

**NOAA**  
**FISHERIES**

# Using Ecosystem Information in the Stock Assessment and Advice Process

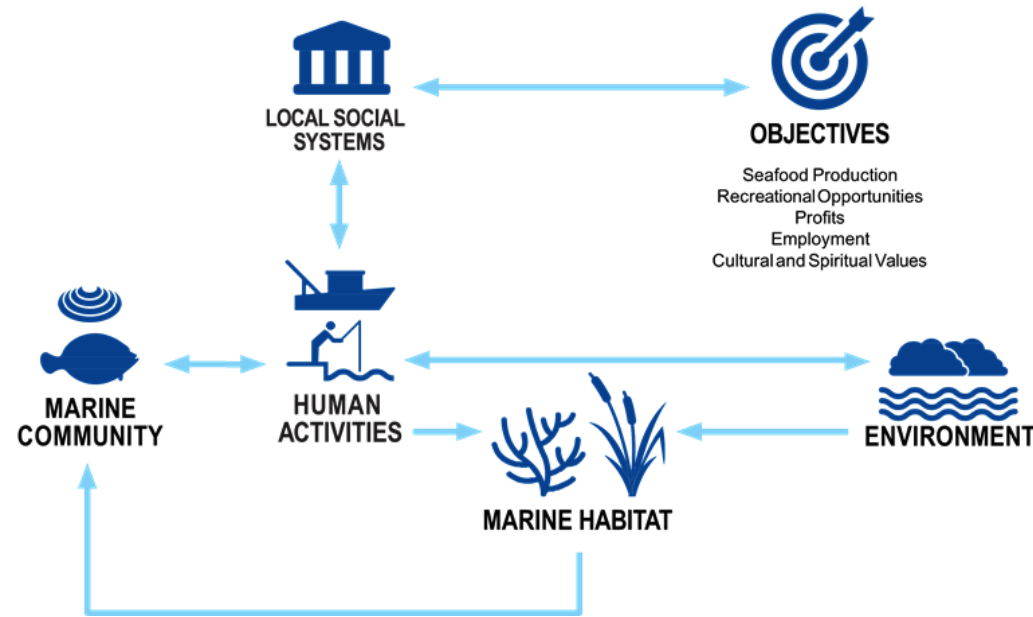
CFMC SSC EBFM-TAP  
2 May 2023

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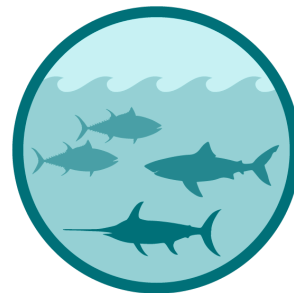
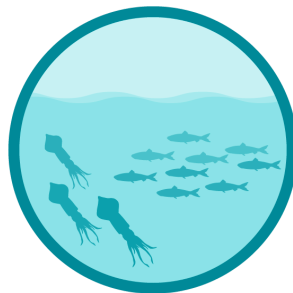
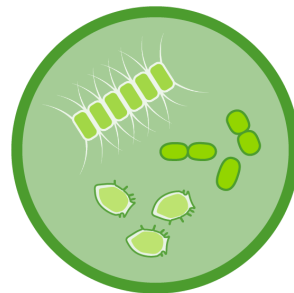
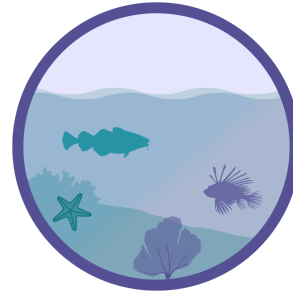
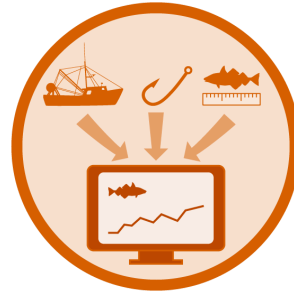
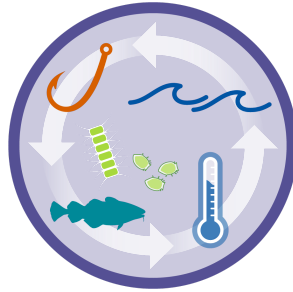
With thanks to Brandon Muffley (MAFMC)

# US Policy defines EBFM as:

A systematic approach to fisheries management in a geographically specified area that contributes to the resilience and sustainability of the ecosystem; recognizes the physical, biological, economic, and social interactions among the affected fishery-related components of the ecosystem, including humans; and seeks to optimize benefits among a diverse set of societal goals.



