EAFM Recreational Summer Flounder MSE

Summary of Process, Outcomes, and Potential Application

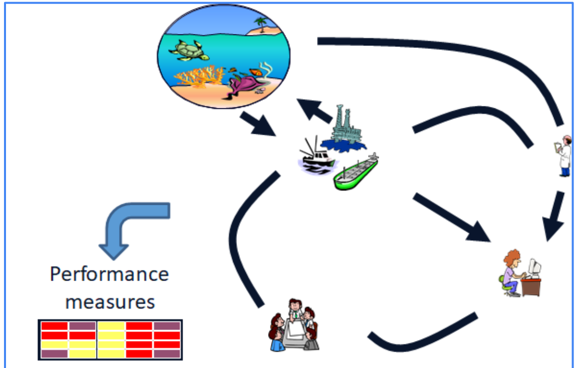
Philadelphia, Pennsylvania
August 9, 2022

MID-ATLANTIC FISHERY MANAGEMENT COUNCIL

Presentation Outline

- Overview of process and MSE development
- Management considerations
- Key findings
- Review of results
- Broader MSE takeaways
- Potential next steps and meeting goals

For all model outputs - https://bit.ly/fluke-mse-metrics



(Figure courtesy of Beth Fulton)

MSE Technical Work Group and Core Group Members

Technical Work Group

- Andrew Carr-Harris/NEFSC
- Dustin Colson-Leaning/ASMFC
- Jonathan Cummings/Contractor, USFWS
- Kiley Dancy/MAFMC
- Geret DePiper/NEFSC
- Jon Deroba/NEFSC
- Gavin Fay/UMass Dartmouth
- Sarah Gaichas/NEFSC
- Kaili Gregory/Cornell
- Jorge Holzer/U. Maryland
- Emily Keiley/GARFO
- Jeff Kipp/ASMFC
- Doug Lipton/NOAA Fisheries
- Annabelle Stanley/Cornell
- Mark Terceiro/NEFSC
- Mike Wilberg/U. Maryland
- Greg Wojcik/CT DEEP

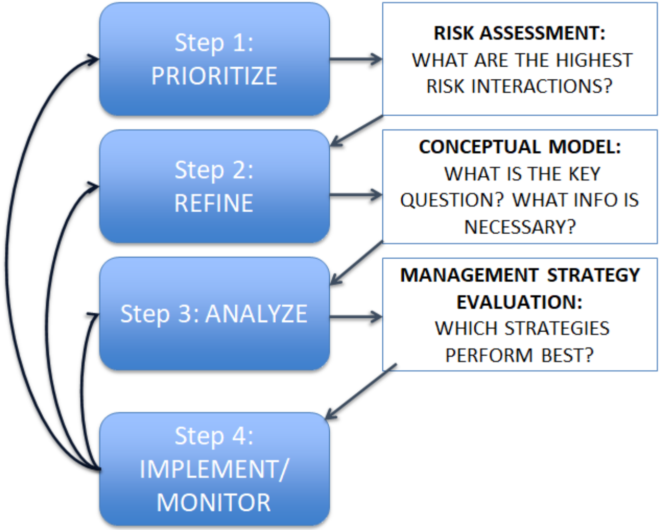
Core Stakeholder Group

- Leah Barton/Shore
- Rick Bellavance/Charter Boat
- Eleanor Bochenek/Academic
- Neil Delanoy/Party Boat
- John DePersenaire/National Recreational Org.
- Greg DiDomenico/Commercial
- Paul Haertel/Private Boat
- Rich Hittinger/Private Boat
- Mike Oppegaard/Charter Boat
- Michael Plaia/Charter Boat
- Harvey Yenkinson/Private Boat
- Mike Waine/Rec. Secondary Market

Also, significant input from Adam Nowalsky, Justin Davis, Tony DeLernia, and Peter deFur

EAFM to MSE

- Project is part of the Council's implementation of the EAFM guidance document
- Structured and deliberative approach to incorporating ecosystem considerations within the management process
- **MSE Goals:** 1) Evaluate biological and economic benefits of minimizing rec discards (live and dead) and convert to landings and 2) identify management strategies to realize benefits
- Opportunity to align EAFM work with traditional management process
- Different approach and process to evaluate management challenges to address and reduce regulatory discards



Source: Sarah Gaichas, http://www.mafmc.org/s/3_Habitat_in_IEAs_Gaiches.pdf

MSE - What? Why?

- A process to identify and compare the performance of alternative management strategies designed to address desired (typically conflicting) objectives
  - Quantify and balance trade-offs of strategies
- Identify sensitivity of management performance to system/ecosystem drivers and key uncertainties
- Allows for an evaluation of the full management cycle
- Test strategies before implementation
  - Simulation is “cheap”, implementation/experiment is expensive
- Decisions not any easier, but process helps and offers avenue for dialogue and new/different information
- Robust tools available for future priorities and issues

MSE Process

Phase 1 - Public Scoping & Engagement

May 2020 - May 2021

AP Kick-Off Webinar –
Introduction to MSE process

Scoping Feedback Form -
Broad input on variety of topics

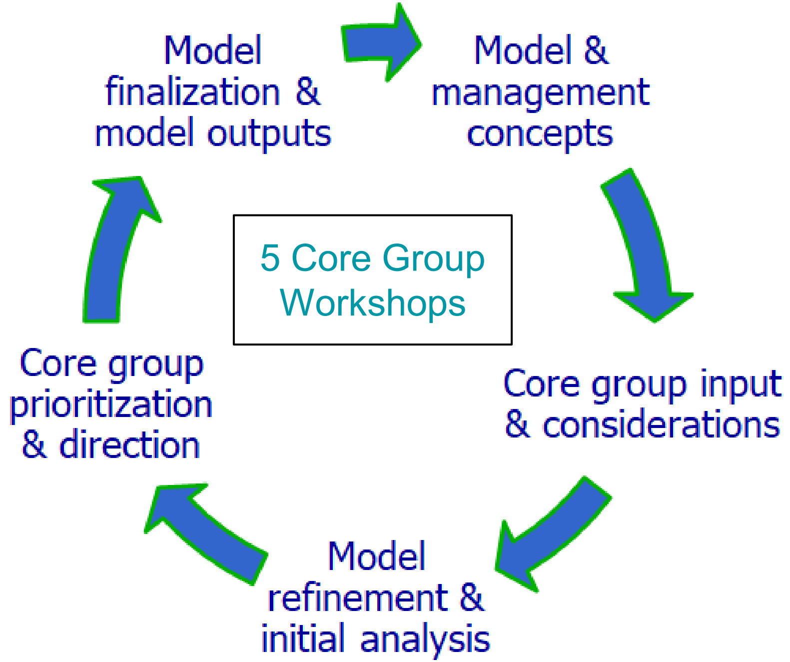
Regional Workshops –
Targeted, focused input

Core Stakeholder Group –
Direct input and feedback to technical team

<u>Early and continued engagement</u>

Phase 2 - Management Application & Model Development

June 2021 - June 2022

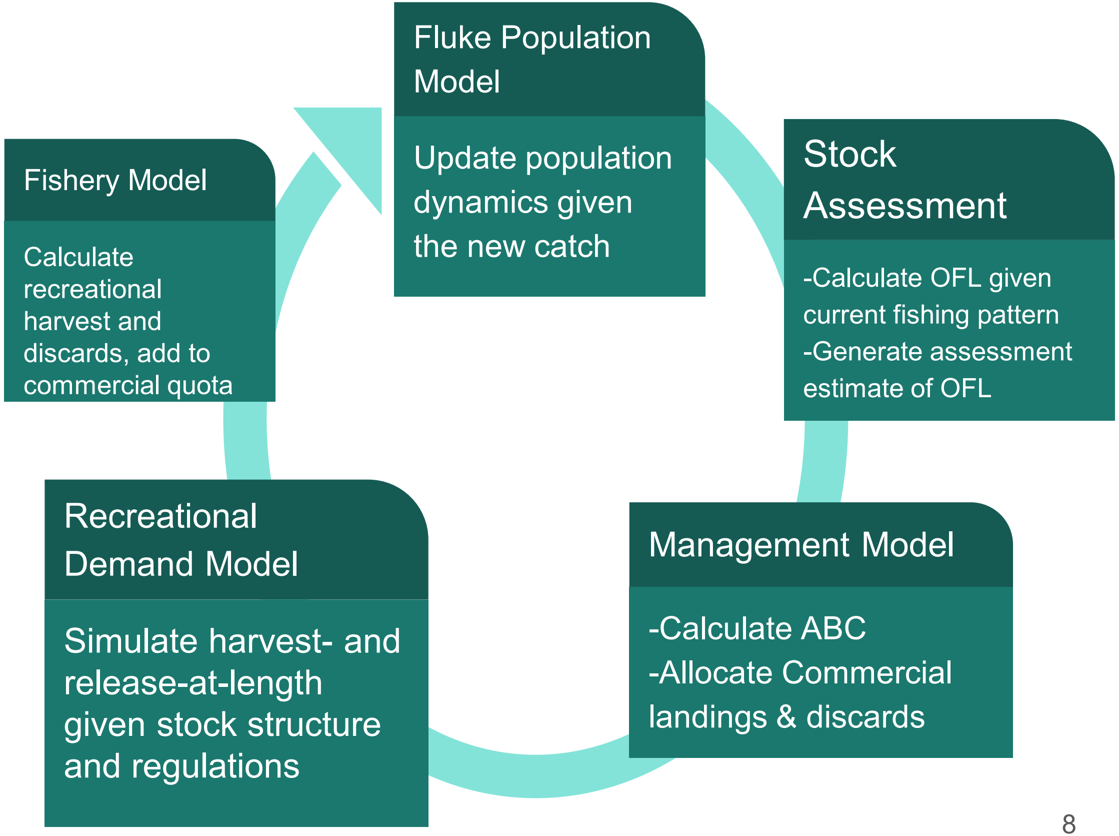


Coupled modeling approach

- Link extant ecological, fishery, & economic models
  - Less time on development & testing, more time on ensuring representation of working group needs
- Population dynamics & fishery model
  - Population size, status, multiple fishing fleets
- Emulate scientific assessment & management advice
- Length structure of population available to recreational fishery
- Simulate response of recreational fishery to both stock availability and regulations (at various scales).
- Feedback effect of recreational fishing response to regulations into the stock dynamics.

