Development of a Decision Support Tool for Gulf of Mexico Red Snapper

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Acknowledgement

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FIU FLORIDA INTERNATIONAL UNIVERSITY
FLORIDA FISH AND WILDLIFE CONSERVATION COMMISSION
GULF OF MEXICO Fishery Management Council
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Sea Grant Florida
Sea Grant Texas

Why we need to develop a MSE tool?

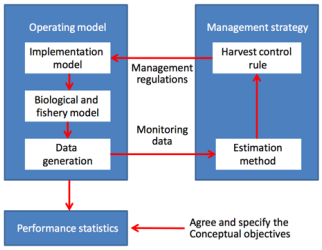
- Feedback should be included in the operating model to highlight useful management strategies that warrant management objectives.
- Interactions among stakeholders can lead to improve in their understanding of the assessment-management system and acceptance of the final management decisions.
- Consistent communication and outreach will eventually improve comprehension and transparency of management decisions.
- Our decision-support tool will enhance the participation of stakeholders.

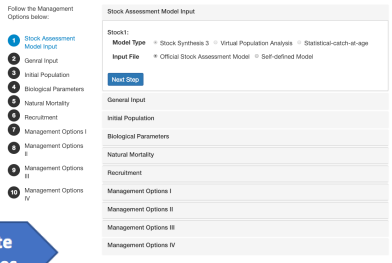
Project Goals

- **Developing a tool that necessary to perform a full MSE**
  - Not performing the MSE itself
    - Determination of management actions requires wide scale interaction among all stakeholders (including managers).
    - Once the tool is developed, user groups can use it to explore management options and tradeoffs among them.
- **Requires understanding:**
  - Biology (spatial structure, productivity dynamics, …)
  - Fishery (selectivity, fishing behavior, …)
  - Socioeconomic (profit, days fished, …)
  - Management (reference points, rebuilding plans, TACs, …)
  - Performance measures (stability of yield, population size, …)

In what parts stakeholders can participate?

- **Model structure design**
- **Detailed constrains in the MSE components**
- **User-friendly interface**





Formulate strategies

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

"Implement" strategies

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

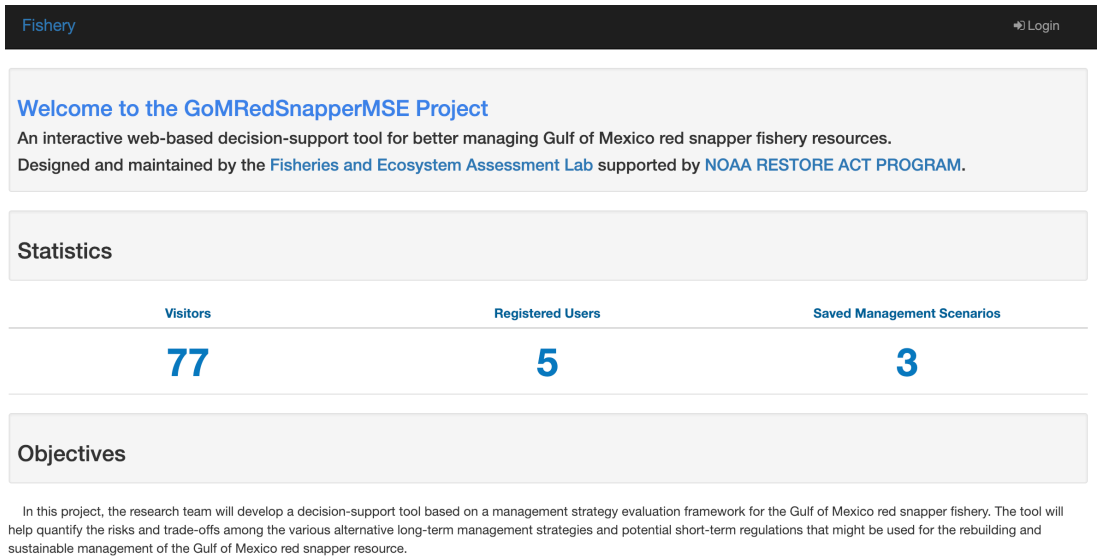
Evaluate strategies

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

Outline

- **Backstage management of our website**
- **Our user-friendly interface**
- **Detailed model structure and components in our MSE tool**

http://gomredsnappermsetool.fiu.edu/



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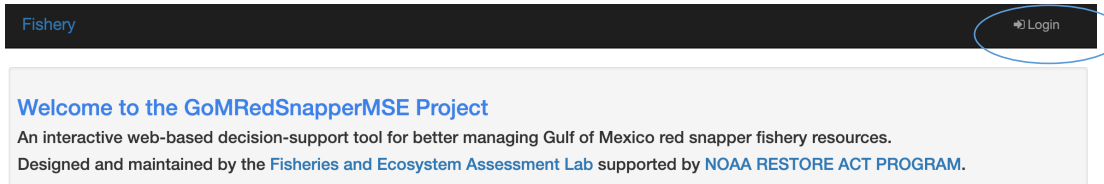

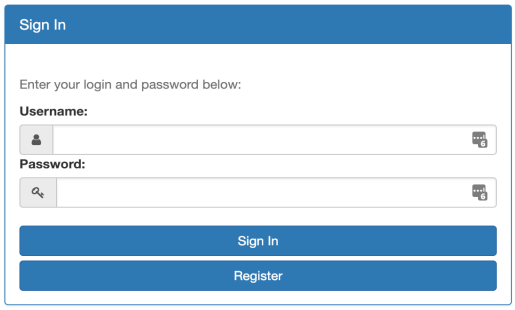

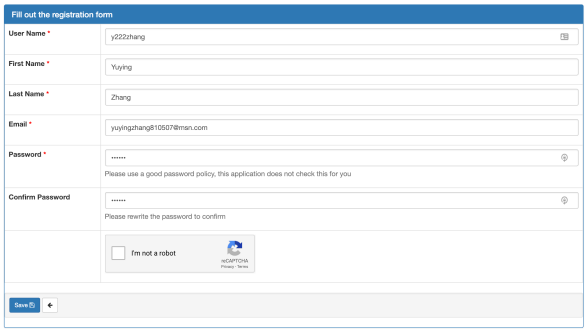

Activation Email

Hello Yuying Zhang

Please go to activation page to finish your registration, your username is **y222zhang**

Follow this link to activate

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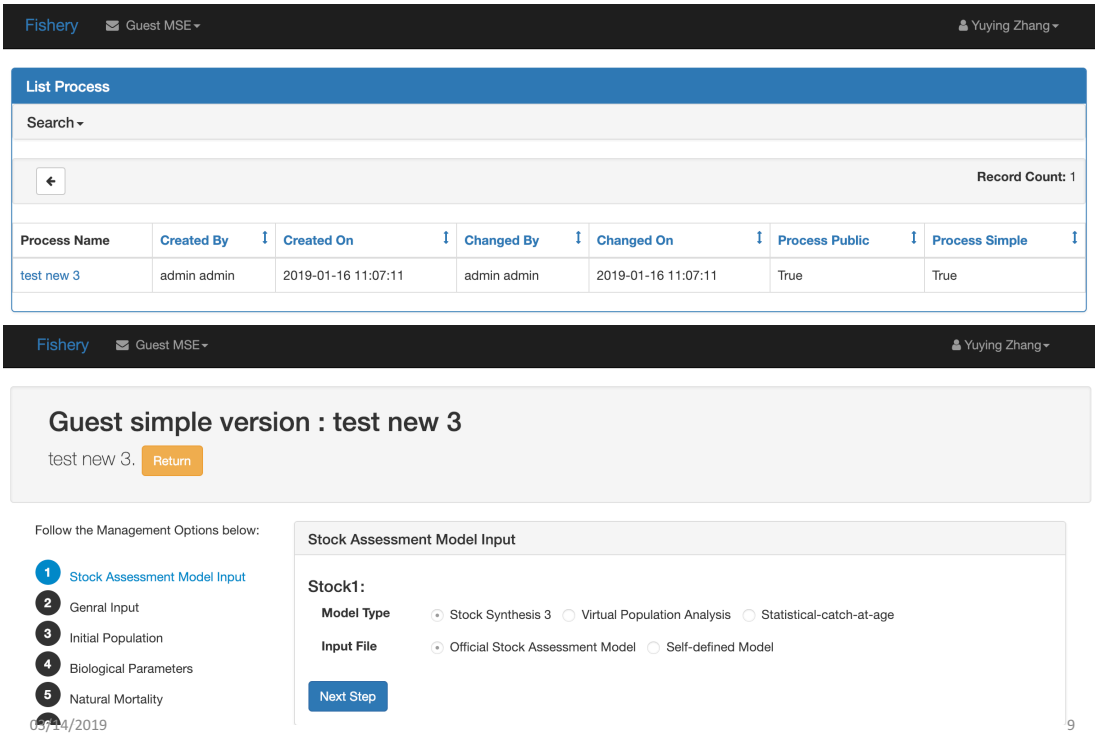

