MRIP FES MSE Update

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Purpose

github.com/nmfs-fish-tools/SSMSE

Objectives:

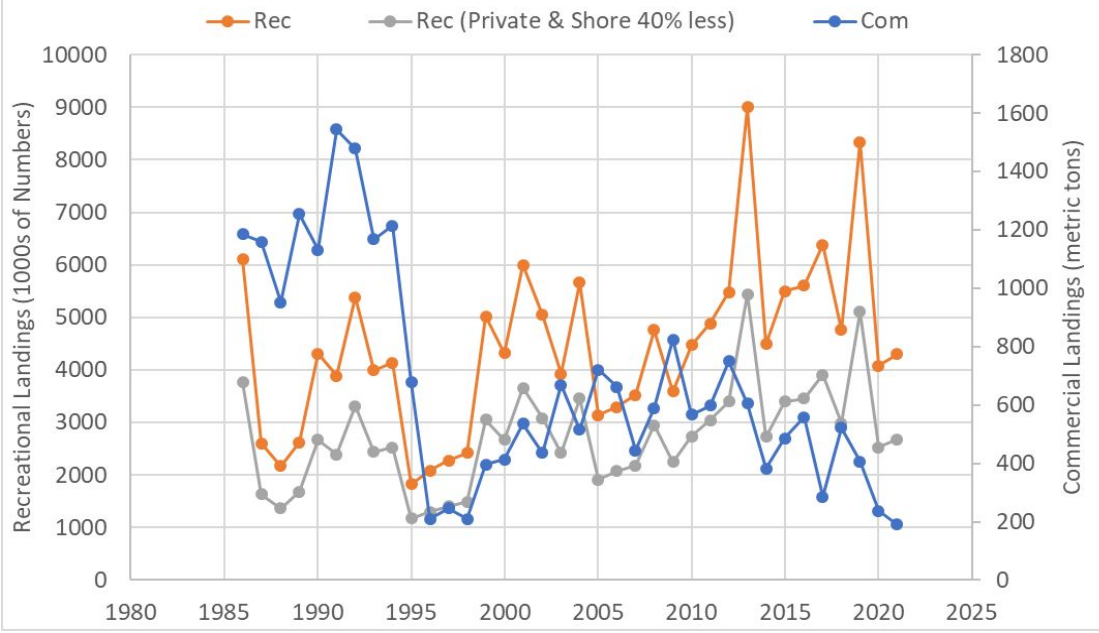
1. *Can we obtain reliable stock status even with uncertainty about the magnitude of the private recreational landings (MRIP-FES)?*
2. *Can we give useful catch advice even when absolute values may be unknown?*

Original test case: Spanish mackerel

- No fixed allocations between recreational and commercial
- Small pelagic fish – high variability in population dynamics and data

Has since been expanded to most of our assessed species to build capacity for MSE work.

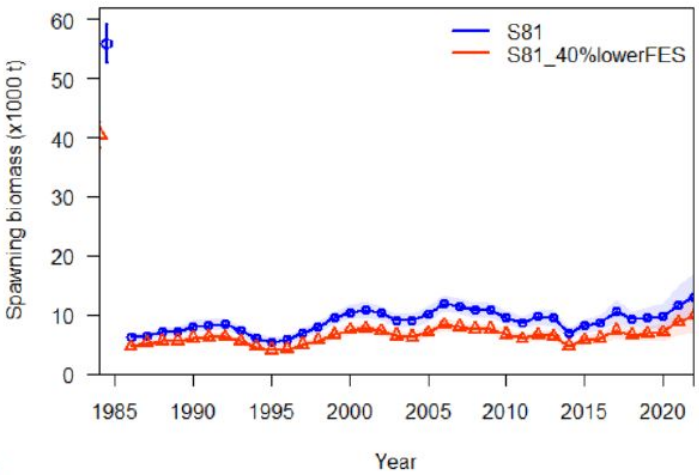
The problem:



1. The magnitude of the FES estimates is in question
2. The scale is likely to change in the future with FES-pilot study completion
3. The scale of catch and discards is and will likely remain highly uncertain
4. Commercial catch units remain constant

Given this and until such time as we have stable MRIP-FES numbers, can we get reliable stock status and recommend catch limits?

Initial investigations using sensitivity analysis



SEDAR 81
Gulf Spanish Mackerel

- Pilot study revealed FES overestimates effort:

"Switching the sequence of questions resulted in fewer reporting errors and illogical responses, and effort estimates that were generally 30 to 40 percent lower for shore and private boat modes than estimates produced from the current design. However, results varied by state and fishing mode."

