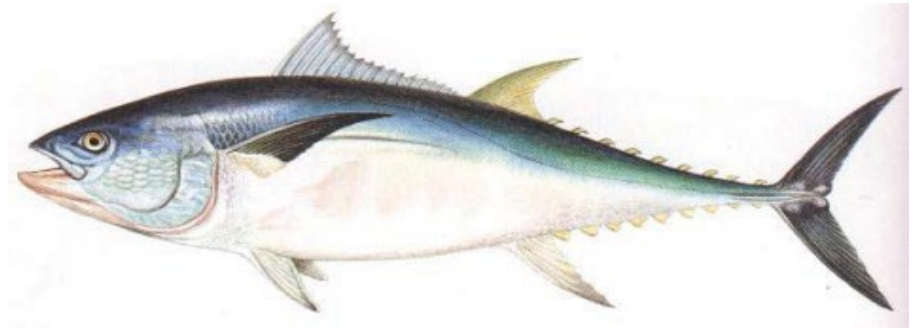


# A few (unfortunate) definitions

- **Management Strategy Evaluation** is a simulation-based, analytical framework used to develop a robust, consensus-driven and realistic **Management Procedure**. Often an iterative process involving dialogue between Scientists, Managers, and Stakeholders.
- **Management procedure (MP)**: A pre-agreed framework for setting catch limits, designed to achieve specific **management objectives**. Essentially the 'recipe' for setting and implementing the ACL
- **Management objectives (MO)**: Formally adopted goals for the fishery.
- **Interim assessment (IA)**: Any simple modeling method designed to modify assessment advice on the basis of recent trends. It is designed to produce ABC recommendations and could give changes to stock status.

# Presentation outline

1. *Key challenges in the Southeast*
2. *What is Management Strategy Evaluation*
3. *An example: Atlantic Bluefin tuna*
4. *Fitting MSE into Magnuson Stevens Act*
5. *SEFSC's MSE Strategic plan*
6. *Steps forward*



# Take home message:

- *Management Procedures developed through Management Strategy Evaluation allow the Council to test management before it goes into place.*
- *Why Management Procedures?*
  - *environmental and other changes challenge the assumption that things will be constant - a key assumption of our stock assessments*
  - *More explicit incorporation of diverse management objectives*
- *Identify a clear objective and match resources to scope of problem. MSE is neither cheap nor easy. Reserve the full 'power' of stakeholder-inclusive MSE for highest priority, decisional applications*

# Key challenges for fisheries management

## 1. Optimum Yield

- *“greatest overall benefit to the Nation, particularly with respect to food production and recreational opportunities prescribed as such on the basis of the MSY as reduced by any relevant economic, social, or ecological factor;*
- *provides for rebuilding to MSY”*

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## 2. Nonstationarity



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## 2. Nonstationarity



## 3. Ecosystem-based fisheries management





# Key challenges for fisheries management

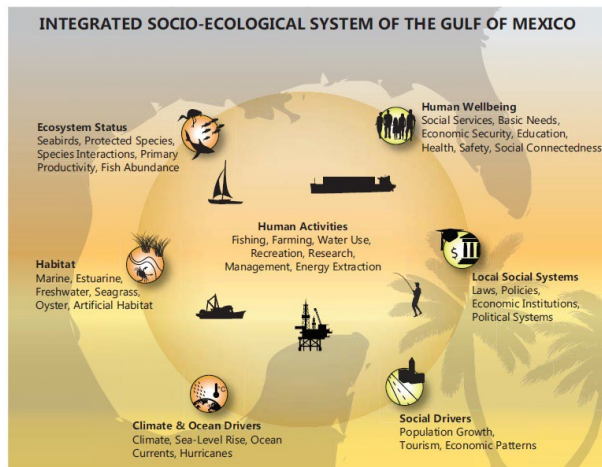
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## 2. Nonstationarity