## Many options and entry points for a systematic ecosystem approach



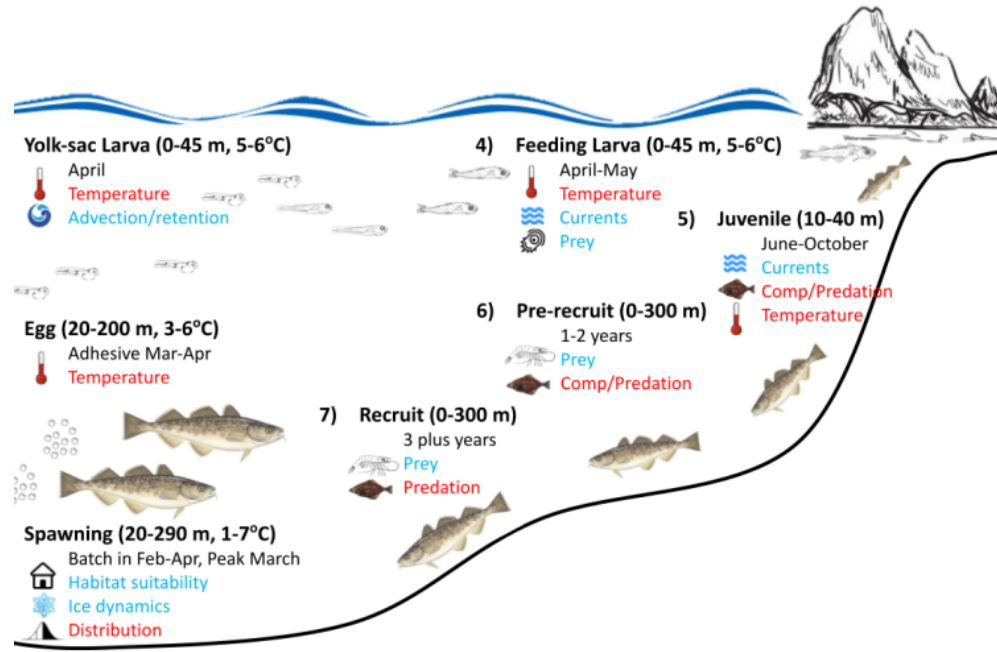
Goal: increased range of opportunities for relevant ecosystem information to be considered in management decision processes

## Outline

- What types of decisions do we need to make?
  - Single species catch limits
  - Allocations to fleets or areas
  - Coordination across boundaries and sectors
  - Multispecies and ecosystem level tradeoffs
- How can ecosystem information support these decisions?
  - Key tools: ecosystem reporting, risk assessment, management strategy evaluation
  - Developing decision processes along with products