Coupled Modeling Approach: Operating & Management Models

- Age, length, sex-structured summer flounder population dynamics model
- Length-based fishing for commercial and recreational landings & discards
- Conditioned on results of 2021 Management Track Stock Assessment
- Emulates our current best estimates of stock status productivity
- Assessment/Management Model includes our perception of scientific uncertainty, focuses on recreational fishery dynamics
- Fishery & Population model is similar to our stock assessment BUT allows us to directly include implications of changes in size structure of the removals (say due to changes in size limits)



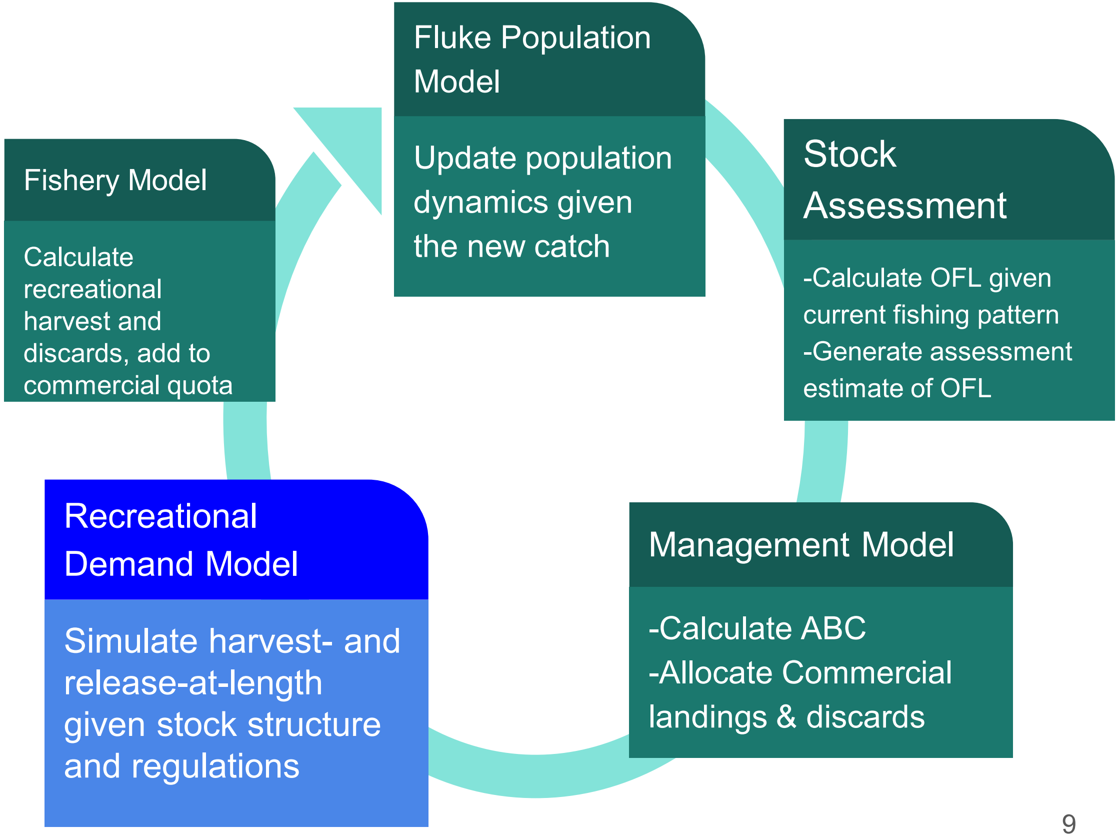
Coupled Modeling Approach: Recreational Demand Model

Predicts recreational harvest & discards given simulated population size and the management alternatives

- Passed back to the fishery model to update the population dynamics with these removals

Also, calculates expected effects of summer flounder population size and mgt. alternatives on:

- fishing effort
- angler satisfaction/welfare
- aggregate trip expenditures → impacts to downstream businesses



Coupled Modeling Approach: Recreational Demand Model

Rationale

- Incorporated rec. demand model as part of the MSE to understand how fishing effort responds to regulations
    - Shifts in fishing effort directly impact rec. fishing mortality and reflect anglers’ core values and preferences
- Quantify the economic benefit to anglers of alternative regulations

Management Objectives & Performance Metrics

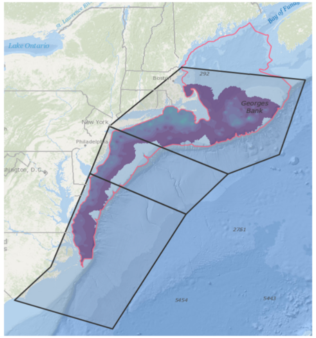
- Broad objectives identified when agreeing to MSE
- Didn't explicitly provide guidance for other management considerations
- Define what a successful fishery that minimizes discards would look like
  1. Improve the quality of the angler experience
  2. Maximize the equity of anglers' experience
  3. Maximize stock sustainability
  4. Maximize the socio-economic sustainability of the fishery
- A set of 17 performance metrics, multiple metrics for each objective
  - Calculated at either the trip, state/region, or coastwide
  - Core group interest in mode specific and other metric options

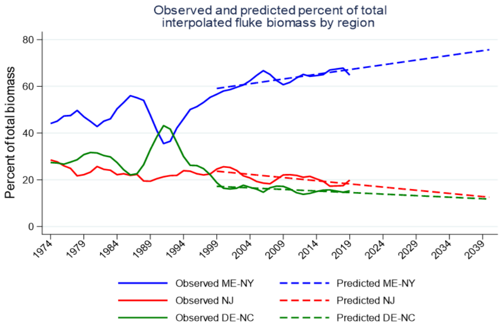
Management Procedures (aka - strategies, regulations)

Management Procedure #	Procedure Explanation
1 (status quo)	Status Quo - 2019 regulations
2 (minsize-1)	2019 regulations but a 1 inch decrease within each state to a minimum of 16 inches
3 (season)	2019 regulations but season of April 1 - Oct 31 for all states
4 (region)	Modified regions: MA-NY - 5 fish, 18 inch min, May 1 - Sept 31 NJ - 3 fish, 17 inch minimum, May 1 - Sept 31 DE-NC - 3 fish, 16 inch minimum, May 1 - Sept 31
~~5~~	~~1 fish, 14 inch minimum, May 15 - Sept 15~~
6 (c3@17)	3 fish possession limit, 17 inch minimum size, May 1 - Sept 30
7 (c1@16-19)	Modified slot: 1 fish from 16” - 19”, 2 fish 19 inches and greater, May 1 - Sept 31
8 (slot)	True slot limit: 3 fish possession limit between 16 inches and 20 inches, May 1 - Sept 31

Alternative Operating Model Scenarios

- Two additional scenarios chosen in addition to the ‘base’ representing key aspects of uncertainty.
- MRIP Bias
  - Models initialized & calibrated based on an assumption that the data from MRIP are biased high.
    e.g. historical recreational removals and effort were not as high
- Distribution Shift
  - Regional availability of summer flounder to the recreational fishery changes in the future.

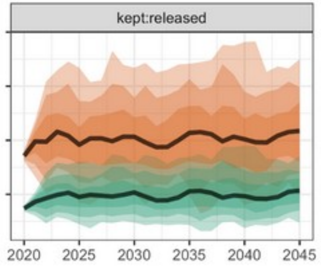


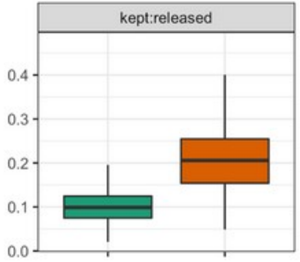


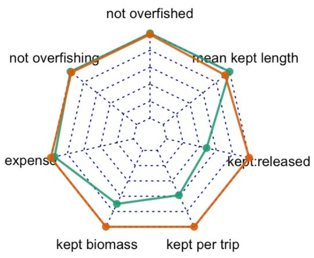
Quick Review: Projections and Outputs

- 100 simulations for each management procedure
- 26-year projection period (13 assessments and management cycles)
- Same management procedure for entire projection
- Metric calculated from final 10 years of projection
- Median values used as point estimate for metric

Ex. outputs



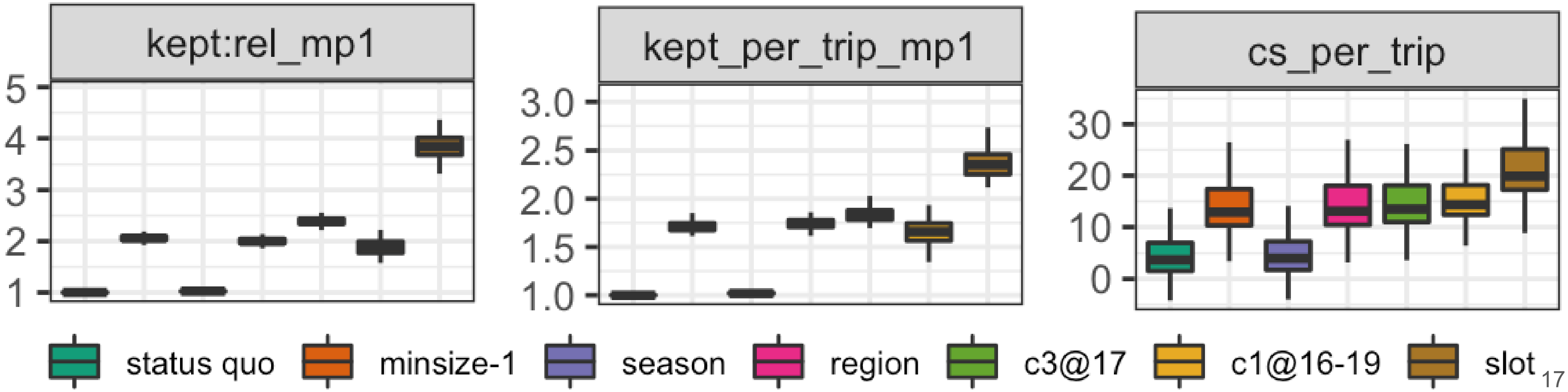




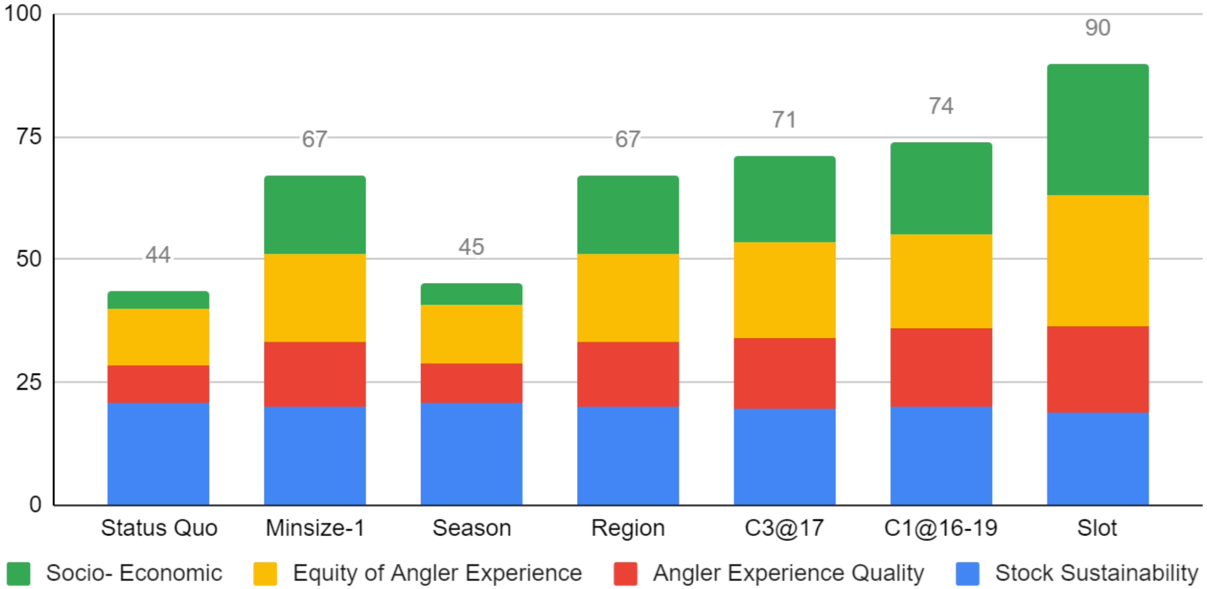
Key Takeaways

Most management procedures outperformed status quo across the majority of metrics

