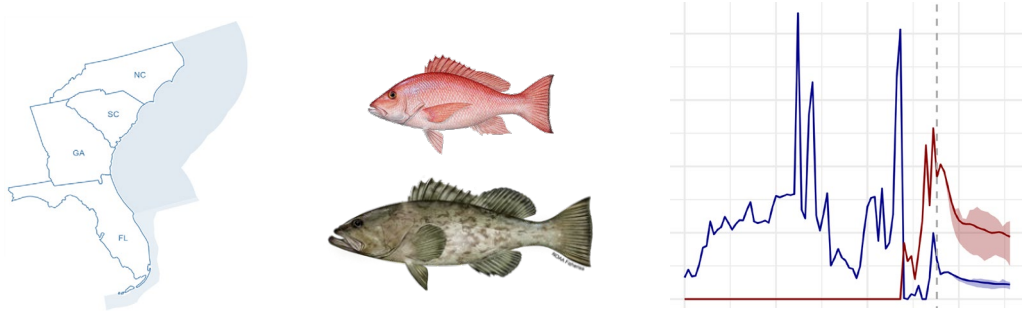
Management Strategy Evaluation for the South Atlantic Snapper-Grouper Fishery

Progress Report 2



South Atlantic Fishery Management Council
7th March 2024

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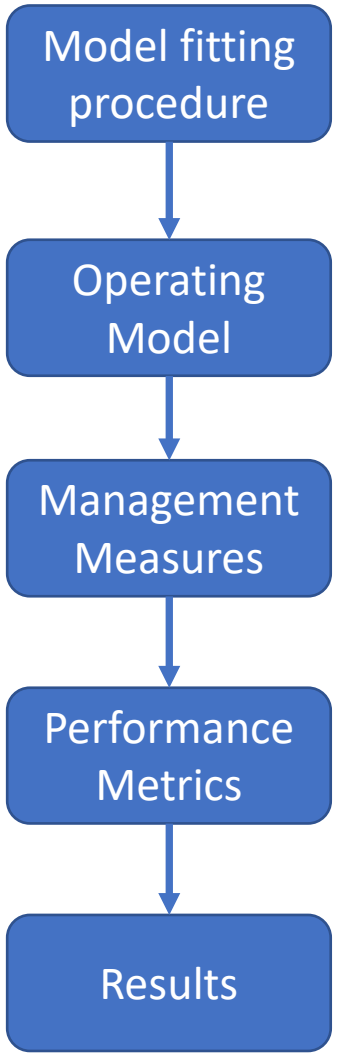
bluematter

openMSE
www.openmse.com

Objectives

1. Report work done so far
2. Demonstrate preliminary results
3. Plan for next steps
4. Feedback from Council

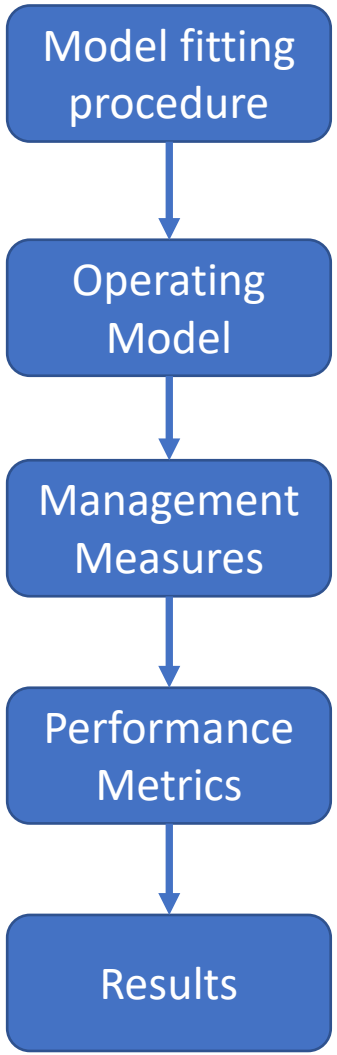
Progress


Model fitting procedure
Operating Model
Management Measures
Performance Metrics
Results

Progress

We have made a complete first pass at all of these steps

We have a working MSE framework that can be used to demonstrate the effectiveness of various management options and show how performance can be evaluated.



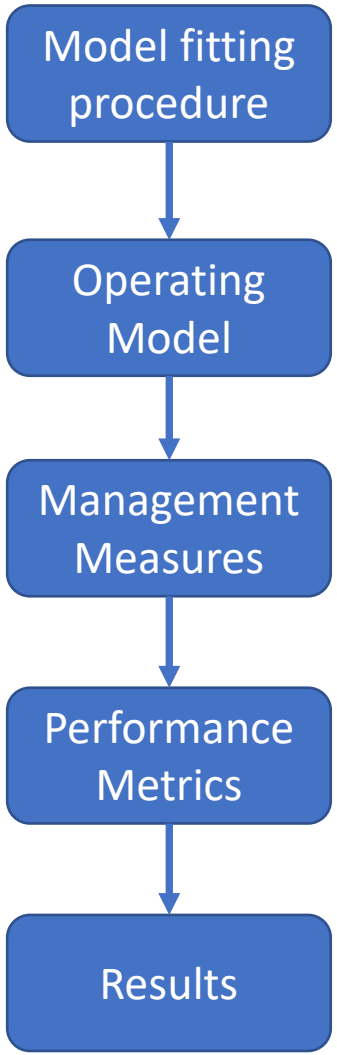
Progress

We have made a complete first pass at all of these steps

We have a working MSE framework that can be used to demonstrate the effectiveness of various management options and show how performance can be evaluated.

Next steps:

- identify specific management options to include in analysis
- finalize additional system hypotheses
- revise performance metrics as needed



Technical Specifications Document

SAFMC MSE Trial Specifications Document

1 Introduction

The South Atlantic Fishery Management Council has started a Management Strategy Evaluation (MSE) process for the Snapper-Grouper fishery, currently managed under the Snapper-Grouper Fishery Management Plan. The Snapper-Grouper fishery includes 55 species of snappers, groupers, and other species.

This document describes the technical specifications of the MSE process. It is a living document that will be continually updated to reflect the current state of the MSE work. Comments, questions, and feedback are welcome by contacting the MSE Technical Group Members.

More information on the MSE process can be found on the SAFMC Snapper-Grouper MSE homepage.

There are three main components in an MSE analysis:

1. **Operating Models (OMs)**

   Operating models contain a mathematical description of the fishery system, including the biology of the fish stock, the historical exploitation pattern by the fishing fleet(s), and the observation processes used to collect the fishery data. The OMs also include the assumptions for the data collection process in the forward projections, and any implementation error for implementing the management advice in the forward projections.

   An MSE process usually includes a number of different operating models, each representing a different hypothesis about the potential fishery dynamics. The OMs should span the key uncertainties in the fishery system. By including these uncertainties, the MSE can identify a management approach that is robust to these uncertainties.

2. **Management Procedures (MPs)**

   Management procedures are a set of rules that convert fishery data into management advice, e.g., a total allowable catch limit (TAC), a size limit, an effort control, a spatial closure, or some combination of different management measures. The main goal of MSE is to evaluate the performance of different MPs and identify the MP that is most robust to the uncertainty in the system.

