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# Coupled Socio-Ecological Modeling in Support of Fishery Management

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Marine Socio-Ecological Systems Symposium

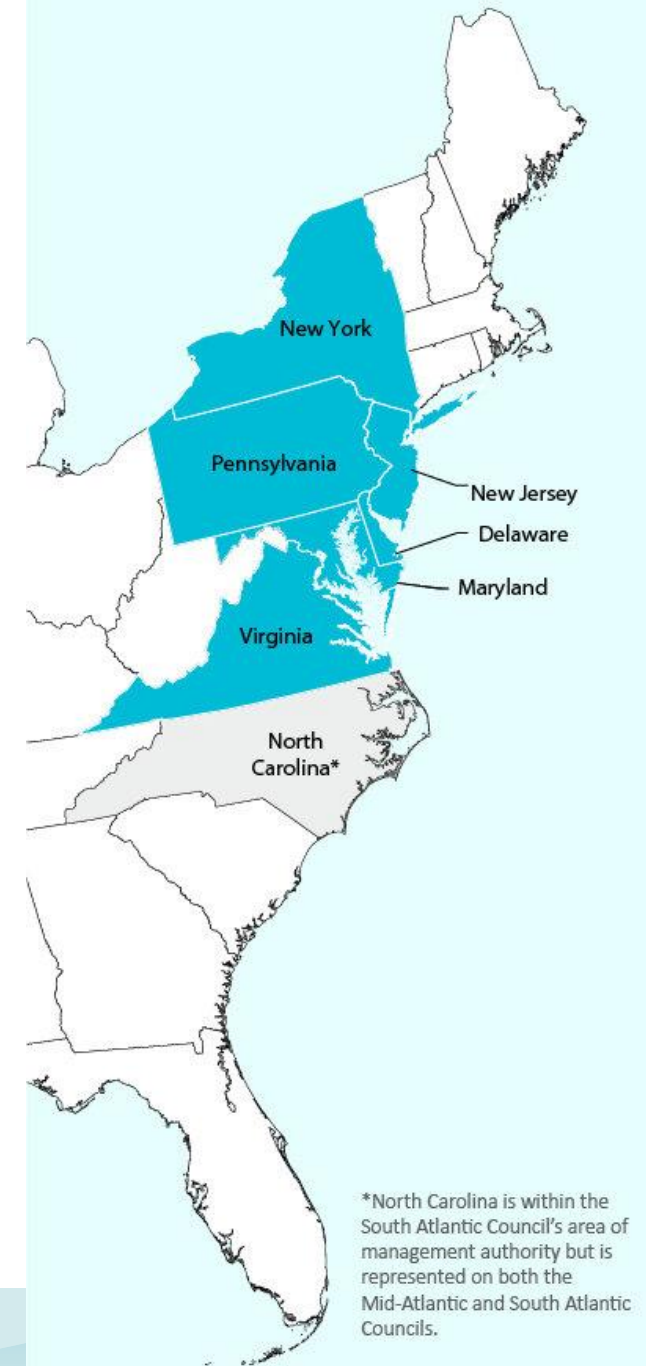
Yokohama, Japan

June 4, 2024

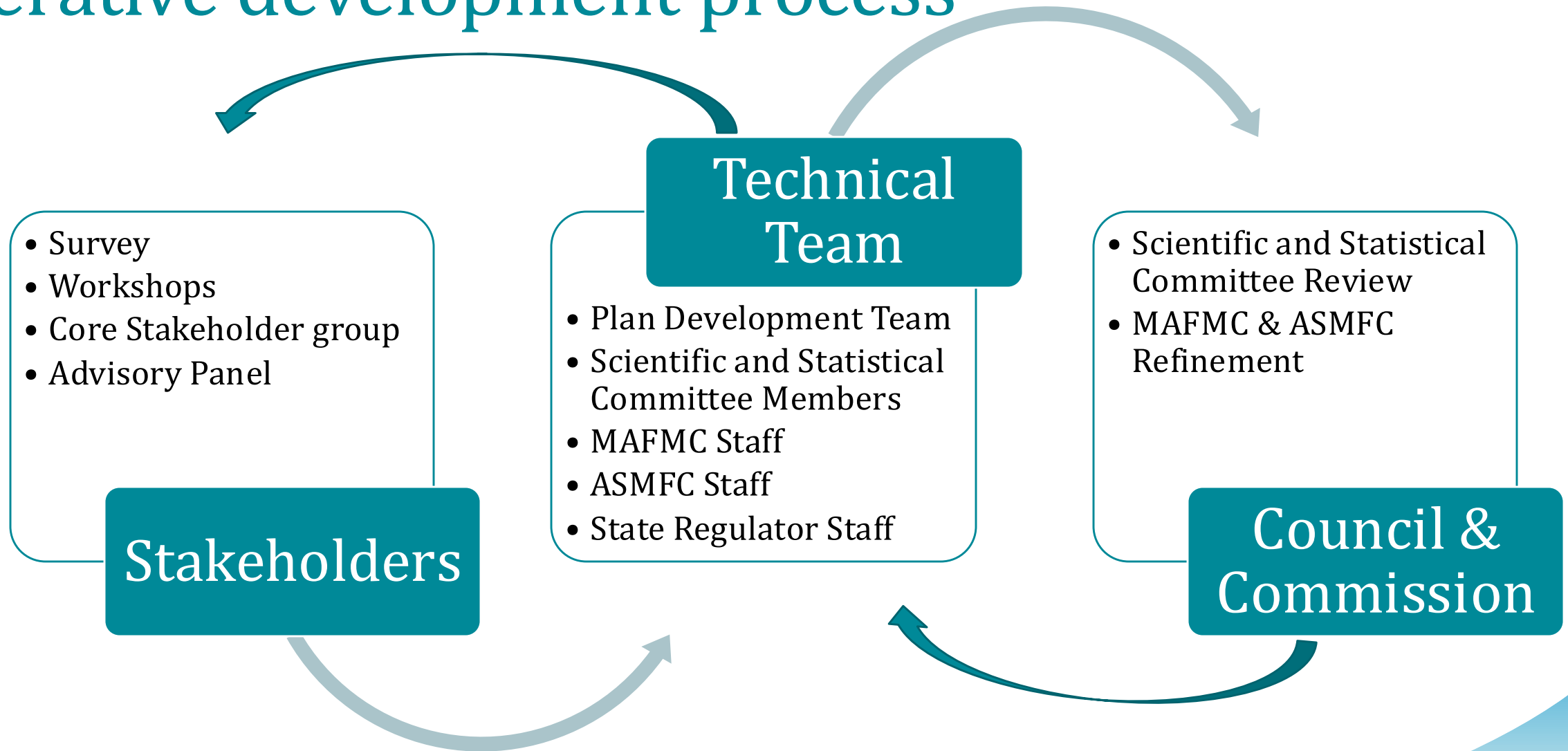
# Focus of today's talk

## MAFMC Ecosystem Approach to Fishery Management

- Transdisciplinary
- Production/Process Efficiencies
- Transition from Strategic to Tactical Advice



# Iterative development process



# Automation & Transparency

- R Markdown
  - HTML vs PDF
- GitHub
  - Data (when possible)
  - Code
  - GitHub Pages
  - Zenodo Archiving
    - <https://doi.org/10.5281/zenodo.4390458>
  - [https://github.com/NEFSC/READ-SSB-DePiper\\_Summer\\_Flounder\\_Conceptual\\_Models](https://github.com/NEFSC/READ-SSB-DePiper_Summer_Flounder_Conceptual_Models)