## 3. Ecosystem-based fisheries management

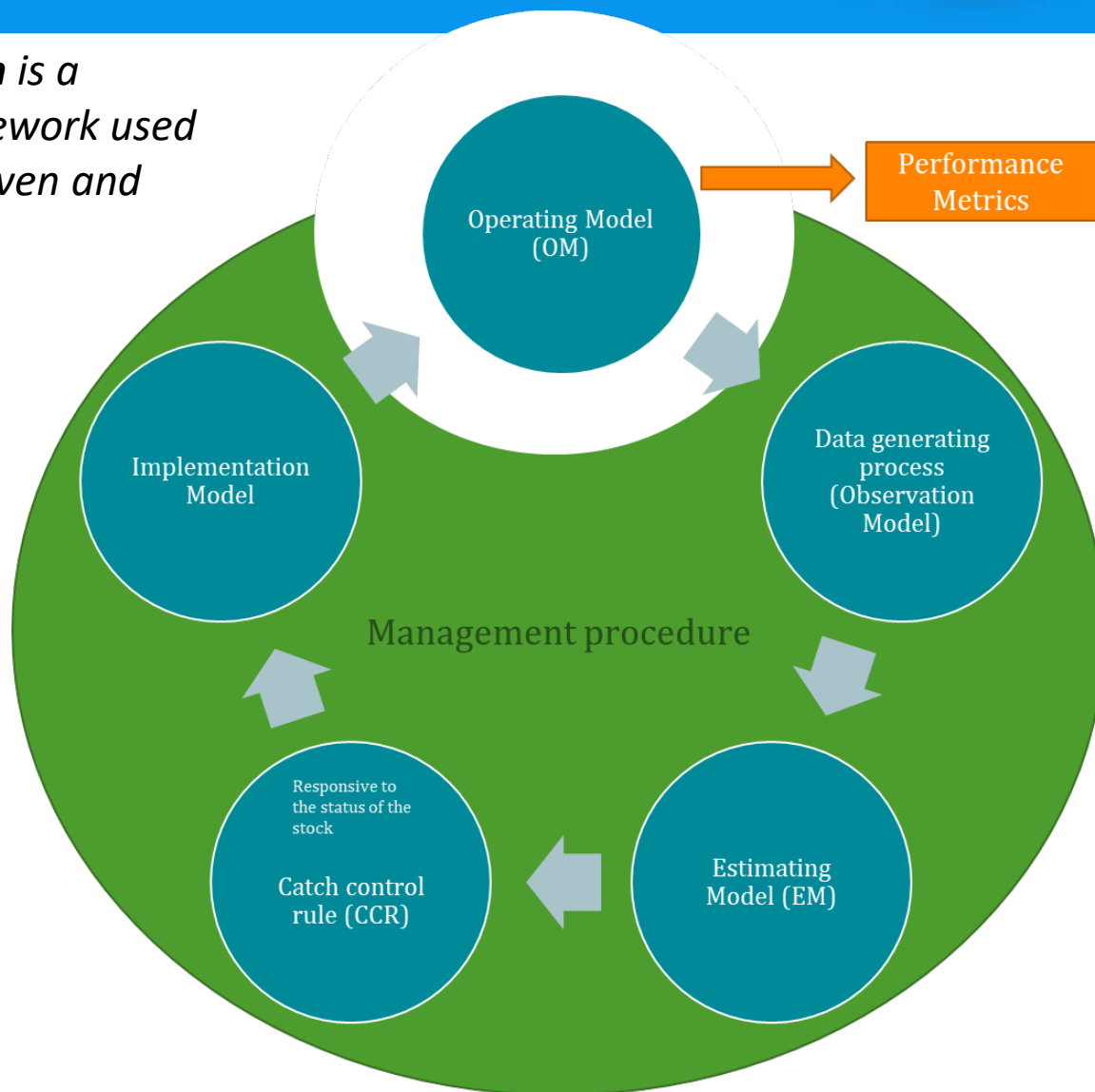


## 4. Tactical management actions: Allocations/promoted fishing areas/size or bag limits





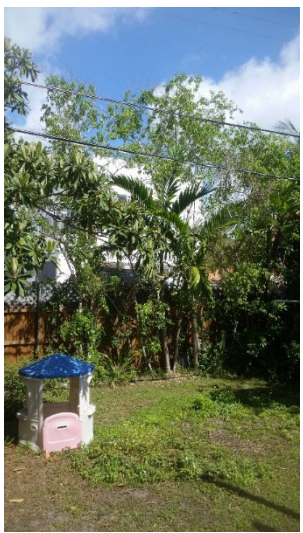
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# MSE analogy: an Air Conditioner thermostat

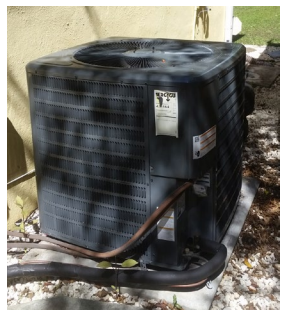
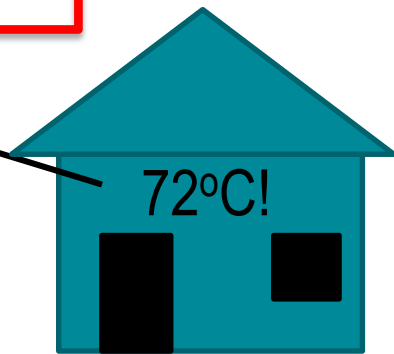
The system  
(simulated by  
Operating  
Model(s))



management procedure  
(feedback, response, action)



management  
objective





**Conceptual Management Objectives:** Desired goals for fishery

**Operational Management Objectives:** specific, codified and measurable objectives, with timelines and minimum required probabilities