3. **Performance Metrics (PMs)**

   Performance metrics are used to evaluate the performance of the management procedures. PMs are quantitative metrics than can be calculated within the MSE framework and be used to evaluate and compare the performance of the CMPs.

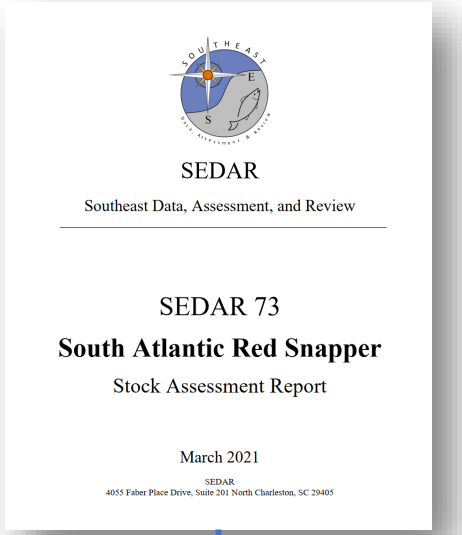
This document describes the OMs, MPs, and PMs that have been developed for the SAFMC Snapper-Grouper MSE.

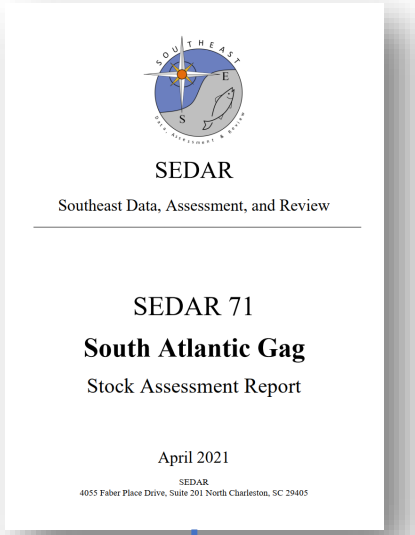
https://safmc-mse.bluematterscience.com/ts/ts

Generating Operating Models

Model fitting procedure

Beaufort Assessment Model (BAM)