# The Mid-Atlantic Fishery Management Council

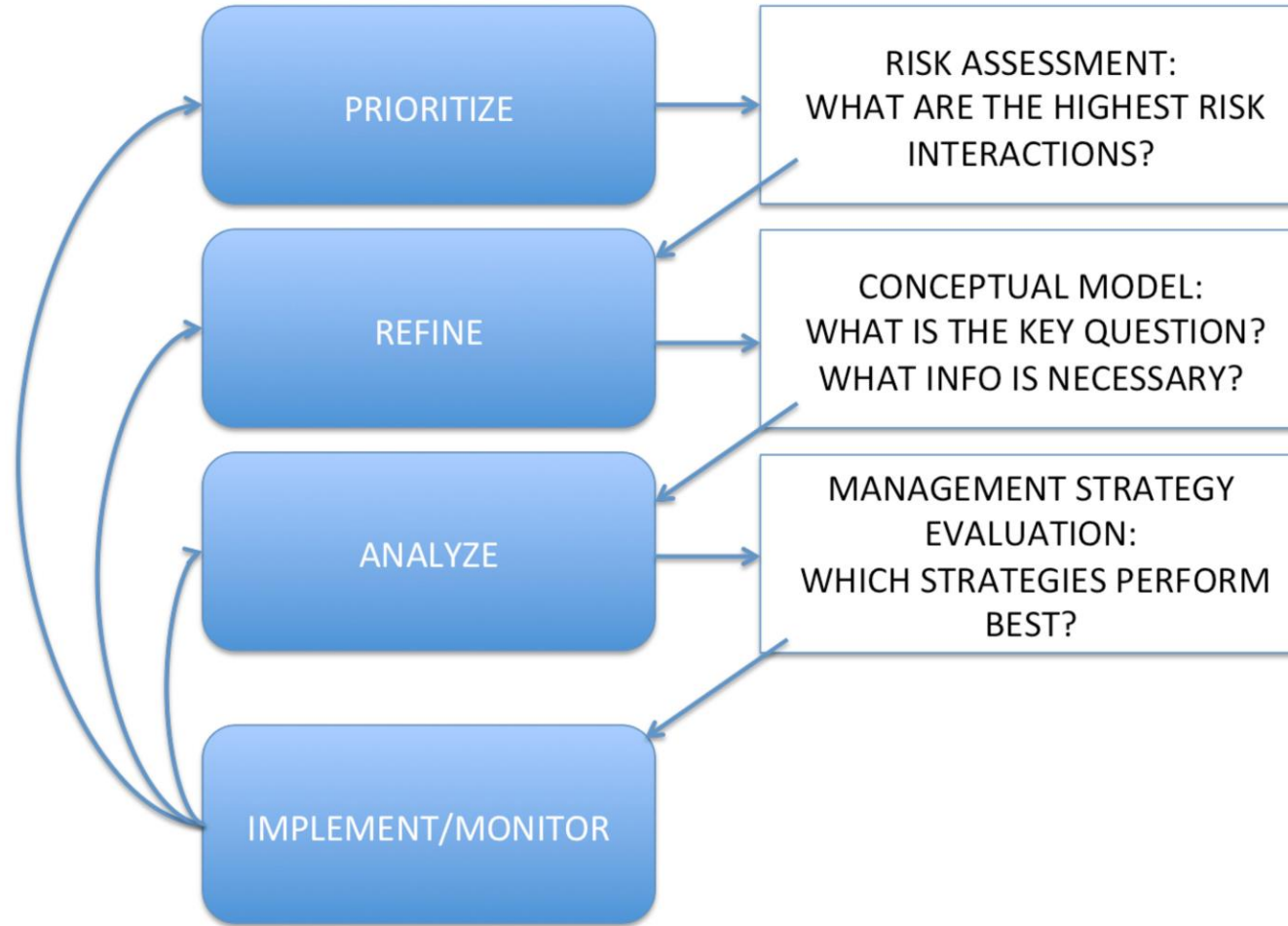


FIGURE 9 | A potential framework for integrating interactions into management.