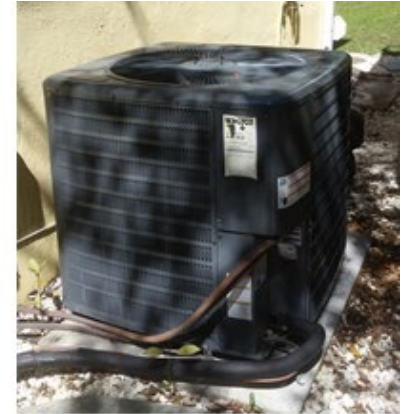
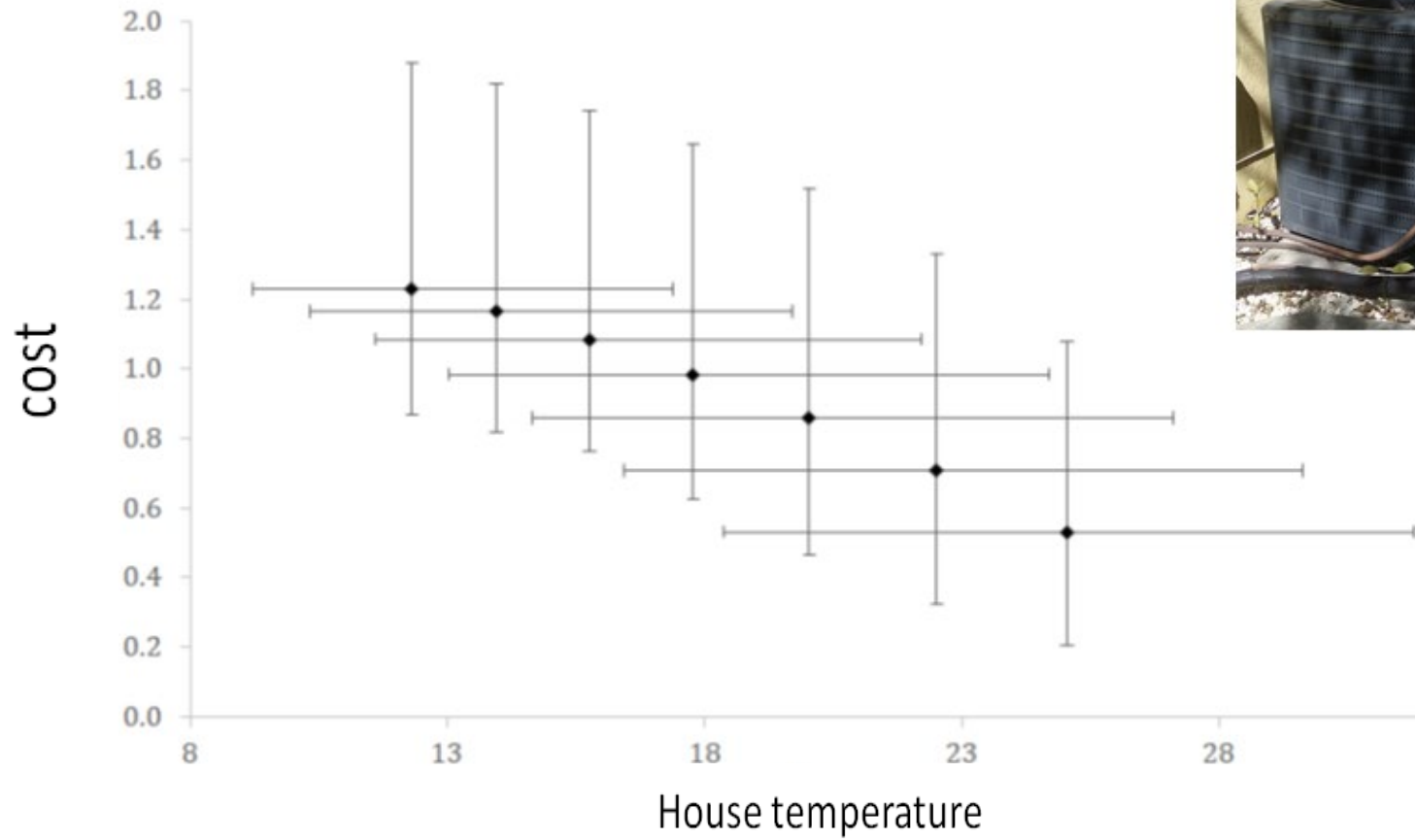
### Conceptual:

- Keep house habitable
- Stay within budget

### Operational:

- Ensure internal temperature stays between 70°-74° at least 70% of the time
- Ensure the internal temperature never exceeds 78°
- Keep electric bill less than \$175/month

# MSE explicitly quantifies tradeoffs



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### 3. ICCAT Bluefin Management Strategy Evaluation Setting

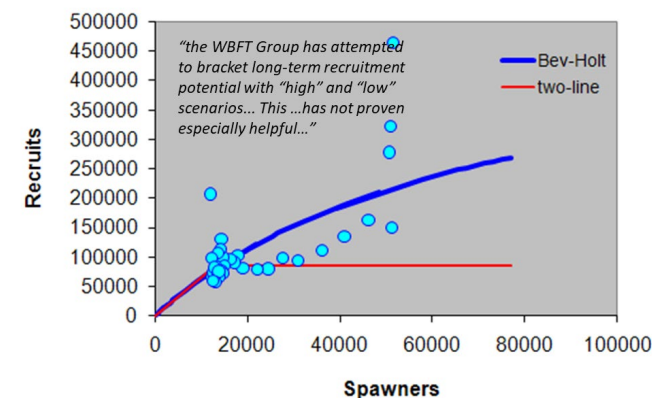
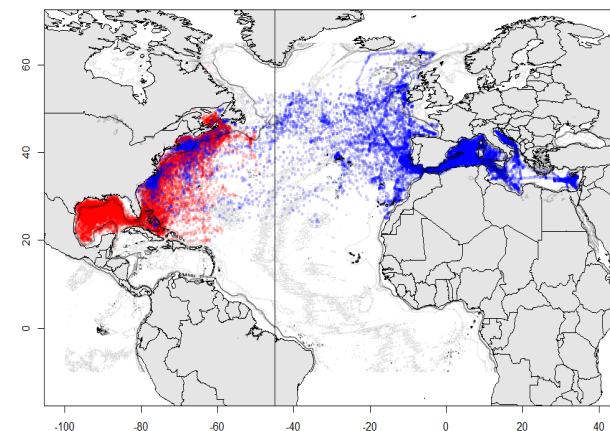
#### Biology