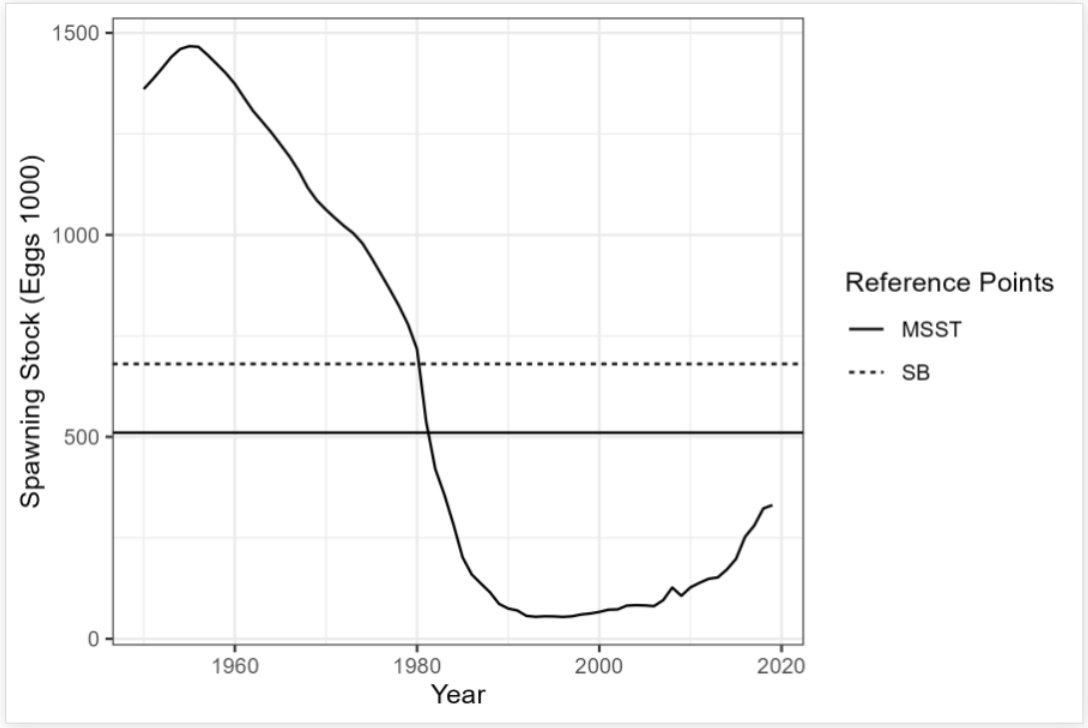
openMSE

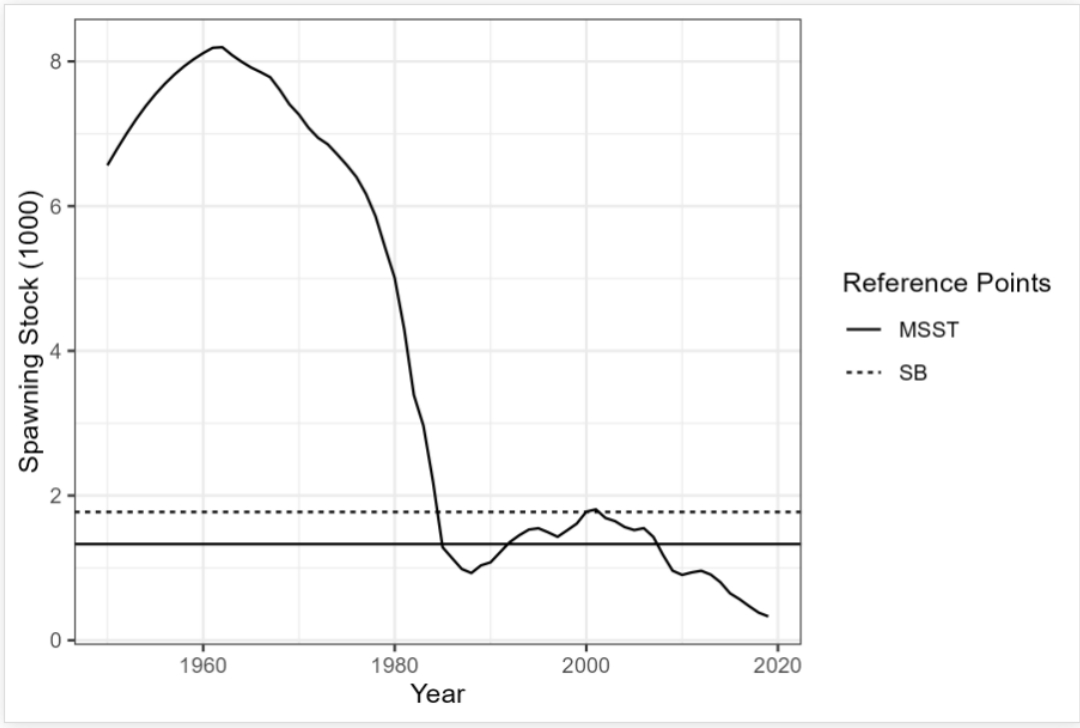
Multi-Species Operating Model

Base Case Operating Model

Base Case Operating Model

Biomass Trends

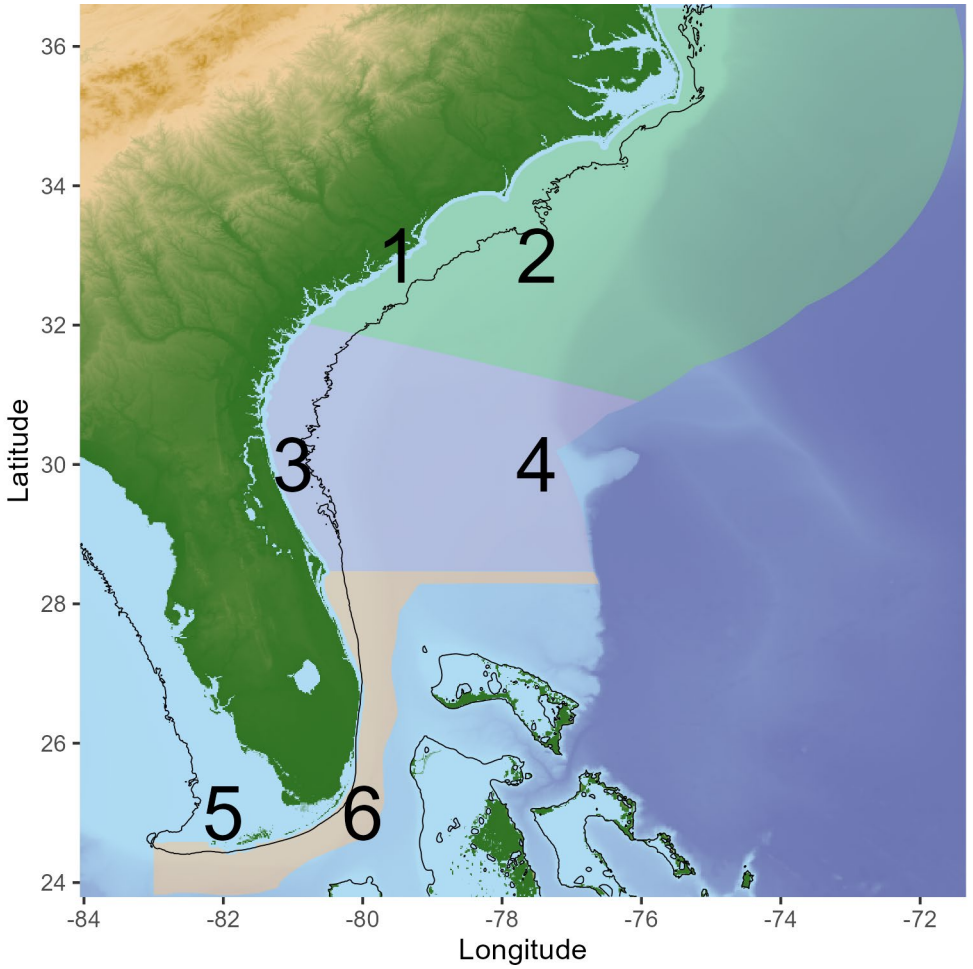




Confirmation OM reproduces dynamics from assessments

Spatial Structure

Definition of Areas



3 Regions & 2 Depth Zones (Nearshore < 100 ft)

Area	Region	Depth
1	North and South Carolina	Nearshore
2	North and South Carolina	Offshore
3	Georgia - Cape Canaveral	Nearshore
4	Georgia - Cape Canaveral	Offshore
5	Cape Canaveral - Florida	Nearshore
6	Cape Canaveral - Florida	Offshore

Recent meeting with SSC:

- Helpful discussion on spatial distribution of stocks
- Spatial analysis by Cao, Shertzer, et al
- VAST model applied to South East Reef Fish Survey (SERFS)
- Currently updating spatial model in OM based on this information

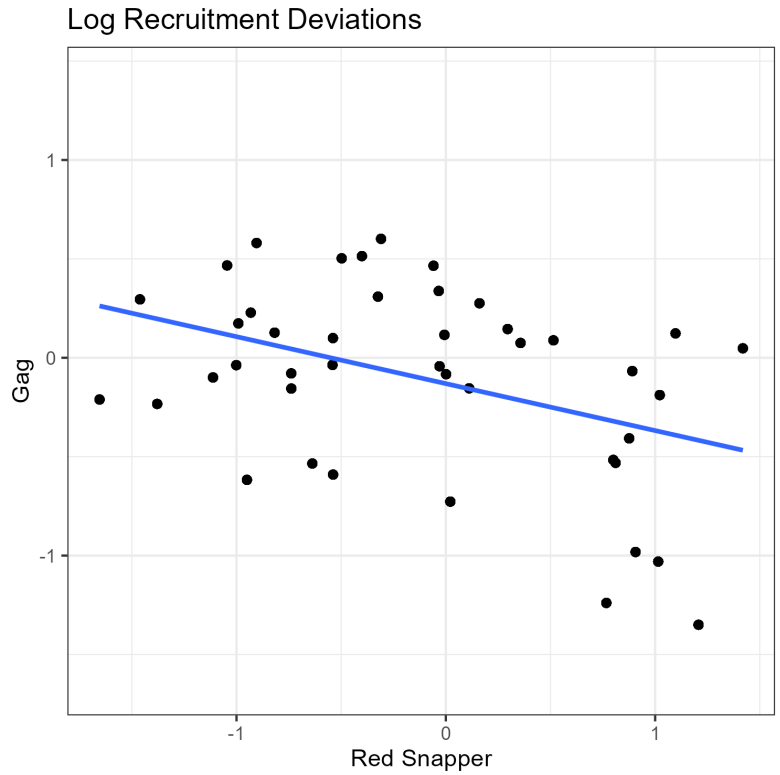
Recruitment Process Error in Projections

Recruitment process error is typically the biggest source of variation in the natural stock dynamics in the future projections

Base Case assumption:
Recruitment deviations in the projections have the same characteristics as those in the past (as estimated by assessments)