## Including ecosystem information at the species level: Ecosystem Socioeconomic Profiles (ESPs)

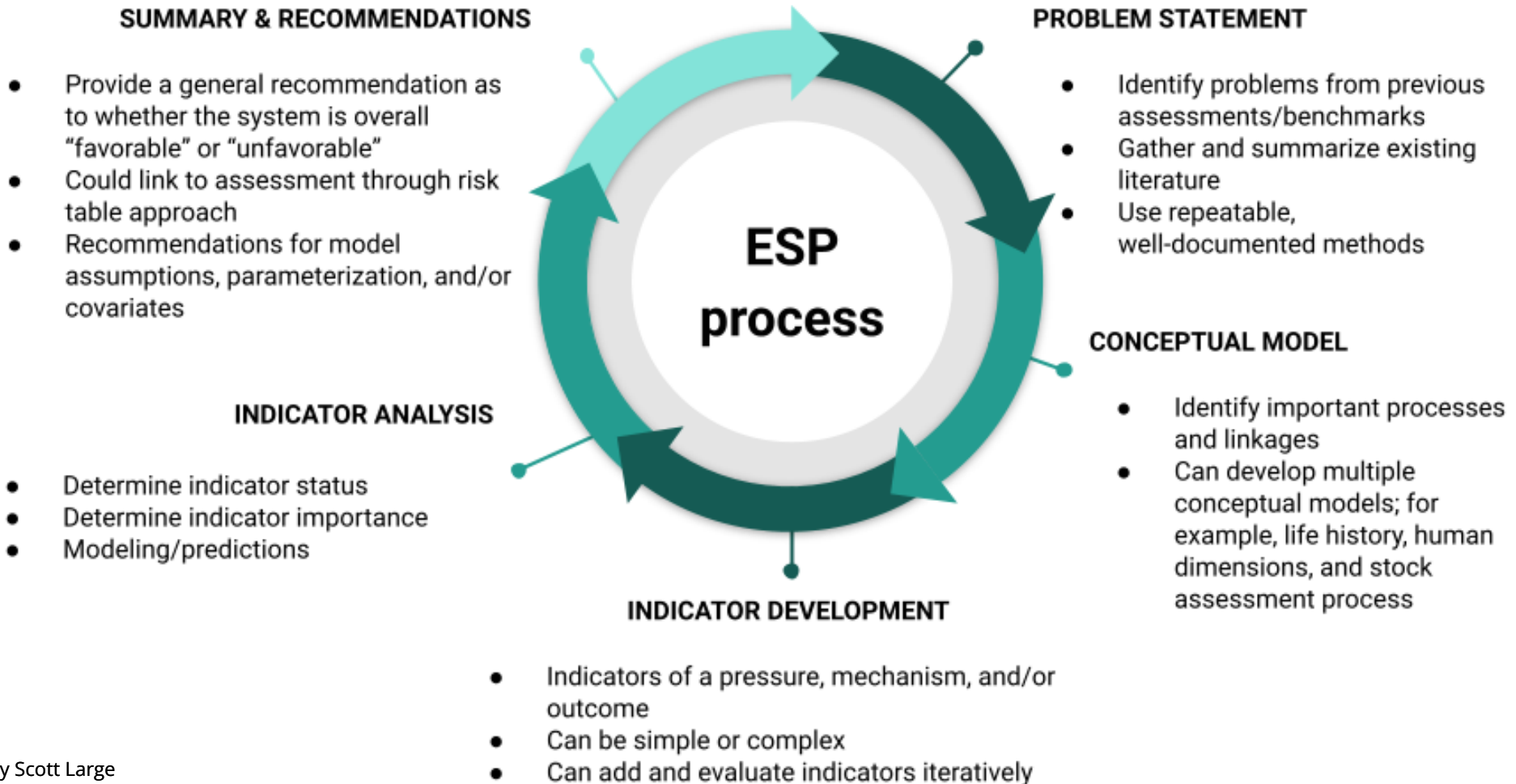


| Indicator category | Indicator                                                         | 2017 Status | 2018 Status | 2019 Status | 2020 Status | 2021 Status |
|--------------------|-------------------------------------------------------------------|-------------|-------------|-------------|-------------|-------------|
| Physical           | Spawning Heatwave GOA Model                                       | neutral     | neutral     | high        | neutral     | neutral     |
|                    | Winter Spring Pacific Cod Spawning Habitat Suitability GAK1 Model | neutral     | neutral     | low         | neutral     | neutral     |
|                    | Summer Temperature Bottom GOA Model                               | neutral     | neutral     | high        | neutral     | neutral     |
|                    | Annual Eddy Kinetic Energy Kodiak Satellite                       | neutral     | neutral     | neutral     | high        | neutral     |
| Lower Trophic      | Spring Chlorophyll a Peak WCGOA Satellite                         | low         | low         | high        | low         | neutral     |
|                    | Summer Large Copepod Abundance Shelikof Survey                    | low         | NA          | neutral     | NA          | NA          |
|                    | Summer Euphausiid Abundance Kodiak Survey                         | low         | NA          | neutral     | NA          | NA          |
|                    | Spring Pacific Cod CPUE Larvae Shelikof Survey                    | neutral     | NA          | neutral     | NA          | neutral     |
|                    | Annual Common Murre Reproductive Success Chowiet Survey           | neutral     | neutral     | high        | NA          | neutral     |
|                    | Summer Pacific Cod Condition Juvenile GOA Survey                  | neutral     | NA          | neutral     | NA          | neutral     |
| Upper Trophic      | Summer Pacific Cod Condition Adult GOA Survey                     | neutral     | NA          | neutral     | NA          | neutral     |
|                    | Summer Pacific Cod Center Gravity Northeast WCGOA Model           | low         | NA          | high        | NA          | neutral     |

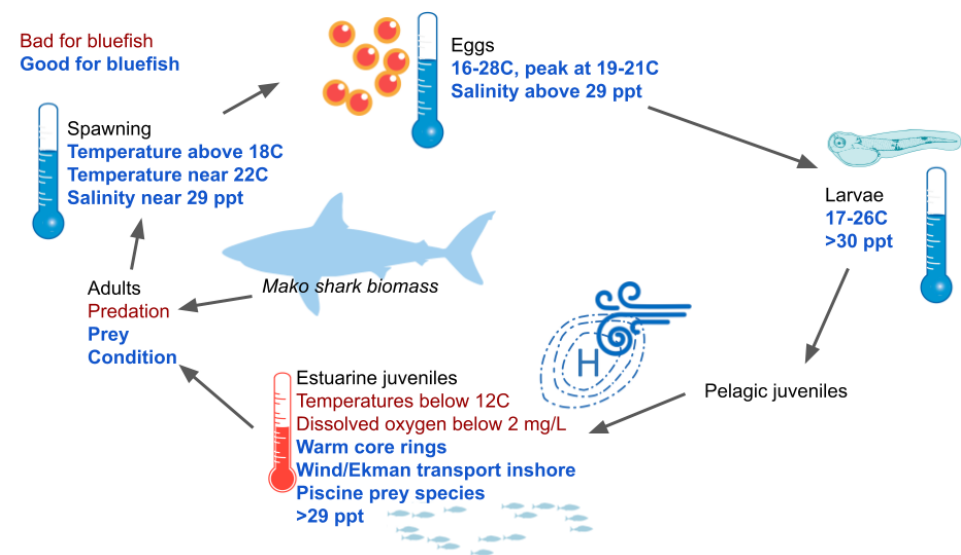
Pacific cod example from ASFC: <https://www.fisheries.noaa.gov/alaska/2021-alaska-fisheries-science-center-year-review> and <https://apps-afsc.fisheries.noaa.gov/refm/docs/2021/GOApcod.pdf>