- Two (or more) stocks
- Time-varying and/or environmentally driven productivity (e.g. high/low stock recruitment relationships)
- Uncertainty in age at maturity
- Highly migratory

#### Stock assessments

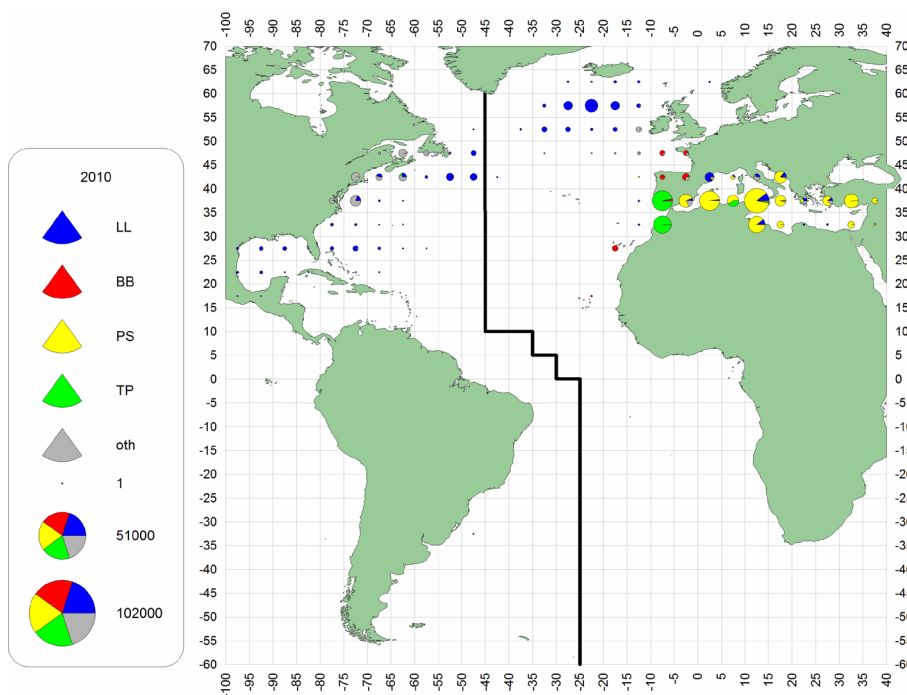
- Eastern VPA, Western VPA, Western Stock Synthesis
  - No biomass-based benchmarks, only F-based management
- Recent assessments considered unreliable for management advice

<https://iccat.github.io/abft-mse>

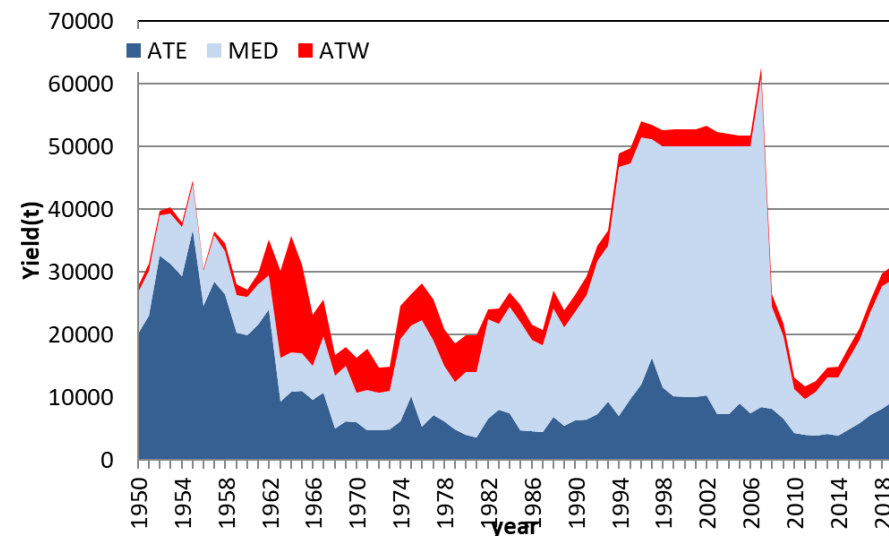




## BFT catches by gear(2010-19)



## BFT -Atlantic yield by region



- \$1 billion in value (McKinney 2020)
- >50% of global bluefin from Atlantic and Mediterranean
- 94% of catch comes from Eastern area