- A sensitivity run (FES sensitivity) was conducted with a 40% reduction in FES. Results indicated that status was largely unchanged, ACL was ~25% lower

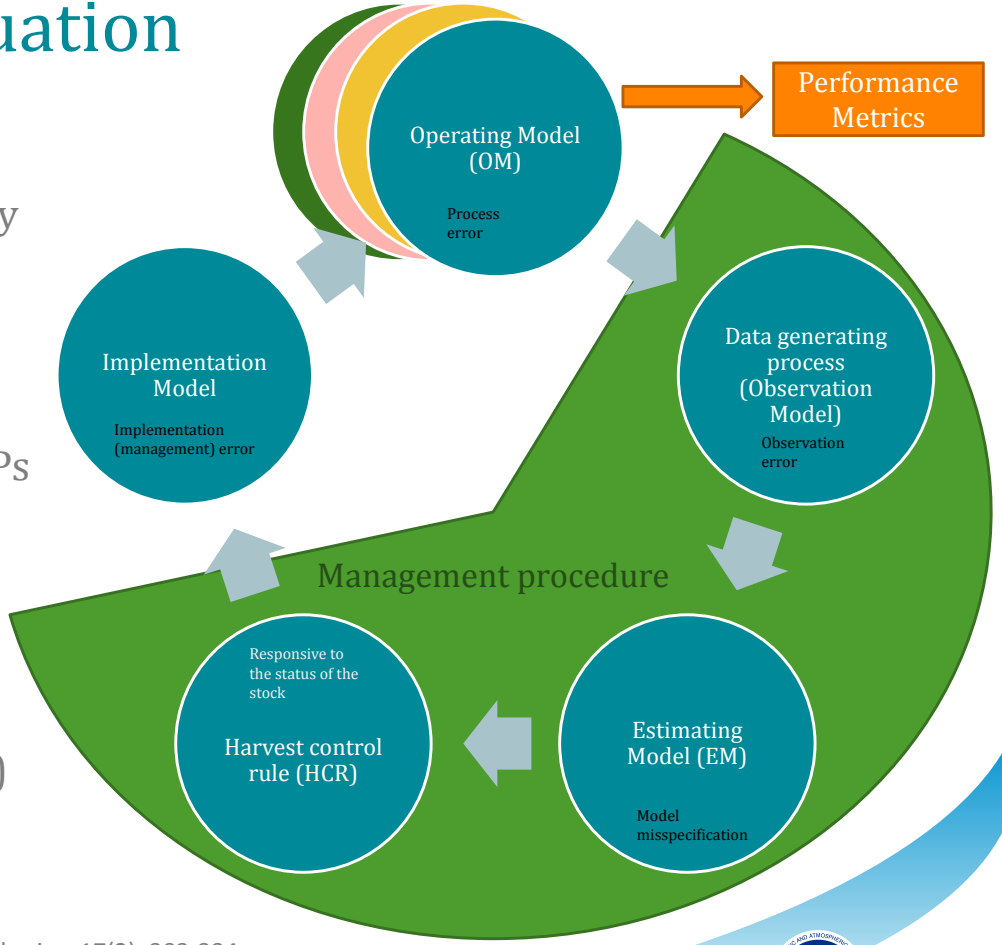
- Is this result about status reliable and how would we use the estimated catch limit in the face of uncertainty? We need to use an MSE to answer these questions.

https://www.fisheries.noaa.gov/recreational-fishing-data/fishing-effort-survey-research-and-improvements

Management Strategy Evaluation

Management Strategy Evaluation (MSE) – a process designed to develop management procedures (MPs) that are robust to uncertainty

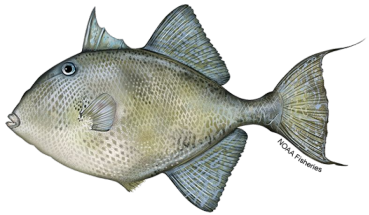
1. Identify fishery-specific, stakeholder/Council-defined management objectives
2. Identify relevant uncertainties over which MPs should be robust
3. Develop operating models, 'true' states of nature, and condition those models
4. Identify management procedures that are responsive to stock dynamics (feedback loop)
5. Simulation exercise; summarize and present resulting performance statistics