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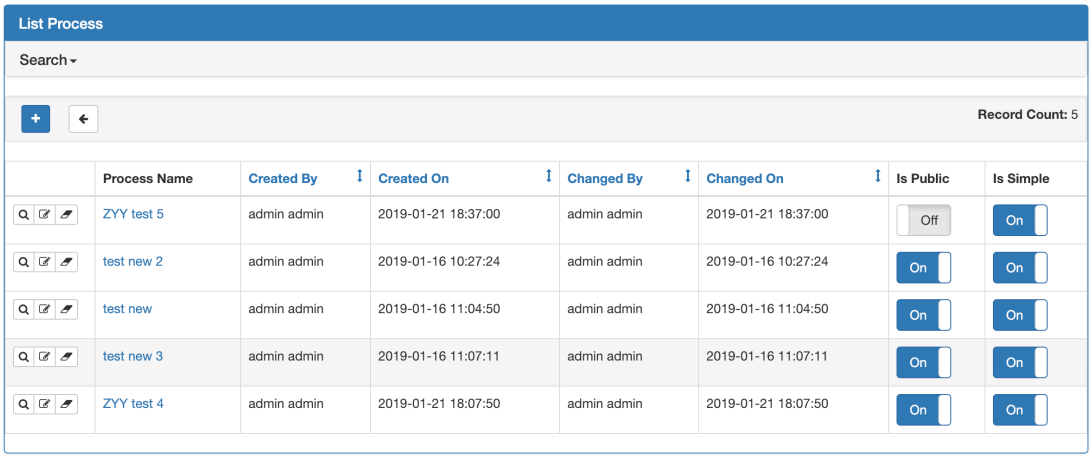

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test new	admin admin	2019-01-16 11:04:50	admin admin	2019-01-16 11:04:50	True	True
test new 3	admin admin	2019-01-16 11:07:11	admin admin	2019-01-16 11:07:11	True	True
ZYY test 4	admin admin	2019-01-21 18:07:50	admin admin	2019-01-21 18:07:50	True	True

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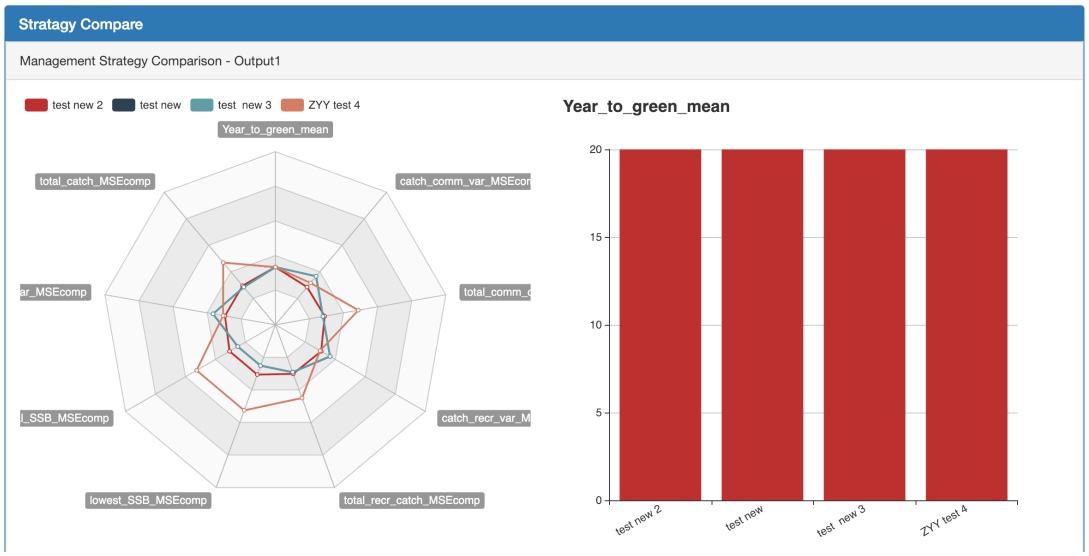

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List Process

Search

Record Count: 5

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	test new 2	admin admin	2019-01-16 10:27:24	admin admin	2019-01-16 10:27:24	On	On
	test new	admin admin	2019-01-16 11:04:50	admin admin	2019-01-16 11:04:50	On	On
	test new 3	admin admin	2019-01-16 11:07:11	admin admin	2019-01-16 11:07:11	On	On
	ZYY test 4	admin admin	2019-01-21 18:07:50	admin admin	2019-01-21 18:07:50	On	On

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test new	admin admin	2019-01-16 11:04:50	admin admin	2019-01-16 11:04:50	True	True
test new 3	admin admin	2019-01-16 11:07:11	admin admin	2019-01-16 11:07:11	True	True
ZYY test 4	admin admin	2019-01-21 18:07:50	admin admin	2019-01-21 18:07:50	True	True

Future work

- Change the webpages from Hyper Text Transfer Protocol to Hyper Text Transfer Protocol Secure
- Change from single-thread process to multi-thread process
- Add affiliation in registration and also allow people to recover their passwords
- Give registered users more functions
- Allow users to switch from a professional version to a simple version
- Add a discussion board

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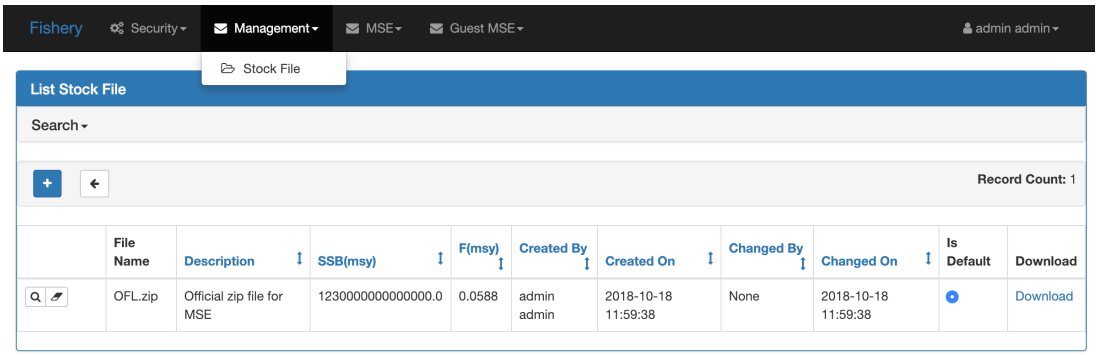

