

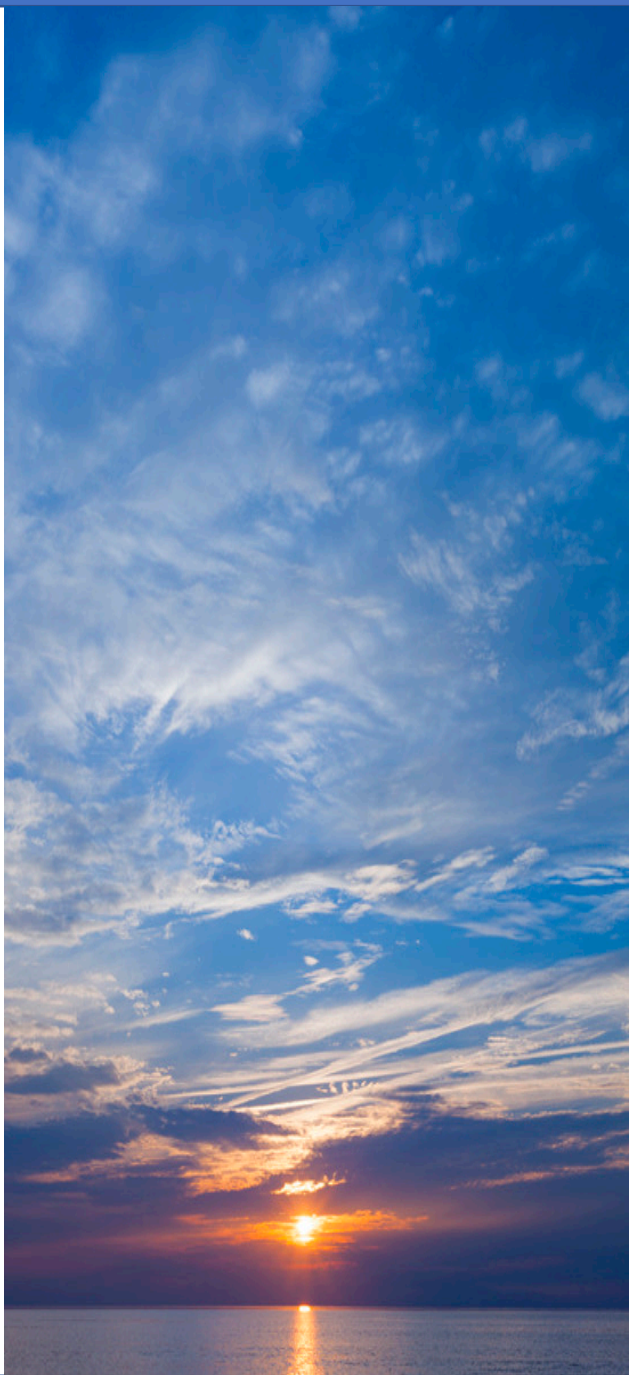


# Ecosystem Approach to Fisheries Management: The Mid-Atlantic Fishery Management Council Perspective

Gulf Council Ecosystem Technical Committee

Brandon Muffley

March 2, 2020



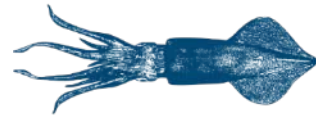
# Mid-Atlantic Council

7 States



64+ Species

7 Fishery Management Plans



Longfin Squid



Shortfin "Illex" Squid



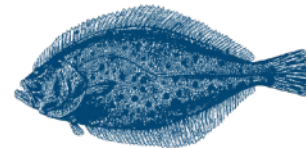
Butterfish



Atlantic Mackerel



Bluefish



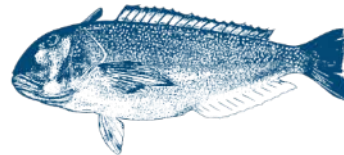
Summer Flounder



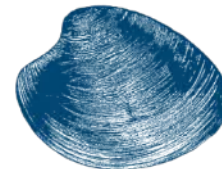
Black Sea Bass



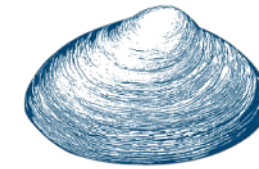
Scup



Golden Tilefish



Ocean Quahog



Atlantic Surfclam



Blueline Tilefish



Spiny Dogfish

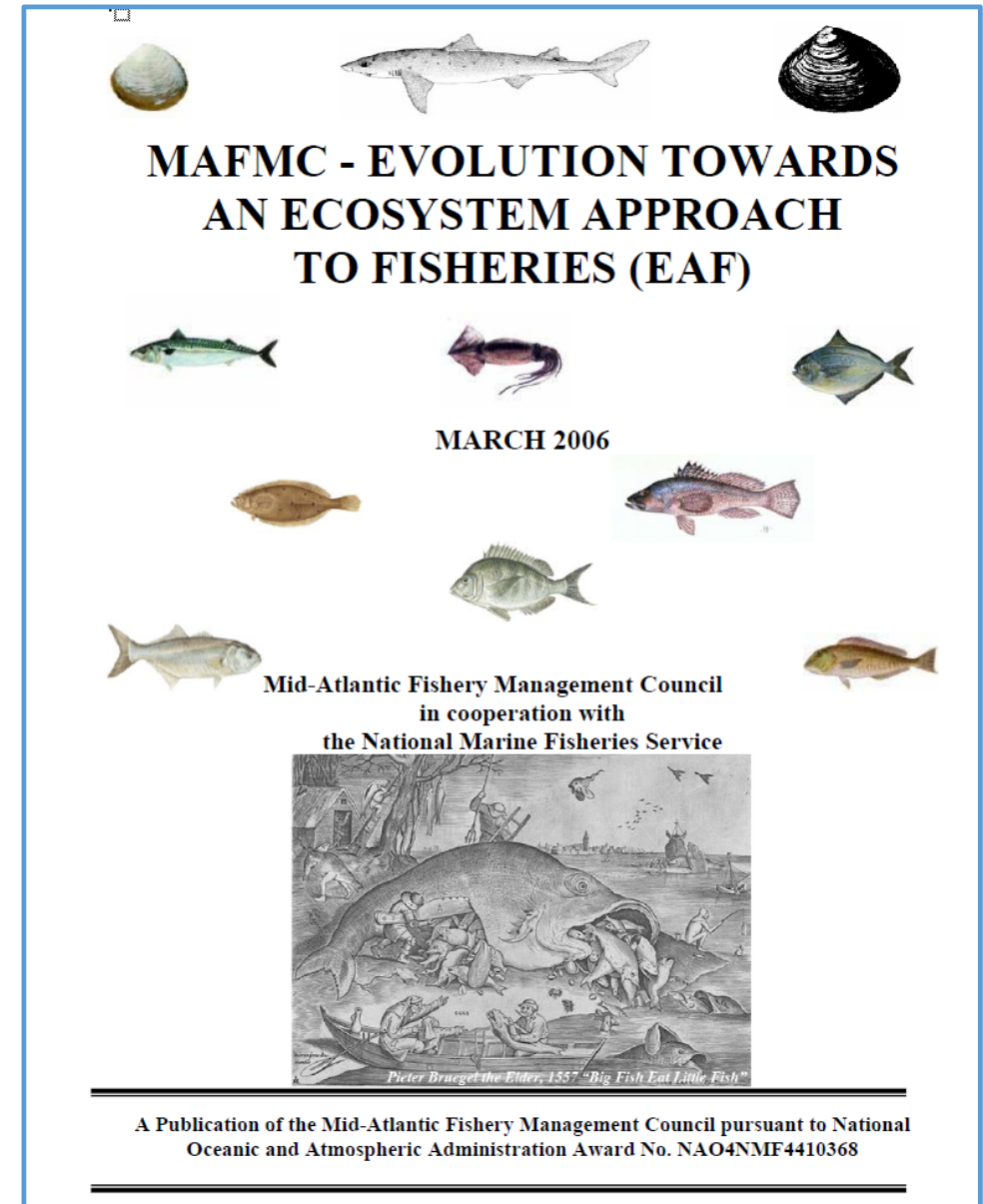


Monkfish

Ecosystem  
Component Species  
(Unmanaged Forage)

# Evolution to EAFM (2006)

- Documented Council positions on moving towards EAFM
- Council noted desire to “be evolutionary, not revolutionary” in approach





# MAFMC Visioning Project and Strategic Plan

- Ecosystem related issues ranked high on the list of concerns raised by stakeholders across all user groups
- EAFM development was identified as a priority in the Council's **2014-2018 Strategic Plan**
  - "A non-regulatory umbrella document intended to guide Council policy with respect to ecosystem considerations across existing Fishery Management Plans"



# EAFM Strategy Allows for...

Transition from single-species to ecosystem level management

Movement towards a definition of OY which takes into account interactions at multiple dimensions of the ecosystem and....

Recognizes that humans are inextricably a major component of marine ecosystems.