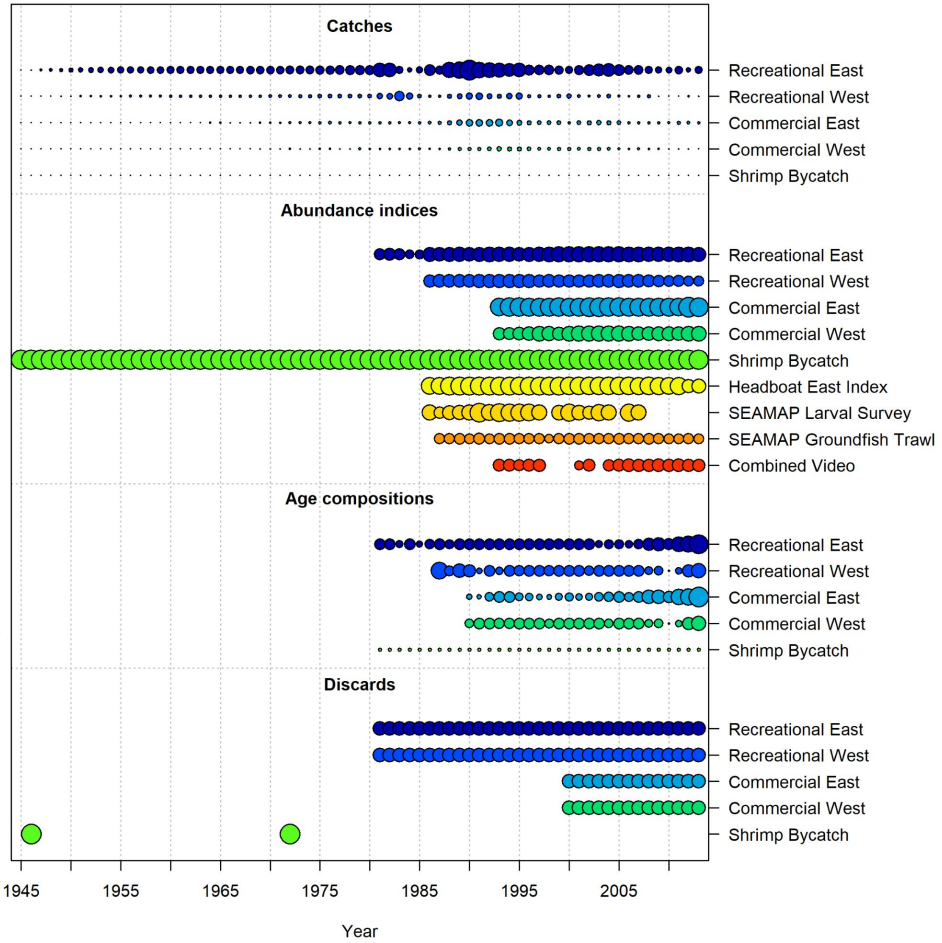


Punt et al. (2016) Management strategy evaluation: best practices. Fish and Fisheries. 17(2): 303-334

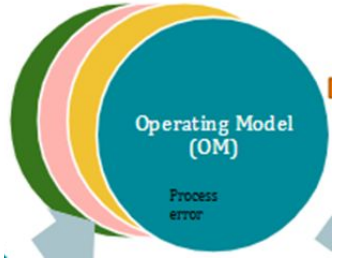
Focus for today: Gray Triggerfish

- Relevant due to ongoing SEDAR 100 assessment and the use of MRIP calibrated data for the private recreational mode removals within the recreational fishery





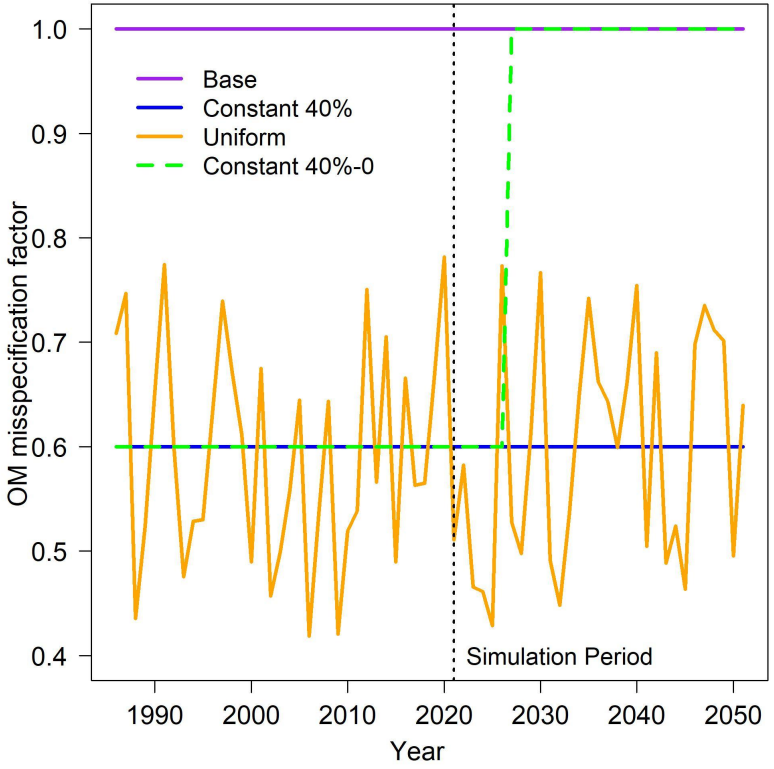
MSE setup: Operating models



- Started with the previous stock assessment
  - We refit the base model with MRIP-FES removals (landings and discards)and used that model as our starting point.
- Refit model with expected data file (= Base OM scenario)
- Adjusted recreational removals to include bias adjustments for bias OM scenarios and refit each model
  - Each OM treated as the truth, which allows us to isolate the effect of bias in the recreational removals within our stock assessments.