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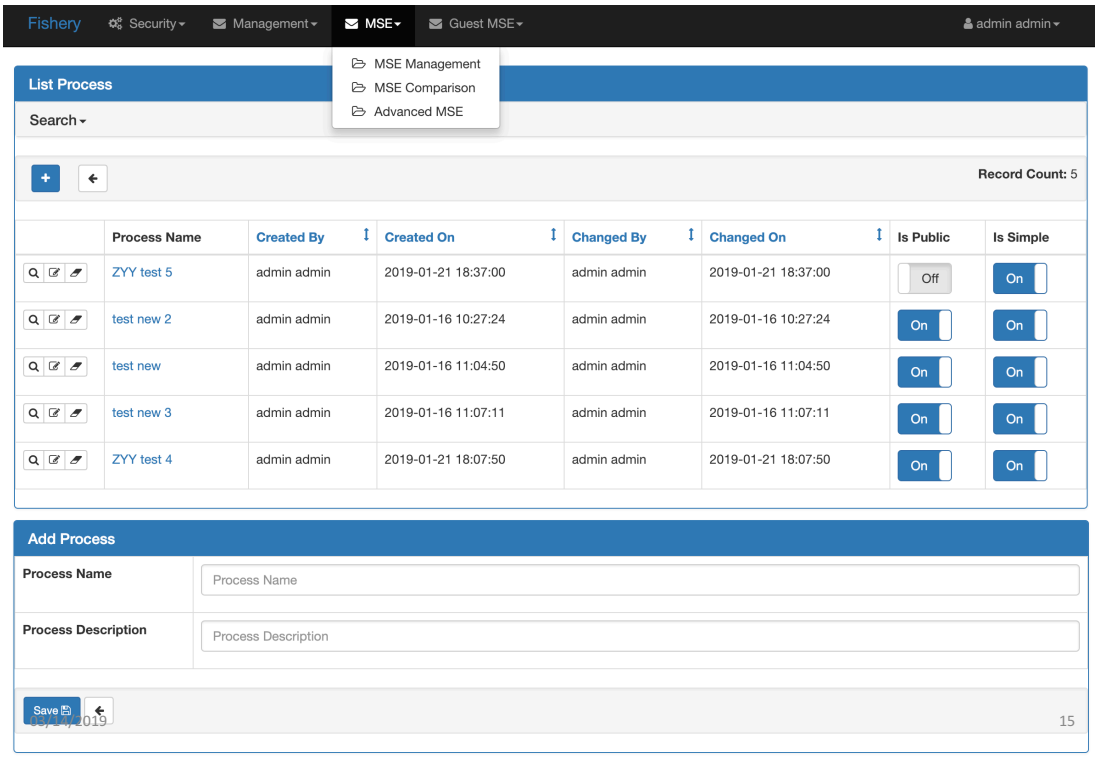

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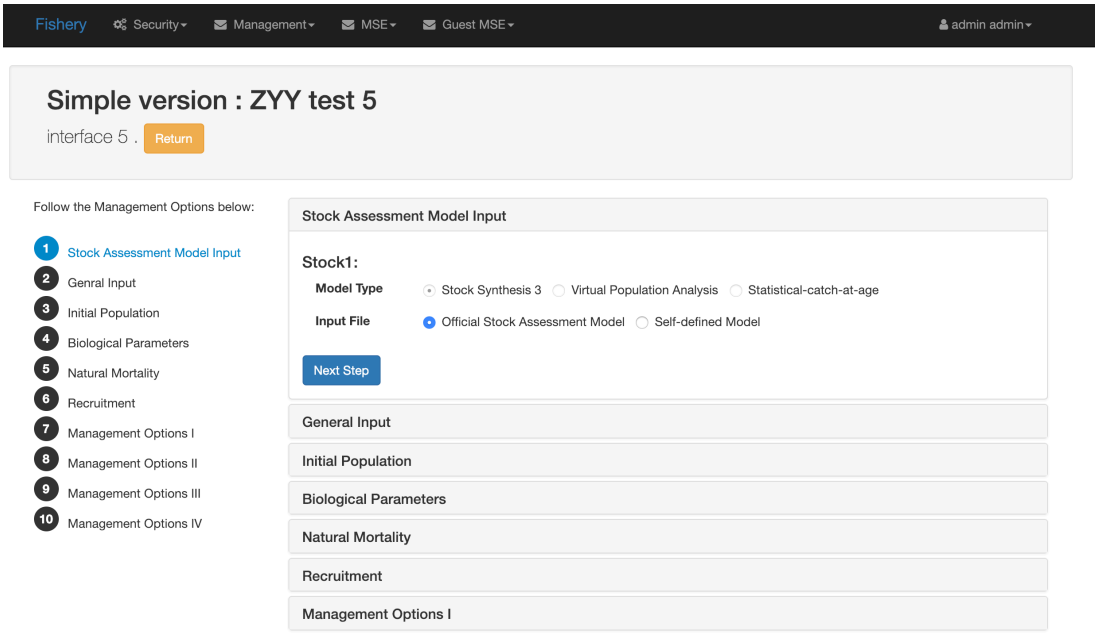

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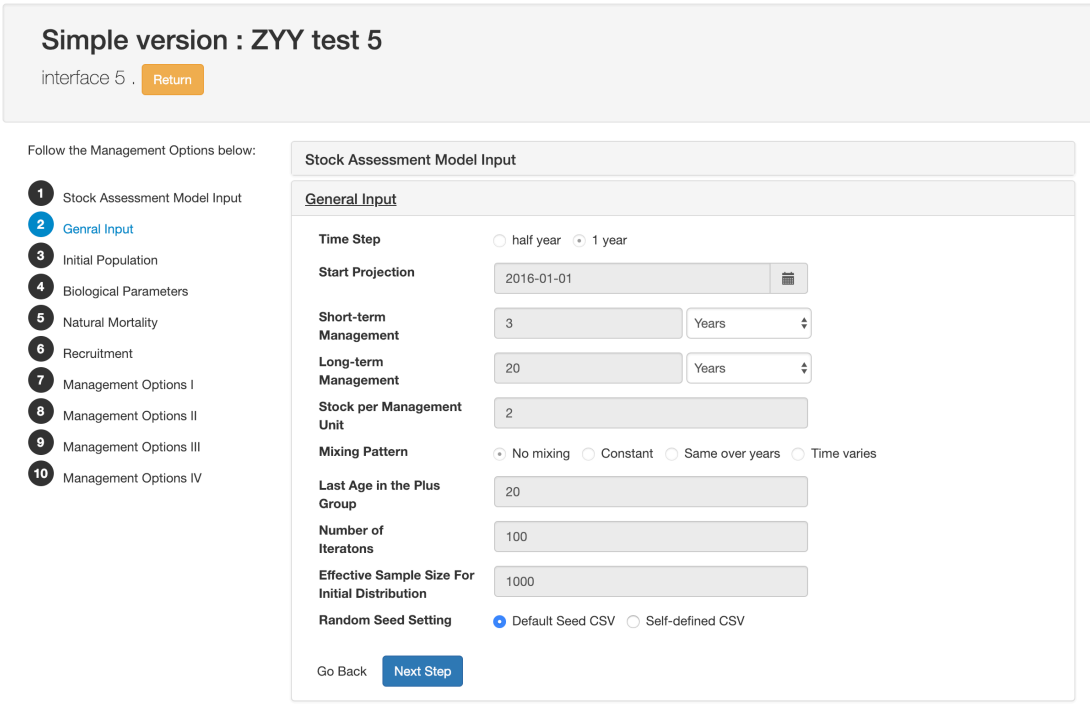

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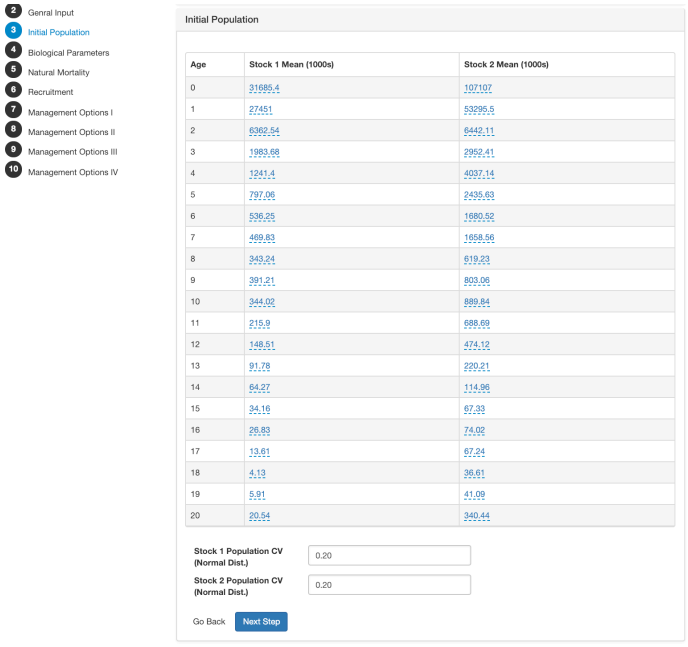