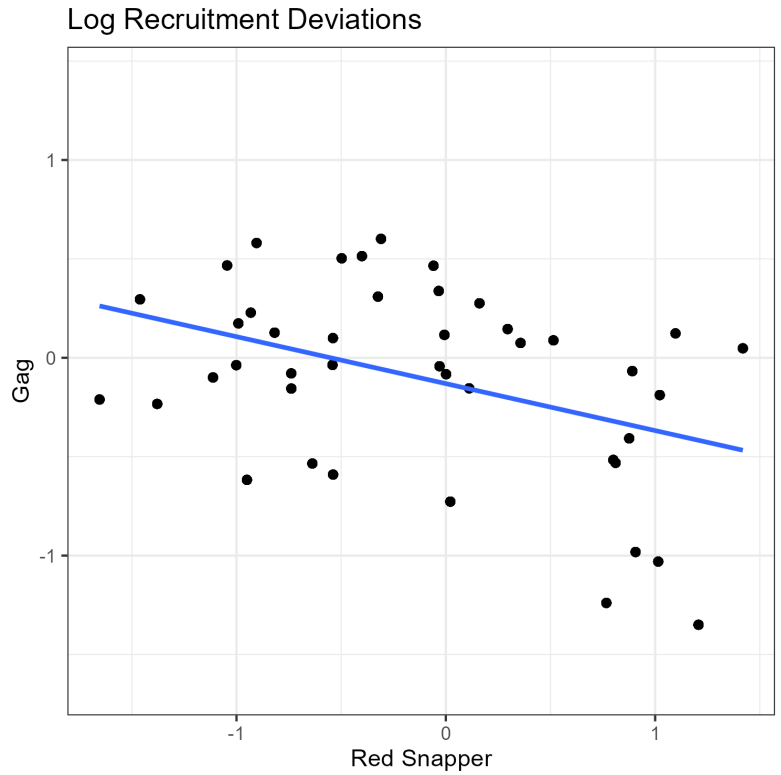
Recruitment Process Error in Projections

- Calculated the variance-covariance matrix of the log recruitment deviations estimated by the SEDAR assessments for RS and GG
- Some evidence that high RS recruitment is correlated with lower recruitment for GG



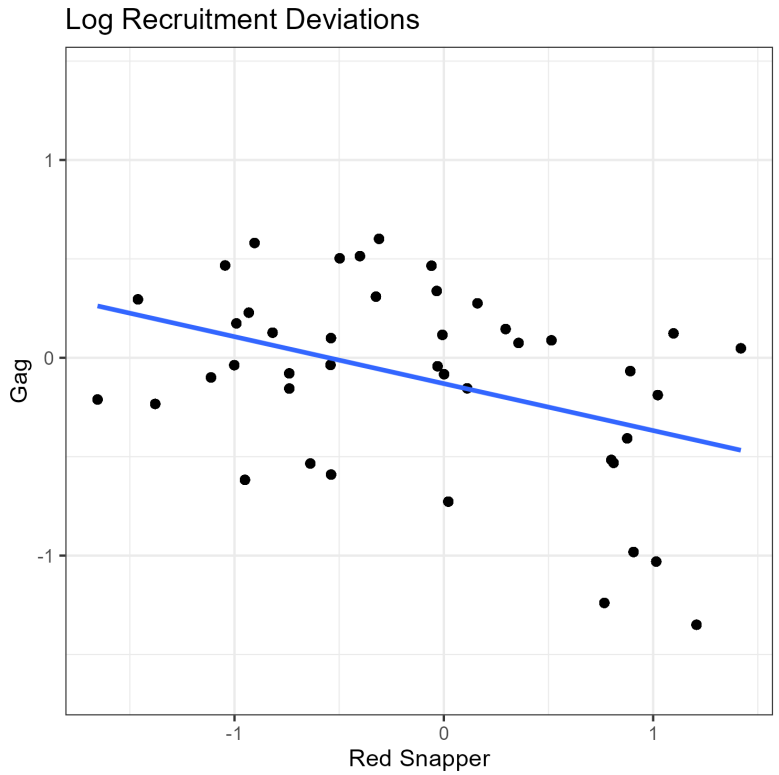
Recruitment Process Error in Projections

- Calculated the variance-covariance matrix of the log recruitment deviations estimated by the SEDAR assessments for RS and GG
- Some evidence that high RS recruitment is correlated with lower recruitment for GG
- Generated recruitment deviations for the projections by sampling from a truncated multivariate normal distribution
- Truncated at 2 s.d. to prevent values well outside those observed in the past



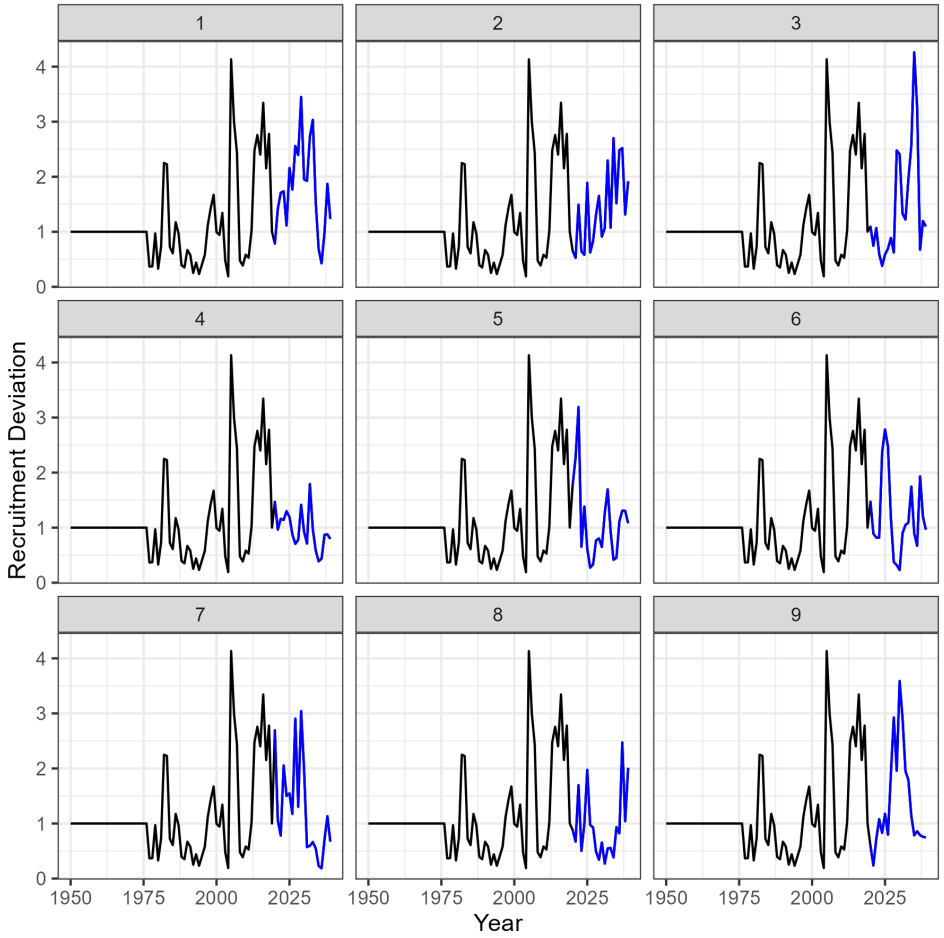
Recruitment Process Error in Projections