MRIP-FES MSE

1. **Base OM** - true and measured recreational removals match
2. **Constant 40% OM** - measured recreational removals are 40% higher than true
3. **Uniform OM** - true recreational removals vary following uniform distribution ranging from 40% to 80%
4. **Constant 40%-0 OM** - as Constant 40% OM, but mismatch in observed recreational removals is eliminated in projection year 5



MRIP-FES MSE

1. Stock Synthesis assessment model
    - Projects the fishing mortality rate that would result in the target spawning potential ratio (SPR) to determine the annual catch limit (ACL)
        - Assuming ACL = OFL estimated by each stock assessment
        - Not reduced to account for either scientific or management uncertainty

Simulation Period:

- An assessment is conducted every three years for a total of 30 years

Year 1:
First year of simulation period

Year 30:
Last year of simulation period

1	2	3	4	5	6	7	8	9	10	...	30

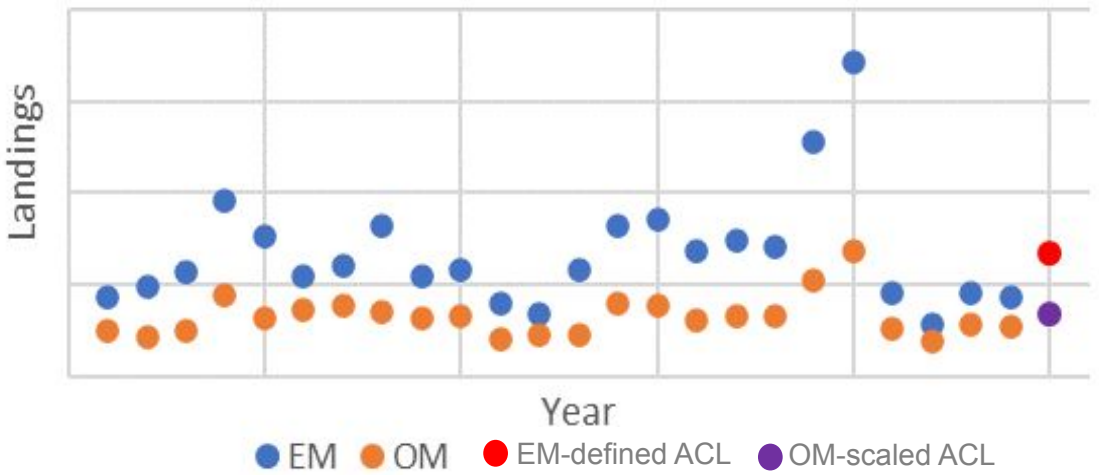
Demonstration of Constant 40% OM

Convert **true rec removals from OM** to **observed rec removals in EM**
(extract bootstrapped random data values)

Operating Model (#2)

"True" simulation

Simple mismatch in recreational removals



Estimating Model:

Observed units in stock assessment

Current MRIP units

Convert **projected rec landings ACL from EM** to **true rec landings in OM**
(using scenario-specific bias conversion)

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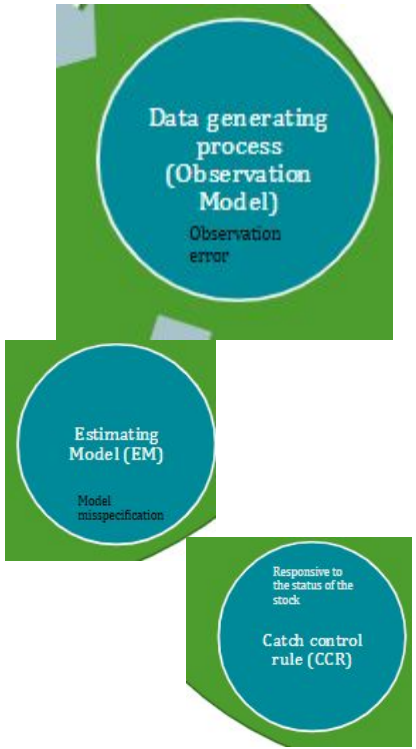
MSE setup: data generation ⇨ assessment