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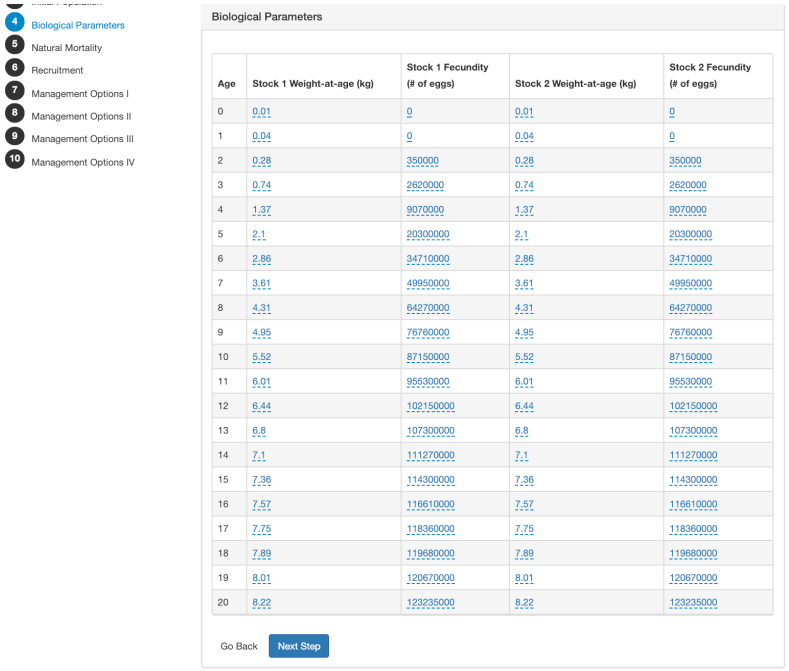

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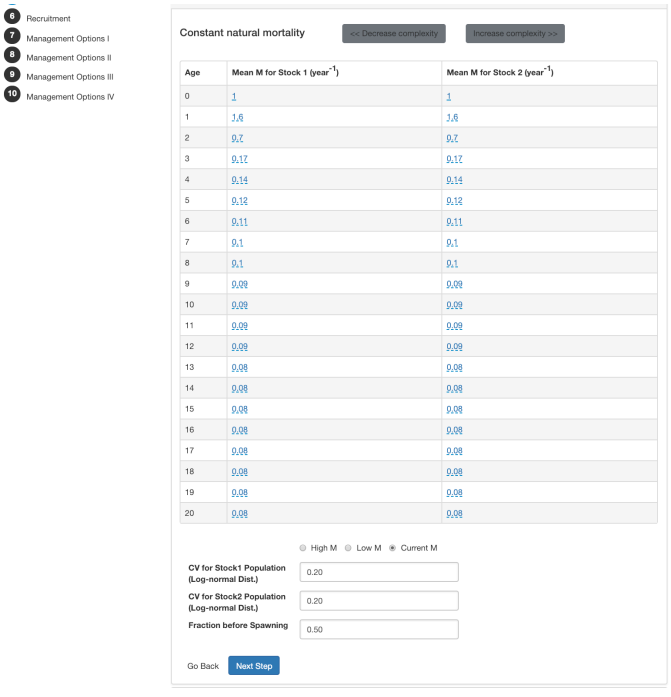

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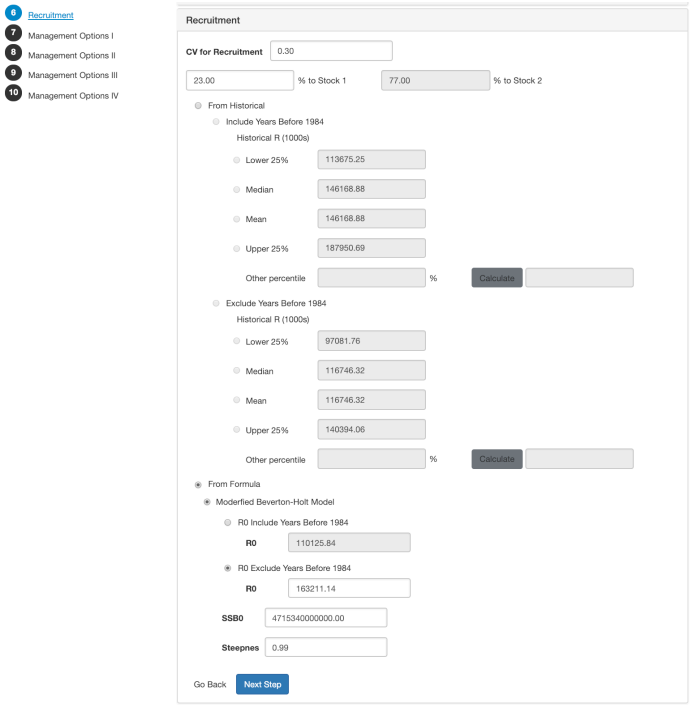

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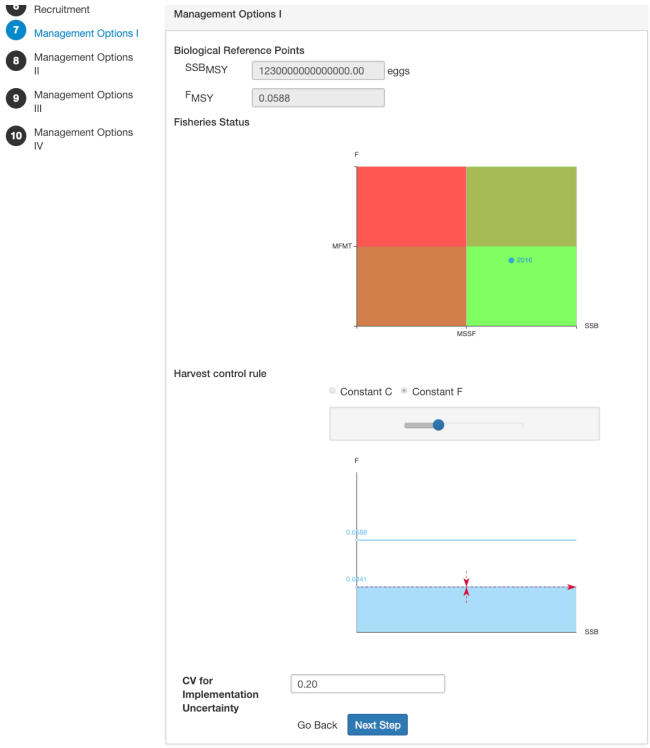