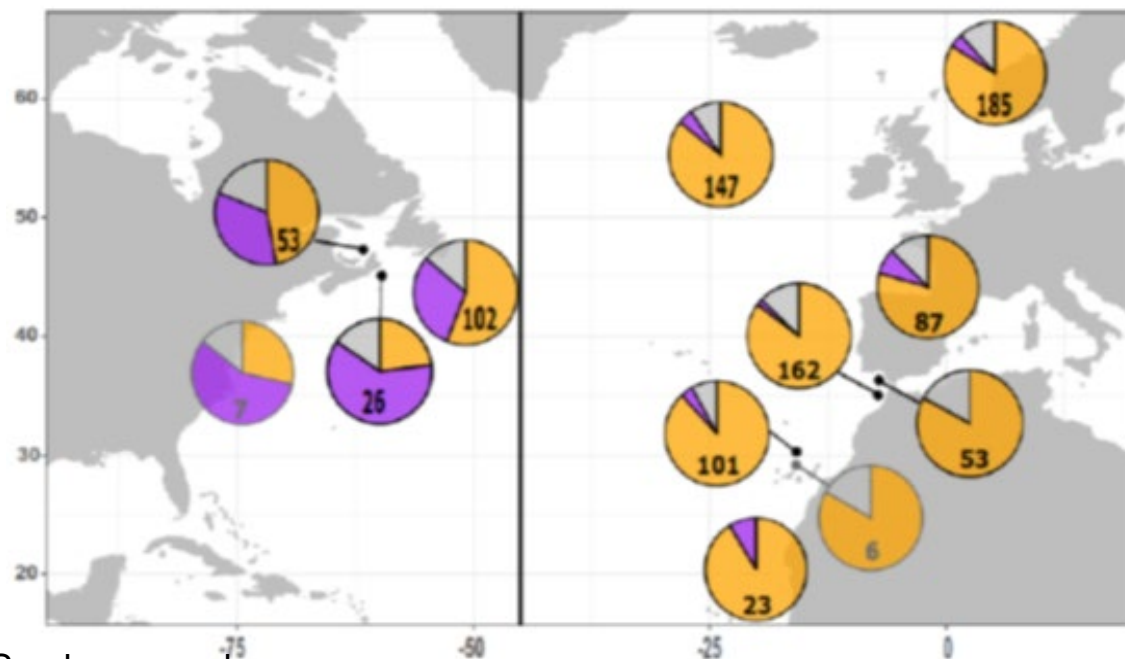
McKinney 2020. <https://www.pewtrusts.org/-/media/assets/2020/10/nettingbillions2020.pdf>



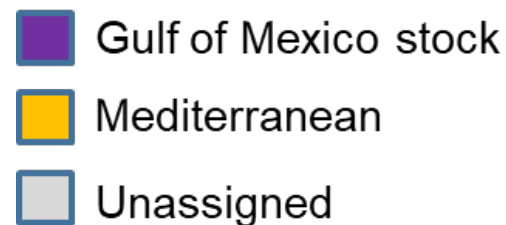


## Mixing: What happens in East affects West

In some years > 50% of Western caught fish may have been of Eastern origin



grey outline indicates Slope Sea larvae and Canary island YOY.  
Numbers are sample sizes.



Rodriguez-Ezpeleta et al. 2019. Determining natal origin for improved management of Atlantic bluefin tuna. *Frontiers in Marine Science*





## *Management objectives*

- ***Conceptual Management Objectives:*** Desired goals for fishery and resource
- ***Operational Management Objectives:*** Specific, codified and measurable objectives, with timelines and minimum required probabilities

**Conceptual:** Want  
stable TAC

**Operational:** TAC varies  
by less than 20% in each  
year



# Operational Management Objectives for Atlantic Bluefin tuna

**Safety:** less than 15% probability of stock falling below  $B_{LIM}$  ( $40\%SSB_{MSY}$ )

**Status:** greater than 60% probability of  $F < F_{msy}$  and  $SSB > SSB_{msy}$

**Stability:** Change in TAC between management periods should be less than 20%

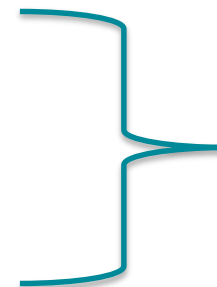
**Yield:** Maximize overall catch levels

short (years 1-10)

long (years 1-30)



Biological  
'must pays'



Stakeholder  
'needs'



# Types of Management procedures explored

## Empirical management procedures

- Use empirical “proxies”, such as indices
- Simple to explain and implement:

index↓TAC↓ and index↑TAC↑

## Model based management procedures

- Use quantities estimated from stock assessment model (e.g.,  $B_{MSY}$ ,  $F_{MSY}$ ) to derive TAC advice.
- Similar to stock assessment advice framework










# 9 original Management Procedures; only one adopted: Butterworth Rademeyer (BR)

Multiple development teams  
(multiple nations, multiple scientists)

Most empirical, several model-based

Competitive, evolutionary process

Performance matters!

