A Decision Support Tool for evaluating the impacts of short- and long-term management decisions on the Gulf of Mexico Red Snapper Resource

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What is MSE?

MSE shorts for "Management Strategy Evaluation"

Management strategy evaluation uses computer simulation methods to quantify the risk associated with a suite of potential fisheries management actions (Jones et al. 2009; Punt and Hobday 2009; Kraak et al. 2010; Milner-Gulland et al. 2011).

MSE components

Formulate strategies → **"Implement" strategies** → **Evaluate strategies**

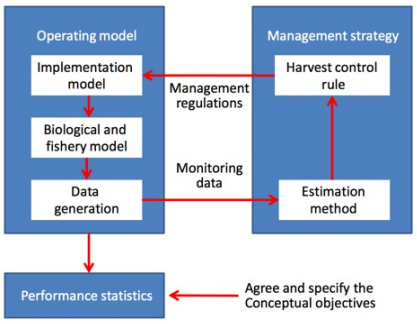
- Biological reference points
- Harvest control rules
- Allocation among fishing sectors
- Size regulations
- Fishing season
- …

- Observational errors
- Process errors
- Implementation errors
- Assessment errors
- …

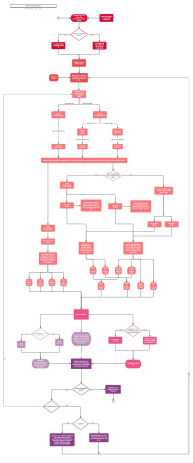
- Total catch
- Catch variation
- Terminal SSB
- Lowest SSB
- …

Advantages of the GoM Red Snapper MSE Tool

I. Model Structure



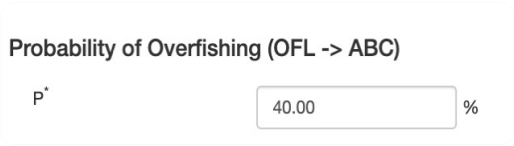
(Punt et *al.*, 2016)

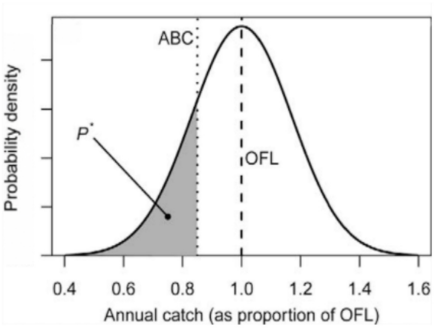


Advantages of the GoM Red Snapper MSE Tool

I. Model Structure

- Probability-based catch levels OFL & ABC





http://gomredsnappermsetool.fiu.edu/intro/glossary/

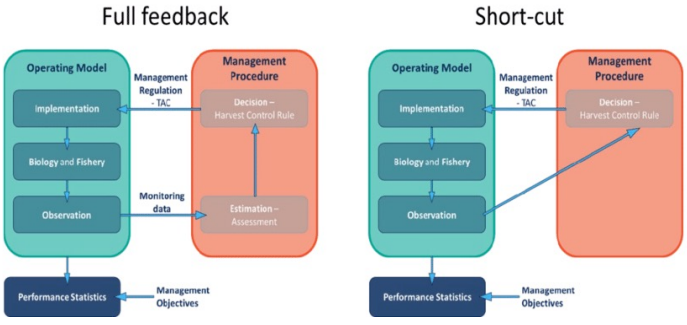
Advantages of the GoM Red Snapper MSE Tool

I. Model Structure

- Assessment error

(Pastoors et *al.*, 2020)

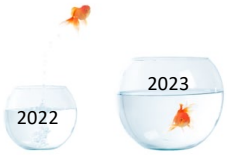
Full MSE vs Shortcut MSE



Advantages of the GoM Red Snapper MSE Tool

I. Model Structure

- Management procedure – adjusting ACL Carryover Provision & Penalty



If the recreational sector did not harvest its ACL, but the commercial harvest exceeded the commercial ACL such that landings for the stock exceeded 100% of the stock ACL, then the recreational ACL for that stock would not be eligible for a carryover in the following fishing year, even though that sector had foregone yield in the previous fishing year.