# Why Not Ecosystem-Based Fisheries Management?

*What's in an Acronym?*

**EAFM**

**Evolutionary** approach that systematically incorporates ecosystem considerations into the current management paradigm

**EBFM**

**Revolutionary** top down approach seeking to achieve certain ecosystem level outcomes or states

# EAFM Development Process

- **Modular, Step-wise Approach**
- **Workshops** - evaluate science (and policy) aspects of each issue

*Forage – Habitat – Climate Science & Fisheries – Species Interactions*
- **White Papers** - include recommendations for best practices to be incorporated into Council's EAFM operational guide
- **Guidance Document** - provides summary and synthesis “under one roof”

# EAFM Guidance Document



## Ecosystem Approach to Fisheries Management Guidance Document

Approved by Council August 8, 2016

Revised February 8, 2019



# What is EAFM?

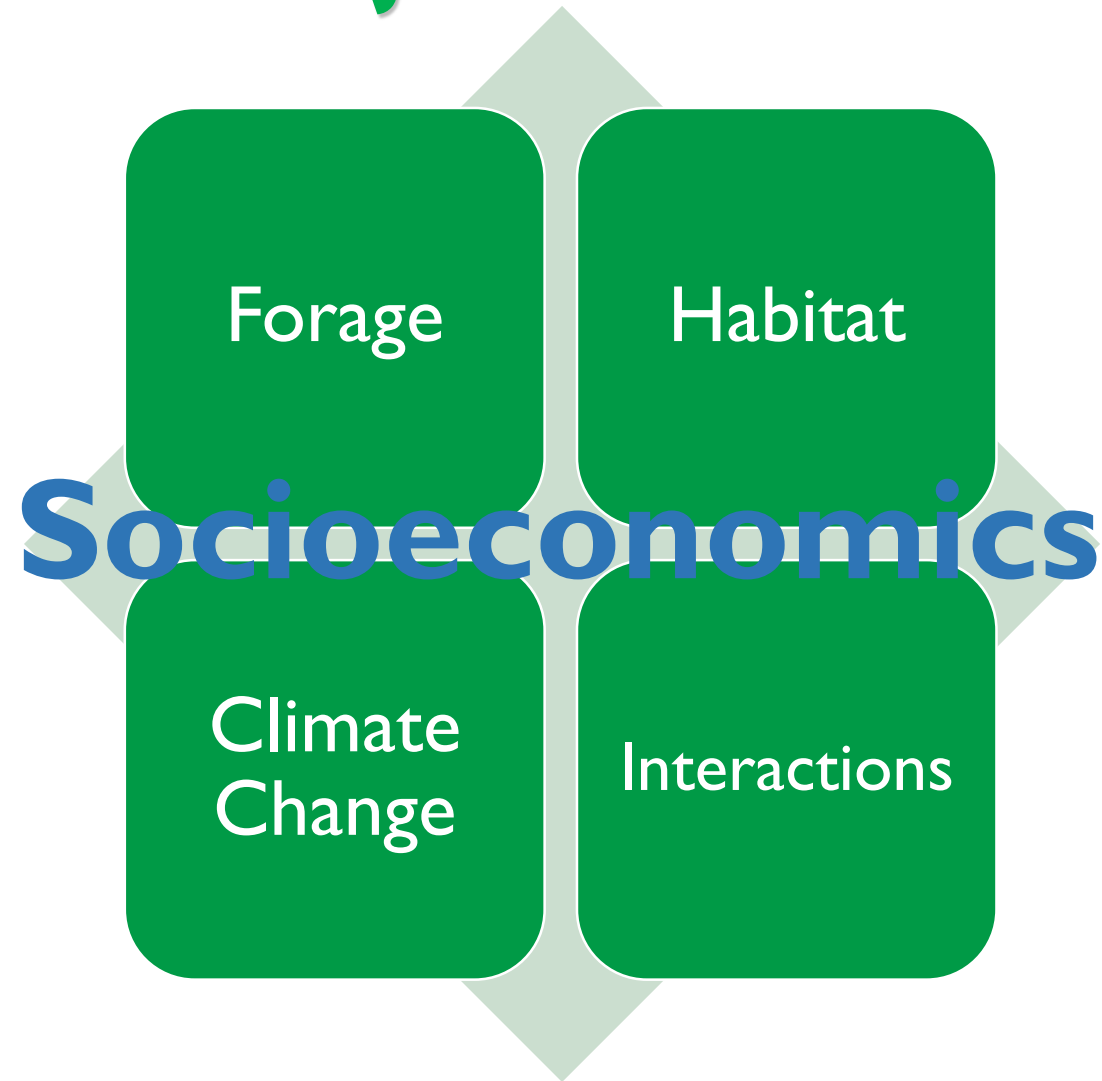
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## MAFMC Definition:

An Ecosystem Approach to Fisheries Management recognizes the biological, economic, social, and physical interactions among the components of ecosystems and attempts to achieve optimum yield taking those interactions into account.



# EA FM Guidance Document: Major Themes





# EAFM Major Theme I: Forage

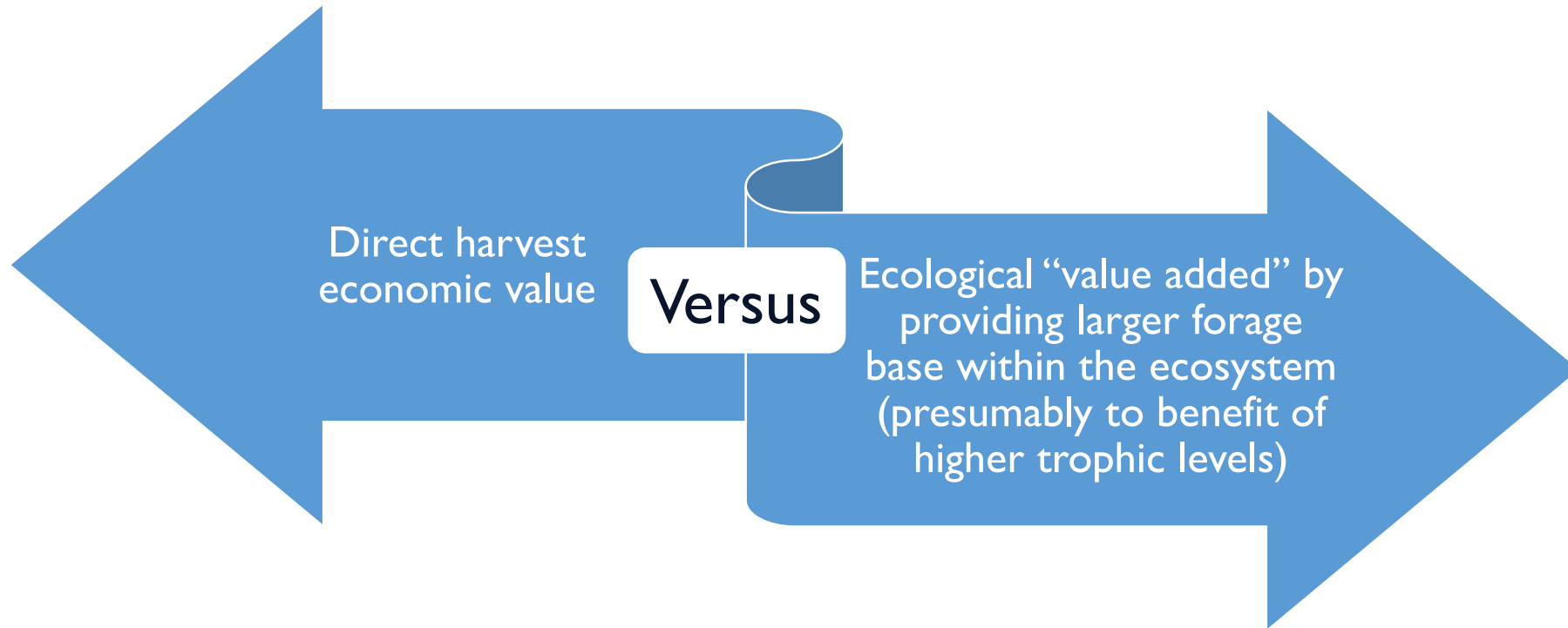
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## Council Policy:

“It shall be the policy of the Council to support the maintenance of an adequate forage base in the Mid-Atlantic to ensure ecosystem productivity, structure and function and to support sustainable fishing communities.”



# Exploited Forage Species – Ecosystem Service Tradeoffs



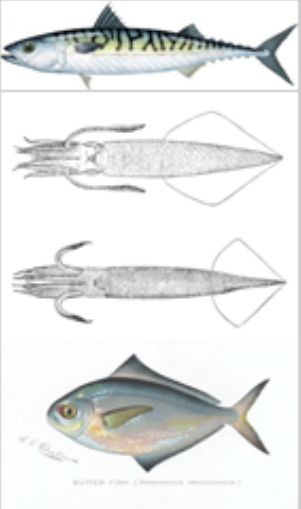
# Modifications to Council Risk policy

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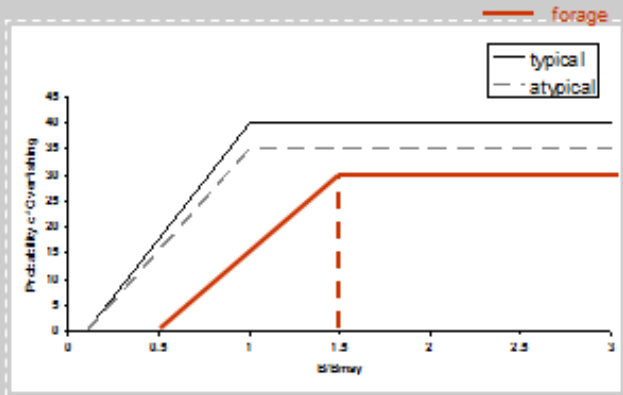
# Modifications to Biological Reference Points

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## Managed Forage Species



## Modified Council Risk Policy



Can the MAFMC Develop a Forage Policy?

- **Mortality-based reference points**
- **Biomass-based reference points**



# Unmanaged Forage Fish

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- Goal of proactively protect and conserve currently unmanaged forage species
- In 2016, designated 16 species and species groups as ecosystem component species (over 50 species in total)
- Prohibits new, expansion of existing or directed commercial fisheries in Mid-Atlantic
- Established an incidental possession limit of 1,700 lb for all species combined
- Recently approved a chub mackerel amendment – added to the Atlantic Mackerel, Squid and Butterfish FMP
  - Allows for commercial fishery with a catch limit and a variety of management and monitoring requirements
  - Currently conducting chub mackerel research on importance of species in diet of HMS species (tunas and billfishes)



# EAFM Major Theme 2: **Habitat**

---

## Council Policies:

- Strengthen Essential Fish Habitat (EFH) designations and emphasize connectivity between species and their habitat
- Demonstrate and communicate the value of habitat to fishery outcomes
- Increased and focused habitat sampling and data collection programs