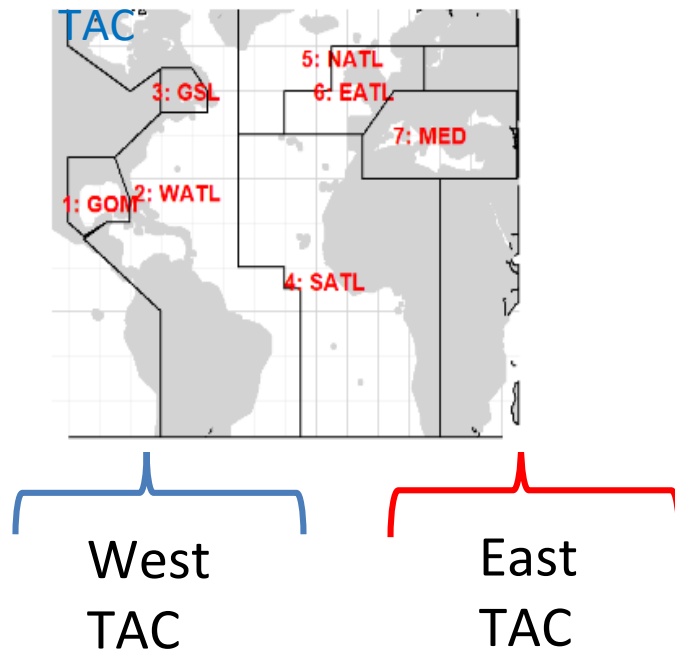
CMP		Indices used		Formulae for calculating TACs
		EAST	WEST	
FZ		FR AER SUV2 JPN LL NEAtI2 W-MED LAR SUV	US RR 66-144, CAN SWNS RR US-MEX GOM PLL	TACs are product of stock-specific F0.1 estimates and estimate of US-MEX GOM PLL for the West and W-MED LAR SUV for the East.
AI		All	All	Artificial intelligence MP that fishes regional biomass at a fixed harvest rate.
BR		FR AER SUV2 W-MED LAR SUV MOR POR TRAP JPN LL NEAtI2	GOM LAR SUV US RR 66-144 US-MEX GOM PLL JPN LL West2 CAN SWNS RR	TACs set using a relative harvest rate for a reference year (2018) applied to the 2-year moving average of a combined master abundance index.
EA		FR AER SUV2 W-MED LAR SUV MOR POR TRAP JPN LL NEAtI2	GOM LAR SUV JPN LL West2 US RR 66-144 US-MEX GOM PLL	Adjust TAC based on ratio of current and target abundance index.
LW		W-MED LAR SUV	GOM LAR SUV	TAC is adjusted based on comparing current relative harvest rate to reference period (2019) relative harvest rate.
NC		MOR POR TRAP	US-MEX GOM PLL	TAC is updated using an average of an index in recent years compared to and average in previous years. The scale of TAC increase/decrease is controlled based on the trend in catches and indices
PW		JPN LL NEAtI2	US-MEX GOM PLL	TAC is adjusted based on comparing current relative harvest rate to reference period (2019) relative harvest rate.
TC		MOR POR TRAP JPN LL NEAtI2 W-MED LAR SUV GBYP AER SUV BAR	US RR 66-144	Model Based: TAC is adjusted based on $F/F_{MSY}$ and $B/B_{MSY}$
TN		JPN LL NEAtI2	US RR 66-144 JPN LL West2	Both area TACs calculated based on their respective JPN_LL moving averages, unless drastic drop of recruitment is detected by US_RR index.



# BR: One management procedure, 2 TACs

Rule for  
West area

Rule for  
East area



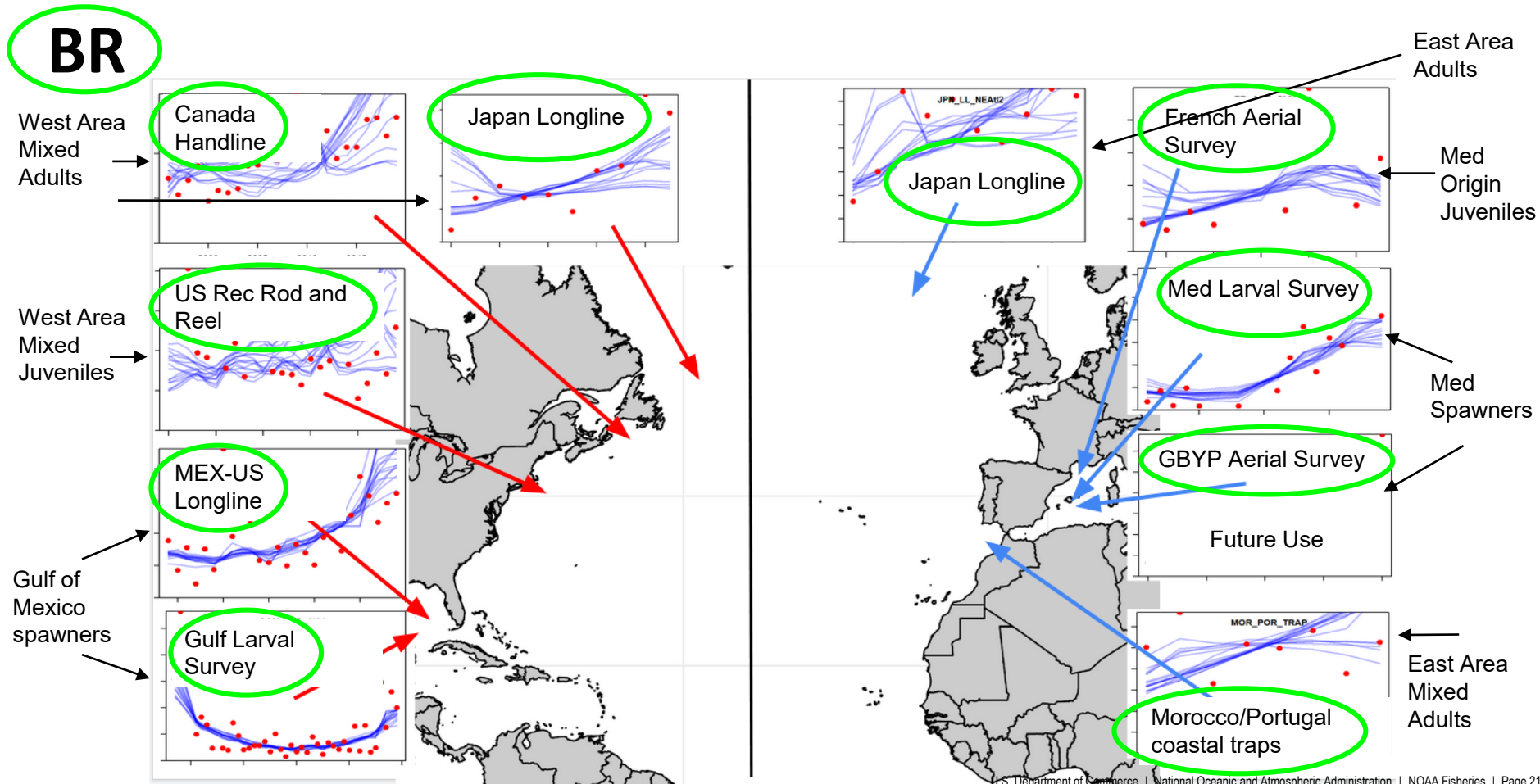
Sets TAC for 3 years based on 10 indices relative to reference year (2017)