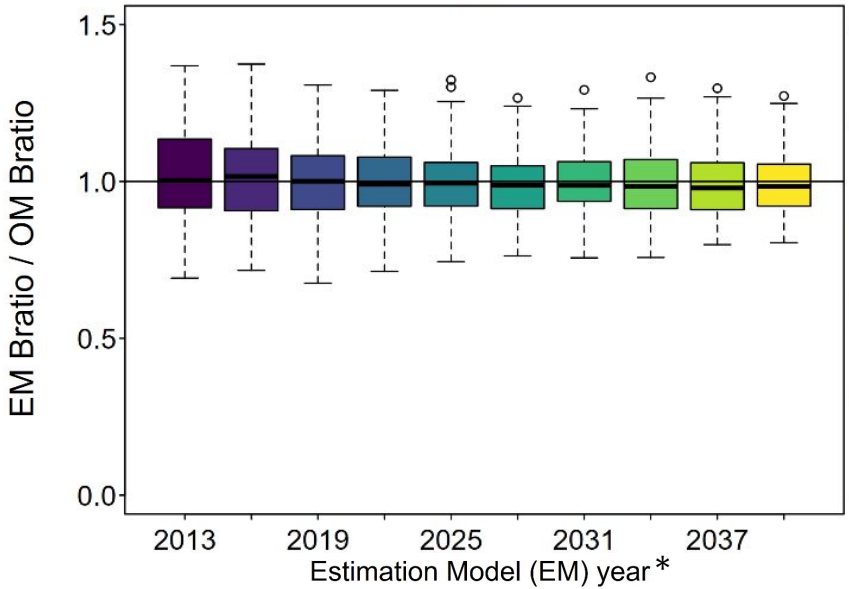


For each scenario's OM:

- Extracted expected data values - these are fed into a new model which is then re-estimated (= initial historic period OM)
- Extracted bootstrapped random data values - these are fed into a new model which is then re-estimated (= initial historic period EM)
- From this time forward the MSE increments in 3 year intervals for a total of 30 years
- Projected removals values are estimated in the EM via stock assessment
- These removals are then used in the OM (accounting for any scenario-specific bias conversion from EM to OM)
- Bootstrapped random data for next 3 years are extracted from OM and added into the EM and re run (accounting for any scenario specific bia conversion from OM to EM)

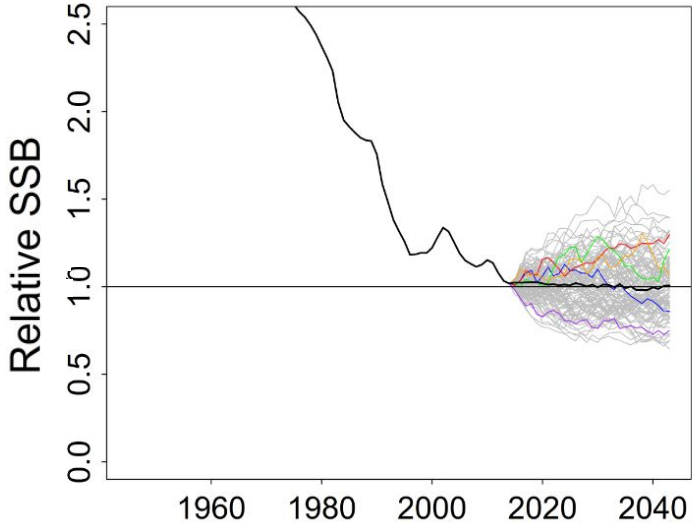
SSMSE performance

Stock assessment performance
EM accuracy



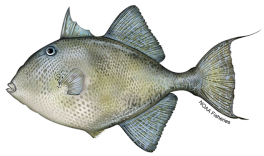
*every three years in 30-year simulation period