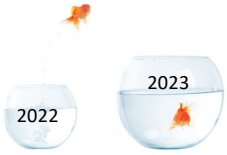
If the combined sector landings exceed the sector ACL or the stock ACL, there will be no carryover, even if one sector component did not harvest its quota for that fishing year.

The amount to be carried over to the following year, when added, cannot result in an ABC which is greater than the OFL. (We set two options, 95% of the OFL, or 50% of the difference between ABC and OFL.)

Advantages of the GoM Red Snapper MSE Tool

I. Model Structure

- Management procedure – adjusting ACL Carryover Provision & Penalty



Carryover - If ACT isn't fully harvested

- (●) No Carryover
- ( ) Carryover to the same sector, component, or state next year, but make sure the actual landing doesn't exceed 95% of the OFL.
- ( ) Carryover to the same sector, component, or state next year, but make sure the actual landing doesnt exceed 50% of the difference between ABC and OFL.

(Diagne *et al.*, 2015)

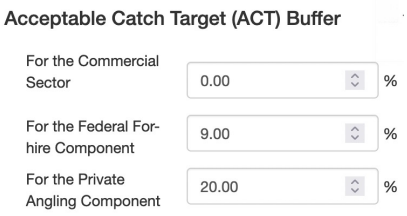
Penalty - If the actual landing exceeds ACT

- ( ) No Penalty
- (●) Before 2032, under the rebuilding plan; after 2032, based on the fishery status. The exceeded recreational catch will be deducted from the next year.

Advantages of the GoM Red Snapper MSE Tool

I. Model Structure

- Pre-cautionary approach – buffers on quotas
  Estimating ACT from ACL



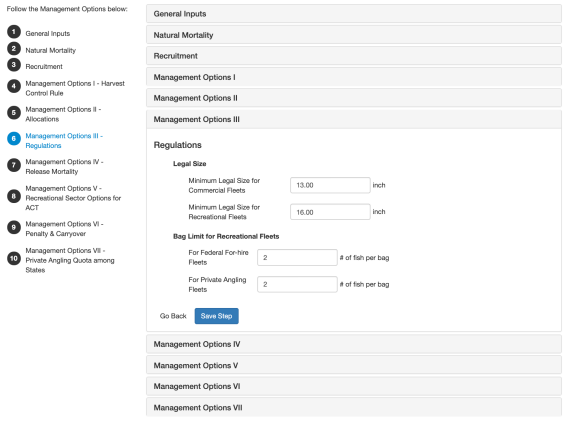
http://gomredsnappermsetool.fiu.edu/intro/glossary/

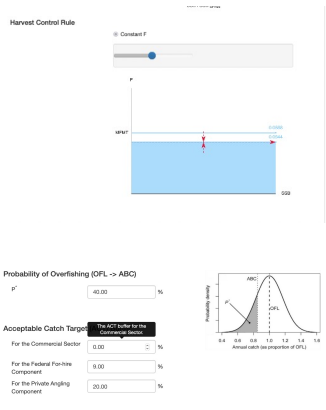
Alternative 2: Modify the red snapper OFL, ABC, ACLs, and recreational ACTs for 2022 and subsequent years based on the OFL and ABC recommendation of the Scientific and Statistical Committee (SSC) at the March 8 – 10, 2022, SSC meeting. These catch limits are based on data derived from the Great Red Snapper Count (GRSC), including a post-stratification analysis of the data for Florida, and on the LGL Ecological Associates, Inc. study (LGL study) of the absolute abundance of red snapper off Louisiana.