- Reduce recreational discards
- Provide increased harvest opportunities
- Increase angler welfare

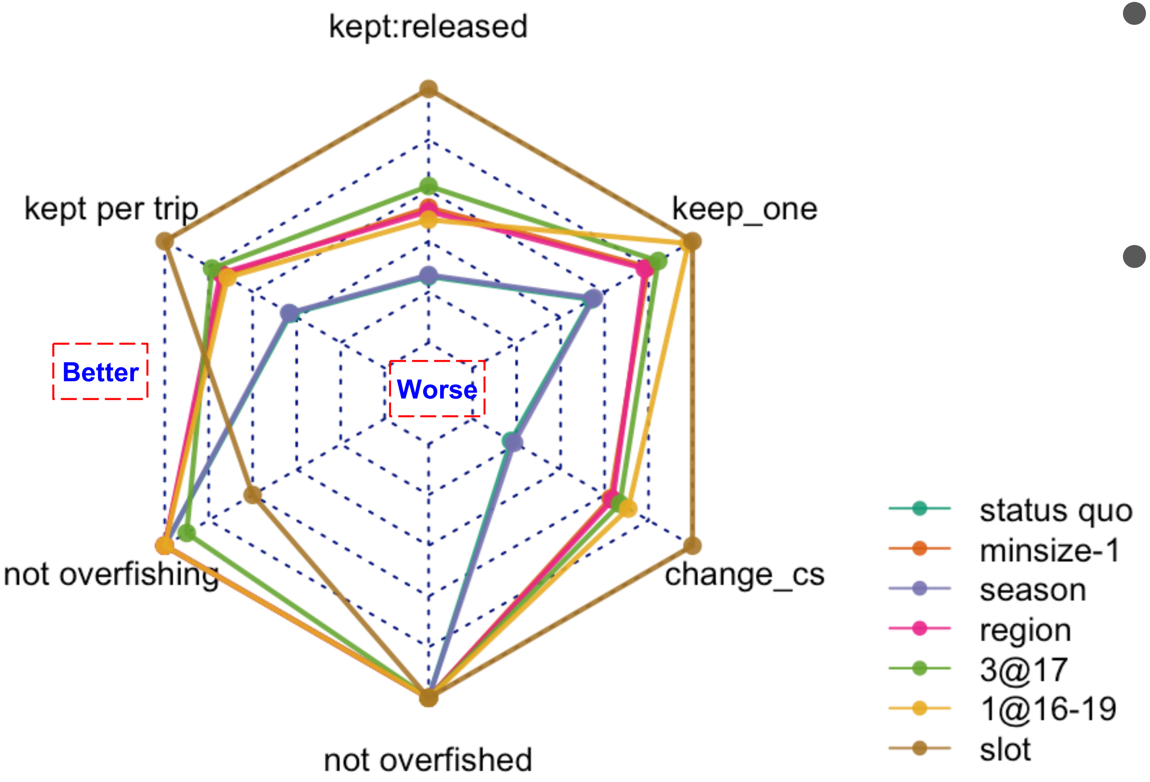


Based on stakeholder preferences, proposed management procedures are expected to increase stakeholder satisfaction.



- Those MPs provide 4 - 106% increase in perceived performance
- Driven by socioeconomics, equity, and experience improvements

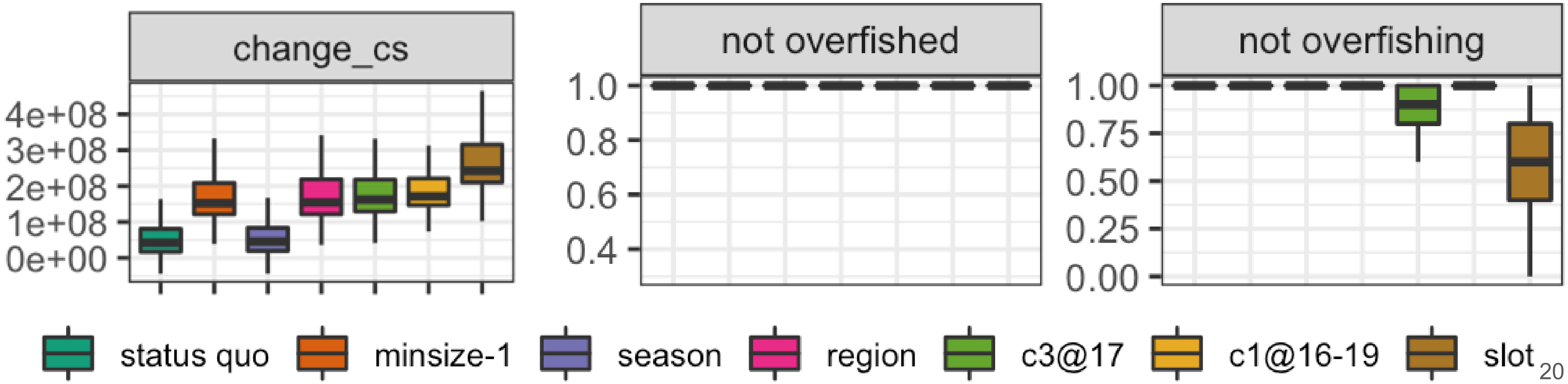
Looking at performance of management procedures for metrics removes stakeholder weightings from rankings.



- Results demonstrate tradeoffs among metrics for the management procedures.
- e.g. the slot limit MP performed the best for most metrics but had highest risk of overfishing

Improved recreational fishery outcome did not come at expense of conservation status.

- No management procedure resulted in stock being overfished.
- Most had low risk of overfishing

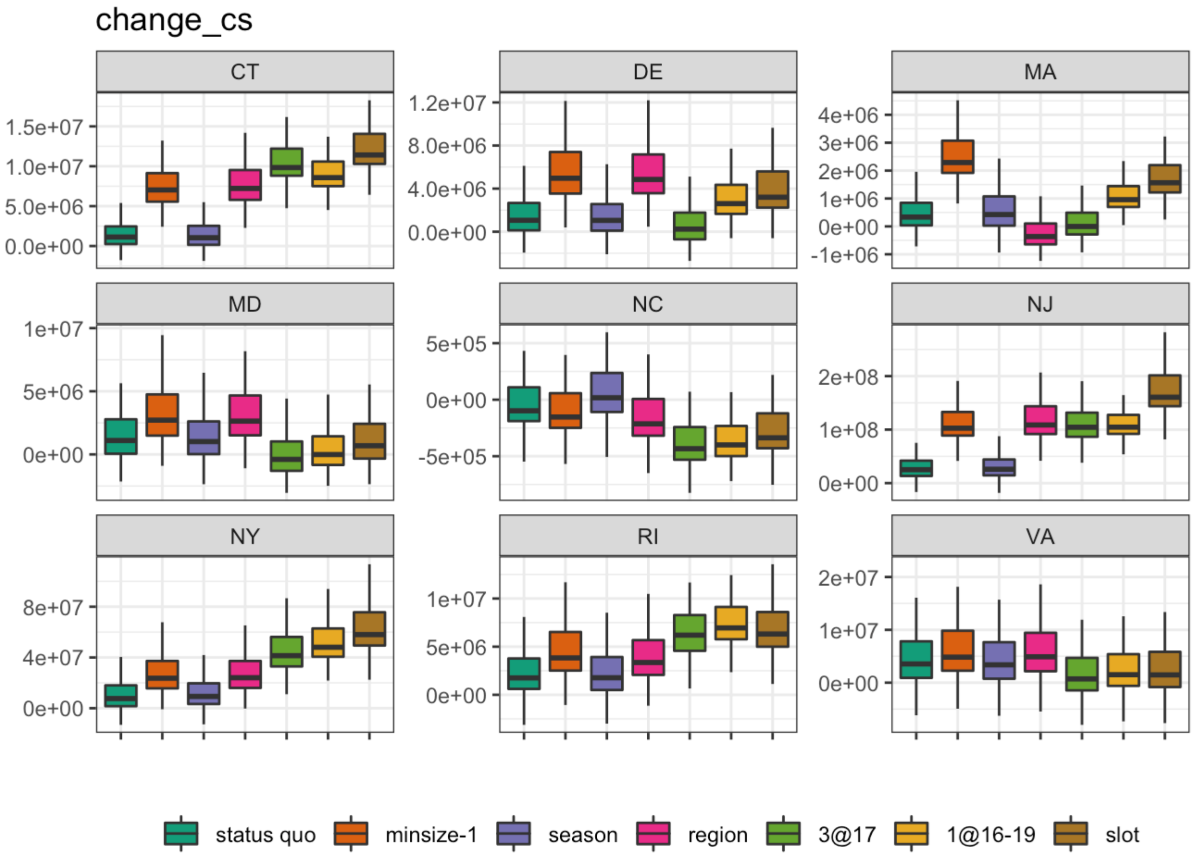


The relative performance of management procedures remained similar under different operating model scenarios.

- Performance of a given management procedure generally lower than baseline under both MRIP bias and distribution shifts.