# ESP process is adaptable to many assessment situations

## Northeast ecosystem and socioeconomic profiles (NE-ESP)



# Bluefish ESP reviewed December 2022



## Ecosystem indicators summary

| Indicator category | Indicator                                                                        | 2017 Status | 2018 Status | 2019 Status | 2020 Status | 2021 Status |
|--------------------|----------------------------------------------------------------------------------|-------------|-------------|-------------|-------------|-------------|
| Distribution       | Fall center of gravity of small (<=30.3cm) bluefish (northings, km)              | neutral     | high        | neutral     | NA          | NA          |
|                    | Fall center of gravity of medium (30.3-50.0cm) bluefish (northings, km)          | neutral     | neutral     | high        | NA          | NA          |
|                    | Fall center of gravity of large (>=50.0cm) bluefish (northings, km)              | neutral     | high        | high        | NA          | NA          |
|                    | Fall center of gravity of small (<=30.3cm) bluefish (eastings km)                | neutral     | neutral     | neutral     | NA          | NA          |
|                    | Fall center of gravity of medium (30.3-50.0cm) bluefish (eastings km)            | neutral     | neutral     | high        | NA          | NA          |
|                    | Fall center of gravity of large (>=50.0cm) bluefish (eastings km)                | neutral     | neutral     | high        | NA          | NA          |
| Climate            | First day of the year when the mean temperature of the region is warmer than 18C | neutral     | neutral     | neutral     | neutral     | low         |
|                    | Last day of the year when the mean temperature of the region is warmer than 18C  | high        | neutral     | neutral     | high        | high        |
|                    | Number of days when at least 75% of the region is warmer than 18C                | high        | neutral     | neutral     | neutral     | high        |
|                    | Proportion of the central Atlantic colder than 18C in July                       | neutral     | neutral     | neutral     | low         | low         |
|                    | Proportion of the central Atlantic between 18-25.6C in July                      | neutral     | neutral     | low         | low         | high        |
|                    | Proportion of the central Atlantic warmer than 25.6C in July                     | neutral     | neutral     | high        | high        | neutral     |
|                    | Mean crossshore wind in the central Atlantic in April and May                    | neutral     | high        | neutral     | low         | low         |
| Natural mortality  | Mean alongshore wind in the central Atlantic in April and May                    | low         | high        | low         | neutral     | neutral     |
|                    | Spring condition of small (<=30.3cm) bluefish                                    | neutral     | neutral     | neutral     | low         | neutral     |
|                    | Spring condition of medium (30.3-50.0cm) bluefish                                | neutral     | neutral     | neutral     | high        | neutral     |
|                    | Spring condition of large (>=50.0cm) bluefish                                    | low         | neutral     | high        | high        | high        |
|                    | Fall condition of small (<=30.3cm) bluefish                                      | neutral     | neutral     | neutral     | high        | high        |
|                    | Fall condition of medium (30.3-50.0cm) bluefish                                  | neutral     | neutral     | neutral     | high        | high        |
|                    | Fall condition of large (>=50.0cm) bluefish                                      | neutral     | high        | neutral     | high        | neutral     |

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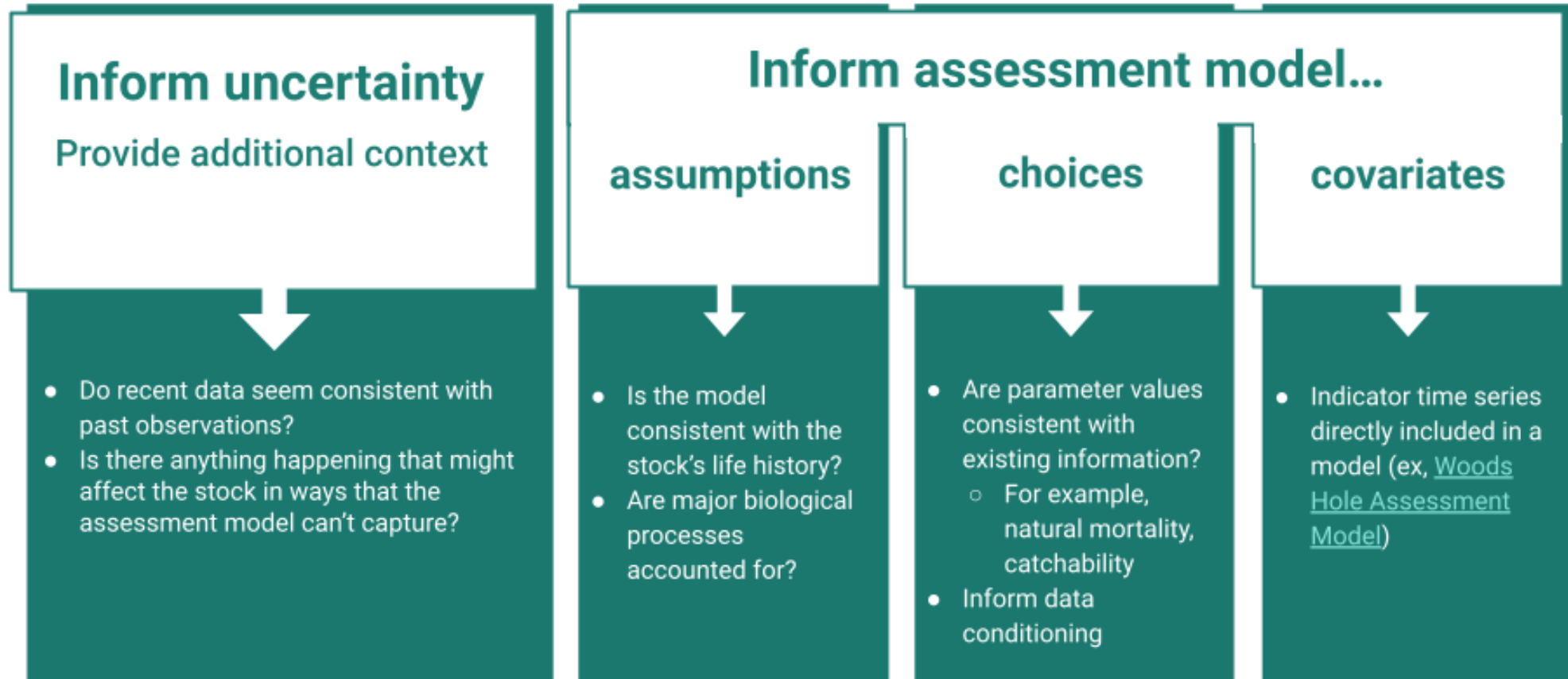
Reviewers commented that it was the most complete treatment of a stock assessment "ecosystem ToR" they had seen, and formed a good basis for integrating further ecosystem information into the stock assessment in the future.