## Habitat and Offshore Productivity – Ecosystem Perspectives

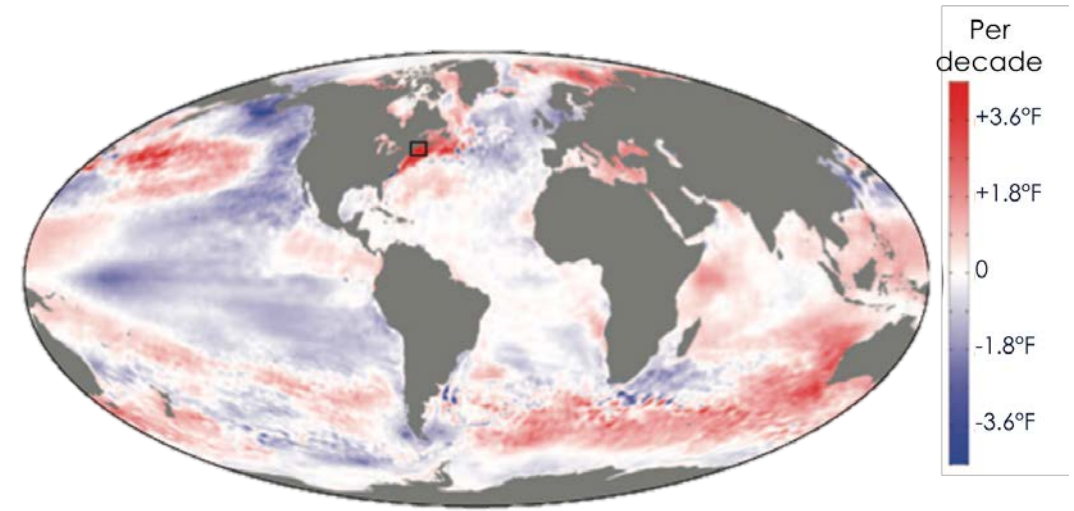
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- Ecosystem models can help quantify the habitat-related effects on fish stocks, including effects on:
  - natural mortality
  - recruitment
  - growth
  - migration
- Example: ecosystem models have been used to determine the contribution of marsh and oyster reef habitats in the Chesapeake Bay to summer flounder and black sea bass production

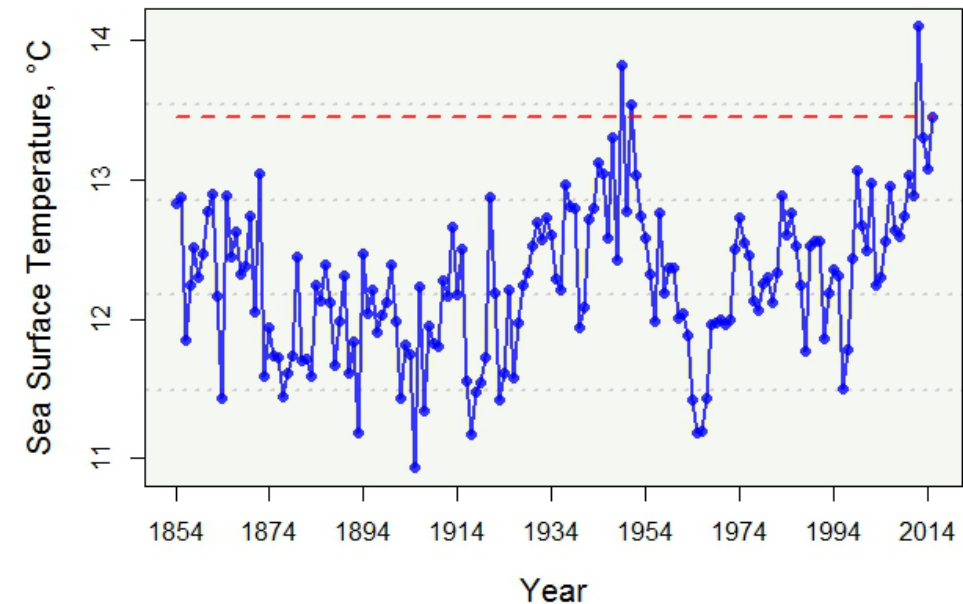
# EAFM Major Theme 3: Climate Change and Variability

## Council Policies:

- Continue to work with NOAA on the NMFS Climate Science Strategy
- Develop and evaluate approaches for Council fisheries and management to be come more adaptive to change
- Continue to support, engage and collaborate on climate change science and incorporate results into stock assessments and management



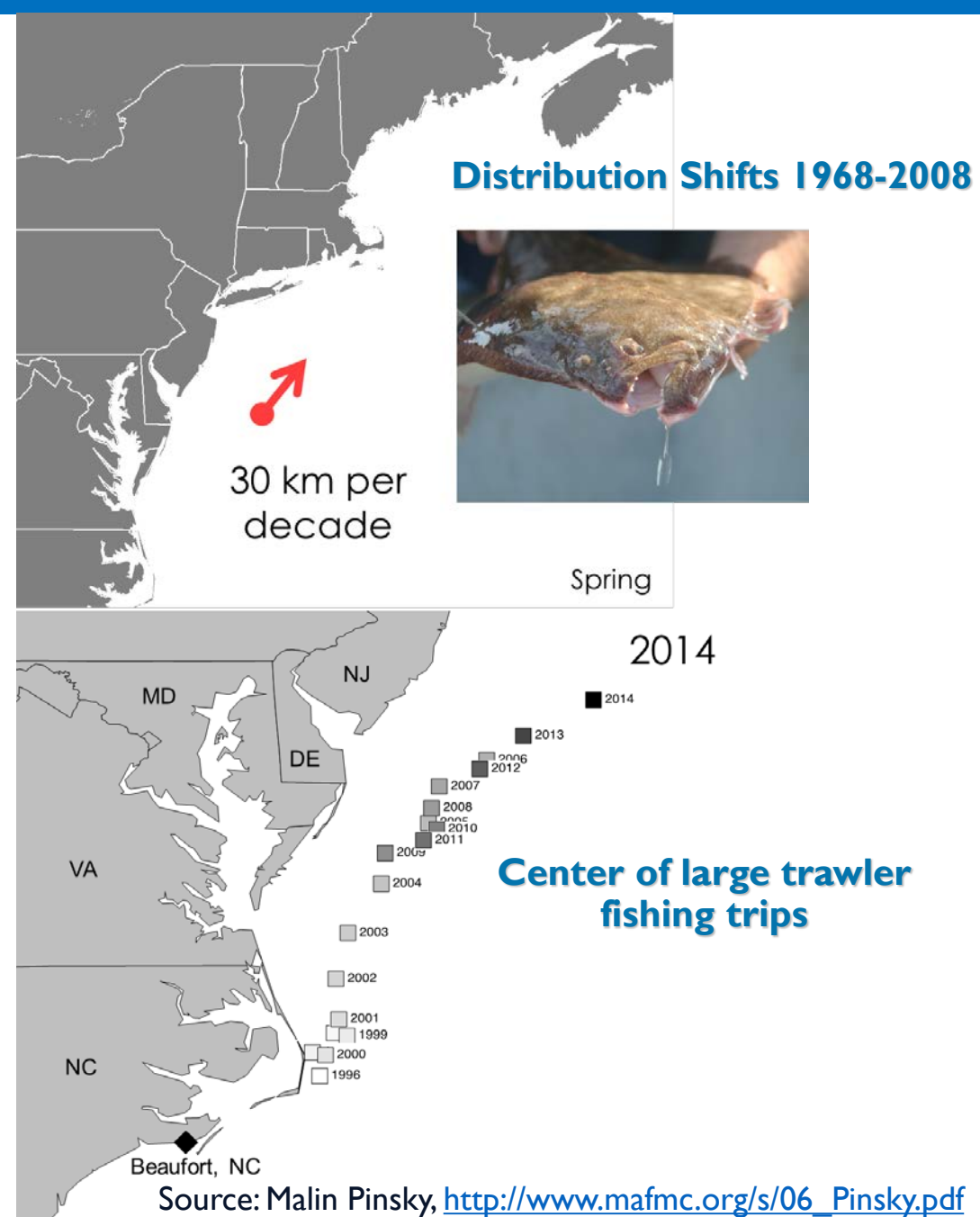
Source: Pershing et al. 2015 *Science*



Source: NEFSC Ecosystem Considerations Report

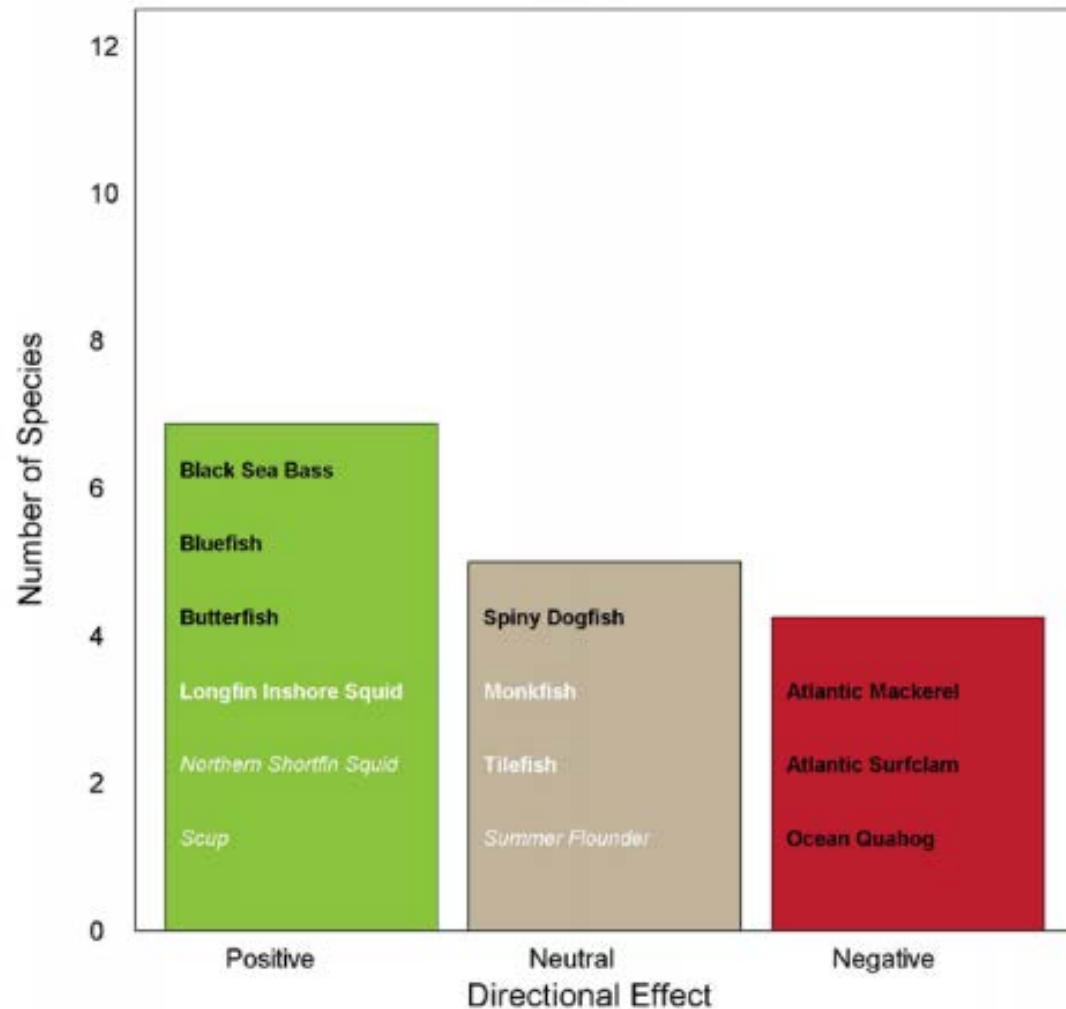
# Changes in:

- Species distribution
- Changes in fisheries/fleet dynamics

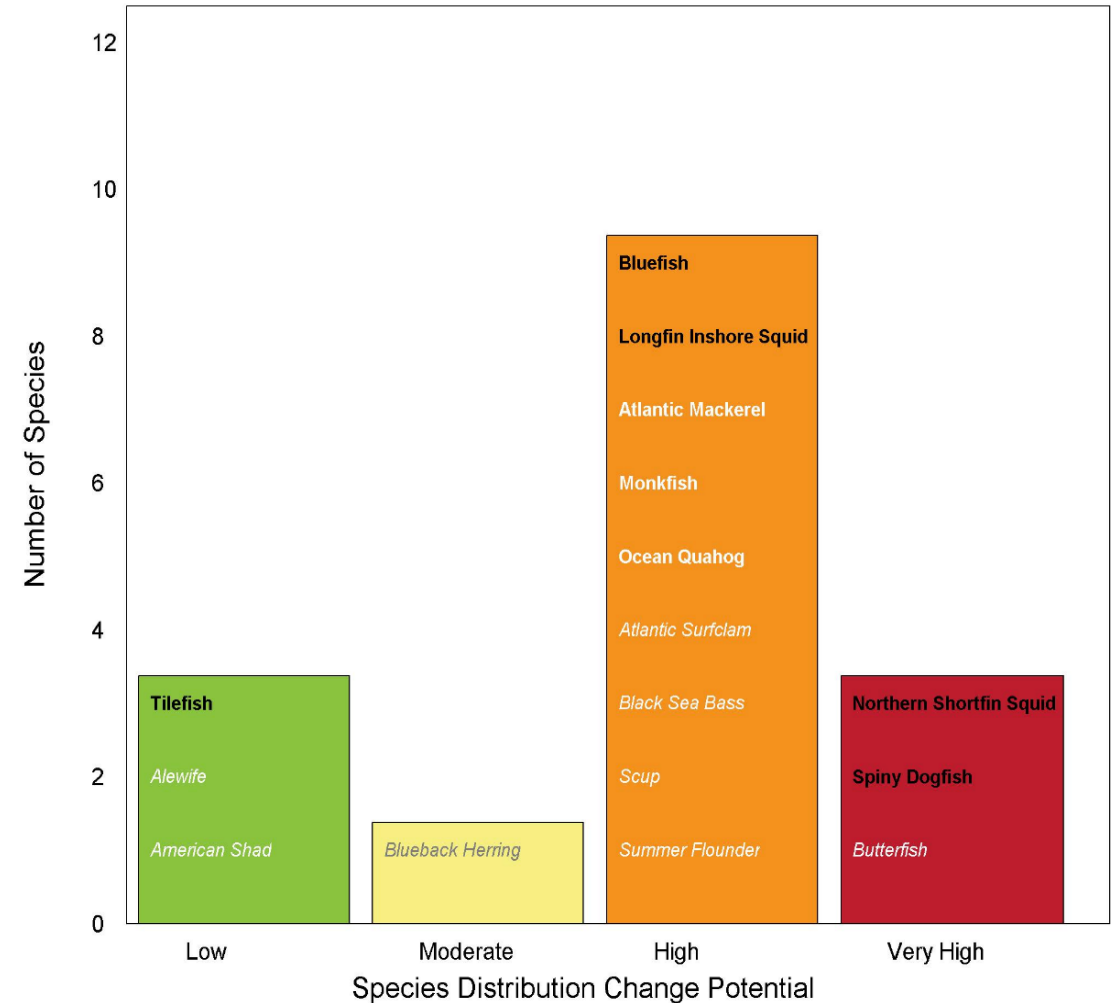




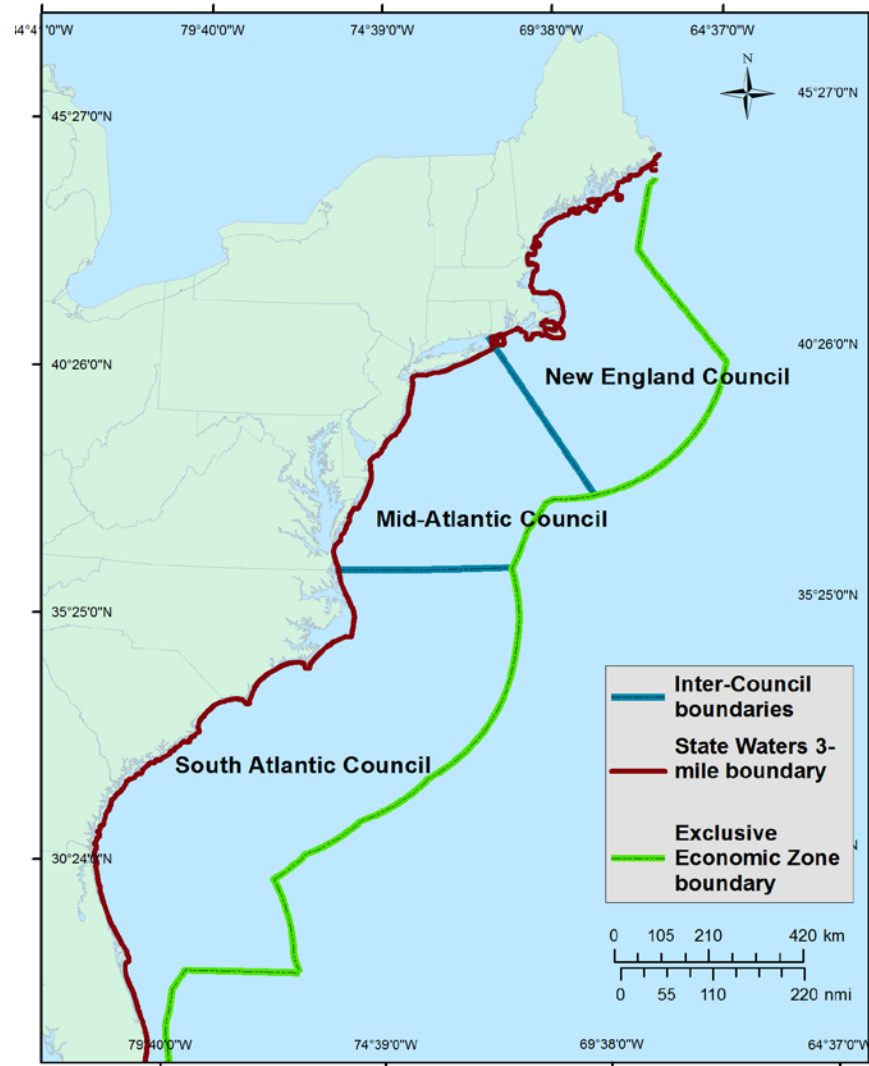
# Directional effect of climate change



# Potential change in species distribution



# Governance Issues



# EAFM Major Theme 4: Interactions

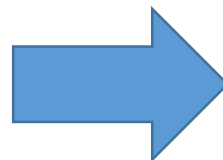
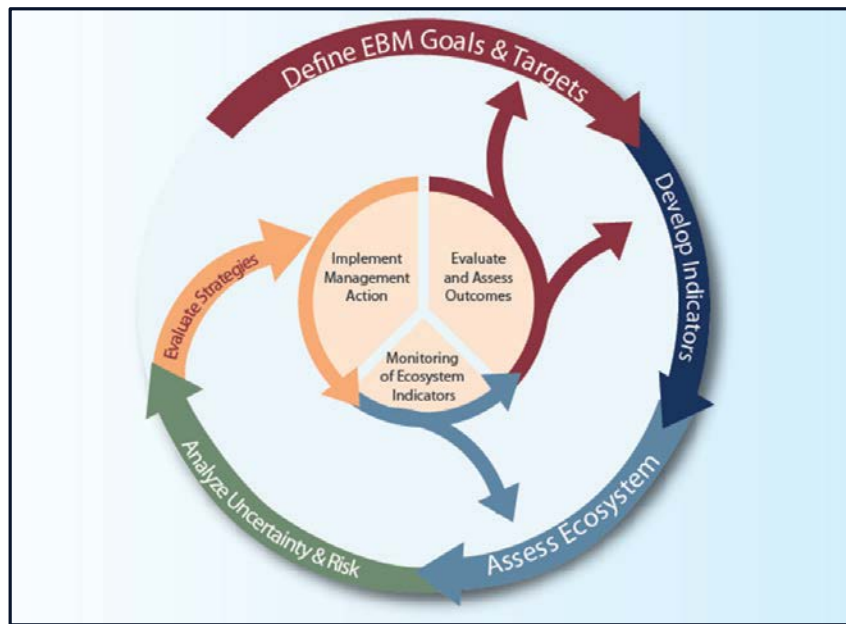
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## Council Policy:

“The Council, in conjunction with its SSC and the NEFSC, shall promote the timely collection of data and development on analyses to support the biological, economic, and social evaluation of ecosystem-level trade-offs, including those required to establish an optimal forage fish policy.”



# Addressing Interactions in the Mid-Atlantic



## A Framework for Incorporating Species, Fleet, Habitat, and Climate Interactions into Fishery Management

Sarah K. Gaichas<sup>1\*</sup>, Richard J. Seagraves<sup>2</sup>, Jessica M. Coakley<sup>2</sup>, Geret S. DePiper<sup>1</sup>, Vincent G. Guida<sup>3</sup>, Jonathan A. Hare<sup>4</sup>, Paul J. Rago<sup>1</sup> and Michael J. Wilberg<sup>5</sup>

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Marine ecosystems are characterized by many complex interactions. Fisheries managers face the challenge of maintaining or restoring sustainability for individual living resources which are affected by both ecological and economic interactions with other species, through processes like predation and fishing fleet interactions. These species interactions are further complicated by interactions with habitats that are changing due to both human activities and climate change. Often, fishery management systems designed to promote sustainability of individual resources have few tools or processes that also address interactions between species, fleets, habitat, and climate. Here, we review existing and potential fishery assessment and management information and tools, and we develop a potential framework for addressing interactions in management at the request of the U.S. Mid-Atlantic Fishery Management Council. The structured framework can be used to first prioritize interactions, second specify key questions regarding high priority interactions, and third tailor appropriate analyses to address them. The primary tools for the initial steps in the framework are risk assessment and Management Strategy Evaluation (MSE). Finally, implemented management would be evaluated to ensure that objectives are being met, or to adjust measures as conditions change. In the final section, we outline an example to illustrate how a structured decision making process within the framework could work.