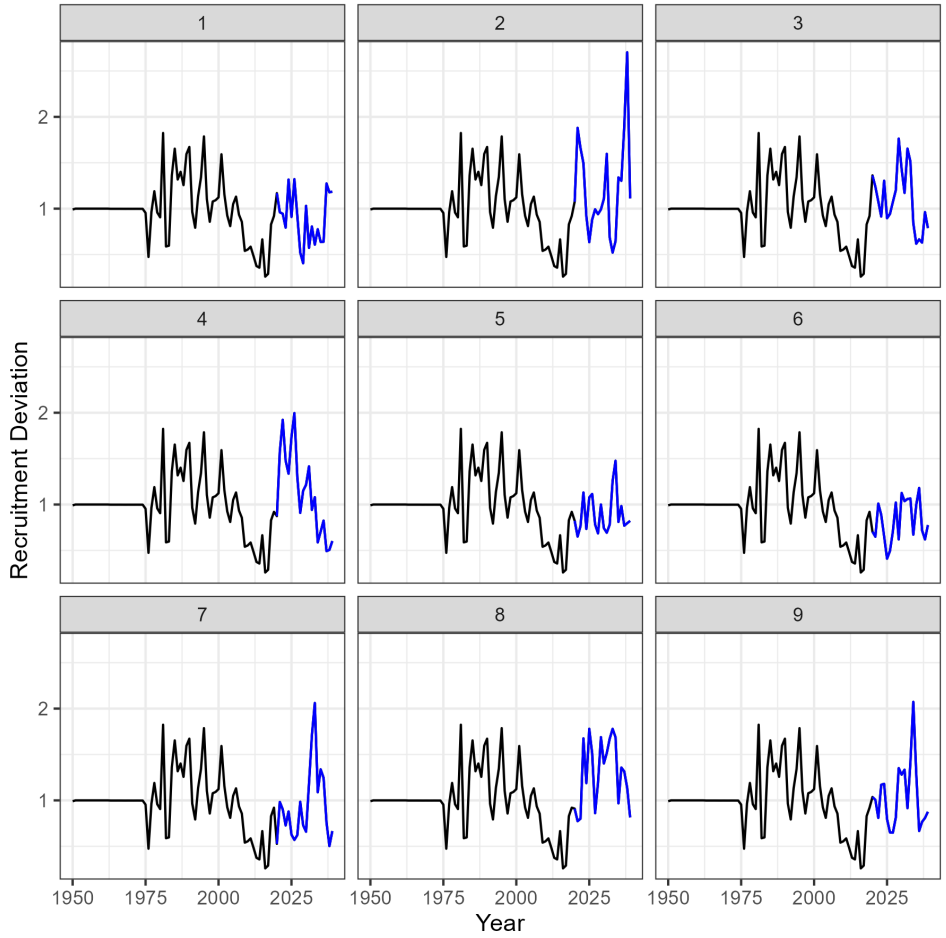
- Calculated the variance-covariance matrix of the log recruitment deviations estimated by the SEDAR assessments for RS and GG
- Some evidence that high RS recruitment is correlated with lower recruitment for GG
- Generated recruitment deviations for the projections by sampling from a truncated multivariate normal distribution
- Truncated at 2 s.d. to prevent values well outside those observed in the past
- Applied the lag-1 auto-correlation estimated from the historical rec devs



Recruitment Process Error in Projections

Examples of Recruitment Process Error in Projections (9 simulations)





Additional Operating Models

Alternative OMs are intended to span the range of critical uncertainties in the knowledge of the system

Aims:

- identify uncertainties that have greatest impact on management performance
- find management options that are robust to these uncertainties
- prioritize research to reduce these uncertainties and/or detect if they occur in the future

Additional Operating Models

OM	Name	Uncertainty	Description
1	Base Case		Base Case Operating Model
2	Lower M	Important assessment sensitivity test	Re-run assessments with M-at-age reduced to the lower values considered in the assessment
3	Higher M	Important assessment sensitivity test	Re-run assessments with M-at-age reduced to the higher values considered in the assessment
4	Reduced Rec Landings	Possible over-estimation of recreational catch	Re-run assessments with Recreational landings decreased by 40%
5	Increased PE	Future productivity changes due to climate	Base Case with increased variability in recruitment process error in the projections
6	Increased Rec Effort	Future recreation capacity (latent effort or tech creep)	Base Case with Recreational effort is increased by 2% per year

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Next Steps: finalize specifications for priority uncertainty OMs (more can be developed later)

Management Measures

Management Questions that can be addressed

MSE is generally focused on identifying robust rules for managing fisheries

However, MSE can also inform other aspects of fishery management decision making:

- What complexity of assessment model is appropriate?
- What data should be collected?
- What is an appropriate assessment interval (yearly, once every 2 years etc)?
- What are appropriate management reference points for these stocks?

Management Measures

- Effort control (season opening, licenses, boat days etc)
- Spatial closures (where model and fleet structure allows)
- Size limits (minimum legal length, slot limits)
- Catch limits
- Gear selectivity
- Bag limits
- Release gear

(and combinations thereof)

Management Measures

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- Size limits (minimum legal length, slot limits)
- Catch limits
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- Bag limits
- Release gear

(and combinations thereof)

Priority:

- Identify specific management questions and measures to evaluate

Example Results

!! For demonstration only !!

Example Management Measures

Name	Class	Description
StatusQuo	Fixed Effort	Fishing Effort for each fleet is fixed to mean from the last 3 historical years
RecEff20	Fixed Effort	Status Quo, but General Recreational Effort is reduced by 20% for all projection years
RecEff40	Fixed Effort	Status Quo, but General Recreational Effort is reduced by 40% for all projection years
Ftarget	Fixed Effort	Effort for all fleets is adjusted, independently by species, by a fixed proportion so that F = Ftarget.
MLL20_25	Size Regulation	StatusQuo Fixed Effort, with a 20 and 25 " MLL for RS and GG respectively
MLL25_25	Size Regulation	StatusQuo Fixed Effort, with a 25 and 25 " MLL for RS and GG respectively