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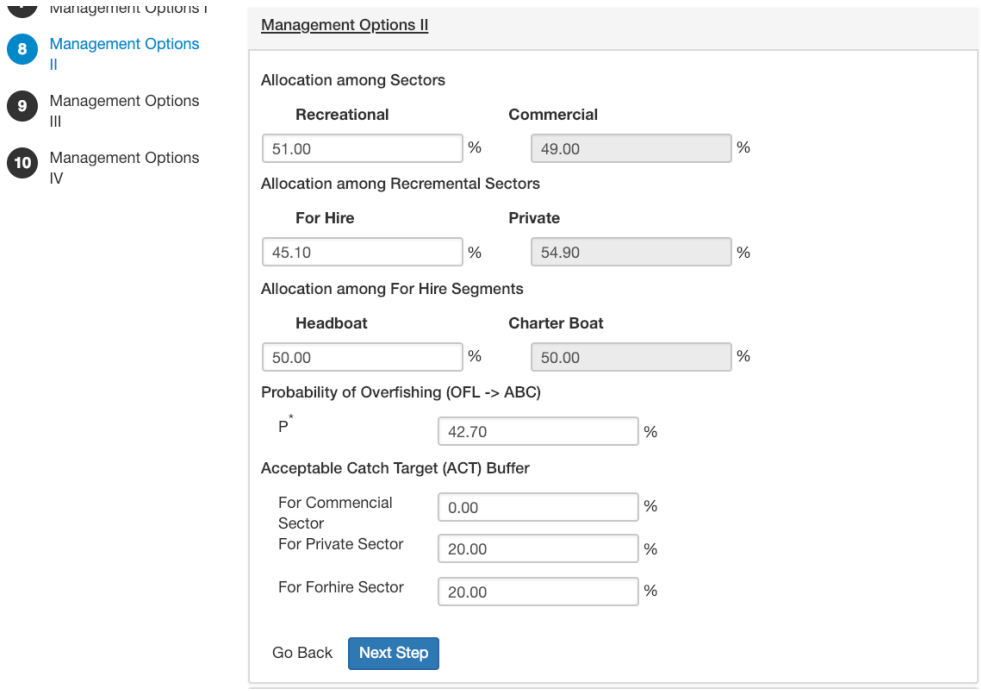

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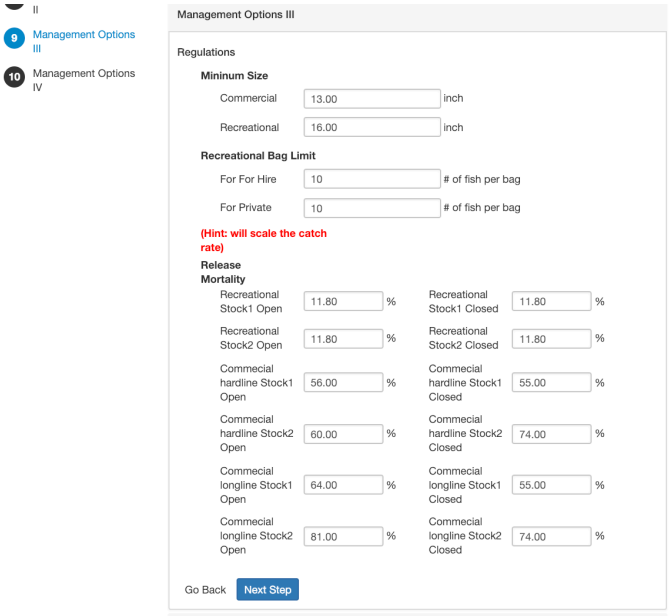

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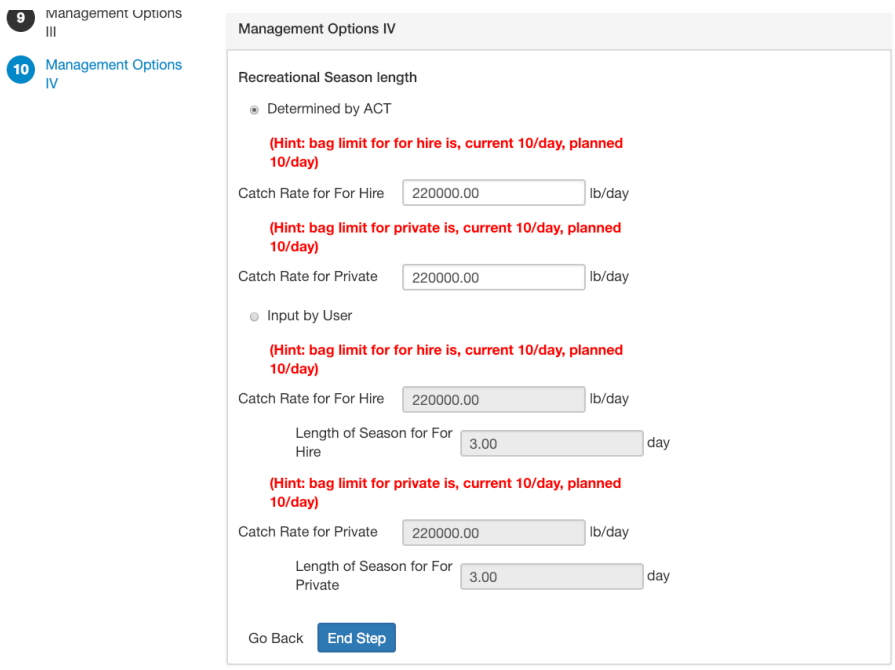

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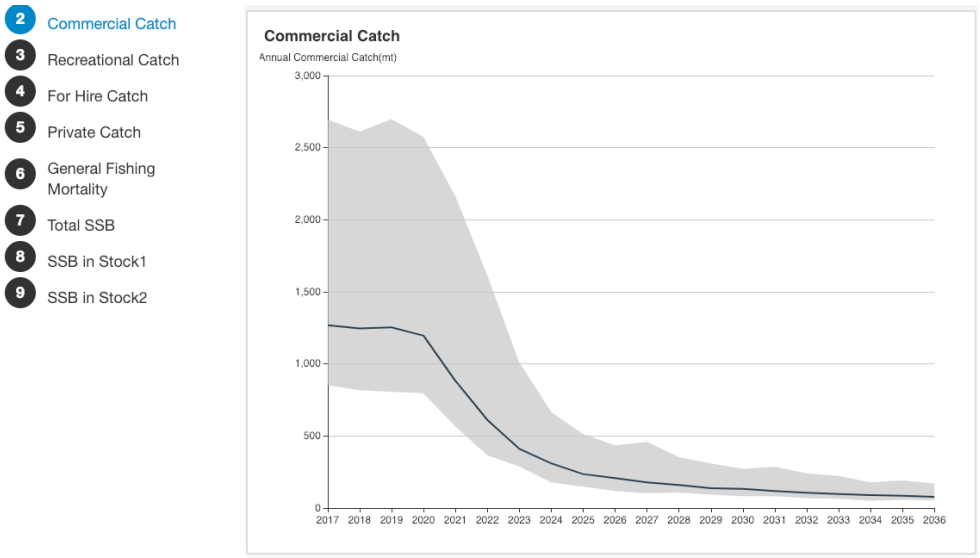

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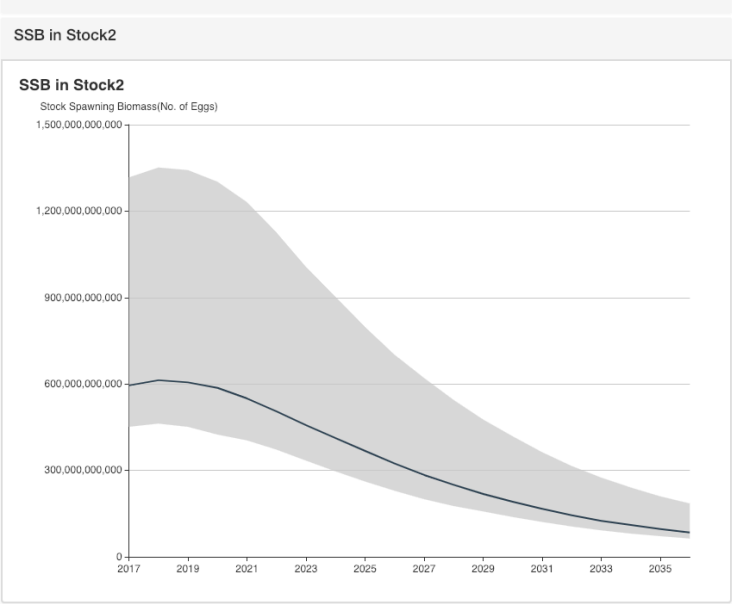
9 SSB in Stock2