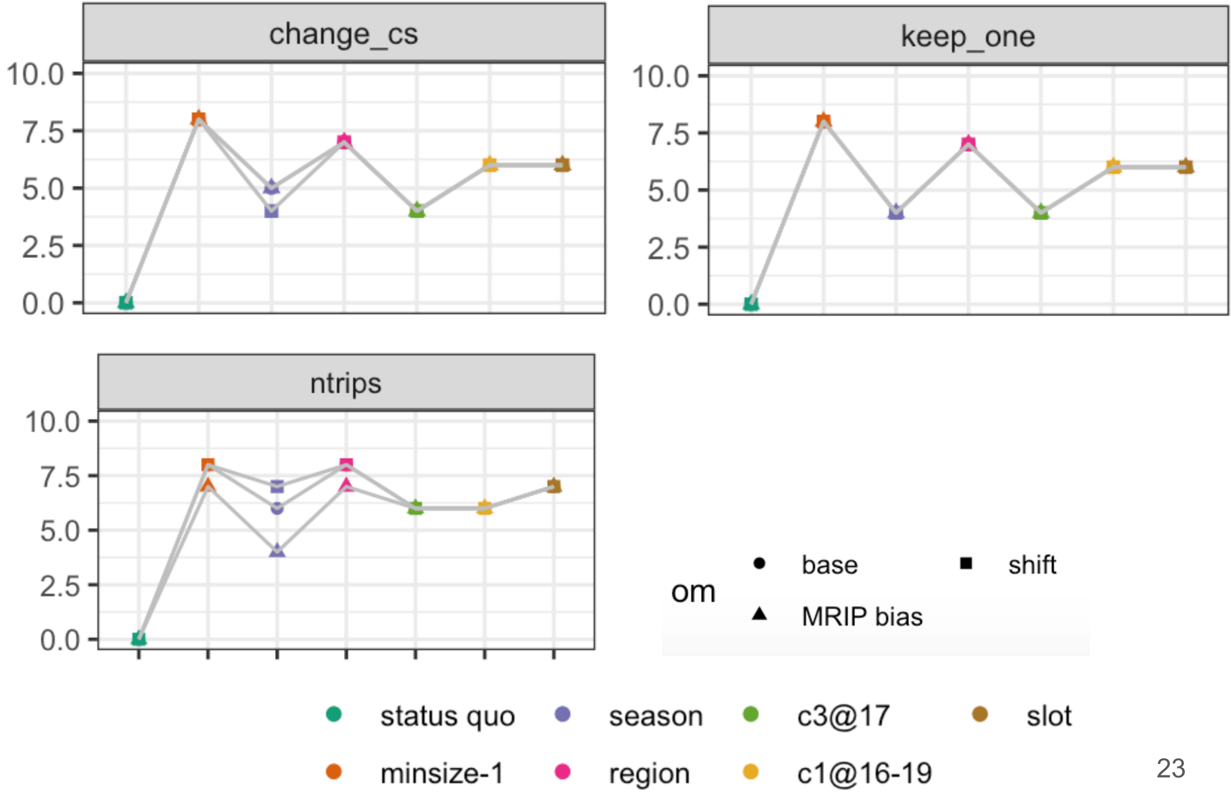
Relative performance of a management procedures is variable at state/regional level.

- For states New Jersey and north, ‘status quo’ and ‘season’ performed worst compared to other management procedures -
- ‘Status quo’ and ‘season’ options performed better or as well as others for Delaware and south.



Management procedures were also evaluated to see how many states outcomes were better than under status quo.

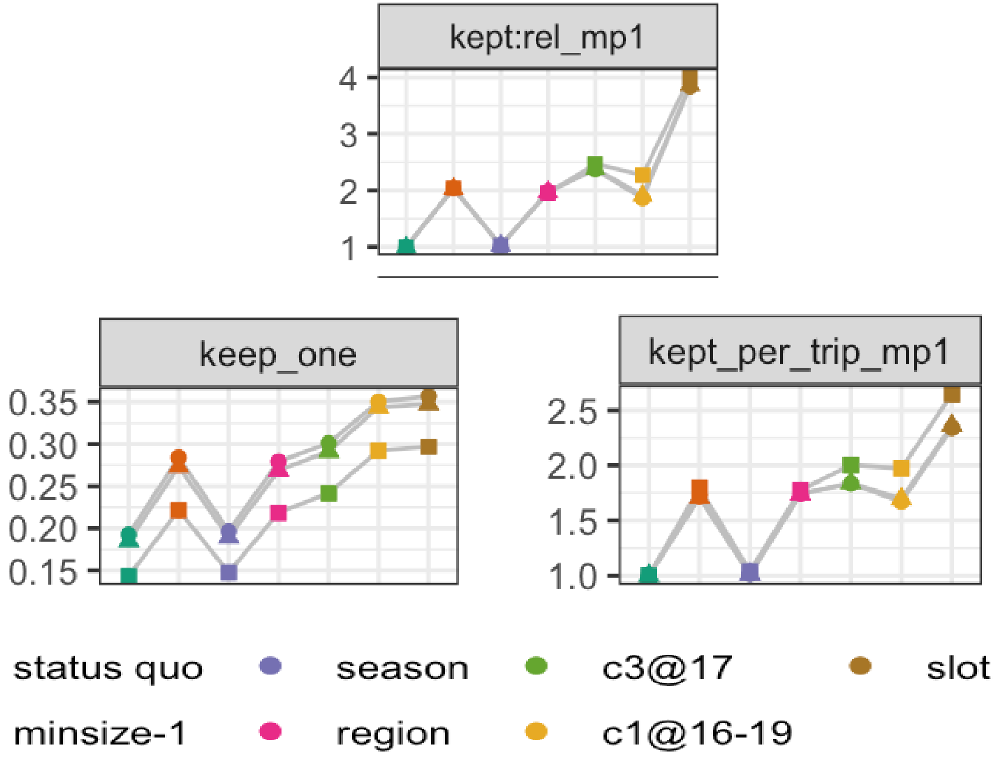
- ‘Minsize-1’ performed better for 8 of the 9 states across several metrics.
- MP #4, #7, and #8 performed better for a majority of states.
- ‘Season’ and ‘3@17’ did not perform better than status quo for a majority of states.



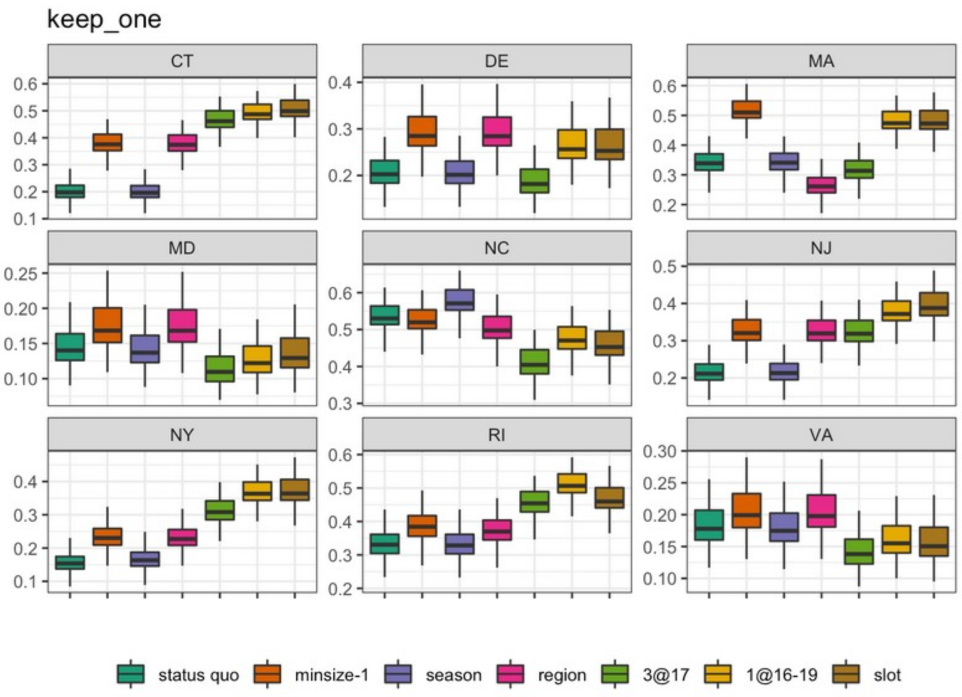
Overview of Additional Results

Management procedures resulted in increases in numbers of fish kept, higher percent of trips that keep a fish, and lower numbers of discarded fish per trip.

- 2-4 keepers for every 10 fish caught
  (1 in 10 under status quo)
- 30-40% of trips keep one fish compared to 20% under status quo
- Number of keepers per trip doubles (~0.5) from status quo (0.27)



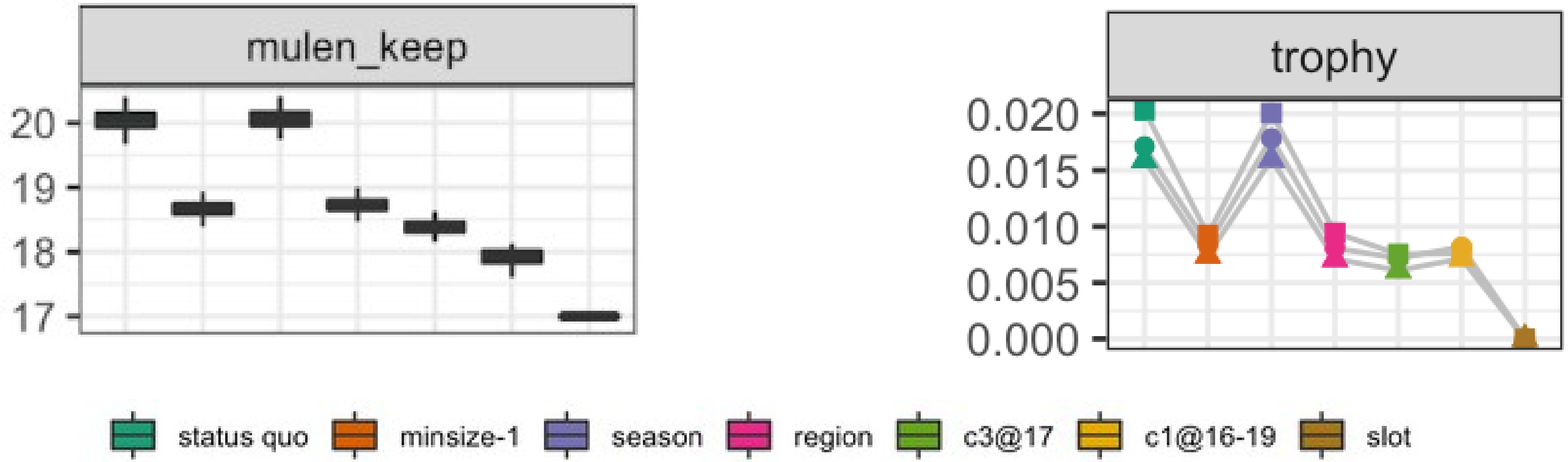
At state specific level, most management procedures still resulted in higher trips with a keeper but relative performance was different and much more variable.