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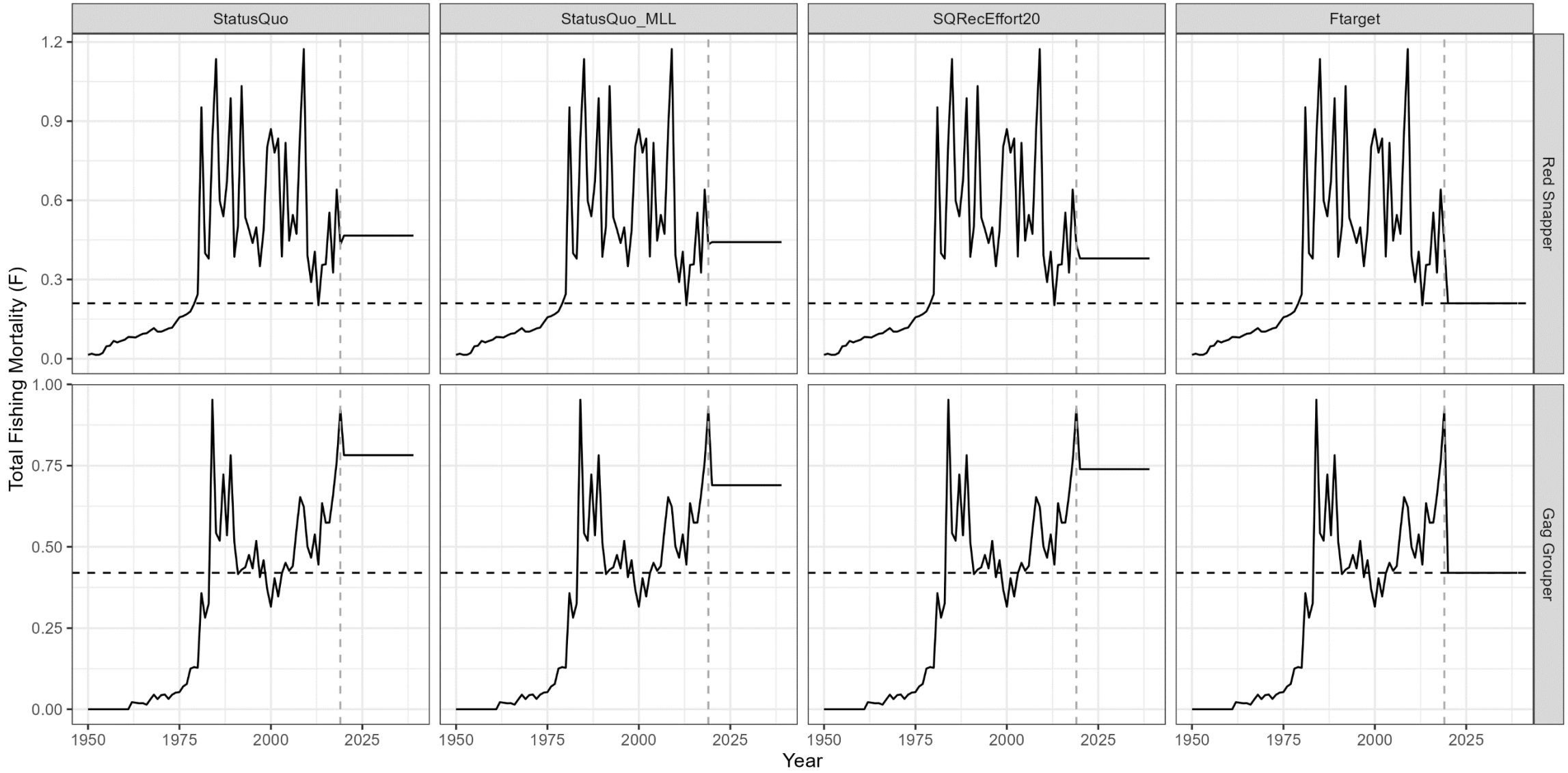
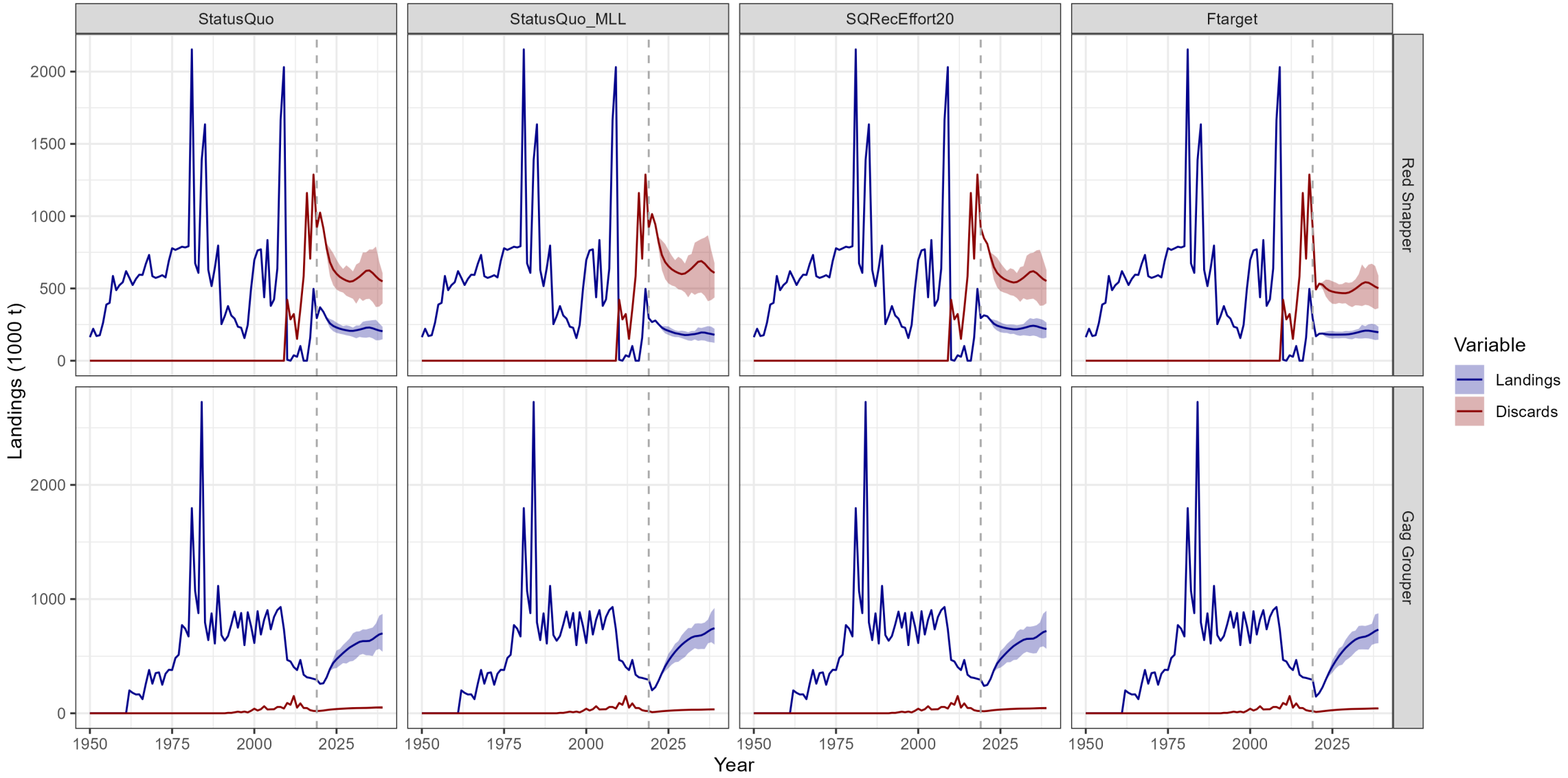
MLL25_25	Size Regulation	StatusQuo Fixed Effort, with a 25 and 25 " MLL for RS and GG respectively

- Static methods (don't change in response to data)
- Useful for scoping out what sorts of management changes are required to meet objectives
- Other measures can be developed and tested; e.g:
  - spatial closures (which areas, how much closed, how long?)
  - size/slot limits: what sizes?