Built-in stability provisions limit initial TAC changes

Simulation tested to be robust to environmental changes and numerous other uncertainties

Achieves multiple, competing, management objectives

# BR uses 10 indices of Abundance (red points) and OM fits (blue lines)



# ICCAT BFT Management procedure schedule

## 3 Year Cycle

	2022	2023	2024	2025	2026	2027	2028
SCRS check for exceptional circumstances		X	X	X	X	X	X
SCRS runs MP	X			X			X
Commission endorses and implements TAC based on MP (unless other action is needed due to exceptional circumstances)	X			X			X
TAC in effect		X	X	X	X	X	X
SCRS MP review						X	X
Status Check/Assessment					X*	X*	
Commission assesses SCRS review and next steps							X

\*The Commission shall decide the timing of the next stock assessment in consultation with the SCRS.

MP sets TACs for 3 years for both East and West by modifying previous TACs based on recent indices

Less frequent stock assessments will occur as 'health or status' checks

MP review/revision and MSE 'reconditioning' 2027

**Exceptional circumstance provisions** specify situations when MP can be overridden, e.g. index outside range tested, inability to update an index for multiple years, natural disasters, etc.

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<https://www.iccat.int/Documents/Recs/compendiopdf-e/2022-09-e.pdf>



## 4. Fitting MSE into MSA

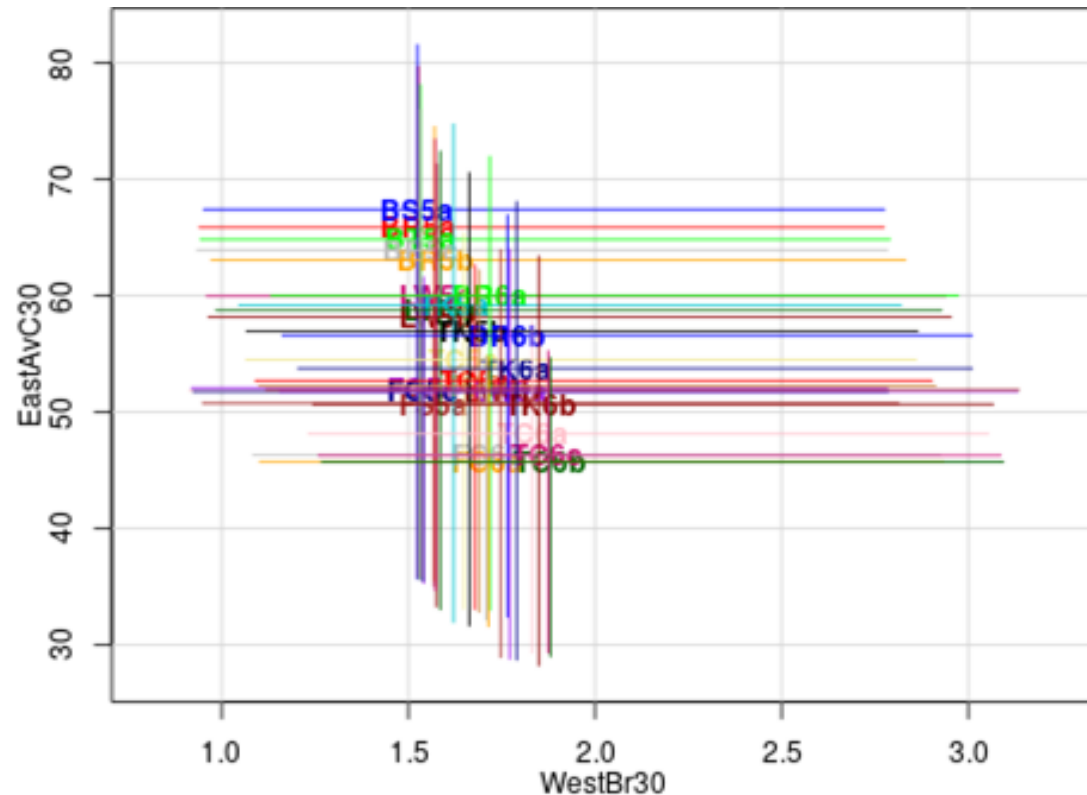
Possible roles and responsibilities of Stakeholders, modelers, SSC and Council (*according to John*)

	Stakeholders	Modeling team	SSC	Council
Operating models	<b>Advise</b> on OM structure and key uncertainties	<b>Construct</b>	<b>Adopt</b>	<b>Advise</b>
Management objectives	<b>Advise</b>	<b>Quantify</b>	<b>Advise</b>	<b>Adopt</b>
Management Procedures	<b>Advise</b>	<b>Test and refine</b>	<b>Advise</b> on biological 'must-pays' e.g. not overfishing and rebuilding	<b>Adopt</b> and implement management procedure based on performance

## 4. Fitting MSE into MSA- Optimal Yield

**Optimum yield-** rather than 'solving' for OY, this is likely to be the compromise space between competing management objectives, e.g. Yield between East and status of Western bluefin tuna, commercial yield/recreational opportunity, etc

Tradeoff space between East catch and vs West stock status for Atlantic bluefin tuna.