Management performance
OM outcomes

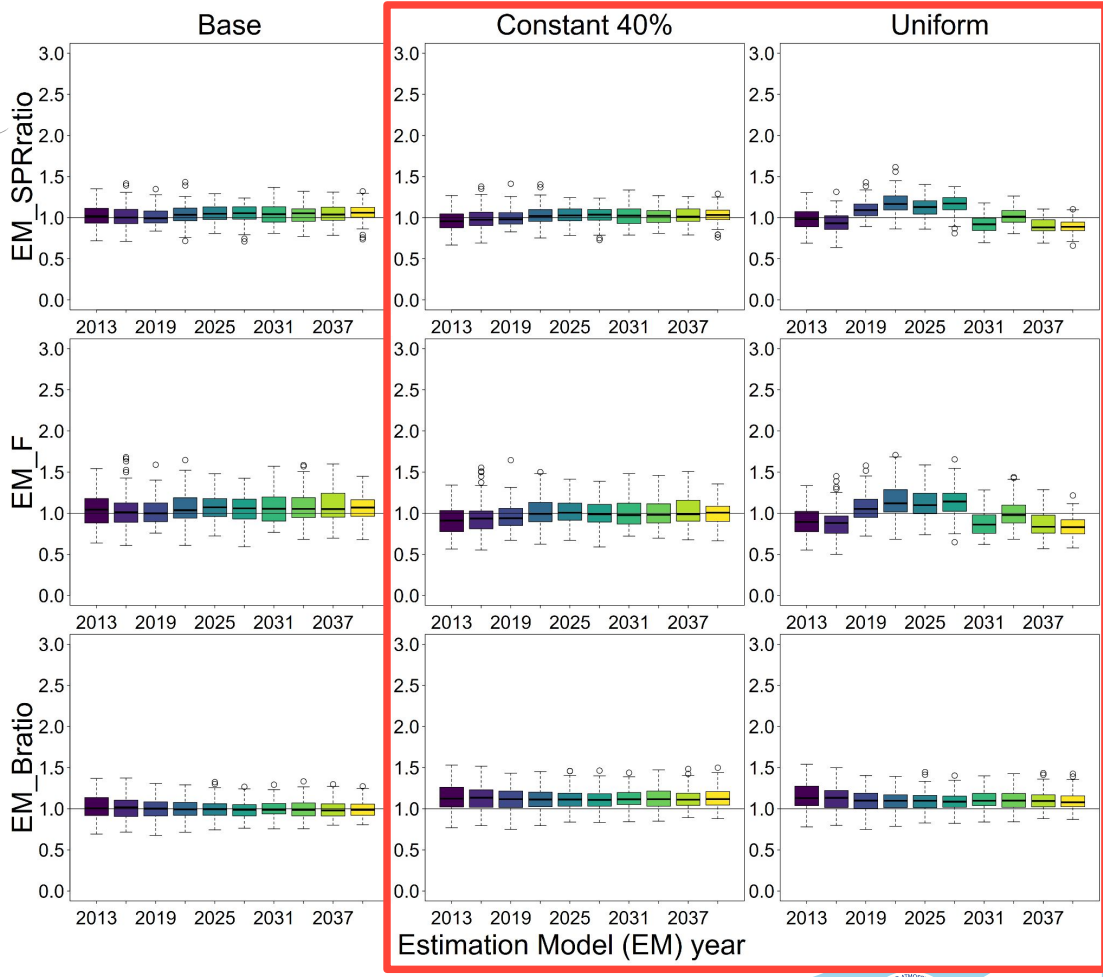


Note: colors identify the last 5 iterations throughout the 30-year simulation period

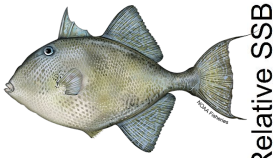
Take home #1 Assessment performance:



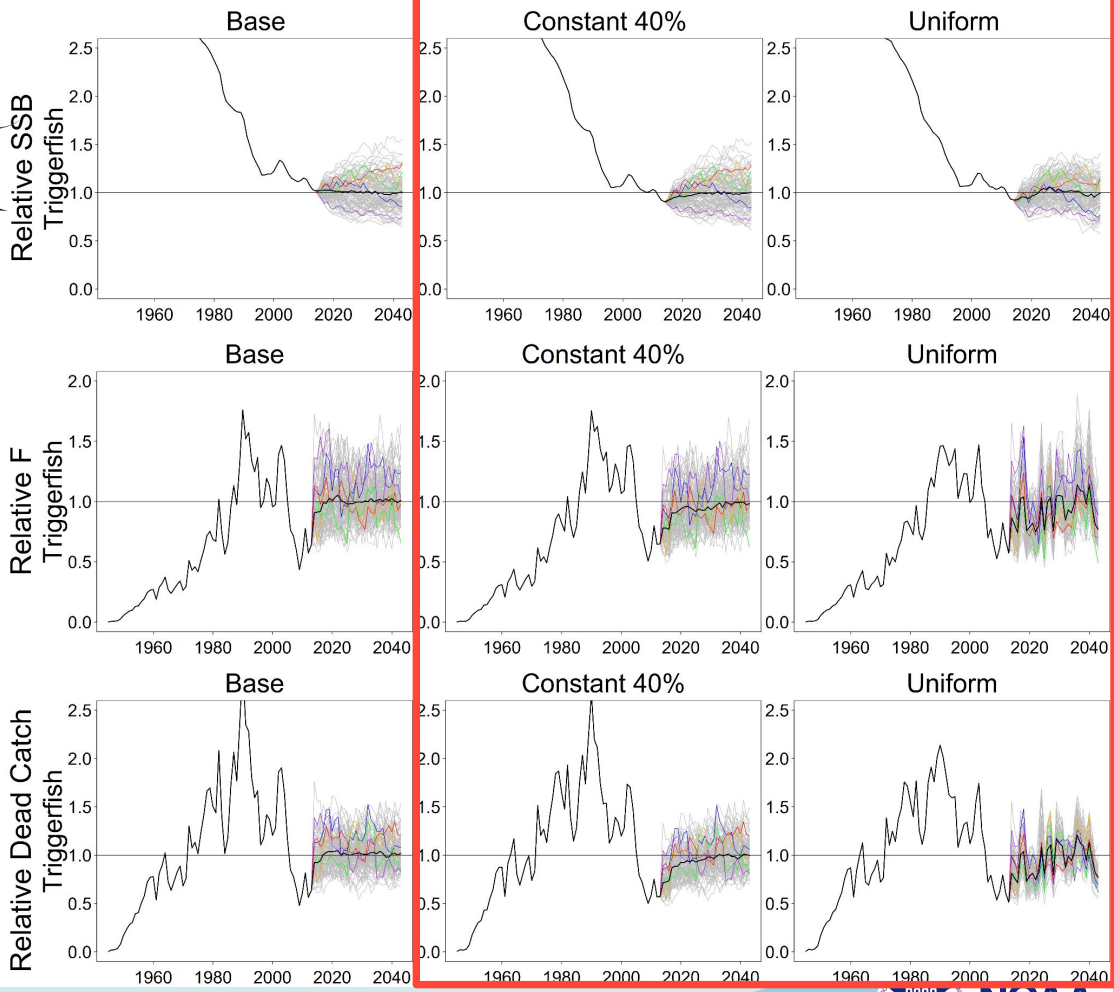
- **Relative population and fishery metrics** were generally **well estimated by the Status Quo approach** despite *constant or randomly varying misspecification* of the magnitude of recreational removals.