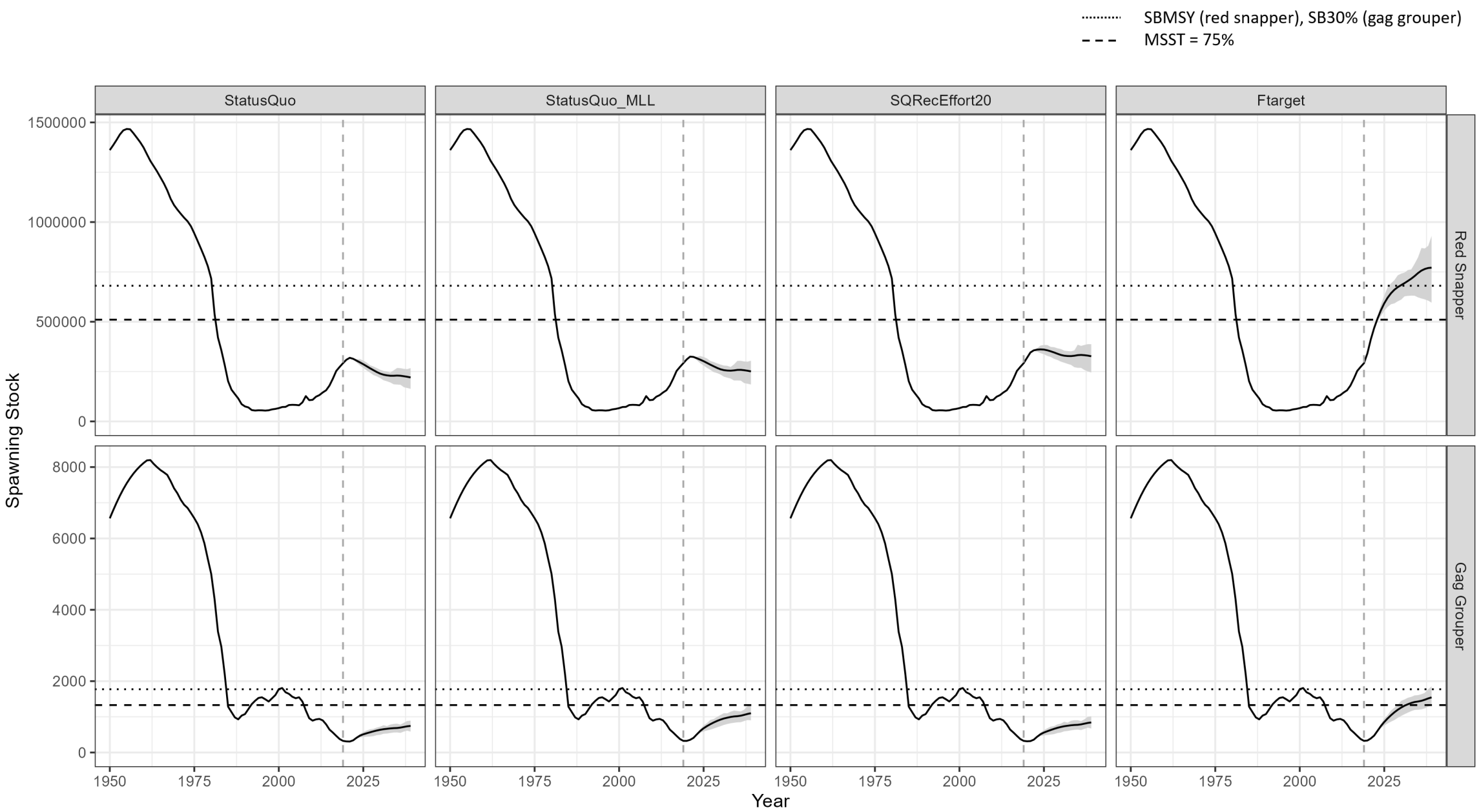
Example Results: Fishing Mortality



Example Results: Catch & Discards



Example Results: Spawning Biomass and Ref Points



Interactive App for Examining Results

https://shiny.bluematterscience.com/app/samse

SAFMC MSE

OM Details

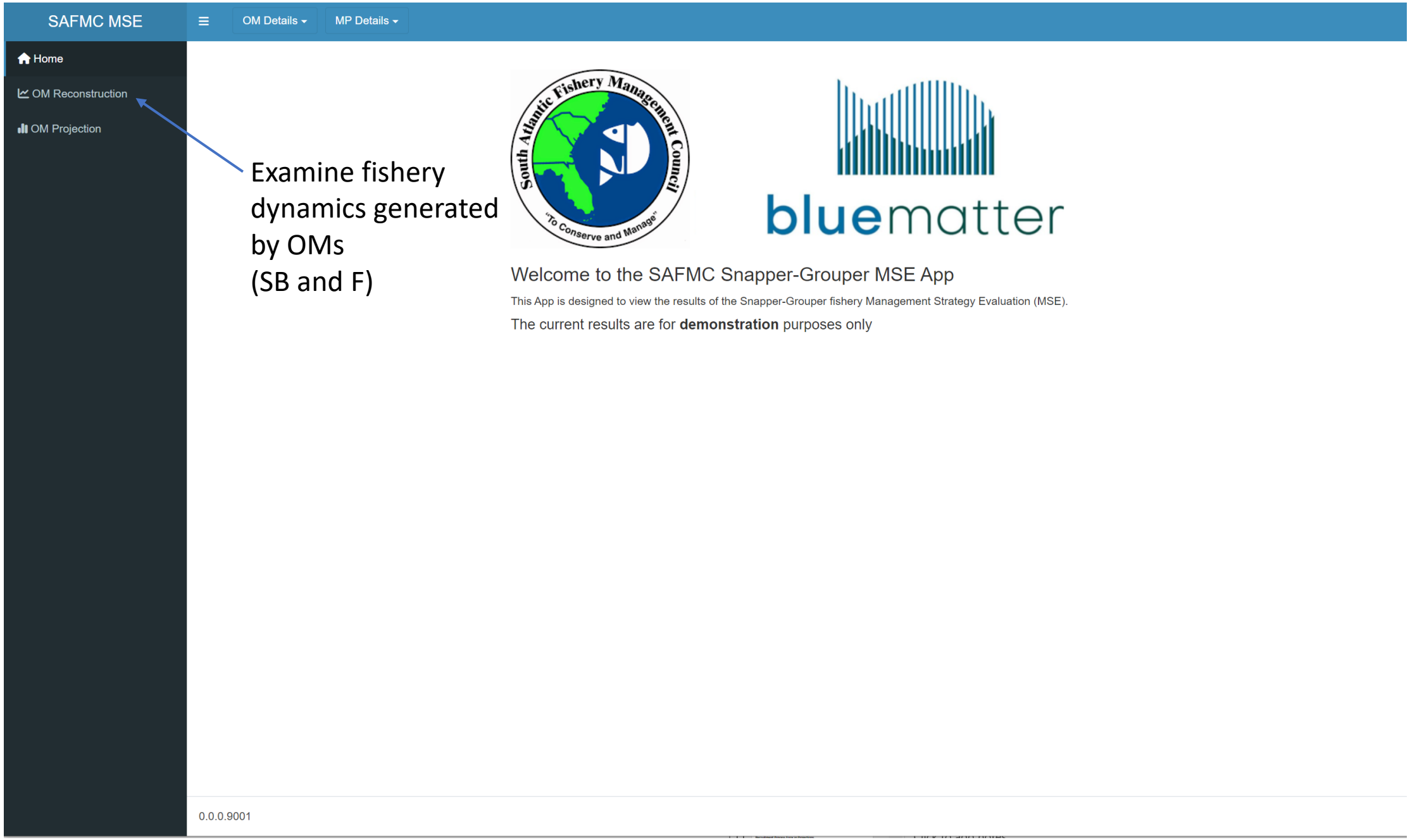
MP Details

- Home
- OM Reconstruction
- OM Projection

Welcome to the SAFMC Snapper-Grouper MSE App

This App is designed to view the results of the Snapper-Grouper fishery Management Strategy Evaluation (MSE).