Catch Limit Type	Current Catch Limits	Calculation
OFL	18,910,000	N/A
ABC	16,310,000	13.7% less than OFL
Total ACL	16,310,000	ACL = ABC
Commercial ACL	8,318,100	51% of ABC
Recreational ACL	7,991,900	49% of ABC
Federal For-Hire ACL	3,380,574	42.3% of Recreational ACL
Federal For-Hire ACT	3,076,322	9% less than For-Hire ACL
Private Angling ACL	4,611,326	57.7% of Recreational ACL
Private Angling ACT	*3,689,061*	*20% below Private Angling ACL*
Florida ACL	2,066,889	44.822% of Private Angling ACL
Alabama ACL	1,212,687	26.298% of Private Angling ACL
Mississippi ACL	163,702	3.55% of Private Angling ACL
Louisiana ACL	881,686	19.12% of Private Angling ACL
Texas ACL	286,363	6.21% of Private Angling ACL

Advantages of the GoM Red Snapper MSE Tool

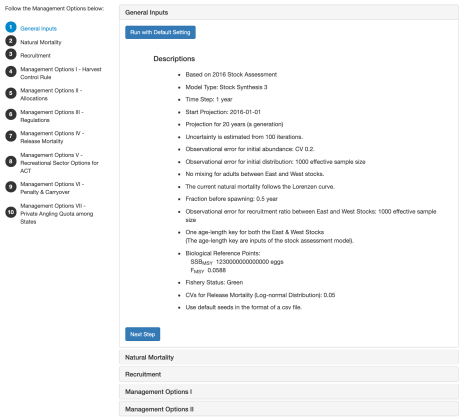
II. User-friendly Inputs





Advantages of the GoM Red Snapper MSE Tool

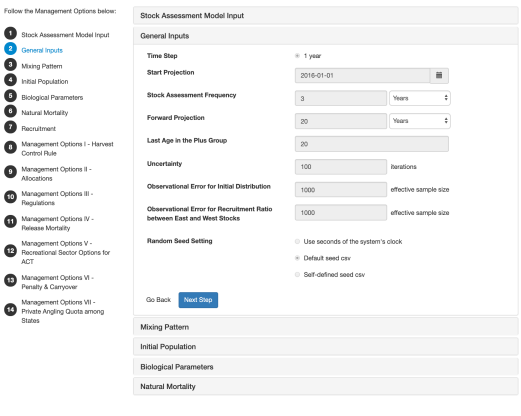
II. User-friendly Inputs – Standard Versions

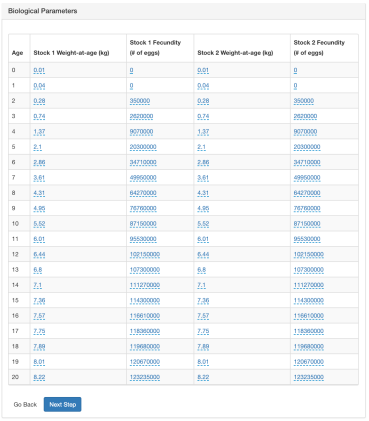


1~5 **Inputs** – from stock assessment
Natural Mortality
Recruitment
7 **Management Options**
- HCR
- Allocations
- Regulations
- Release Mortality
- Recreational Sector Options for ACT
- Penalty & Carryover
- Private Angling Quota among States

Advantages of the GoM Red Snapper MSE Tool

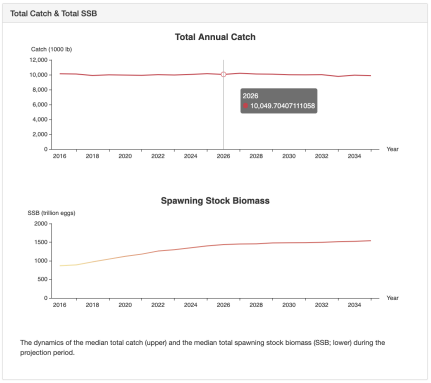
II. User-friendly Inputs – Professional Version