**Keywords:** fisheries management, risk assessment, management strategy evaluation, ecosystem approach, conceptual modeling

### INTRODUCTION

The Mid-Atlantic Fishery Management Council (Council) manages fishery resources in the US Exclusive Economic Zone (EEZ; out to 200 nmi from shore) from North Carolina to New York (Figure 1). The Council recently articulated objectives for the living marine resources under its management authority in its Strategic Plan (<http://www.mafmc.org/strategic-plan/>). Foremost among these objectives is the need to advance ecosystem approaches to fisheries management in the Mid-Atlantic. This will be accomplished by moving beyond single species

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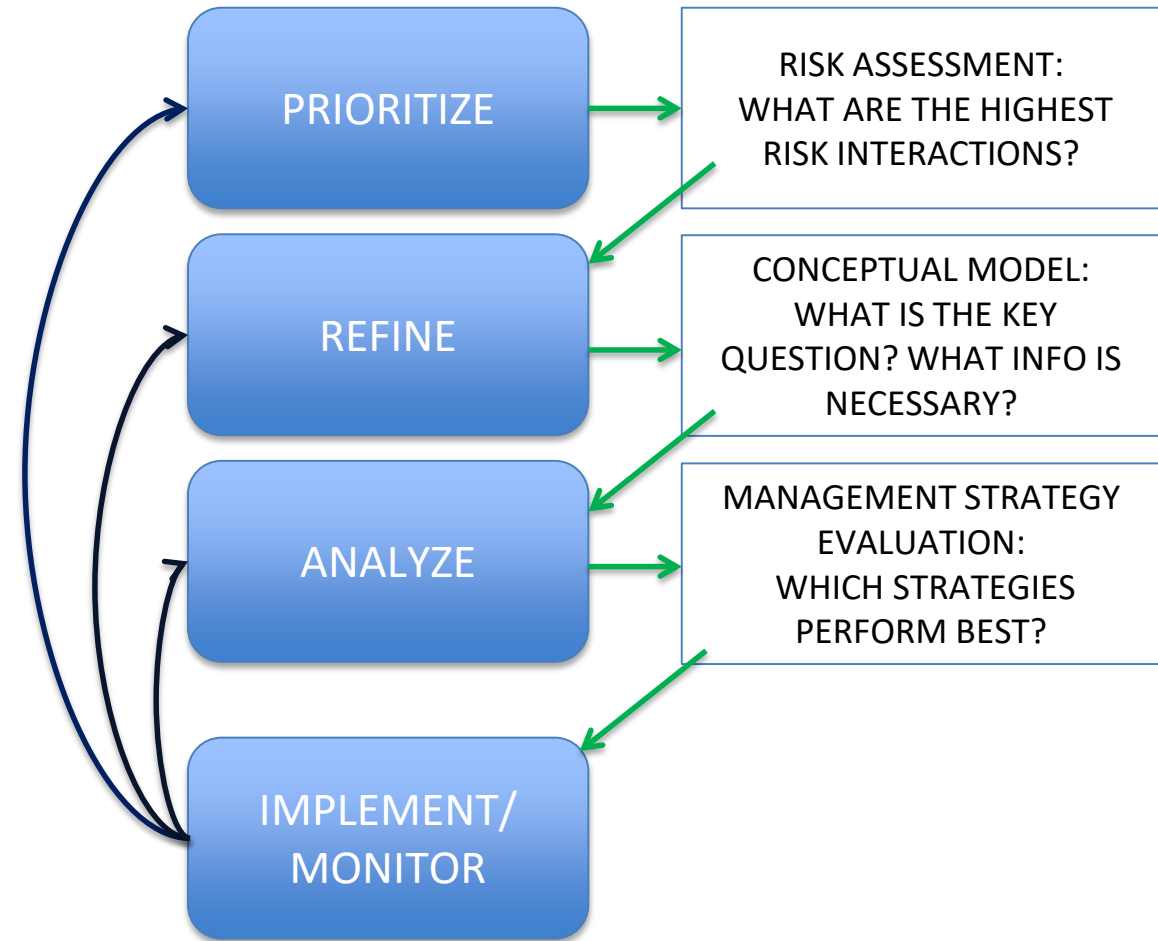
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Gaichas SK, Seagraves RJ,  
Coakley JM, DePiper GS, Guida VG,  
Hare JA, Rago PJ and Wilberg MJ  
(2016) A Framework for Incorporating  
Species, Fleet, Habitat, and Climate  
Interactions into Fishery Management.  
Front. Mar. Sci. 3:105.  
doi: 10.3389/fmars.2016.00105

# Council's EAFM Decision Framework

- Developed a strategic, deliberative and structured process
  - Goal of incorporating species, fleet, habitat and climate interactions into management
  - Planning tool to help Council transition and incorporate EAFM approaches
  - Not an end to itself



Source: Sarah Gaichas,  
[http://www.mafmc.org/s/3\\_Habitat\\_in\\_IEAs\\_Gaiches.pdf](http://www.mafmc.org/s/3_Habitat_in_IEAs_Gaiches.pdf)



# Step 1:

## Prioritize



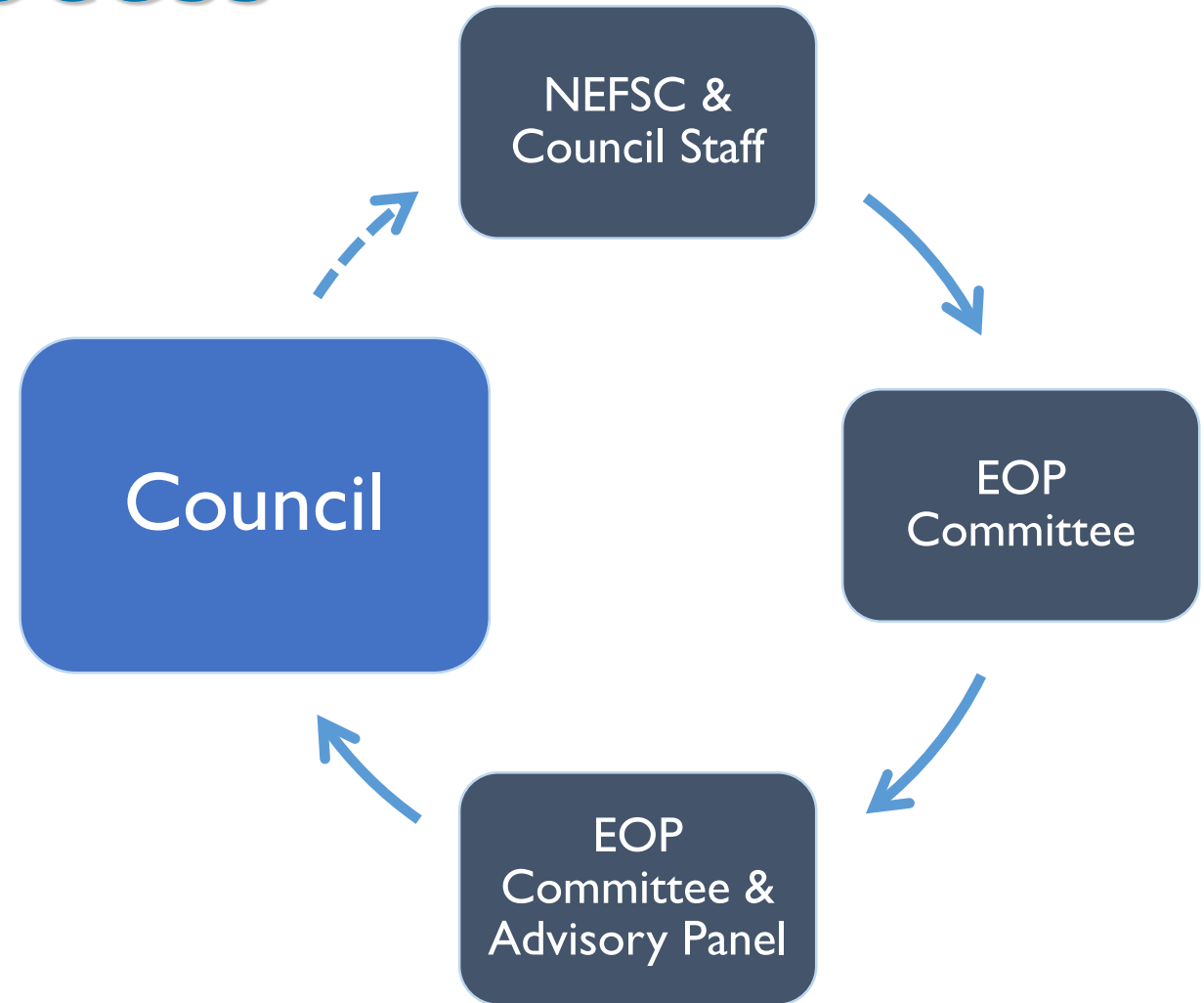
**RISK ASSESSMENT:** WHAT ARE  
THE HIGHEST RISK  
INTERACTIONS

- Given limited resources, develop highest priority ecosystem considerations
- **Risk Element** - aspect that may threaten achieving the biological, economic, or social objectives that the Council desires from a fishery
  - Ecological
  - Social
  - Management
  - Economic
  - Food Production
- Evaluated at the:
  - Species level
  - Species and sector level
  - Ecosystem level
- Identified risk definitions (why), risk indicators (how), risk ranking criteria (what)
- Evolves and updated – new science, data and priorities