## 4. Fitting MSE into MSA- testing novel MPs

*Address non-stationarity and simulation test MPs to be robust to environmental changes*

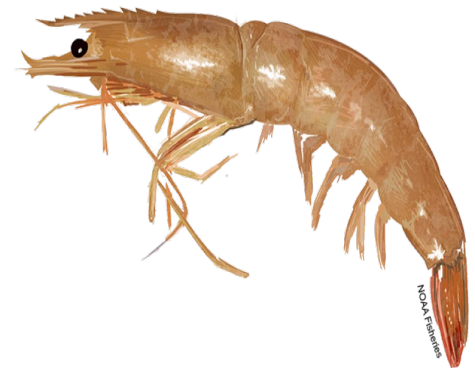
*Reduce 'delay' between advice and action – see next talk' Potential Options for Regulatory Streamlining'*

*Development of novel management procedures based on exploitation rate proxies - SARSP may employ gene-tagging to estimate exploitation rate*

# 5. SEFSC's MSE Strategic plan (see presentation by Cassidy Peterson to Oct 2022 South Atlantic SSC)

## 3 'Flagship' MSEs for SEFSC

- Focus on paradigm-changing, high profile applications that have the potential to improve management of fisheries in the southeast region



<https://www.fisheries.noaa.gov/feature-story/scientists-consider-more-adaptive-approaches-atlantic-dolphinfish-management>

# 6. Steps forward: when to do Management strategy evaluation

ICES Journal of Marine Science, 2023, 8, 1–8  
DOI: 10.1093/icesjms/fsad031  
Food for Thought



## When to conduct, and when not to conduct, management strategy evaluations

J. F. III Walter<sup>1,\*</sup>, C. D. Peterson<sup>1</sup>, K. Marshall<sup>2</sup>, J. J. Deroba<sup>3</sup>, S. Gaichas<sup>3</sup>, B. C. Williams<sup>4</sup>, S. Stohs<sup>5</sup>, D. Tommasi<sup>5,6</sup> and R. Ahrens<sup>7</sup>

### High priority situations for full stakeholder MSEs

1. *For adoption of binding management advice versus exploring management options*
2. *When there is a really difficult policy decision*
3. *When there are heretofore intractable stakeholder conflicts*
4. *When there are disenfranchised stakeholders, including ecosystem considerations*
5. *When scientific uncertainty threatens the integrity of the current management approach or when status quo management is clearly failing ('known unknowns')*
6. *When there are conditions which make future projections really unclear ('unknown unknowns')*

### Other situations where a full stakeholder MSE may be requested but simpler approaches may suffice

1. *When an empirical management procedure approach might improve upon status quo management*
2. *To adopt or modify a catch control rule when time and resources are limited*
3. *Mainly tactical decisions regarding allocation of survey and scientific resources*
4. *When stakeholders desire information for an external purpose*
5. *Research/Scientific questions not intended to directly support management advice*



## 6. Steps forward

*Apply the right tool for the job, consider MSE as part of the upcoming Fisheries Ecosystem Initiatives*

### Full stakeholder MSE

- Full iterative stakeholder involvement
- MSE intended to result in management action
- Where management objectives are not fully developed
- Expensive and time consuming

### Intermediate MSE

- Spectrum between full stakeholder MSE and desk MSE
- Moderate resource requirements

### Desk MSE

- No stakeholder input
- General research questions
- management objectives are known
- Can be used to test Interim approaches

### Not MSE

- Simulation exercises where the full feedback-loop characterizing the MSE is not necessary
- Consider other less resource-intensive approaches
- Risk analyses

Walter, Peterson, Marshall, Deroba, Gaichas, Williams, Stohs, Tommasi, Ahrens (*in press*) When to conduct management strategy evaluation.

# 6. Steps forward: Increasing use of MSEs & its cousins

**ICCAT:** Northern Albacore- model-based MP adopted, Bluefin tuna  
Empirical MP- this year, Tropical tunas & Swordfish-in progress



**South Atlantic Dolphinfish:** Empirical Management Procedure in development (joint effort of NCSU, SEFSC, & SAFMC)

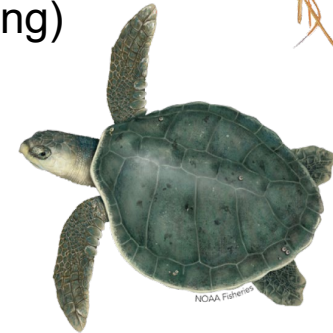


**South Atlantic reef fish:** (SAFMC funded, external contractor)

**Gulf Shrimp:** (currently unfunded- stakeholder workshops in planning)



**Kemps sea turtles:** (partially funded, modeling work ongoing)

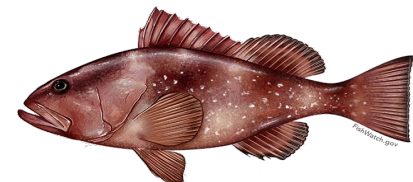


**Interim Assessments:**

Yellowtail Snapper: Updated assessment (lite) + projections

Red grouper

Vermilion snapper





# Take home message, again:

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- *Why Management Procedures?*
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# Acknowledgements

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