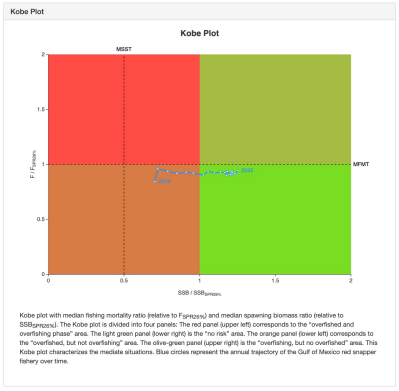




Advantages of the GoM Red Snapper MSE Tool

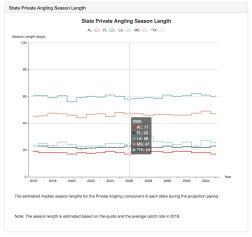
III. Dynamic Outputs – Single Scenario

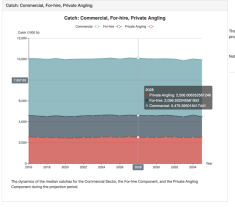


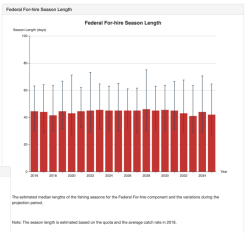


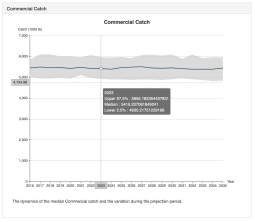
Advantages of the GoM Red Snapper MSE Tool

III. Dynamic Outputs – Single Scenario (examples also in the "Demo" menu)



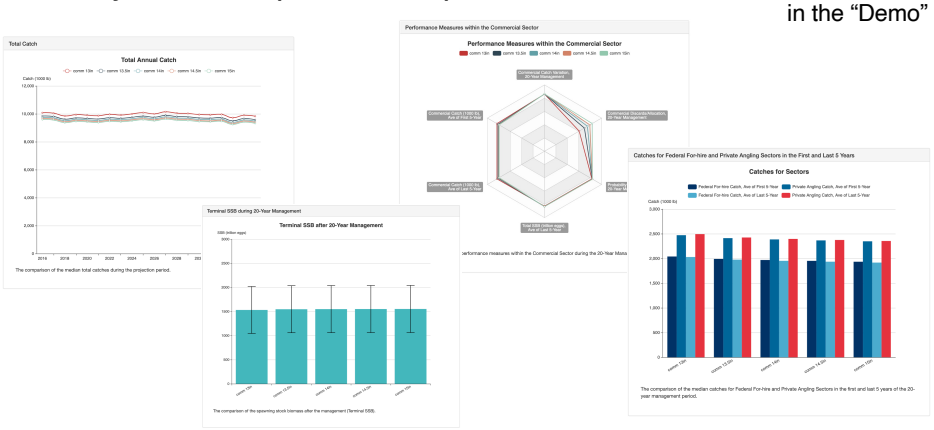






Advantages of the GoM Red Snapper MSE Tool

III. Dynamic Outputs – Comparison of MSE Scenarios (examples also in the "Demo" menu)



Advantages of the GoM Red Snapper MSE Tool

IV. Web-based MSE tool -- Why?

- **Feedback** should be included in the operating model to highlight useful management strategies that warrant management objectives.
- **Interactions** among stakeholders can improve their understanding of the fishery stock assessment and management, and raising the acceptance of the final management decisions.
- Consistent **communication** and outreach will eventually improve comprehension and transparency of management decisions.

gomredsnappermsetool.fiu.edu (mainsite)