- **In VA -** very little difference across management procedures with only a 6% difference between worst (3@17) and best (region)
- **In CT -** there were significant differences across management procedures with the best (both slot options) resulting in nearly 3x as many keeper trips as the worst (status quo and season)
- **In MA -** slightly different pattern compared to other northern states with the minsize-1 performing the best and about 2x as well as the worst (region)

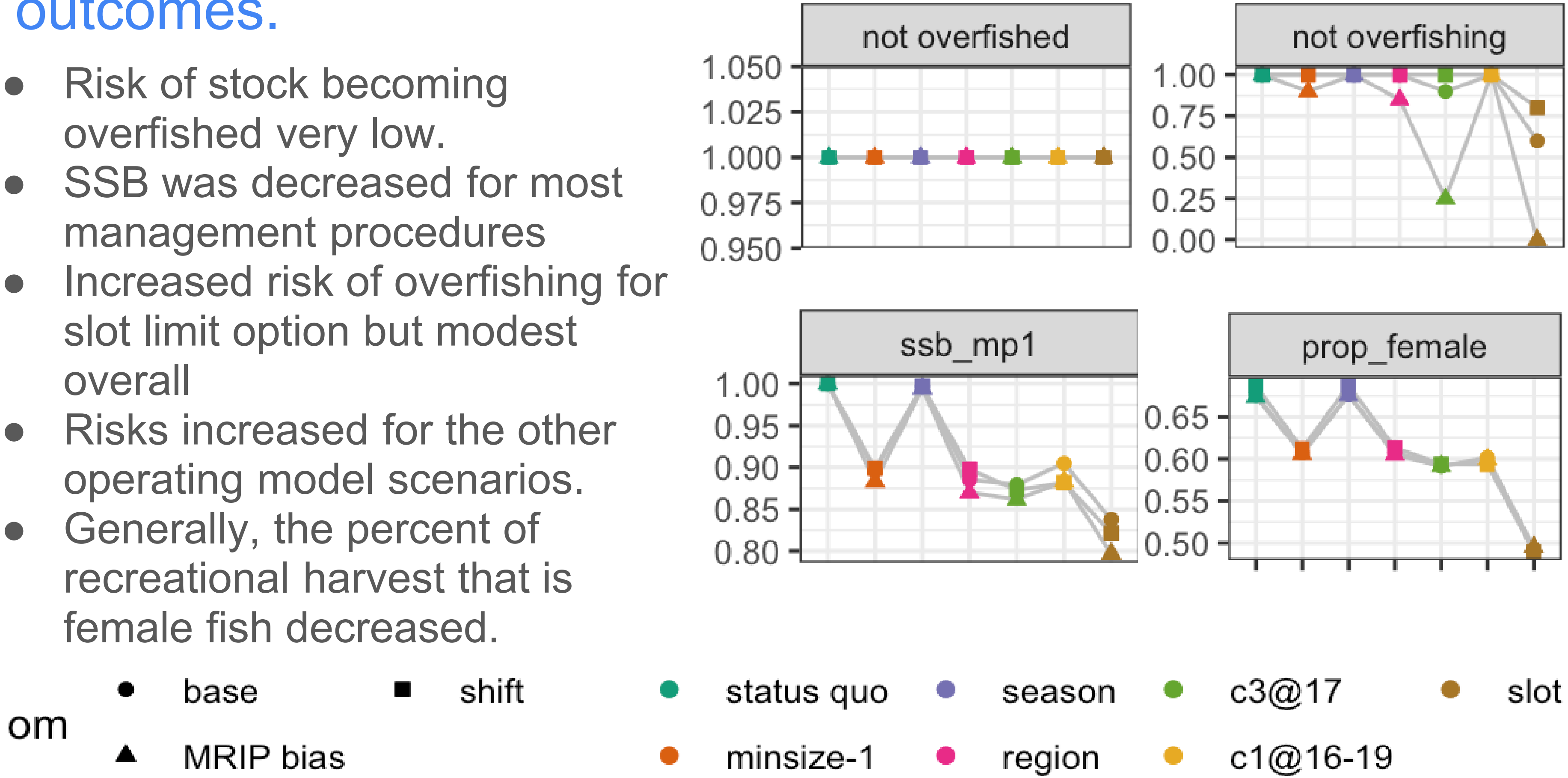
Most management procedures resulted in decrease in average size of kept fish & chance of catching a ‘trophy’ sized fish (>28”).

- Expected results given decreases to size limits or bag limits of large fish for most management procedures.



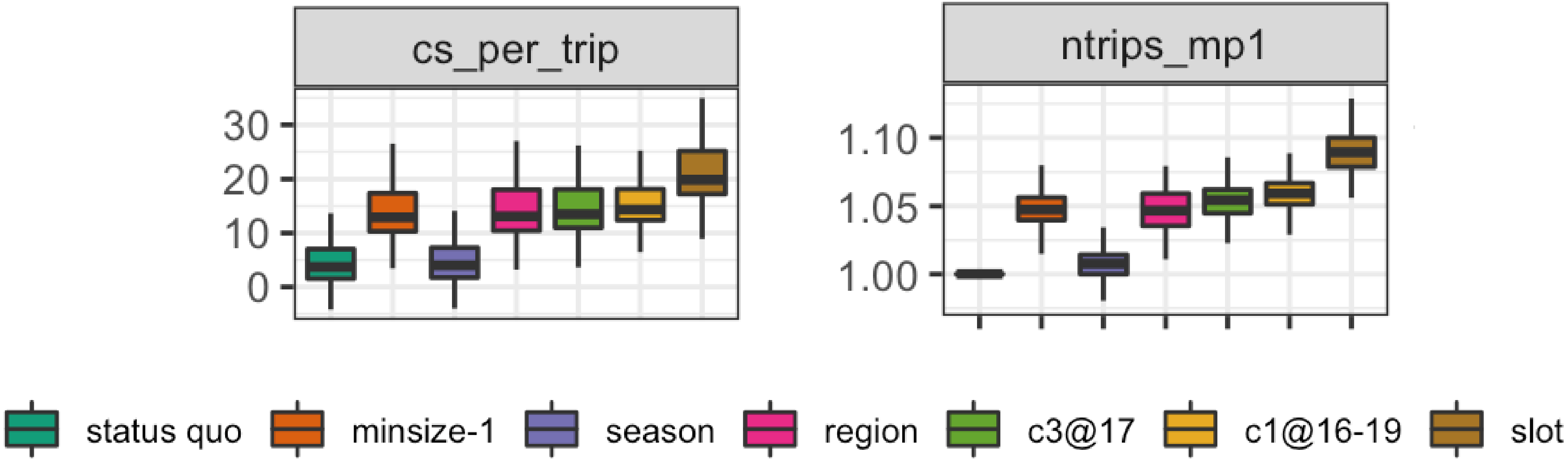
Many management procedures had similar stock status outcomes.

- Risk of stock becoming overfished very low.
- SSB was decreased for most management procedures
- Increased risk of overfishing for slot limit option but modest overall
- Risks increased for the other operating model scenarios.
- Generally, the percent of recreational harvest that is female fish decreased.



The coupled MSE allowed for opportunity to estimate social and economic benefits for different management procedures.

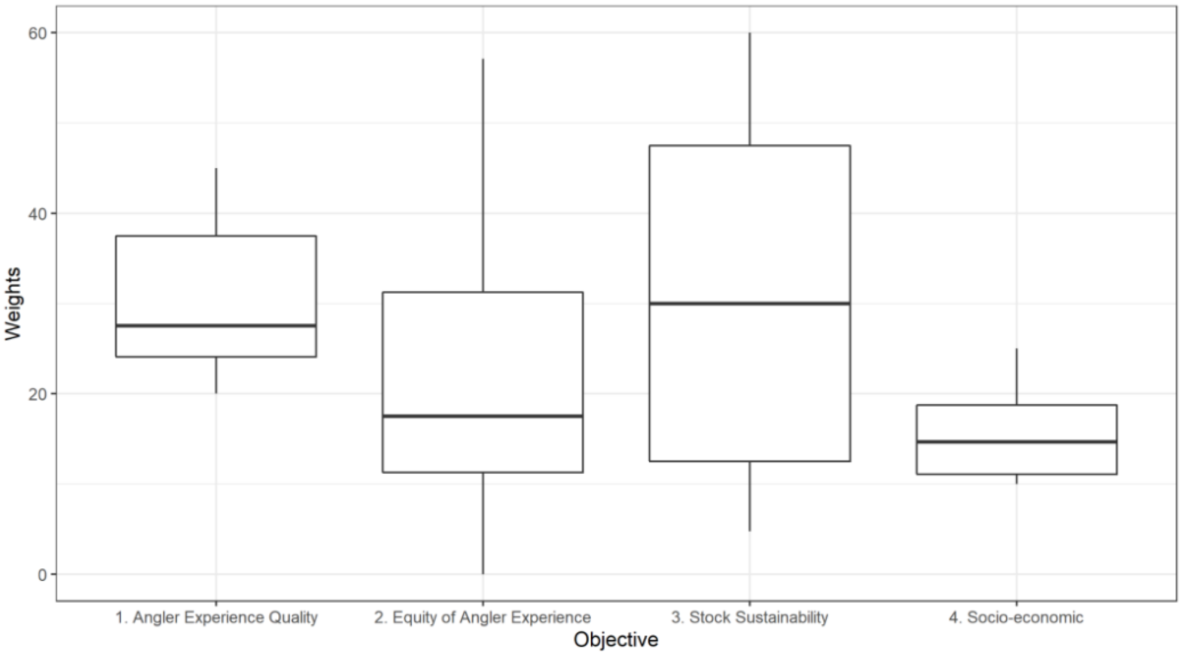
- Procedures with higher % of trips with keepers, more fish kept per trip, & higher kept:discard ratio had greater economic benefits



Total trip expenditures closely linked to the total number of trips.

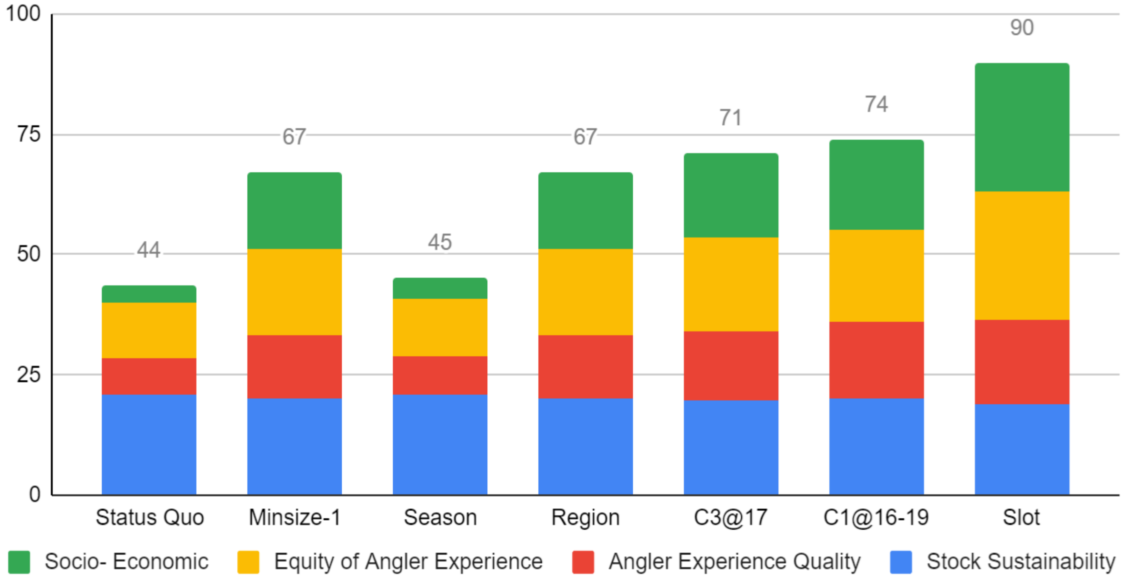
- Status quo resulted in lowest trip expenditures ($470.9M).
- ‘Minsize-1’, ‘region’, and ‘3@17’ resulted in 5% increase in trip expenditures ($493.5M) or $23 million more per year than status quo.
- ‘1@16-19’ resulted in 2nd highest trip expenditures ($499.3M)
- ‘Slot’ resulted in highest trip expenditures ($513.0M), a 9% increase compared to MP #1 or nearly $43 million more per year.