Generate Report

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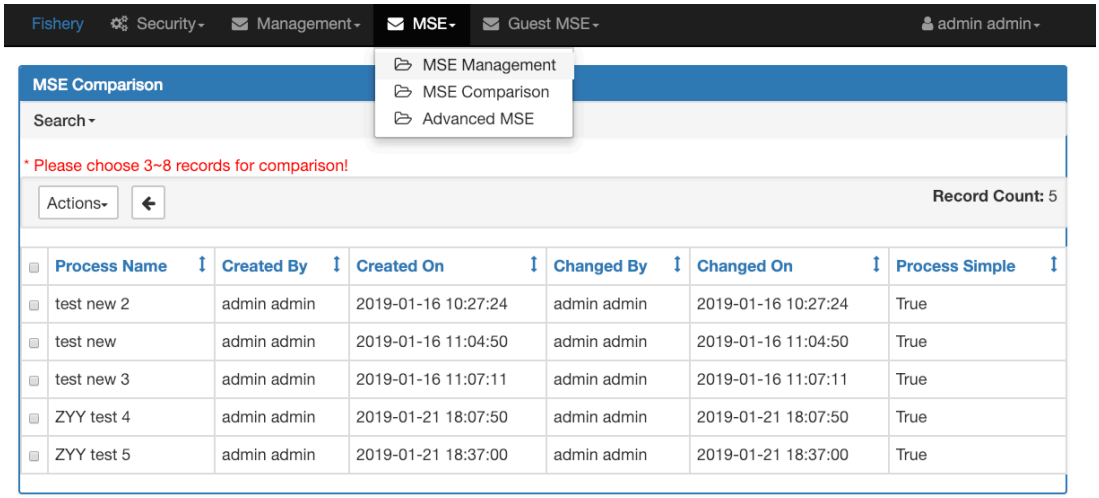

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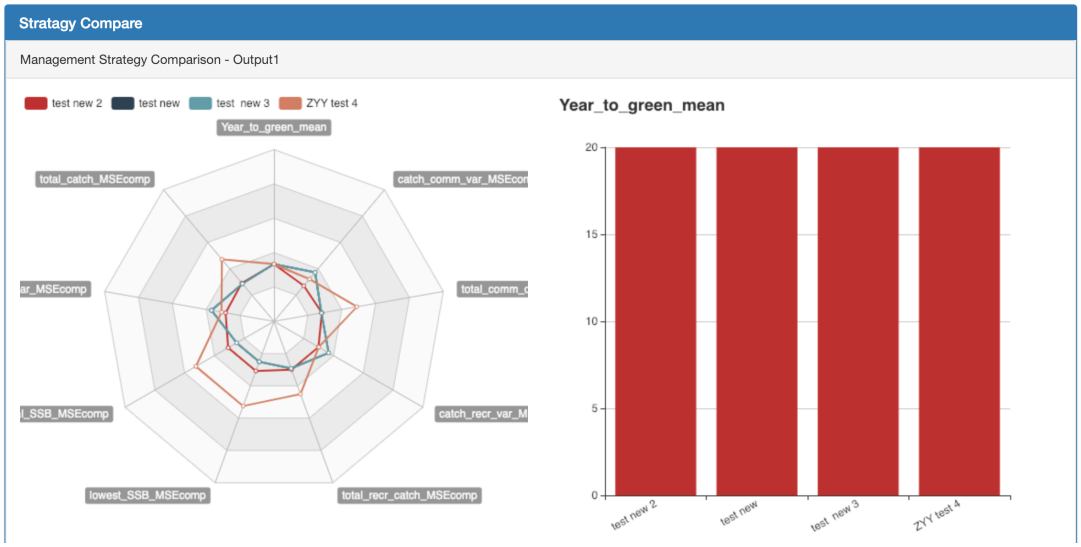

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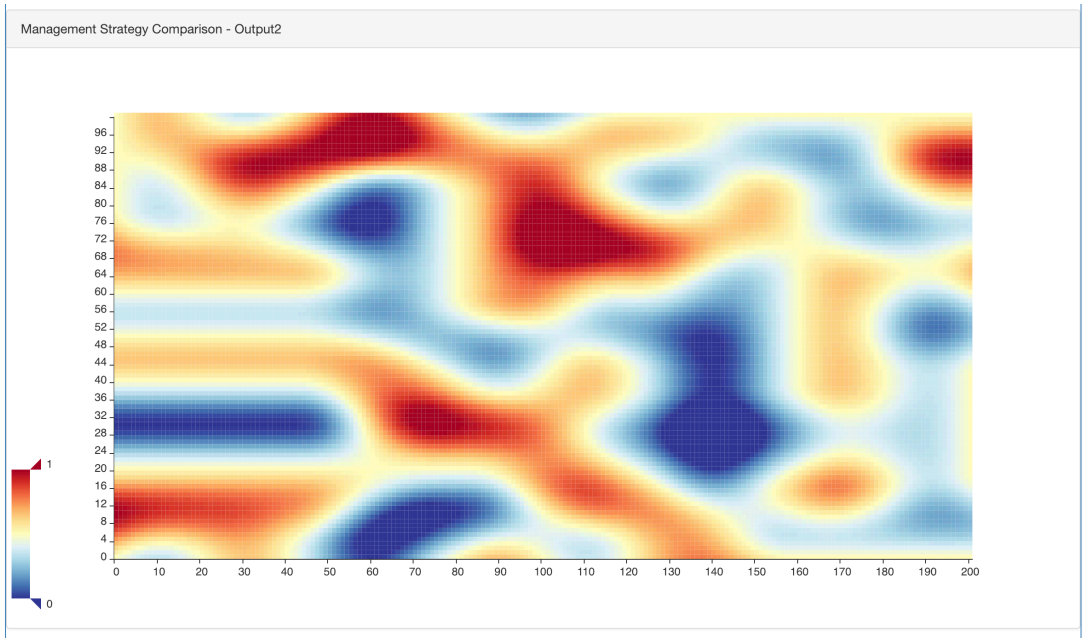


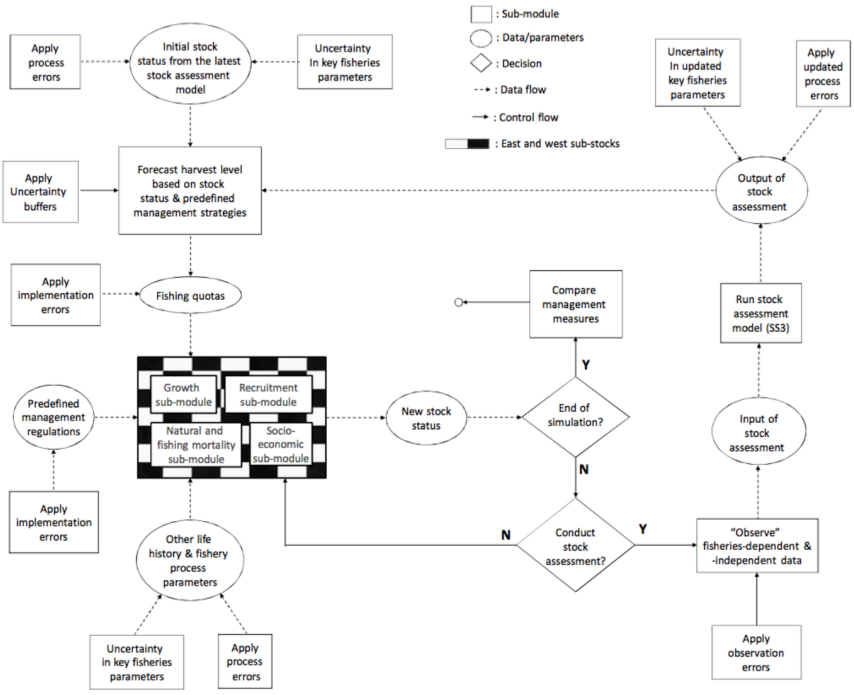
Future work

- Add more performance measures
- Improve MSE comparison
- Finish the advance comparison
- Create an auto output function for comparisons
- Simulate the consequence of annual quota changes to States' recreational landings