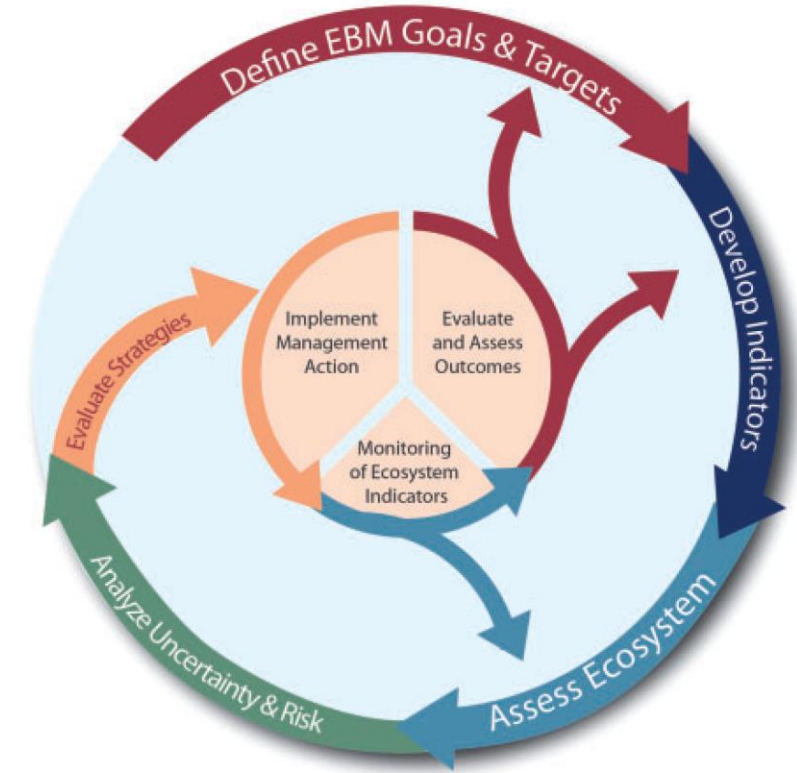


Figure 2. Conceptual diagram of the Integrated Ecosystem Assessment reproduced from Levin, P. S., Fogarty, M. J., Murawski, S. A., and Fluharty, D. 2009. Integrated ecosystem assessments: Developing the scientific basis for ecosystem-based management of the ocean. PLoS Biology, 7(1): 23–8, with permission from NOAA Fisheries.

# Risk Assessment to Prioritize

Element	Definition	Indicators
<b>Economic</b>		
Commercial Revenue	Risk of not maximizing fishery value	Revenue in aggregate
Recreational Angler Days/Trips	Risk of not maximizing fishery value	Numbers of anglers and trips in aggregate
Commercial Fishery Resilience (Revenue Diversity)	Risk of reduced fishery business resilience	Species diversity of revenue
Commercial Fishery Resilience (Shoreside Support)	Risk of reduced fishery business resilience due to shoreside support infrastructure	Number of shoreside support businesses
<b>Social</b>		
Fleet Resilience	Risk of reduced fishery resilience	Number of fleets, fleet diversity
Social-Cultural	Risk of reduced community resilience	Community vulnerability, fishery engagement and reliance
<b>Food Production</b>		
Commercial	Risk of not optimizing seafood production	Seafood landings in aggregate
Recreational	Risk of not maintaining personal food production	Recreational landings in aggregate



# Risk Assessment

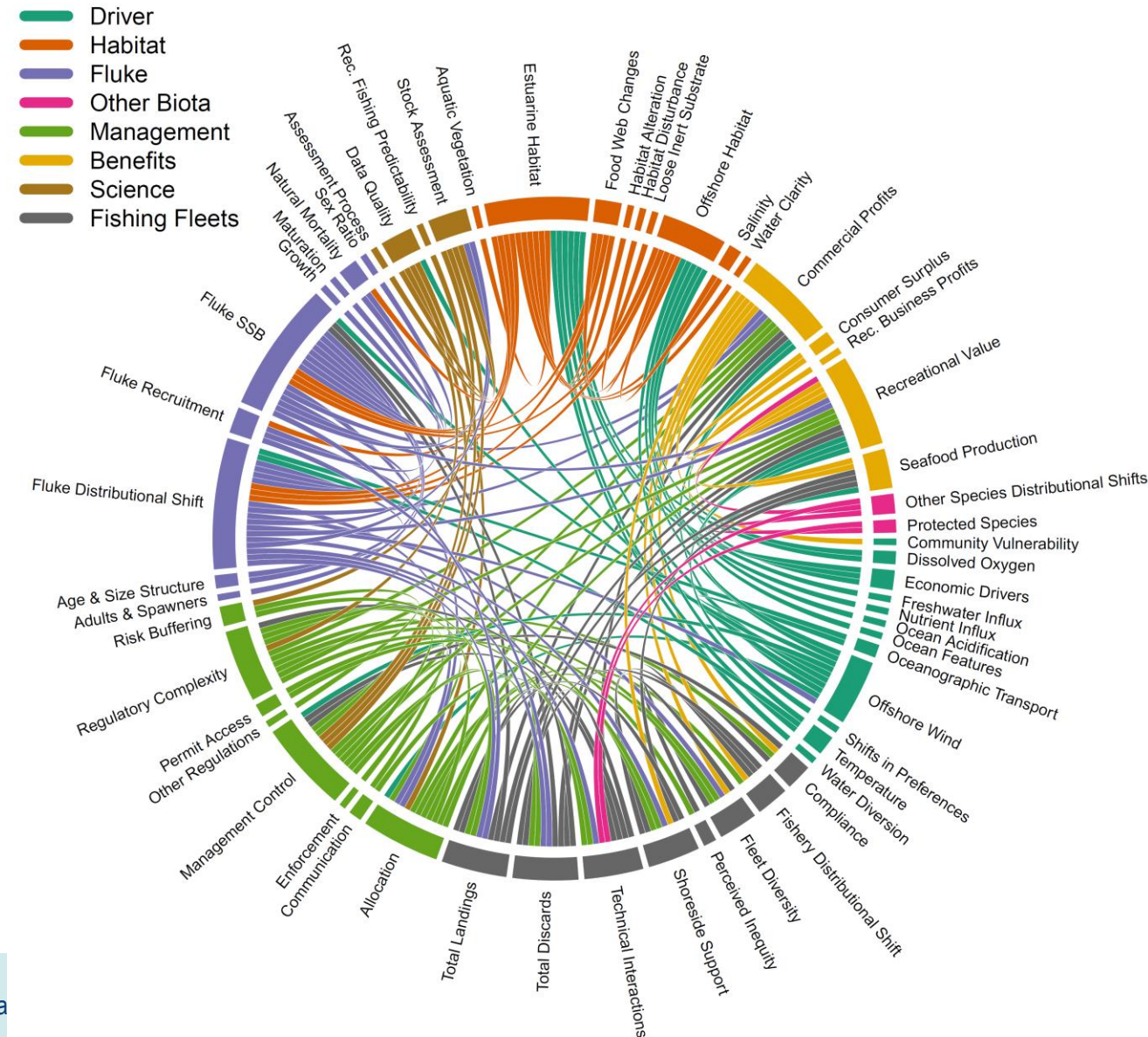
- Summer Flounder
  - Most high risks faced