To examine tradeoffs among metrics and procedures, core group preferences were captured through weights assigned to the management objectives.



- Stock Sustainability & Quality of Angler Experience Quality are higher priority.
- Can be used to evaluate future procedures

Relative ranking of the management procedures was consistent across the range of relative importance placed on each objective by the stakeholders.



- 'Slot' had the highest score across weighting schemes,
  - Robust to range of stakeholder preferences, always ranking best
- Relative ranking of other procedures similar across stakeholder preferences
  - All higher than status quo.

Broader MSE Results & Takeaways

Core Group Feedback

Positives:

- Valuable for management
  - Supported the science/model conclusions
- Think outside the box
- Learned and thought about recreational fisheries and management differently
- Diverse membership; all encouraged to participate

Negatives:

- Too technical and slow at times
- Some ideas were not pursued and limited discussion and ideas
- Concerns about data sources and therefore uncertainty in results
- Outcomes won’t help recreational community

Additional applications - other research projects, use for other recreational species, other Council priorities

Application of MSE and Results

- Developed a novel modeling framework unique to Mid-Atlantic region
  - Linking summer flounder population dynamics model to a recreational demand model
  - Understand how recreational behavior responds to changing regulations and stock availability

- Strategic Information
  - The MSE helped evaluate long-term fishery and biological performance of different management strategies
  - Can identify the types of strategies the Council and Board is/is not interested in pursuing given priority management objectives

- Tactical Implementation
  - Models used within MSE can also provide insight for future (i.e., 2023) recreational management measures
  - Project recreational catch and harvest estimates under different regulations and current stock conditions and evaluate to an RHL or ACL

Potential Next Steps & Meeting Goals

Next Steps:
- Limited updates/runs based on feedback
- Finish final report

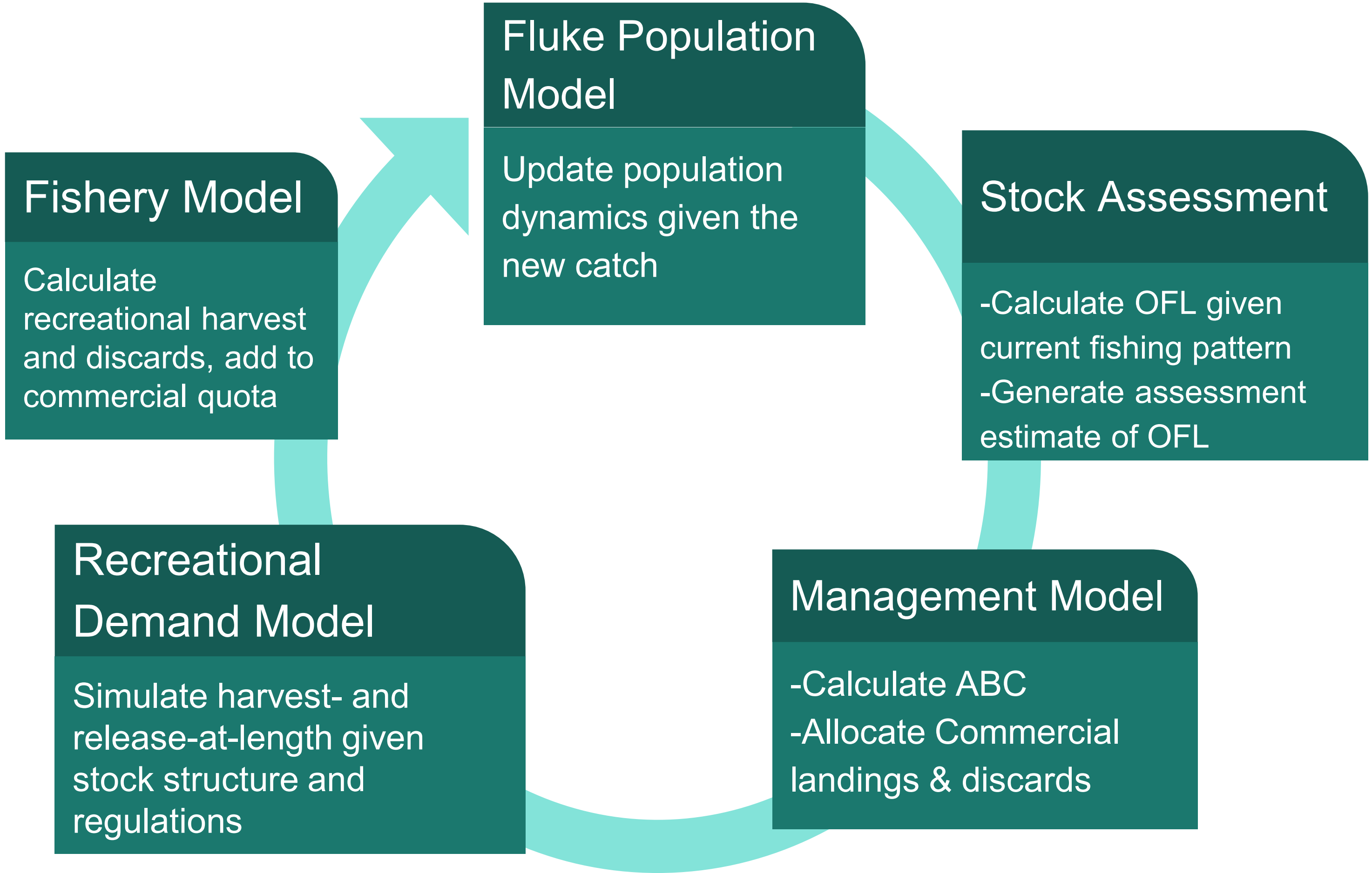
Future Direction:
- Update recreational demand model with 2022 choice experiment info
- Potential integration with Harvest Control Rule implementation

Council/Board Input:
- General direction on management procedures to develop
    - Keep/drop; broad areas of refinement
- Priority objectives to address and evaluate
- Summer flounder vs. other recreational species
- Timeline
    - Use to help inform 2023 recreational specs
    - Some time later

Questions?

Backup Slides

MSE projection sequence



RDM overview

Model uses information about **angler preferences** and **historical/projected recreational catch** to calculate expected impacts of fluke stock structures and regulations on:

- fishing effort
- recreational harvest and discards
- angler satisfaction/welfare
- aggregate trip expenditures à impacts to downstream businesses

RDM method

Model input

Fluke stock structure (numbers-at-age)

Set of management measures

Information about angler preferences for harvesting/releasing fish

Catch-per-trip/catch-at-length distributions

Simulate individual trip outcomes

Calculate angler welfare, angler effort, and expected harvest/discards

Angler effort is function of trip costs and expected harvest and discards

Model output

Sum of individual trip outcomes across state/region:

- Recreational harvest and discards
- Metrics related to angler satisfaction and success

Angler survey data and behavioral model

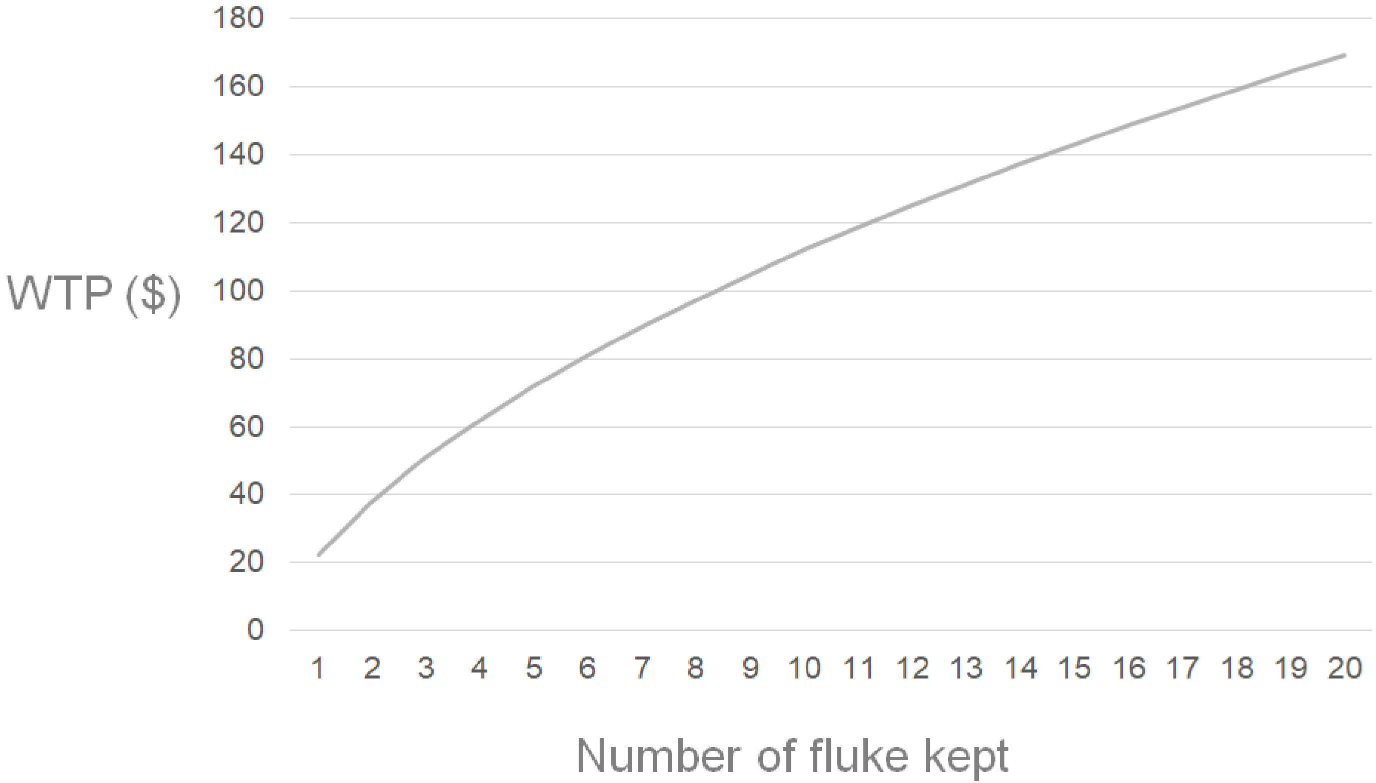
2010 saltwater fishing survey (2022 survey data coming soon)