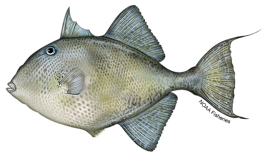
Take home #2 Management performance:



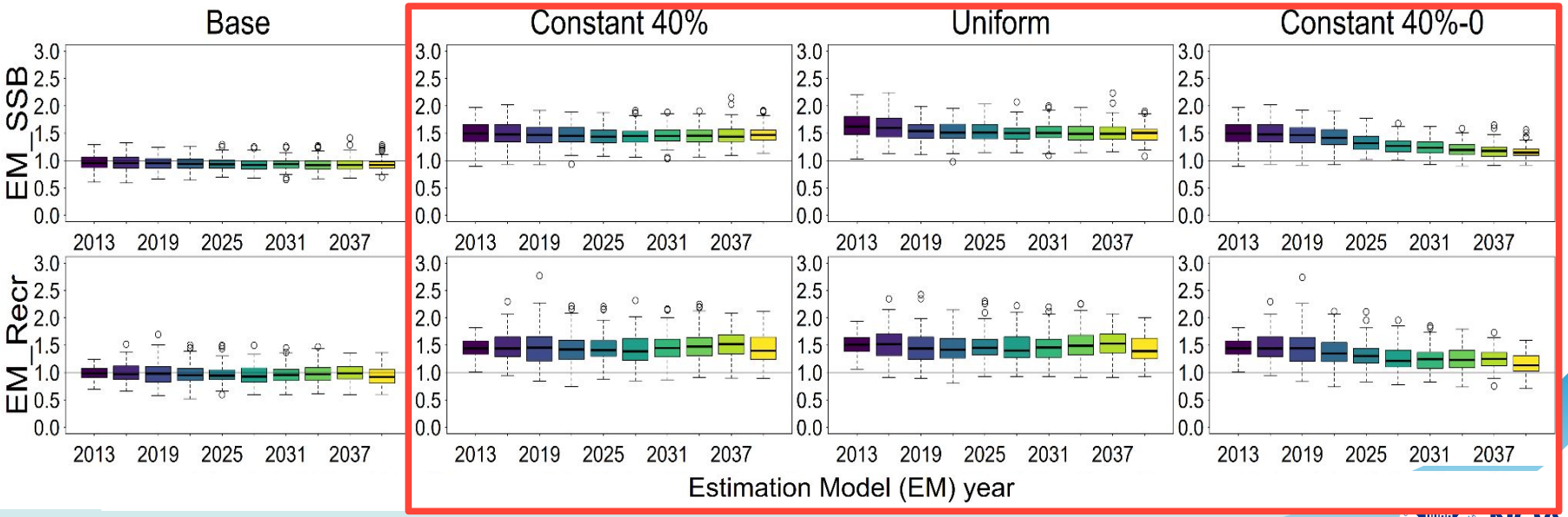
- Status Quo management **successfully achieved** relative depletion, exploitation, and yield targets despite *constant or randomly varying misspecification* of the magnitude of recreational removals.