The full ESP document is available as a working paper from the [stock assessment data portal](#)

Potential use of summary table in OFL CV or other decisions?

## Ecosystem information can be used in decisions even if not directly in the stock assessment

### Pathways for scientific advice



# The Mid-Atlantic Fishery Management Council (MAFMC)



Summer Flounder, Scup, Black Sea Bass



Spiny Dogfish



Mackerel, Squid, Butterfish



Bluefish



Surfclam and Ocean Quahog

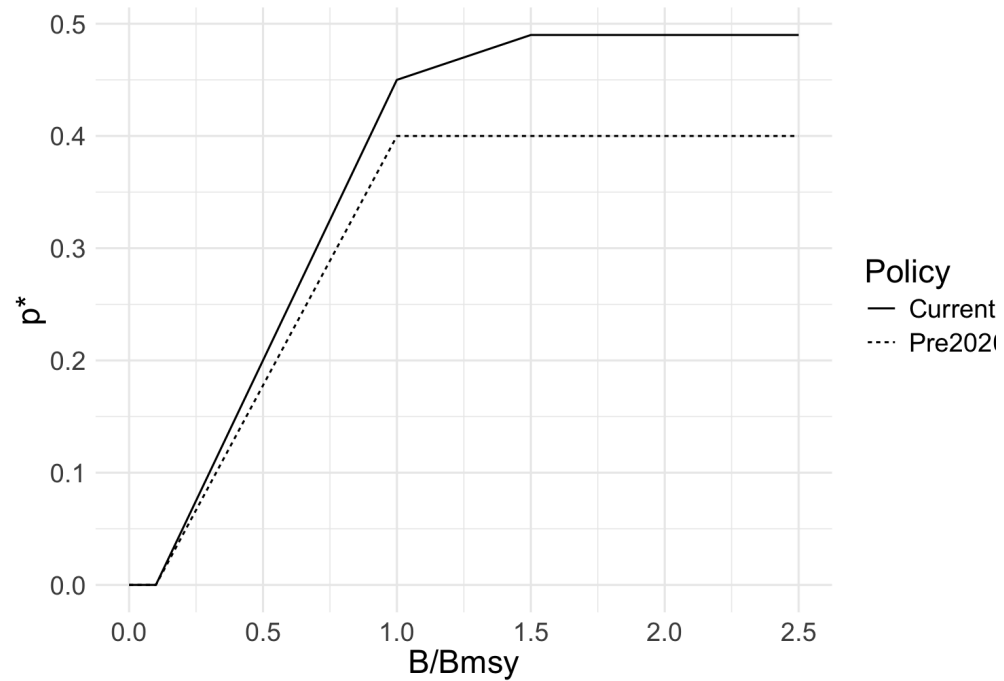


Tilefish

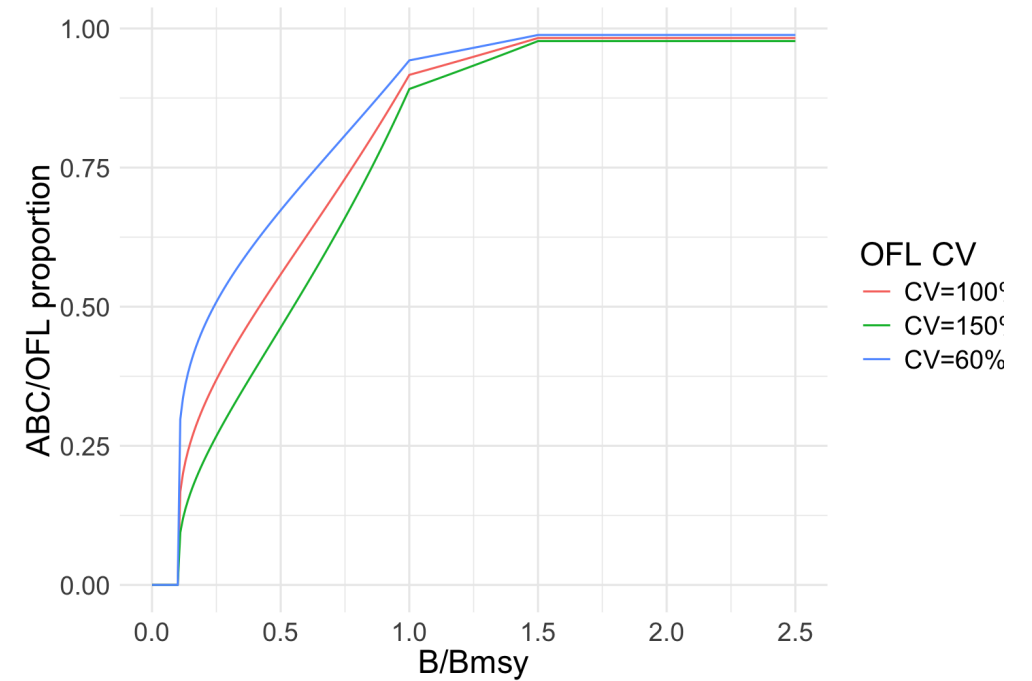


# Acceptable Biological Catch (ABC) determination: MAFMC approach

## Council Risk Policy



## ABC proportion of OFL given OFL CV



## How to get the OFL CV? Characterizing scientific uncertainty

### SSC evaluates 9 criteria

1. Data quality
2. Model appropriateness
3. Retrospective analysis
4. Comparison with simpler analysis
5. Ecosystem factors
6. Recruitment trends
7. Prediction error
8. Informative F
9. Simulations/MSE