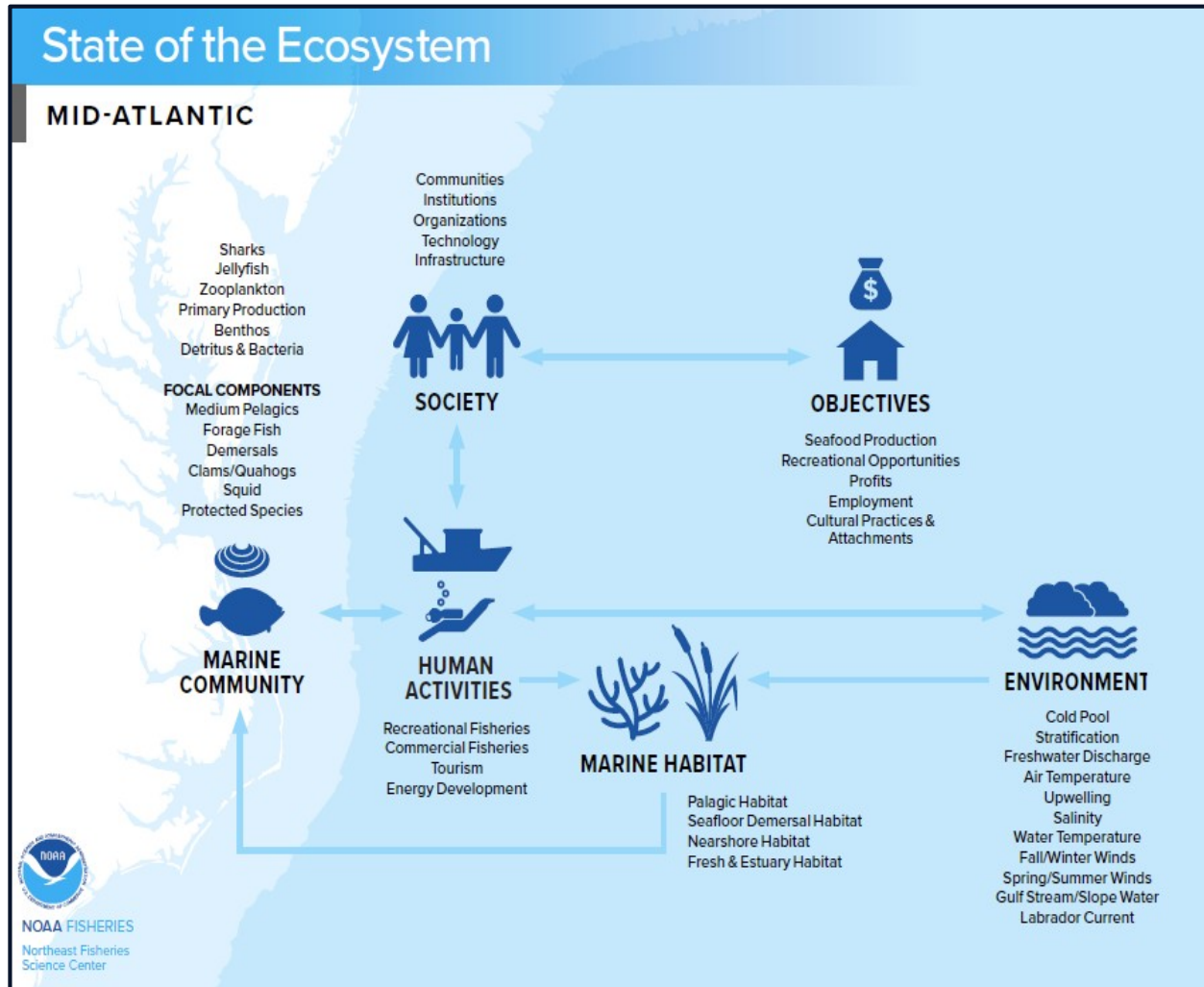


# Risk Assessment Process

- Series of meetings and workshops in 2016-2017
  - Initial scoping of ideas/concepts
  - Feedback and refinement
  - Iterate as needed
- Allowed process to develop relatively quickly
- Managers, scientists, and stakeholders all together
  - Ensures management objectives and priorities are focus
  - Build relationships, trust, buy-in (maybe?)



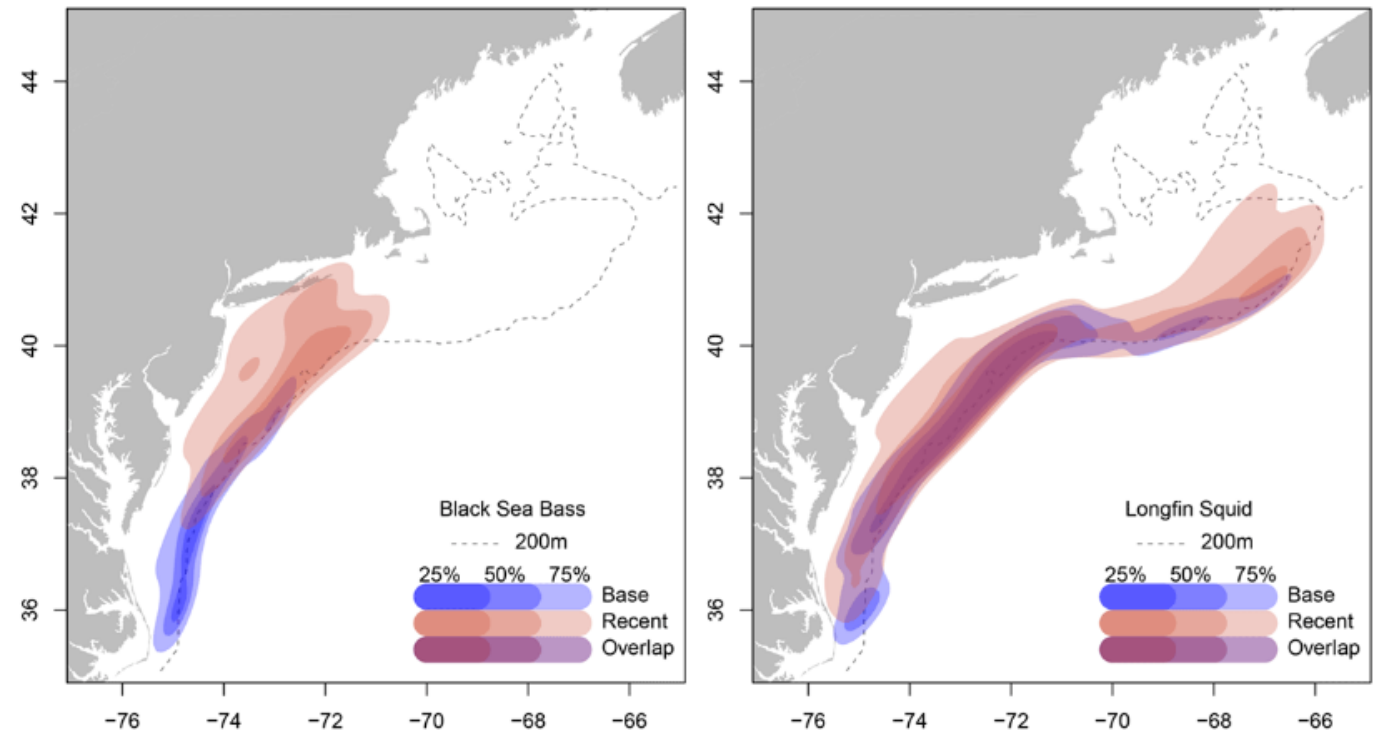
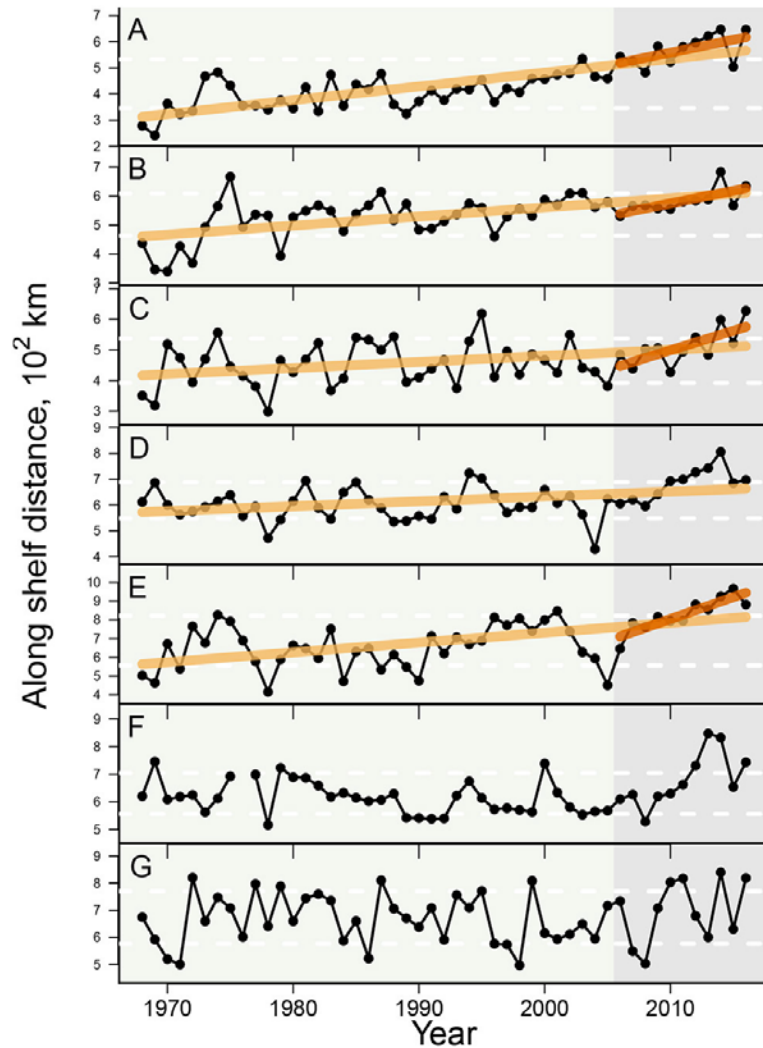
# NEFSC State of the Ecosystem Reports



- Opportunity to utilize available resources (e.g. ESR) to evaluate risk elements
- SOE supported much of the data and analysis for risk assessment
- Provided to Council annually
  - Familiarity with ecosystem concepts and consideration
- Updates/improvements linked with risk assessment

# Distribution Shifts

| Risk Level    | Definition                                  |
|---------------|---|
| Low           | Low potential for distribution shifts       |
| Low-Moderate  | Moderate potential for distribution shifts  |
| Moderate-High | High potential for distribution shifts      |
| High          | Very high potential for distribution shifts |