- discrete choice experiment

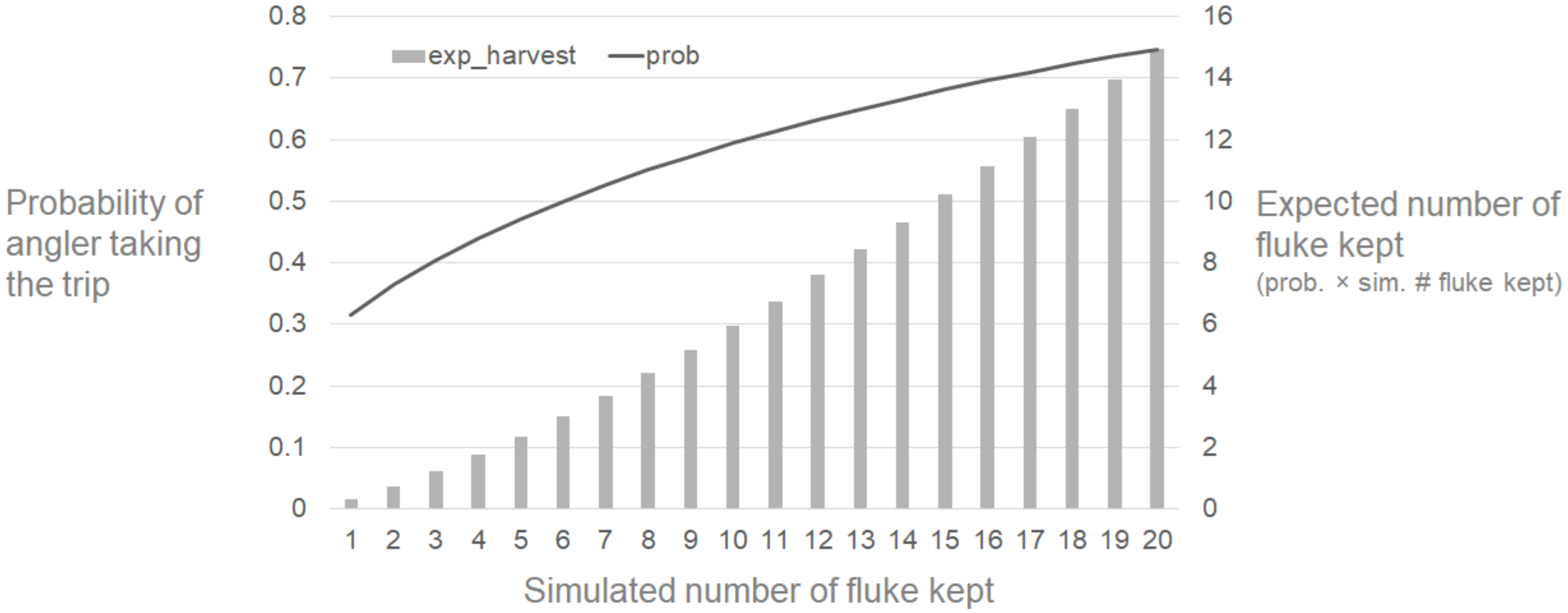
Given a value of catch and cost on a simulated trip, we calculate:

- satisfaction/welfare of that trip
- probability an angler would take that trip (fishing effort)
- expected number of fish harvested and released on that trip

Angler willingness-to-pay for keeping fluke



Relationship between simulated fluke keep, trip probability, and expected keep



Results from a simulated trip occasion with no other catch, trip cost of $35

Key features of the RDM

Model relates projected fluke stock structure to the size and number of fish caught by recreational anglers

Incorporates correlated catch-per-trip data

- i.e., changes in expected fluke catch-per-trip affect black sea bass catch-per-trip

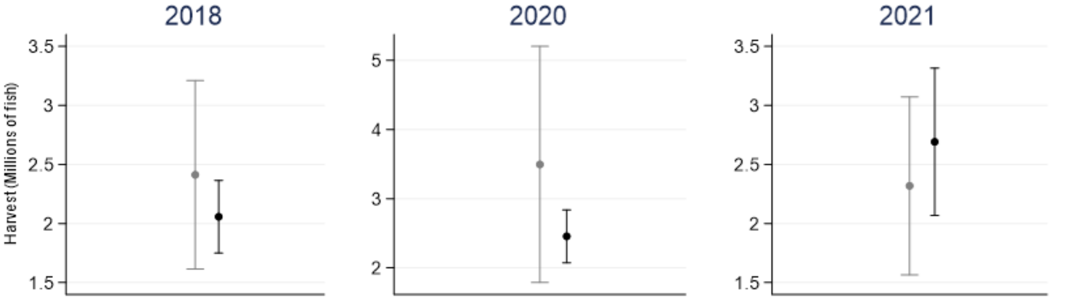
RDM output

Out-of-sample predictions suggest the model can predict fluke catch and harvest within the range of MRIP confidence bounds

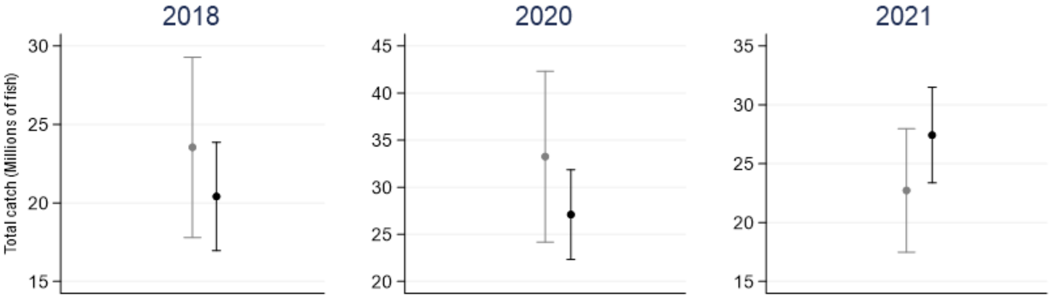
Fishery metrics:

- Recreational harvest- and discards-at-length → feeds back into the operating model
- Angler welfare change from baseline year (consumer surplus)
- Number of directed fluke fishing trips → aggregate trip expenditures