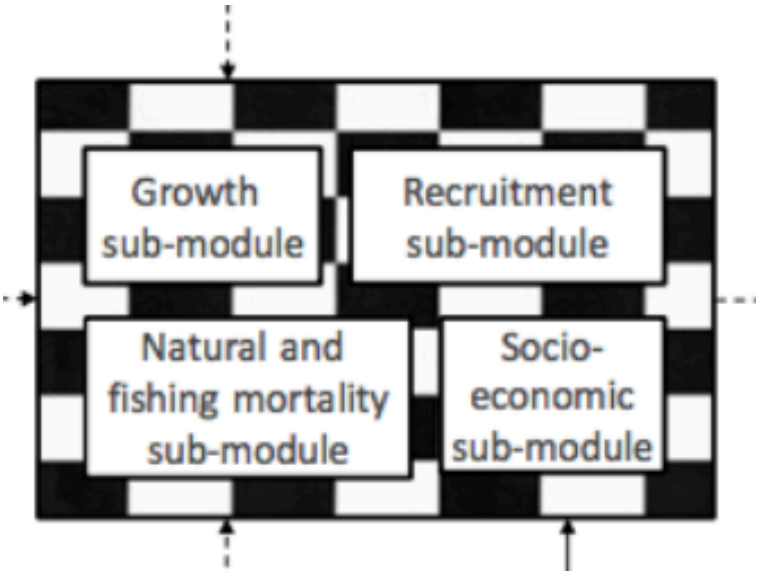
  https://gulfcouncilportal.shinyapps.io/RedSnapperDecisionSupportTool/

- Add tooltip text

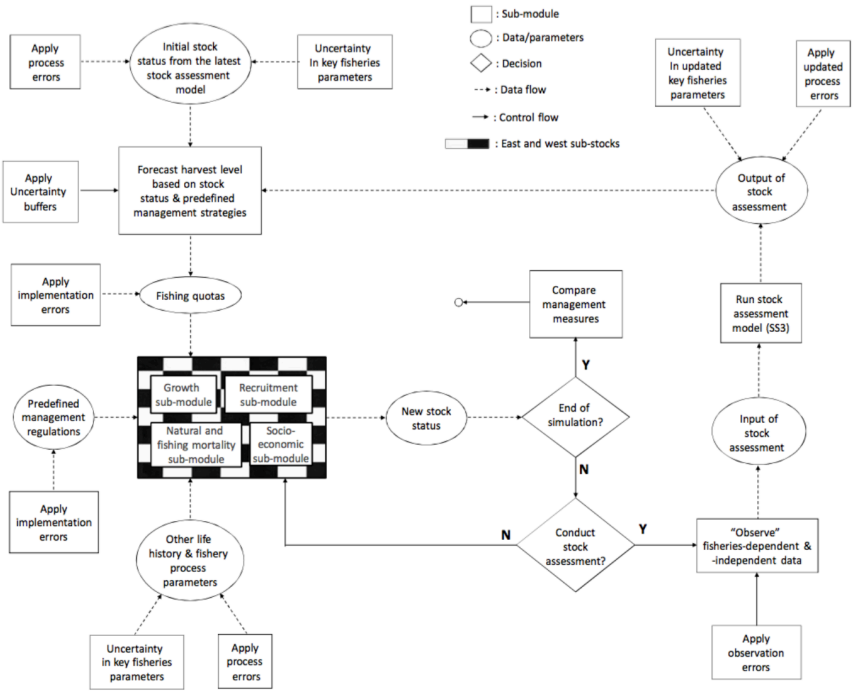
Conceptual model structure



Conceptual model structure



Conceptual model structure



Uncertainty

Environmental variations (processor error)

Structural uncertainty (processor error)

Partial observability (observational error)

Partial controllability (implementation error)

Imperfect data sampling for stock assessment (assessment error)

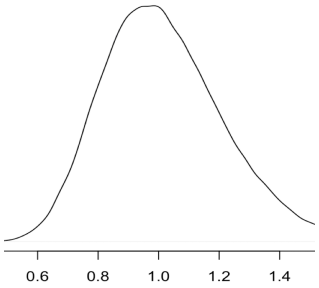
…

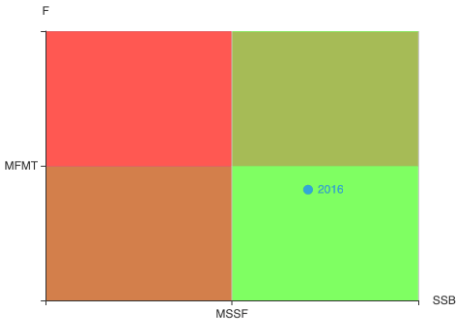
Detailed model structure and uncertainty

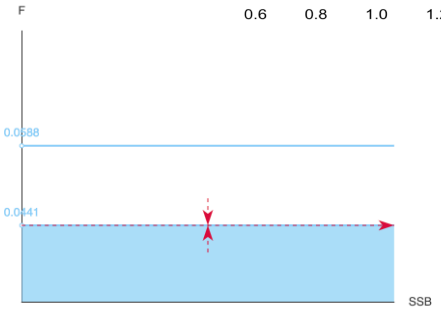
Step 1: Planned fishing mortality (F)

$$F^* = F \times \varepsilon_F$$

$$\ln(\varepsilon_F) \sim \text{Normal}(0, \sigma_F^2)$$



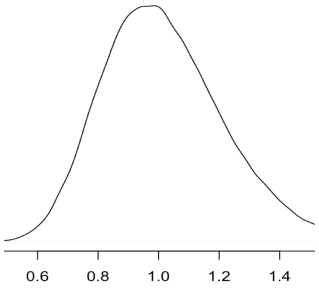




Detailed model structure and uncertainty

Step 2: Inherit stock abundance (N) and age structure

$$N^* = N \times \varepsilon_N$$
$$\ln(\varepsilon_N) \sim \text{Normal}(0, \sigma_N^2)$$



Use a multinomial sampling approach for age structure

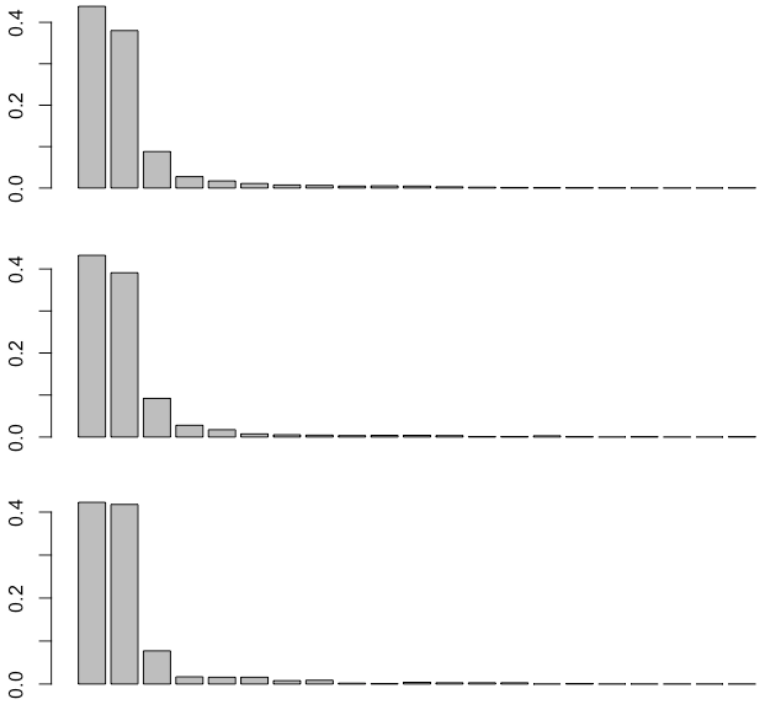
Effective Sample Size For Initial Distribution 1000