# Economic Elements

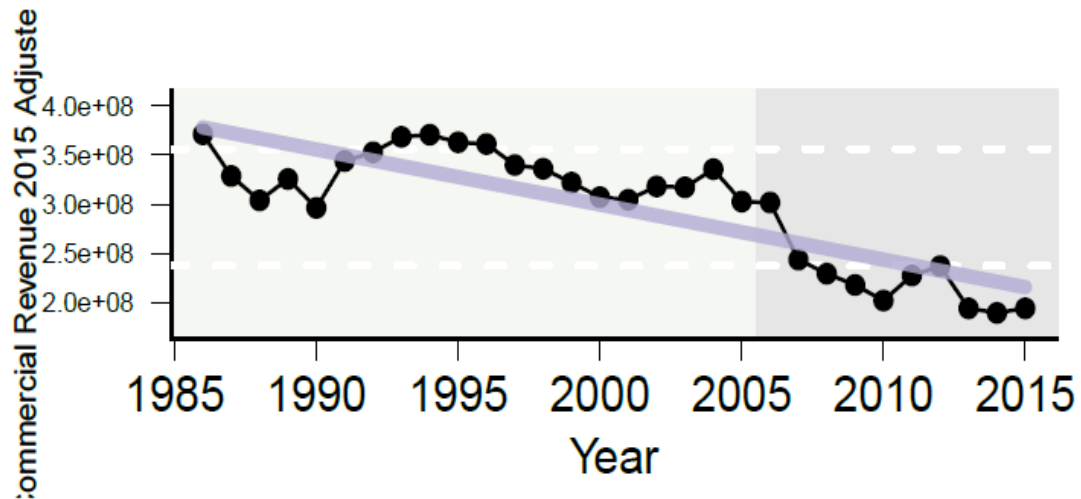


Figure 13: Aggregate Mid-Atlantic managed species revenue

| Risk Level    | Definition                                |
|---------------|---|
| Low           | No trend and low variability in revenue   |
| Low-Moderate  | Increasing or high variability in revenue |
| Moderate-High | Significant long term revenue decrease    |
| High          | Significant recent decrease in revenue    |

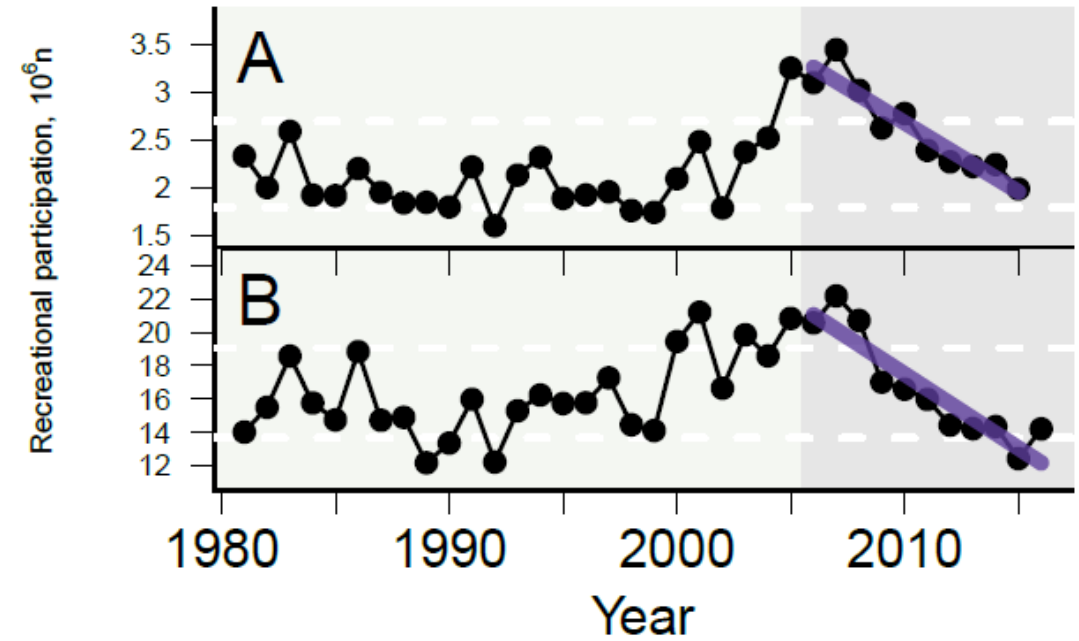


Figure 14: A: number of anglers, B: number of trips

| Risk Level    | Definition   |
|---------------|--|
| Low           | No trends in angler days/trips                       |
| Low-Moderate  | Increasing or high variability in angler days/trips  |
| Moderate-High | Significant long term decreases in angler days/trips |
| High          | Significant recent decreases in angler days/trips    |



# Risk Assessment Summary Results

Species  
Level

| Species           | Assess | Fstatus | Bstatus | FW1Pred | FW1Prey | FW2Prey | Climate | DistShift | EstHabitat |
|-------------------|--------|---------|---------|---------|---------|---------|---------|-----------|------------|
| Ocean Quahog      | l      | l       | l       | l       | l       | l       | h       | mh        | l          |
| Surfclam          | l      | l       | l       | l       | l       | l       | mh      | mh        | l          |
| Summer flounder   | l      | l       | lm      | l       | l       | l       | lm      | mh        | h          |
| Scup              | l      | l       | l       | l       | l       | l       | lm      | mh        | h          |
| Black sea bass    | l      | l       | l       | l       | l       | l       | mh      | mh        | h          |
| Atl. mackerel     | l      | h       | h       | l       | l       | l       | lm      | mh        | l          |
| Butterfish        | l      | l       | l       | l       | l       | l       | l       | h         | l          |
| Longfin squid     | lm     | lm      | lm      | l       | l       | lm      | l       | mh        | l          |
| Shortfin squid    | lm     | lm      | lm      | l       | l       | lm      | l       | h         | l          |
| Golden tilefish   | l      | l       | lm      | l       | l       | l       | mh      | l         | l          |
| Blueline tilefish | h      | h       | mh      | l       | l       | l       | mh      | l         | l          |
| Bluefish          | l      | l       | lm      | l       | l       | l       | l       | mh        | h          |
| Spiny dogfish     | lm     | l       | lm      | l       | l       | l       | l       | h         | l          |
| Monkfish          | h      | lm      | lm      | l       | l       | l       | l       | mh        | l          |
| Unmanaged forage  | na     | na      | na      | l       | lm      | lm      | na      | na        | na         |
| Deepsea corals    | na     | na      | na      | l       | l       | l       | na      | na        | na         |

Ecosystem  
Level

| System       | EcoProd | CommRev | RecVal | FishRes1 | FishRes4 | FleetDiv | Social | ComFood | RecFood |
|--------------|---------|---------|--------|----------|----------|----------|--------|---------|---------|
| Mid-Atlantic | lm      | mh      | h      | l        | mh       | l        | lm     | h       | mh      |

## Step 2:

Refine

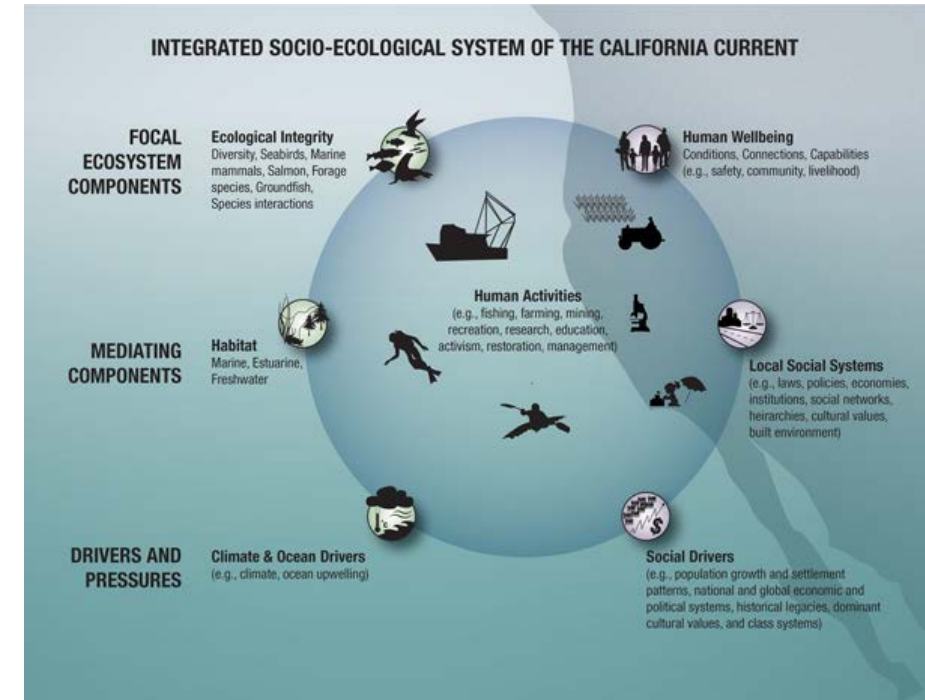


**CONCEPTUAL MODEL:** WHAT IS THE KEY QUESTION? WHAT INFO IS NECESSARY?

*Council used risk assessment results to help prioritize and select species/fishery/element for further development*

Begin conceptual model development

- Built to address high-risk factors and specific management questions
- Links and relationships throughout system remain to account for feedback and unexpected effects
- Not conducting a stock assessment or other comprehensive analysis



California Current IEA model –  
[www.noaaintegratedecosystemassessment.noaa.gov](http://www.noaaintegratedecosystemassessment.noaa.gov)

# Summer Flounder Conceptual Model

- Potential outcomes identified by Council
  - Identify data availability and needs (i.e., gap analysis and inform research priorities)
  - Identify key ecosystem relationships associated with risk factors
  - Develop 10 management questions that could be answered with model and available data
  - Scoping process for specific and strategic approach to inform possible MSE



# Conceptual Model Development Process

- Technical workgroup established sub-groups – Physical Environment and Human Dimension
  - Identified key elements that are drivers/have influence on high risk elements
    - Elements linking models
    - Documenting justification for inclusion and linkages
    - Data availability (Y/N) and if yes, documentation
  - Full workgroup then review and identify cross-linkages, data sources
- Once elements finalized, development of visualization tools
- Once “ecosystem” built, development of management questions