**TABLE 4** | Species and sector (C, commercial; R, recreational) level risk analysis results; l, low risk (green); lm = low-moderate risk (yellow), mh = moderate to high risk (orange), h = high risk (red).

Species	MgtControl	TecInteract	OceanUse	RegComplex	Discards	Allocation
Ocean quahog-C	l	l	lm	l	l	l
Surfclam-C	l	l	lm	l	l	l
Summer flounder-R	mh	l	lm	h	h	h
Summer flounder-C	lm	mh	lm	mh	lm	h
Scup-R	l	l	lm	mh	mh	l
Scup-C	l	mh	lm	mh	mh	l
Black sea bass-R	h	l	mh	h	mh	h
Black sea bass-C	lm	lm	h	mh	lm	h
Atl. mackerel-R	l	l	l	l	l	h
Atl. mackerel-C	l	lm	mh	h	lm	h
Butterfish-C	l	lm	mh	h	mh	l
Longfin squid-C	l	mh	h	h	h	h
Shortfin squid-C	l	lm	lm	lm	l	l
Golden tilefish-R	na	l	l	l	l	l
Golden tilefish-C	l	l	l	l	l	l
Blueline tilefish-R	l	l	l	mh	l	h
Blueline tilefish-C	l	l	l	mh	l	h
Bluefish-R	lm	l	l	l	mh	h
Bluefish-C	l	l	lm	lm	lm	h
Spiny dogfish-R	l	l	l	l	l	l
Spiny dogfish-C	l	mh	mh	mh	lm	h
Unmanaged forage	na	na	na	na	na	na
Deepsea corals	na	na	mh	na	na	na

# Conceptual Model to Refine

- 10 management questions that can be answered with existing data & information
- Focused on high risk components