### 5. Informed by ecosystem factors or comparisons with other species

a. Stock-relevant ecosystem factors directly included in the assessment model, e.g.,:

- Environmentally dependent growth or other population processes;
- Factors limiting/enhancing stock productivity (habitat quality, etc.);
- Predation, disease, or episodic environmental mortality (e.g., red tide);

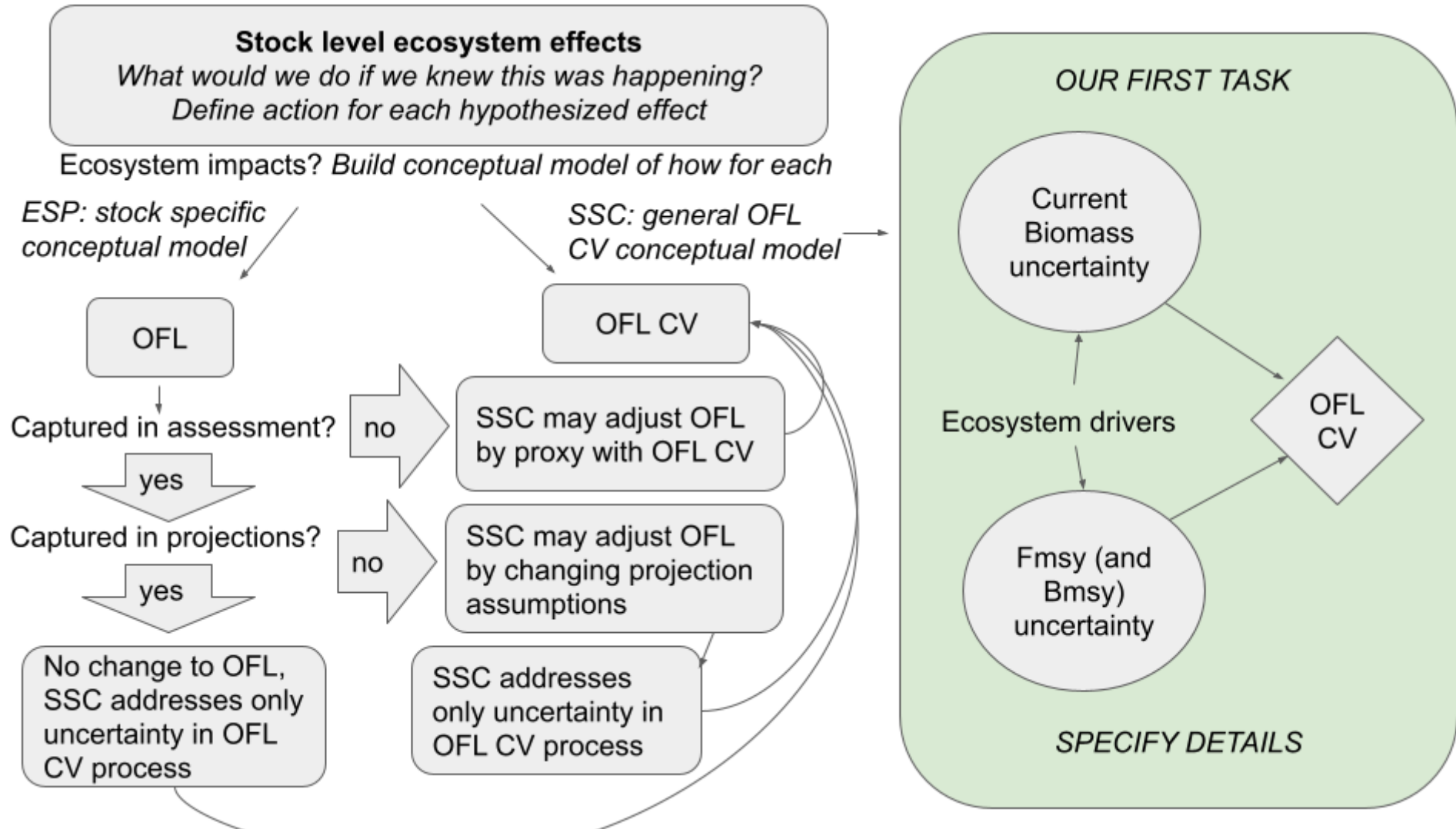
b. Ecosystem factors outside the stock assessment affecting short term prediction

- General measures of ecosystem productivity and habitat stability (e.g., primary production amount and timing, temperature trends, etc.);
- Comparisons among related species; e.g., recruitment, growth, condition patterns across Mid Atlantic fish species stable, varying synchronously, or varying unpredictably;
- Climate vulnerability or other risk assessment evaluation of potential for changing productivity under changing conditions.