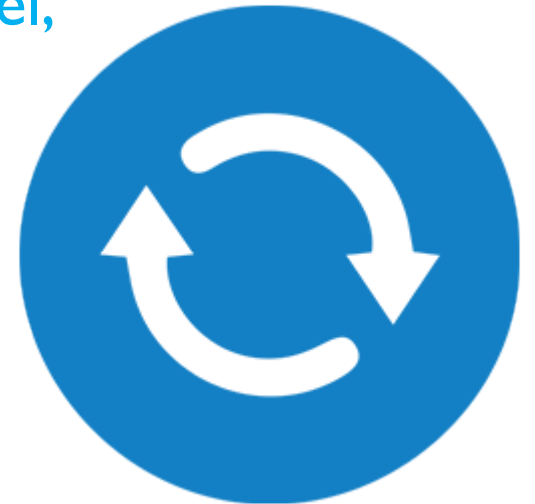
- Once elements finalized, development of visualization tools



- [https://gdepiper.github.io/Summer\\_Flounder\\_Conceptual\\_Models/sfconsmod\\_riskfactors\\_subplots.html](https://gdepiper.github.io/Summer_Flounder_Conceptual_Models/sfconsmod_riskfactors_subplots.html)
- [https://gdepiper.github.io/Summer\\_Flounder\\_Conceptual\\_Models/sfconsmod\\_final\\_2col.html](https://gdepiper.github.io/Summer_Flounder_Conceptual_Models/sfconsmod_final_2col.html)

# Conceptual Model Development Process

- Similar iterative, Council and stakeholder driven process followed here as with Risk Assessment
  - Draft model, data elements and management questions presented to Council's Ecosystem and Ocean Planning (EOP) Committee and AP
    - Offered feedback and recommendations for workgroup consideration
    - E.g., inclusion of offshore wind risk factor and associated ecosystem elements; risk factor definitions
  - Workgroup then updated, refined and finalized conceptual model, ecosystem elements, and data tables based on feedback
  - EOP Committee then prioritized management questions for Council consideration
    - Identifies Council's management goals and objectives
    - Ecosystem issue, consideration and relationships
    - Scopes out next step - MSE



# Conceptual Model Management Questions

- EOP Committee initially considered a wide range of topics and issues covering:
  - Distribution shifts, discards, data quality, commercial profits, recreational satisfaction, habitat change, and changes in stock dynamics
- Three priority questions to full Council for consideration and selection:
  1. How does utilizing recreational data sources at scales that may be inappropriate for the data source (e.g., Marine Recreational Information Program (MRIP) data at the state/wave/mode level) affect management variability, uncertainty, and fishery performance? Evaluate the impact of that variability and uncertainty and its use in the current conservation equivalency process on recreational fishery outcomes.
  2. What are the mechanisms driving summer flounder distribution shift and/or population range expansion? What are the biological, management, and socioeconomic implications of these changes? Identify potential management and science strategies to help account for the impacts of these changes.
  3. 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.
    - Opportunity to align EAFM work with traditional management process
    - EAFM issue – seven linked risk factors: Management, Summer Flounder Stock, Science, Fishing Fleets, and Benefits

## Step 3:

## ANALYZE



## MANAGEMENT STRATEGY EVALUATION: WHICH STRATEGIES PERFORM BEST?

- Conceptual model provided the initial scoping of the MSE
  - Identified management goal and objectives
  - Potential data availability and modeling approaches
- In 2020, will begin a deliberative and iterative process involving Council, ASMFC, EOP and AP members and stakeholders
- Develop and evaluate potential management strategies the Council can implement
- Implement, monitor, adapt, and repeat....

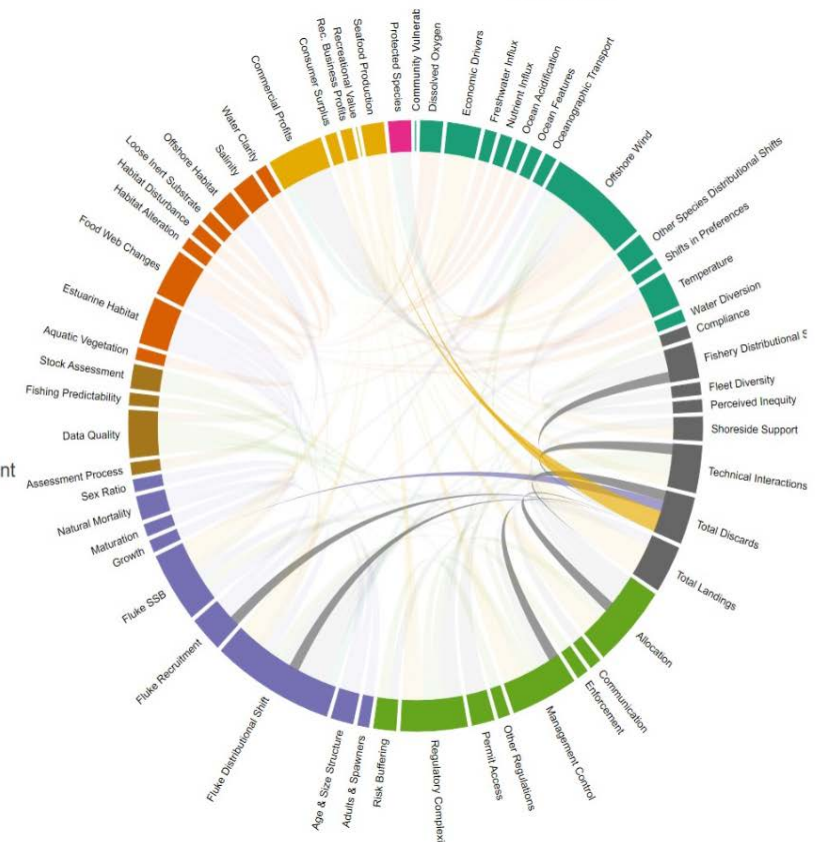
Management questions



3

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.

Full model





# Additional EAFM Applications

- Research Track Stock Assessments - Ecosystem Terms of Reference (ToR)
- Ecosystem Context for Stock Advice
  - Summer Flounder example
  - Ecosystem factors influencing changes in distribution, stock productivity and recruitment
    - Temperature
    - Salinity
    - Primary production
    - Zooplankton abundance
    - Habitat occupancy
    - Diet composition
- SSC ABC Term of Reference and variable in scientific uncertainty considerations



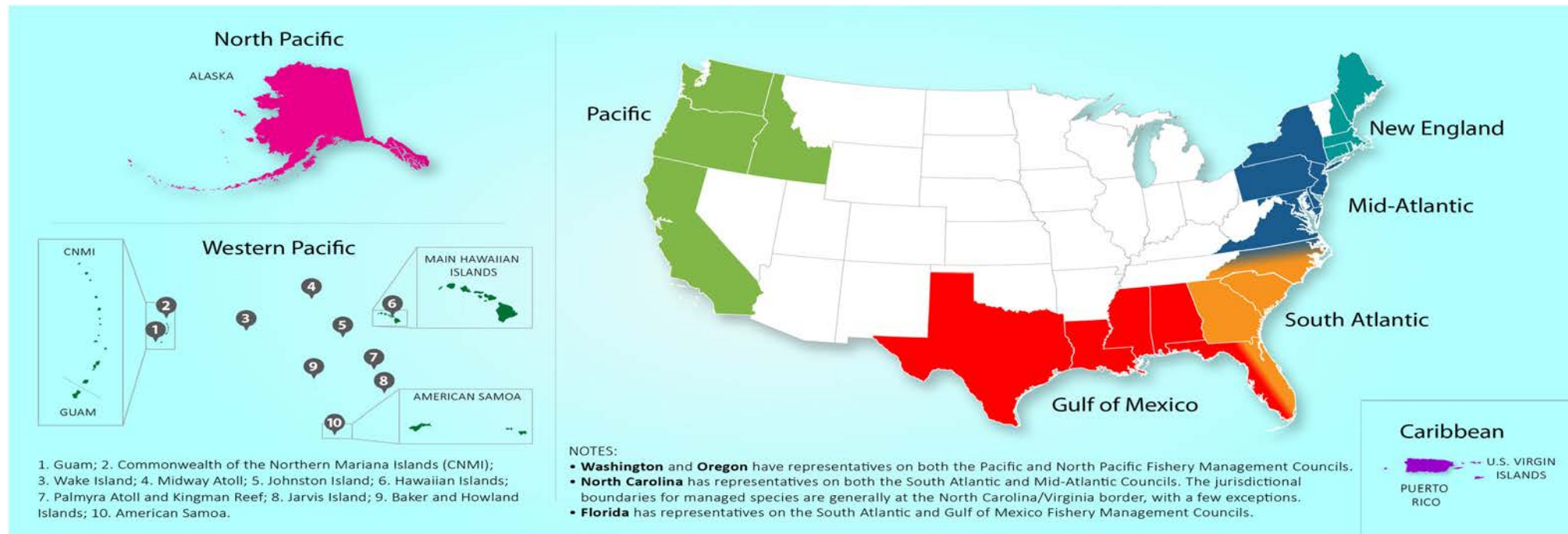
# Conclusions

- EAFM emphasizes an integrated approach to habitat, sustainability, multi-species interactions, connectivity, and dynamic change
- We are in transitional state – data and science are incomplete
- Need to move forward both strategically and systematically, not radically
- Deliberate, stepwise approach will have better outcomes
- Significant investment with Council, scientists and stakeholders
  - Crucial for support, trust, and buy-in



# Mid-Atlantic Approach from a National Context

- National/centralized statutes under MSA, regulations, and guidance
- MSA intended regional, participatory governance
  - Regional EBFM Implementation Plans
- EAFM, EBFM, EAM
- Each Council tackling this issue differently – as intended!





# Questions??

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## Thanks to a lot of people:

|                 |                           |                       |
|-----------------|---------------------------|-----------------------|
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| Rich Seagraves  | Andy Loftus               | Jeff Brust            |
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| Kiley Dancy     | Members of EOP Committee  | Danielle Palmer       |
| Julia Beaty     | EOP Advisor Panel members | Greg Ardini           |
| Michael Fogarty | Ed Houde                  | Kirby Rootes-Murdy    |
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| Paul Pago       | Howard Townsend           | Dustin Colson Leaning |
| Vincent Guida   | Mike Wilberg              | ICES WGNARS members   |
| Rob Latour      | Patricia Clay             | ..... and many more   |
| David Stevenson | Terra Leaderhouse         |                       |
| Karen Abrams    | Jon Hare                  |                       |
| Sean Lucy       | Sean Hardison             |                       |