redsnapperdev.fiu.edu (dev site) – will be tested extensively in Summer 2022

Advantages of the GoM Red Snapper MSE Tool

IV. Web-based MSE tool

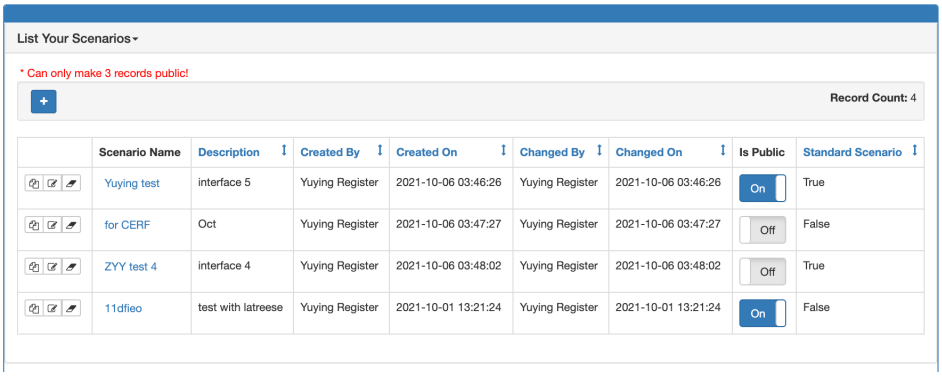
- 2 Versions: Standard and Professional

	Standard Version (shoutcut MSE for general public)	Professional Version (full MSE for stock assessment scientists)
Initial setting	Must be the same with the latest stock assesment.	Can be different from the latest stock assesment.
Natural mortality	Must be the same among years.	Can be different from year to year (under construction).
Recruitment	Either from historical data or fixed Beverton-Holt Model	Can also modify Beverton-Holt Model parameters.
Stock mixing assumption	No mixing.	Mixing occurs between the East and West Gulf (under construction).
Assesment error	Add errors to the "true" age-based abundance and fishing mortality.	Generate a set of survey data, then input that into SS3 to get updated fisheries and other related parameters (under construction).
Selectivity setting	Must be the same with the latest stock assesment.	The asymptote of the selectivity curve can be modified (under construction).

- 3 Roles: Admin, Register, and Public User

Advantages of the GoM Red Snapper MSE Tool

V. Communications – Method 1: Make scenarios viewable to others



Advantages of the GoM Red Snapper MSE Tool

V. Communications – Method 1: Make scenarios viewable to others

MSE Comparison

Search

* Please choose 4~7 records for comparison!

Rows selected : 0

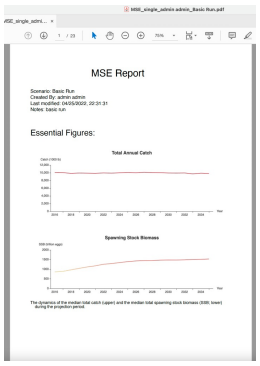
« < 0 1 2 > » Page size Actions

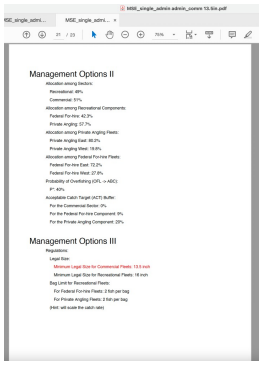
Record Count: 25

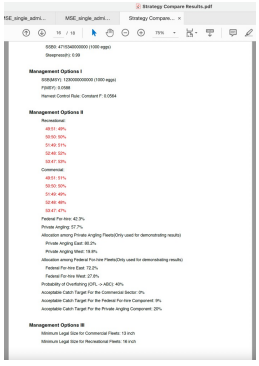
Scenario Name	Description	Created By	Created On	Changed By	Changed On	Standard Scenario
Basic Run	basic run	admin admin	2020-10-07 16:15:43	admin admin	2020-10-07 16:15:43	False
comm 13in	test legal size 1	admin admin	2020-10-07 17:45:08	admin admin	2020-10-07 17:45:08	False
comm 13.5in	test legal size 2	admin admin	2020-10-07 17:47:17	admin admin	2020-10-07 17:47:17	False
comm 14in	test legal size 3	admin admin	2020-10-07 17:48:25	admin admin	2020-10-07 17:48:25	False
comm 14.5in	test legal size 4	admin admin	2020-10-07 17:51:26	admin admin	2020-10-07 17:51:26	False
comm 15in	test legal size 5	admin admin	2020-10-07 17:52:24	admin admin	2022-01-04 21:39:30	False
49:51	test allocation 1	admin admin	2020-10-11 14:46:20	admin admin	2020-10-11 14:46:20	False