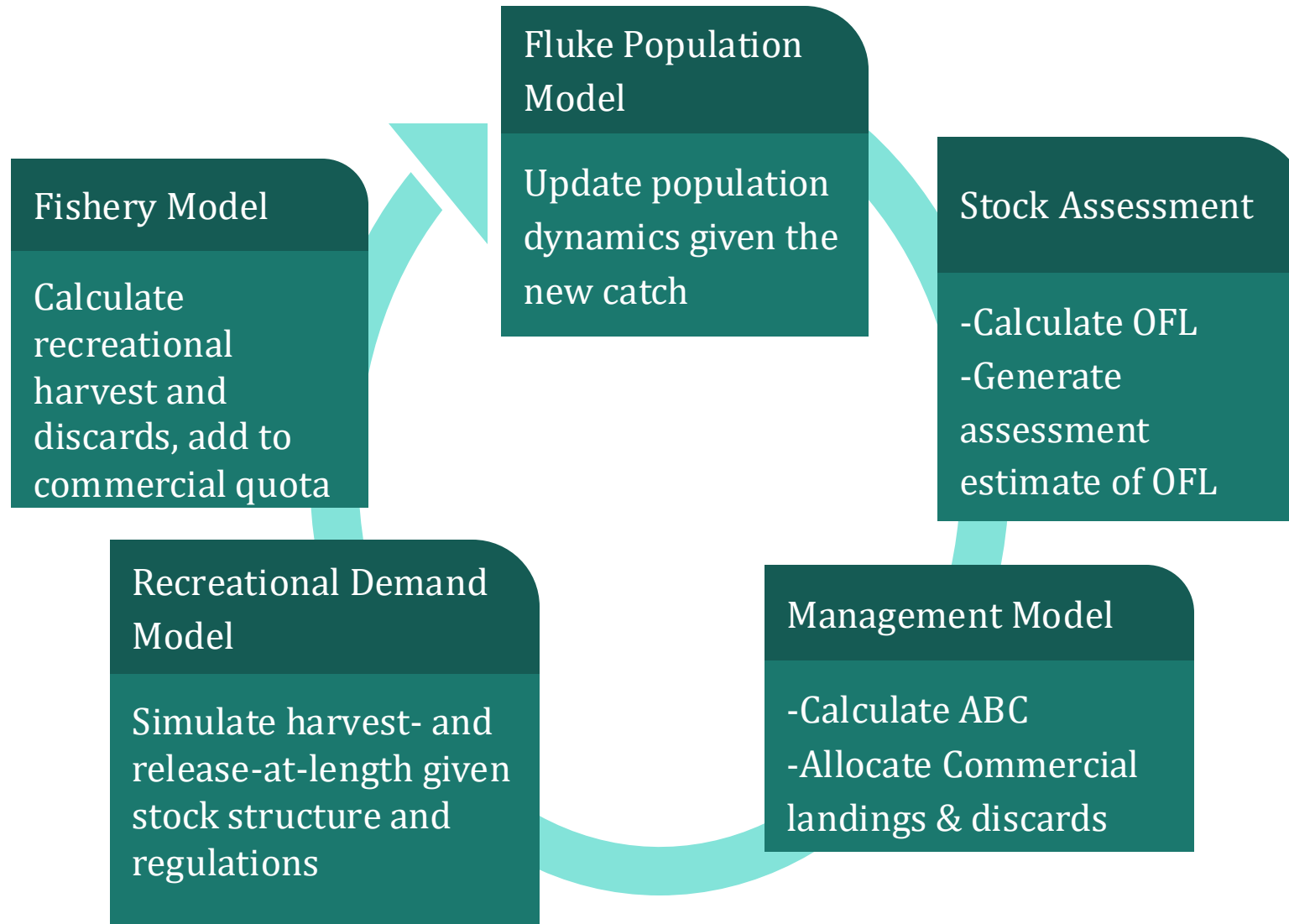


# Question selected

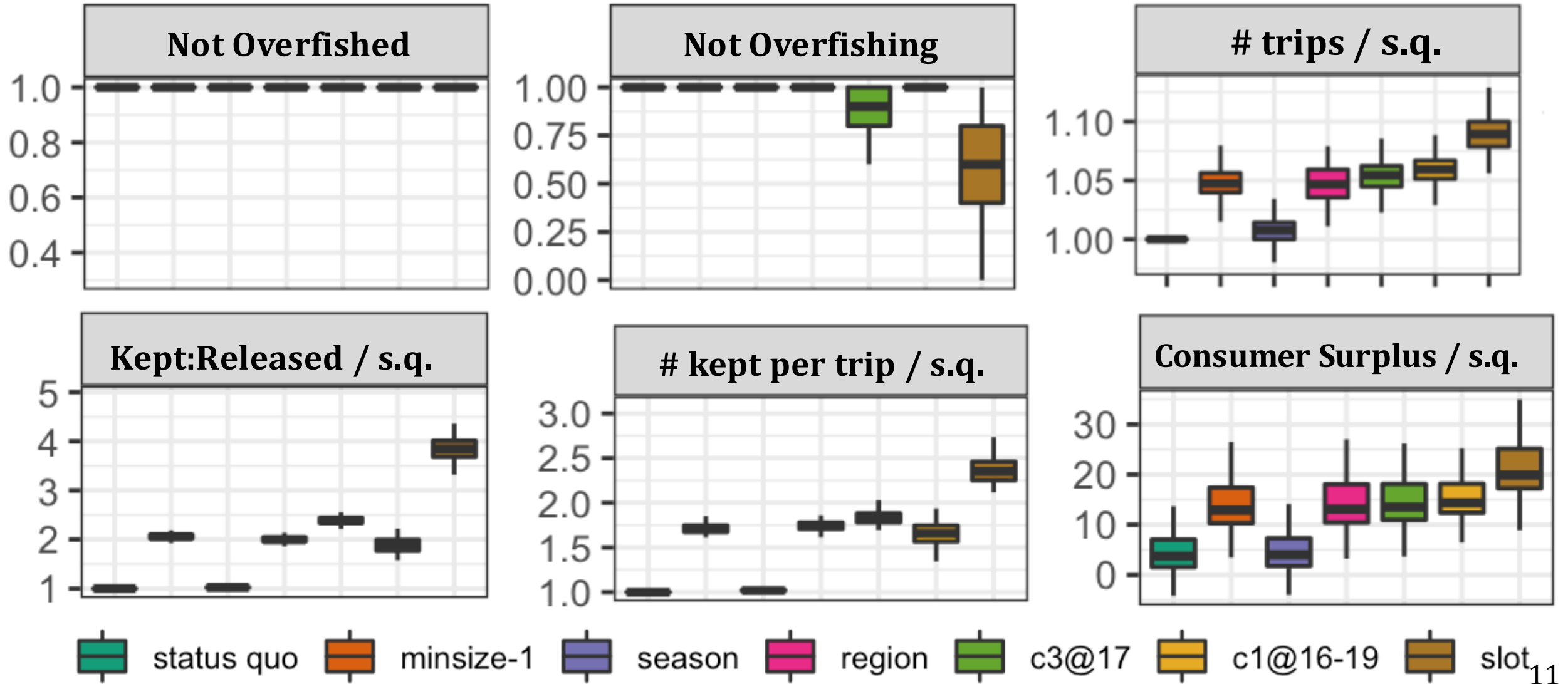
Evaluate the biological and economic benefits of minimizing discards and converting discards into landings in the recreational sector.

Identify management strategies to effectively realize these benefits.

# Coupled Modeling Approach: Operating & Management Models



# Most management procedures outperformed status quo across the majority of metrics



# Developed Cloud-based version for specification setting

## Recreational Fisheries Decision Support Tool

Regulation Selection

Results

Documentation

**REMINDER: (1) select state(s) (2) Make selections below (3) click run me and then the 'Results' tab to run model**  
State

MA  RI  CT  NY  NJ  DE  MD  VA  NC

### Summer Flounder - NY

Regulations combined or separated by mode?

All Modes Combined

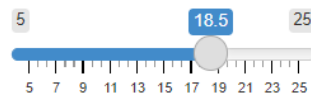
Open Season 1



Bag Limit

4

Min Length



Add Season

### Black Sea Bass - NY

Regulations combined or separated by mode?

All Modes Combined

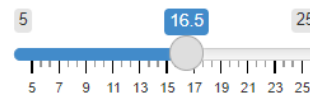
Open Season 1



Bag Limit

3

Min Length



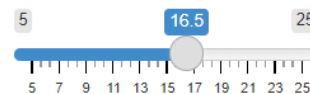
Open Season 2



Bag Limit

6

Min Length



### Scup - NY

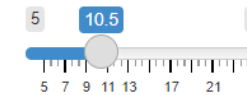
For Hire Open Season 1



Bag Limit

30

Min Length



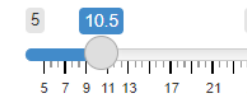
For Hire Open Season 2



Bag Limit

40

Min Length



For Hire Open Season 3



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# In summary...

- Multiple pathways by which coupled models can feed into fishery management
  - Strategic vs. Tactical advice
  - Qualitative vs. Quantitative approaches
- Timing & outreach is critical
  - Difficult management issues
- Open science
  - Automation, Reproducibility & Transparency
- Adopting a process can be important



# Contributors

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