## Characterizing scientific uncertainty from ecosystem factors

| Decision Criteria           | Default OFL CV = 60%                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | Default OFL CV = 100%                                                                                                                                                                                                                                                                                                                                                                                                                                              | Default OFL CV = 150%                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
|-----------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Data quality                | One or more synoptic surveys over stock area for multiple years. High quality monitoring of landings size and age composition. Long term, precise monitoring of discards. Landings estimates highly accurate.                                                                                                                                                                                                                                                                                                               | Low precision synoptic surveys or one or more regional surveys which lack coherency in trend. Age and/or length data available with uncertain quality. Lacking or imprecise discard estimates. Moderate accuracy of landings estimates                                                                                                                                                                                                                             | No reliable abundance indices. Catch estimates are unreliable. No age and/or length data available or highly uncertain. Natural mortality rates are unknown or suspected to be highly variable. Incomplete or highly uncertain landings estimates                                                                                                                                                                                                                                            |
| ...                         | ...                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | ...                                                                                                                                                                                                                                                                                                                                                                                                                                                                | ...                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| Ecosystem factors accounted | Assessment considered habitat and ecosystem effects on stock productivity, distribution, mortality and quantitatively included appropriate factors reducing uncertainty in short term predictions. Evidence outside the assessment suggests that ecosystem productivity and habitat quality are stable. Comparable species in the region have synchronous production characteristics and stable short-term predictions. Climate vulnerability analysis suggests low risk of change in productivity due to changing climate. | Assessment considered habitat/ecosystem factors but did not demonstrate either reduced or inflated short-term prediction uncertainty based on these factors. Evidence outside the assessment suggests that ecosystem productivity and habitat quality are variable, with mixed productivity and uncertainty signals among comparable species in the region. Climate vulnerability analysis suggests moderate risk of change in productivity from changing climate. | Assessment either demonstrated that including appropriate ecosystem/habitat factors increases short-term prediction uncertainty, or did not consider habitat and ecosystem factors. Evidence outside the assessment suggests that ecosystem productivity and habitat quality are variable and degrading. Comparable species in the region have high uncertainty in short term predictions. Climate vulnerability analysis suggests high risk of changing productivity from changing climate. |

## Making improved use of ecosystem information in OFL CV decisions



## SSC Ecosystem working group analyses in progress

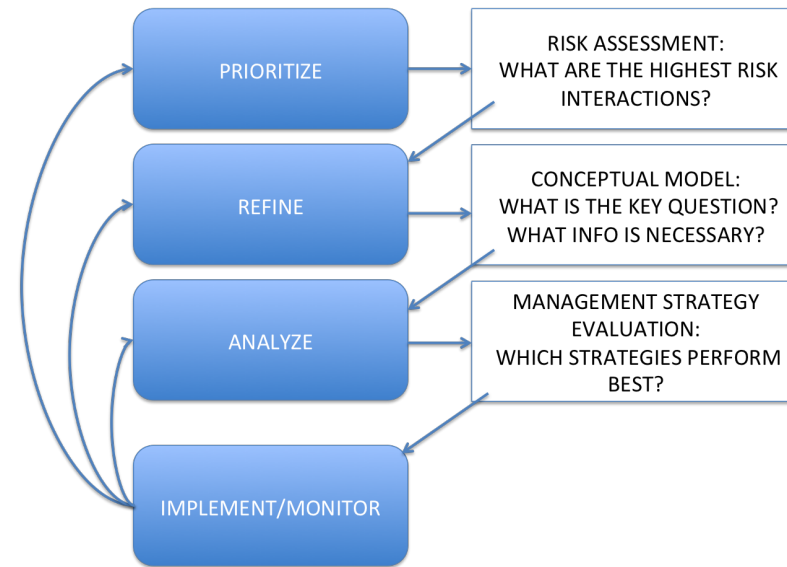
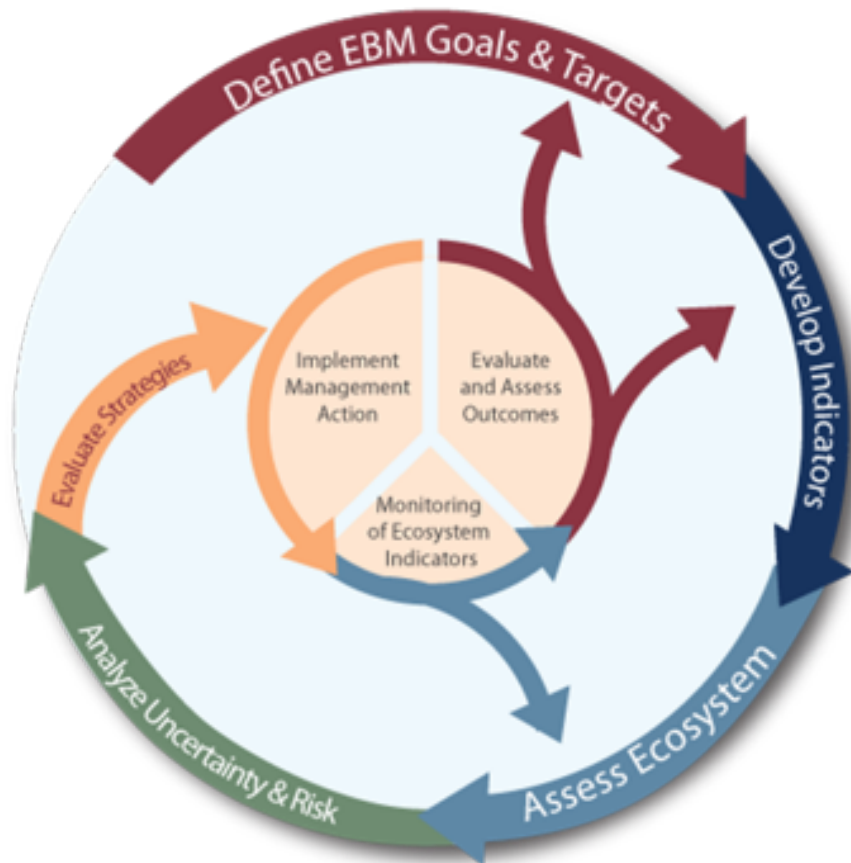
- Using explicit ecosystem drivers in OFL CV decision
  - For selected stocks representing a range of life history types
    - Which ecosystem factors affect uncertainty in current stock biomass and  $F_{msy}$ ?
    - Conceptual model mapping ecosystem factors to stock processes
    - Which current ecosystem indicators best match relevant ecosystem factors?
    - Simulation analysis: do changes in those indicators predictably change uncertainty?
- *Starting with existing summer flounder MSE framework, focusing on recruitment drivers*
- *Evaluating both benefits of correct decision and costs of incorrect decision*