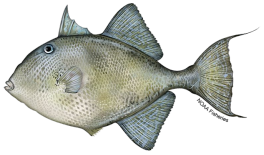
Assessment performance: absolute values



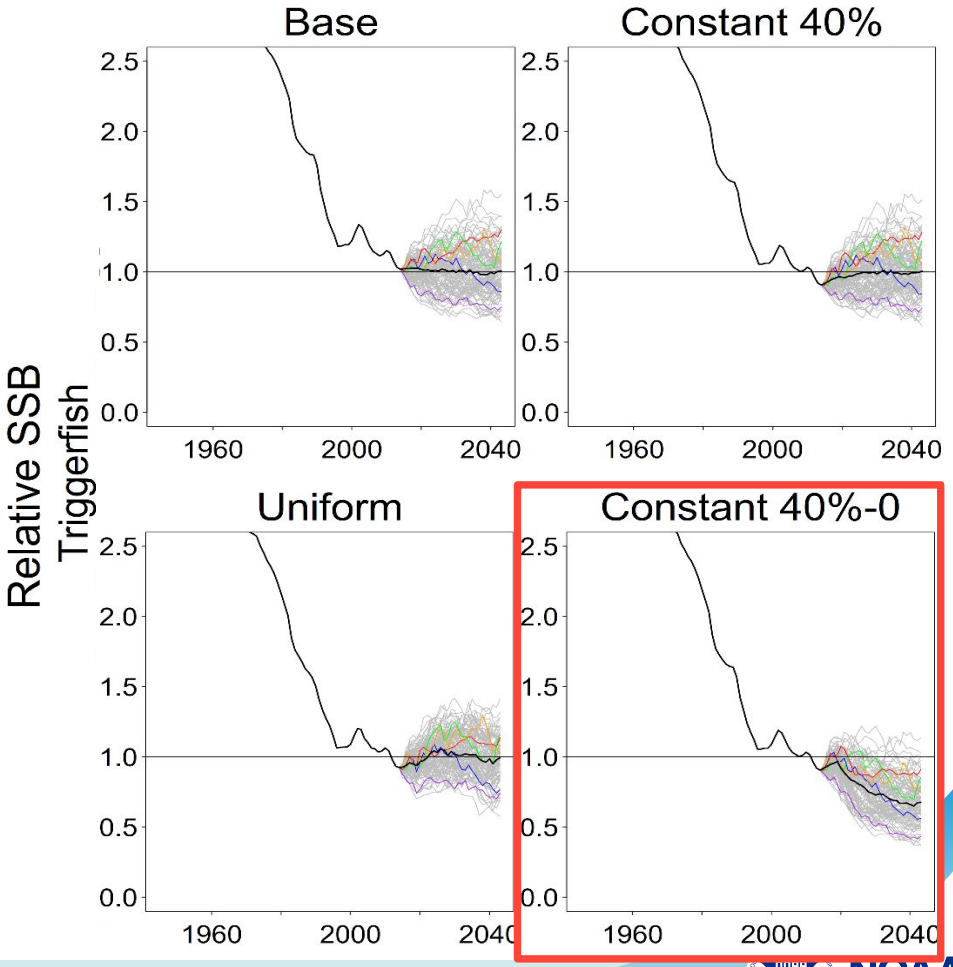
- When *recreational catches were misspecified*, estimating models **were not capable** of estimating absolute stock magnitude (e.g., raw biomass or recruitment)



Take Home #3
Survey changes



- Management outcomes following an *uncalibrated change in removals scale* **were worse** than when a constant or randomly biased data stream was utilized
  - Highlights the importance of calibration before combining recent state removals estimates (e.g., SRFS) with historic FES removals estimates



Conclusions

- Robust management advice can be provided using biased MRIP-FES data, provided the bias is constant and not trending.
- Management advice from models using stationary, biased data consistently outperformed that from models that reduced data bias part way through the timeseries without calibration.
- Consistent monitoring through time is likely more important for successful management than achieving a perfect estimate of absolute scale
- Bias in MRIP-FES data directly translated into bias in absolute population size
- Stock assessment interpretation should focus on relative benchmarks and not absolute population scale

Next steps: allocations analysis

Demonstrate the importance of allocations assumed in projections:

- Quantify the impact of allocation changes on status and OFL estimates
- Identify the ramifications of managing to allocations when they are not realized
- Test framework for automating runs to demonstrate the effect of different allocations

Species	Recreational Allocation (MRFSS)	Recreational Re-allocation
Gag Grouper	61% (Amendment 30B)	65% (SRFS/MRIP-FES; Amendment 56)
Greater Amberjack	73% (Amendment 30A)	80% (MRIP-FES; Amendment 54)
Red Grouper	24% (Amendment 30B)	31.8% (SRFS; Amendment 62) 40.7% (MRIP-FES; Amendment 53)

Next steps: Harvest Control Rules (longer term goal) and sandbar shark

- Test ABC control rule parameterization for Gulf stocks
- Planning an MSE for sandbar shark (relates to the Gulf stocks in that we've received a lot of feedback about the impacts of depredation on stocks)

Questions & Comments?