RDM out-of-sample predictions - 2019 calibration



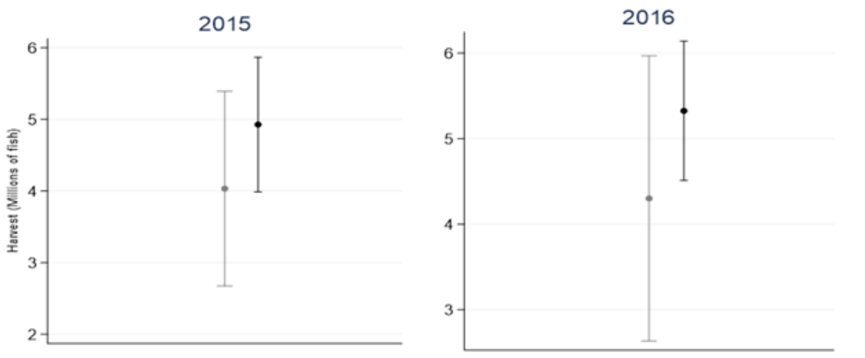
Total fluke harvest



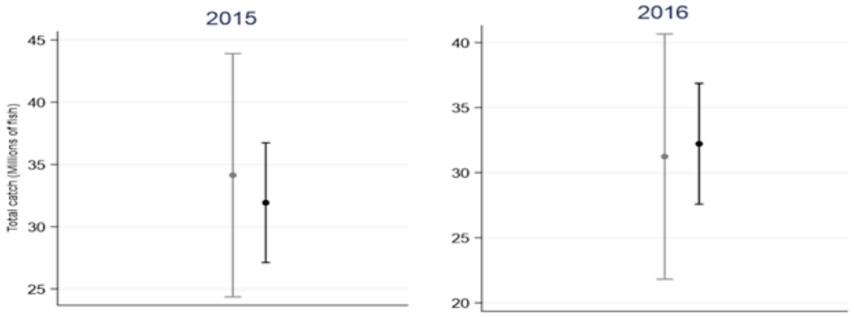
Gray = MRIP, black = model

Total fluke catch

RDM out-of-sample predictions - 2017 calibration



Total fluke harvest

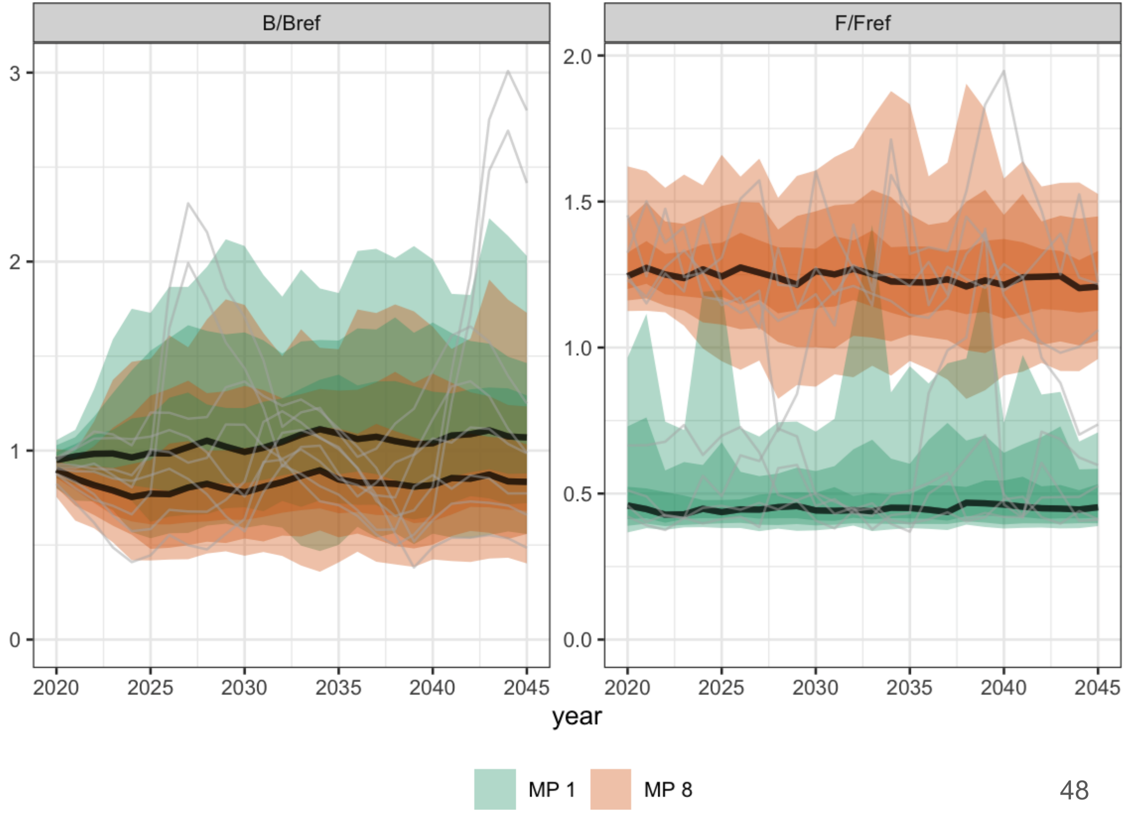


Total fluke catch

Gray = MRIP, black = model

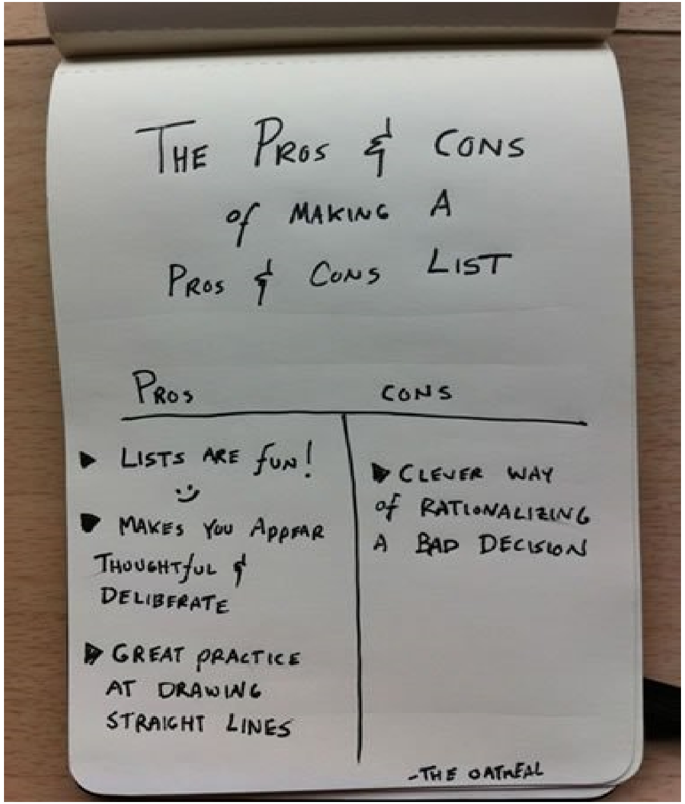
The MRIP bias scenario results in high risk of overfishing for the slot limit (MP8) but stock has low probability of being overfished

- F is higher than FMSY under the slot limit but not egregiously so.
- The stock never really drops below 0.5BMSY during the simulations.



Why consider tradeoffs and stakeholder preferences?

Improve upon Pro vs. Con lists



Which employer was chosen?

	Employer 1	Employer 2
Pros	Good location	Rewarding job
	Opportunity for development	Competitive pay
	Great team	Parking included
Cons	Restricted job scope	Long commute
	Slightly lower pay	Unknown development opportunities
	Parking costs aren’t covered	Small isolated team

Example trade off based decision

Objective	Metric	Weight	Employer 1	Employer 2
Location	Commute (short, long)			
Development	Opportunity present			
Team	Excitement scale			
Rewarding Scope	Rewarding scale			
Pay	Relative to competitive			
Parking	Covered			
		Total Score		

Trade-off Tables

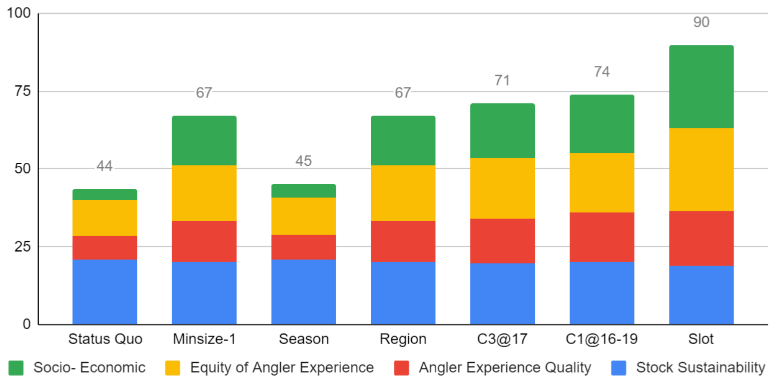
	Angler Experience Quality				Equity of Angler Experience		
	% of trips with a keeper	Average # kept per trip	consumer surplus per trip	% of trips with a trophy	% change chance of retaining a fish	Difference in chance of retaining a fish	% change in retention rate
Status Quo	3.50	1.14	0.55	2.44	6.07	1.18	3.39
Minsize-1	7.00	3.68	1.21	1.18	8.95	1.34	6.95
Season	3.89	1.27	0.58	2.54	6.39	1.00	3.73
Region	7.00	3.81	1.23	1.16	8.95	1.38	6.78
C3@17	7.78	4.06	1.26	1.03	9.59	1.29	8.14
C1@16-19	9.72	3.55	1.32	1.17	11.19	1.21	6.27
Slot	10.11	5.84	1.72	0.00	11.51	1.25	13.22
Weight	**15.6**	**8.0**	**2.8**	**4.3**	**12.1**	**2.4**	**6.8**

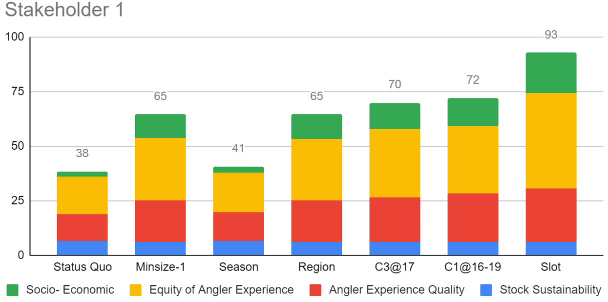
Trade-off Tables

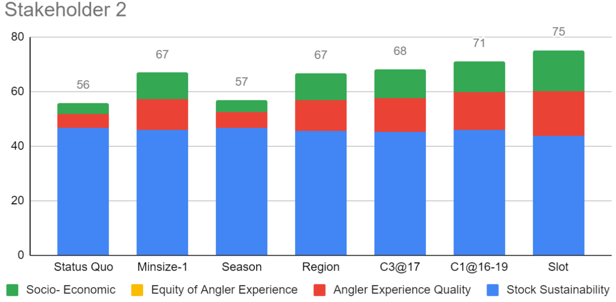
	Stock Sustainability					Socio- Economic		
Options	% chance overfished	% chance overfishing	SSB	# fish released per trip	rec removals	number of trips	aggregate consumer surplus	% change in fishery investment
Status Quo	9.08	3.80	4.03	0.55	1.93	1.82	0.98	0.83
Minsize-1	9.08	3.80	3.36	0.94	1.47	3.11	11.13	1.77
Season	9.08	3.80	4.00	0.51	1.88	2.08	1.30	0.99
Region	9.08	3.80	3.29	0.83	1.42	3.11	11.35	1.78
C3@17	9.08	3.42	3.25	1.13	1.44	3.37	12.07	1.92
C1@16-19	9.08	3.80	3.42	0.77	1.59	3.63	12.93	2.08
Slot	9.08	2.28	2.99	1.57	1.49	4.41	19.47	2.68
Weight	**9.1**	**3.8**	**9.5**	**2.8**	**2.6**	**6.5**	**4.9**	**4.3**

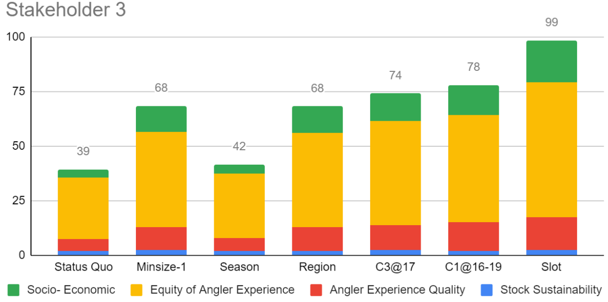
Trade-off Figures

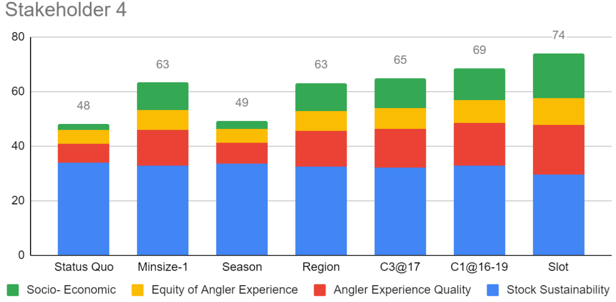
- Ranking is robust
- Degree of improvement
  - ‘Slot’ 34% to 228% increase in satisfaction relative to status quo

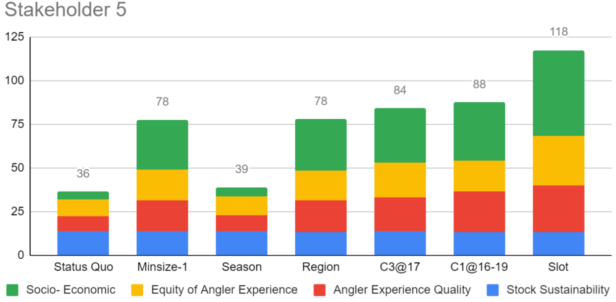


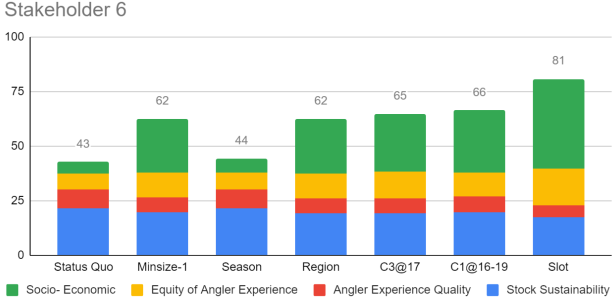












Rec. Harvest Control Rule Percent Change Approach

① RHL compared to harvest estimate →

Determine if upcoming 2-year average RHL is **above, below, or within** a confidence interval around an estimate of harvest under status quo measures.

② Compare biomass to target level →

Three categories:

- **Very high:** Greater than 150% of target level
- **High:** At least the target level, but no higher than 150% of target level
- **Low:** Below target level

③ Determine percent change in harvest →

Steps 1 and 2 determine the appropriate percent change in harvest needed (if any).

④ Set management measures

Management measures modified as needed to achieve the percent change determined through step 3.

Measures are set for 2 years at a time.

Future RHL vs Harvest Estimate	Biomass vs. target level	Change in Harvest
Future 2-year avg RHL **greater than** upper bound of harvest estimate CI (harvest expected to be lower than RHL)	**Very high** (above 150% of target)	Liberalization % equal to difference between harvest estimate and 2-year average RHL, not to exceed 40%
	High (at least target but no higher than 150% of target)	Liberalization % equal to difference between harvest estimate and 2-year average RHL, not to exceed 20%
	Low (below target)	Liberalization: 10%
Future 2-year avg RHL **within** harvest estimate CI (harvest expected to be close to RHL)	**Very high** (above 150% of target)	Liberalization: 10%
	High (at least target but no higher than 150% of target)	No change: 0%
	Low (below target)	Reduction: 10%
Future 2-year avg RHL **less than** lower bound of harvest estimate CI (harvest expected to exceed RHL)	**Very high** (above 150% of target)	Reduction: 10%
	High (at least target but no higher than 150% of target)	Reduction % equal to difference between harvest estimate and 2-year average RHL, not to exceed 20%
	Low (below target)	Reduction % equal to difference between harvest estimate and 2-year average RHL, not to exceed 40%