The current results are for **demonstration** purposes only


SAFMC MSE
OM Details
MP Details
Home
OM Reconstruction
OM Projection
Examine fishery dynamics generated by OMs (SB and F)
South Atlantic Fishery Management Council
"To Conserve and Manage"
bluematter
Welcome to the SAFMC Snapper-Grouper MSE App
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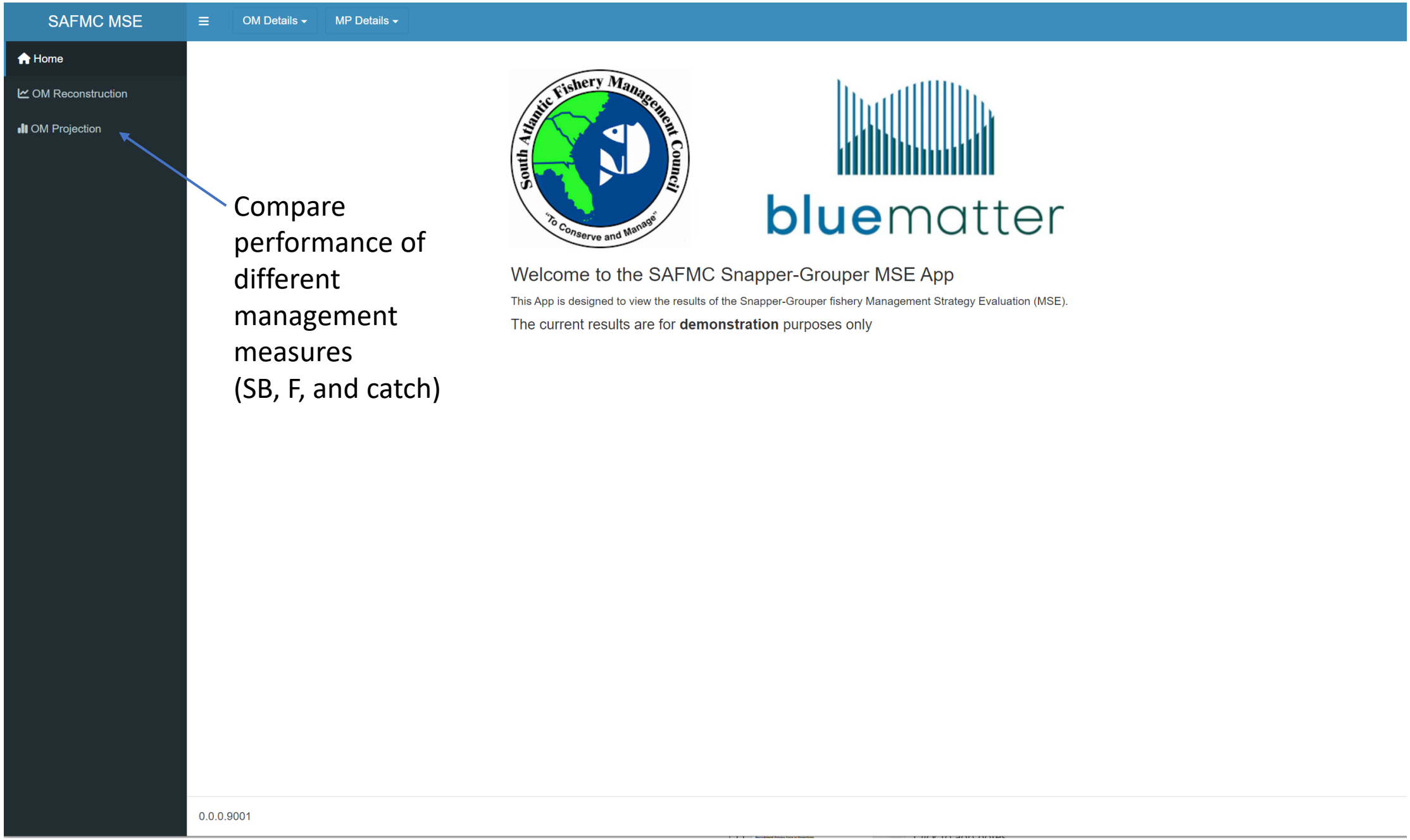
SAFMC MSE
OM Details
MP Details
Home
OM Reconstruction
OM Projection
Compare performance of different management measures (SB, F, and catch)
South Atlantic Fishery Management Council
"To Conserve and Manage"
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Demonstration

Objectives

1. Demonstrate:
    - main features of App
    - how to compare fishery dynamics of different OMs
    - how to compare performance of management measures

2. Collect feedback on App design, graphs/tables to add, etc

https://shiny.bluematterscience.com/app/samse

Next Steps

1. Finalize spatial structure in OMs
2. Finalize specifications of uncertainty OMs
3. Update App based on feedback
4. Identify primary management questions to address in MSE
5. Define management measures to evaluate
6. Run initial MSE analyses
7. Update App with new MSE results
8. Present initial results to Council and AP
9. Re-run analyses based on feedback from AP and Council

Acknowledgements

Many thanks to the MSE technical team for their input on the MSE framework thus far:

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Christina Wiegand

Judd Curtis

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Michael Larkin

Mike Schmidtke

Quang Huynh

Scott Crosson

Performance Metrics

Management Objective	Quantitative Metric	Category
Avoid stock being in an overfished state	Probability SSB > MSST	Biological
Avoid overfishing the stock	Probability F < MFMT	Biological
If overfished, rebuild stock to target within desired time-frame	Probability SSB > SSB_{targ} by 2044 (red snapper; SSB_{targ} = $SSB_{F30\%}$) and 2040 (gag; SSB_{targ} = SSB_{MSY})	Biological
Stability in catch	Average inter-annual variability in catch	Commercial
Maximize yield	Average landings	Commercial & Recreational
Reduce discards	Ratio of kept to discarded fish	Commercial & Recreational
Catch and keep enough to make the trip worthwhile	Average catch rate relative to current	Recreational
High probability of catching reasonably sized fish	Probability of catching a 10 lb fish	Recreational
High probability of catching trophy sized fish	Probability of catching a 30 lb red snapper and 45 lb gag	Recreational
Maximize fishing opportunity	Average fishing effort relative to recent historical	Recreational