Advantages of the GoM Red Snapper MSE Tool

V. Communications – Method 2: Download results and distribute

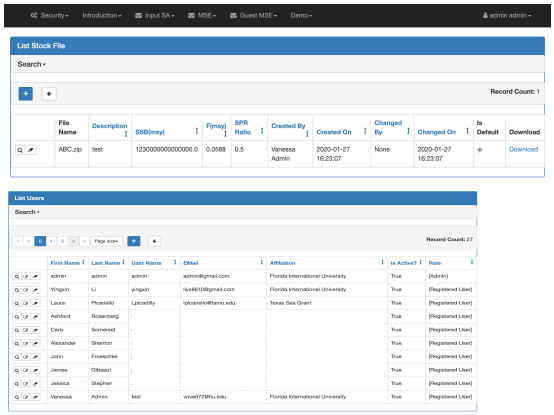






Advantages of the GoM Red Snapper MSE Tool

VI. Flexible for the future stock assessment updates



Advantages of the GoM Red Snapper MSE Tool

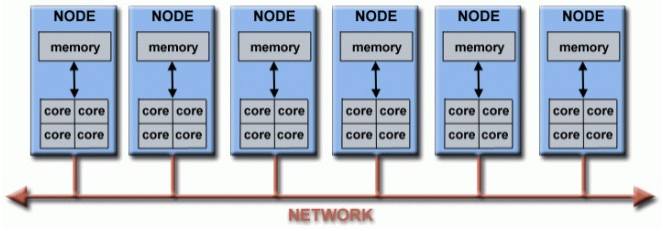
VI. Flexible for the future stock assessment updates

- Website: Python & Linux
- Database: MongoDB
- User-friendly Interface: JavaScript & html
- MSE operating model: R
- Stock assessment in future full MSE: SS3 (NOAA ToolBox)

Advantages of the GoM Red Snapper MSE Tool

VII. Website Performance

- Parallel Computing -16 CPUs + 32 GB RAM
- Pre run to save end-users' time



Slated for release in Fall 2022

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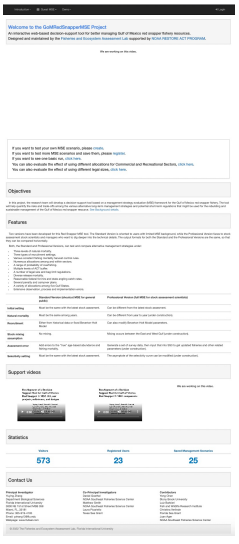
- National Academies book *Data and Management Strategies for Recreational Fisheries with Annual Catch Limits* (2021)

  (Chapter 5, Page 154-156) http://nap.edu/26185

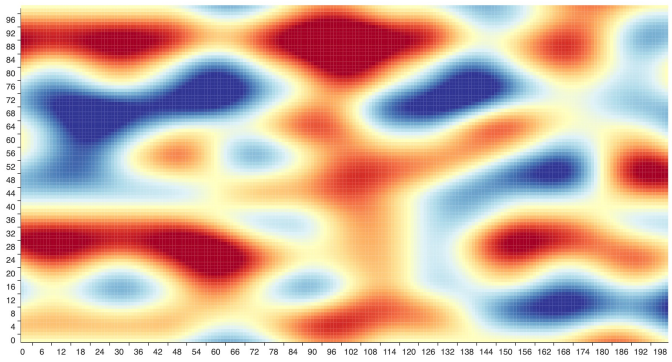
- A simulation framework to assess management trade-offs associated with recreational harvest slots, discard mortality reduction, and bycatch accountability in a multi-sector fishery

  (Bohaboy *et al.*, 2022)
  https://doi.org/10.1016/j.fishres.2022.106268



Directions for future collaborations

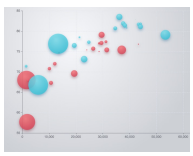
- Advanced MSE comparison (finished, but hide)

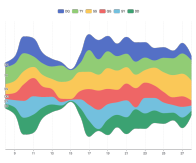


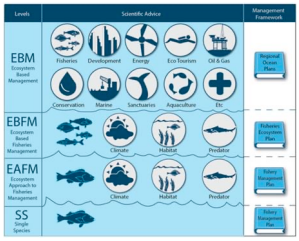
Directions for future collaborations

- Customized MSE for commercially-important species
- Multi-species MSE for ecosystem-based fishery management
- Data and results visualization
- A platform for stakeholders to communicate

FIU Fisheries and Ecosystem Assessment Lab: fiufeal.com







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- Yingxin Li
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- Yudong Tao
- Jie Li

RESTORE SCIENCE PROGRAM

NA17NOS4510089

References

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