Detailed model structure and uncertainty

Original

ESS=1000

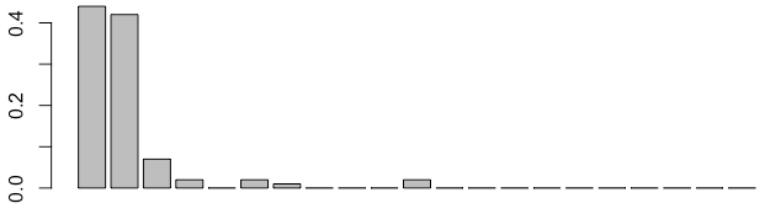
ESS=1000



Detailed model structure and uncertainty

Original

ESS=100



ESS=100

Detailed model structure and uncertainty

Original

ESS=10

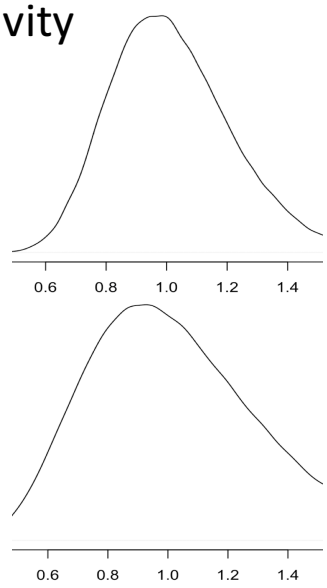
ESS=10

Detailed model structure and uncertainty

Step 3: Set life history (M and R), and fisheries process parameters (selectivity and relative F)

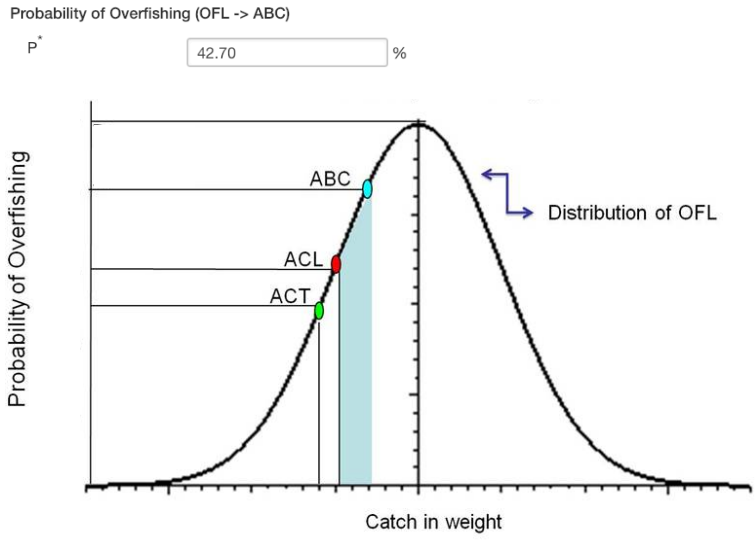
$$M^* = M \times \varepsilon_M$$
$$\ln(\varepsilon_M) \sim \text{Normal}(0, \sigma_M^2)$$

$$R^* = R \times \varepsilon_R$$
$$\ln(\varepsilon_R) \sim \text{Normal}(0, \sigma_R^2)$$



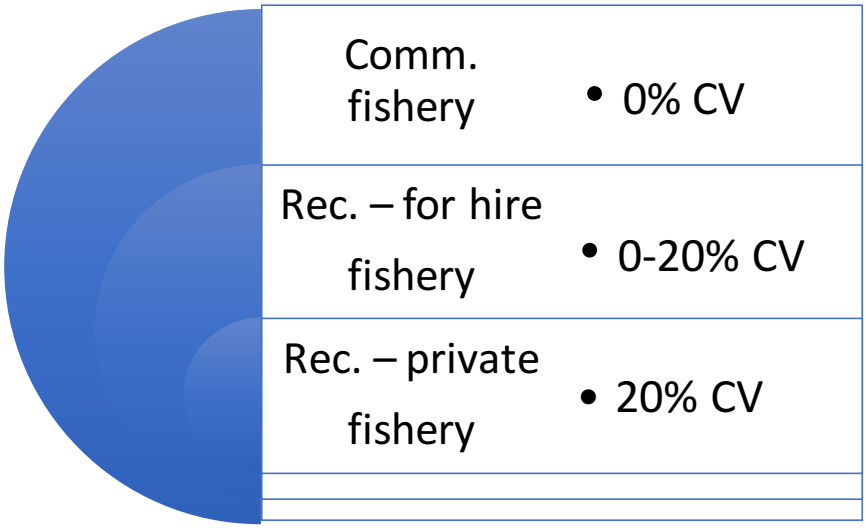
Detailed model structure and uncertainty

Step 4: Short-term projection for Catch (C) and estimate OFL, ABC and ACL



Detailed model structure and uncertainty

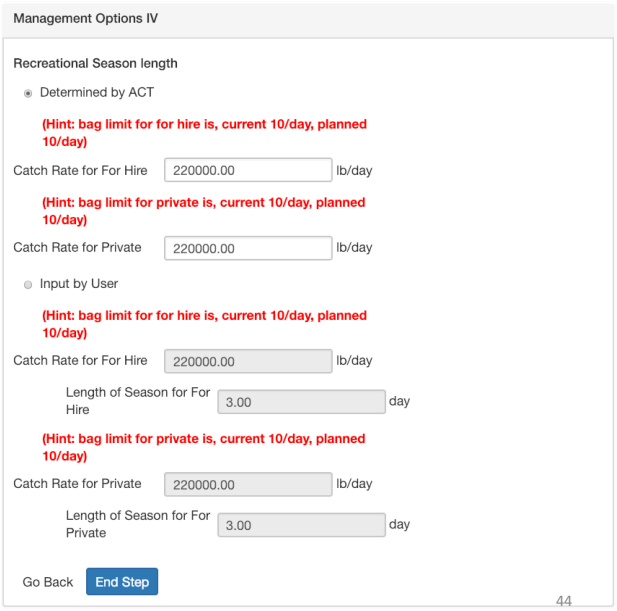
Step 5: Estimate ACT and apply that to fisheries



Detailed model structure and uncertainty

Step 6: Accountability measures (AM)

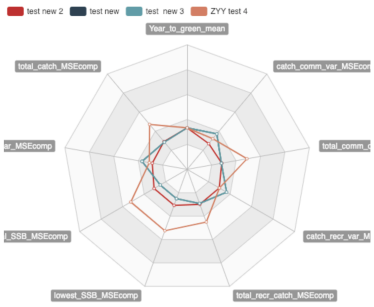
Overage for a certain year will be subtracted from the next two years

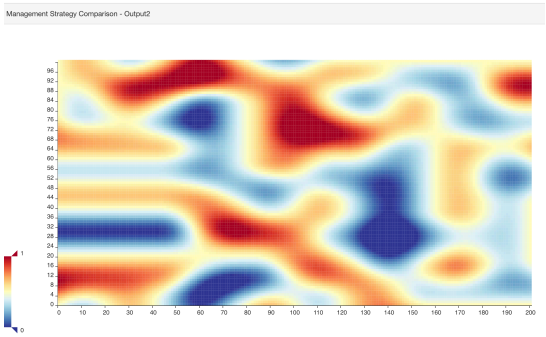


Detailed model structure and uncertainty

Step 7: Repeat Step 1, but skip Steps 2 and 3

Step 8: Long-term projection to record the details of the simulated fishery and summarize the statistics of performance measures





Future work

- Evaluate various harvest control rules
- Add assessment error
- Test various stock mixing patterns
- Set higher and lower M to mimic regime shift
- Add more carryover provision alternatives and different strategy to derive ABC from OFL

Any suggestions or comments?

- Is what we did consistent with reality?
- Is what we plan to do necessary?
- Do we miss anything?