## SSC Ecosystem working group analyses in progress

- Using explicit ecosystem drivers in OFL CV decision
  - For selected stocks representing a range of life history types
    - Which ecosystem factors affect uncertainty in current stock biomass and Fmsy?
    - Conceptual model mapping ecosystem factors to stock processes
    - Which current ecosystem indicators best match relevant ecosystem factors?
    - Simulation analysis: do changes in those indicators predictably change uncertainty?
- *Starting with existing summer flounder MSE framework, focusing on recruitment drivers*
- *Evaluating both benefits of correct decision and costs of incorrect decision*
- Outlining multispecies and system level advice: identify initial priorities in collaboration with Council
  - Where are there multispecies/multifleet tradeoffs linking to economic and social outcomes?
  - Are there multi-indicator thresholds suggesting when FMP level management needs to change?
  - Are there changes in ecosystem productivity that imply standardized approaches for
    - Setting reference points?
    - Developing rebuilding plans?
    - Other analyses requiring short-term projections?
- *More direct SSC involvement in ecosystem reporting priorities MAFMC EAFM*
- *Evaluate current multispecies indicators for common signals*
- *Evaluate proposed ecosystem-level reference points and thresholds for regional ecosystems*

# Integrated Ecosystem Assessment and the MAFMC Ecosystem Approach

Diverse stakeholders agreed that an ecosystem approach was necessary. Developing and implementing EAFM is done in collaboration between managers, stakeholders, and scientists. <https://www.mafmc.org/eafm>

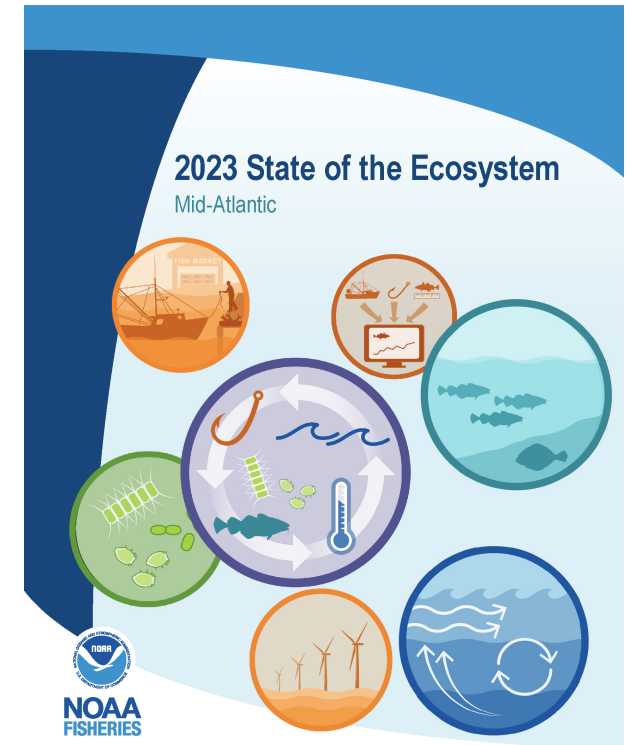


- Direct link between ecosystem reporting and risk assessment
- Conceptual model links across risk elements for fisheries, species
- Management strategy evaluation includes key risks

# Northeast US State of the Ecosystem (SOE) reporting

## Improving ecosystem information and synthesis for fishery managers

- Ecosystem indicators linked to management objectives (DePiper et al., 2017)
  - Contextual information
  - Annual reporting since 2016
  - Fishery-relevant subset of full Ecosystem Status Reports
- Open science emphasis (Bastille et al., 2021)
- Used within Mid-Atlantic Fishery Management Council's Ecosystem Process (Muffley et al., 2021)
  - Risk assessment (Gaichas et al., 2018)
  - Conceptual modeling (DePiper et al., 2021)
  - Management strategy evaluation (MSE)



# State of the Ecosystem Summary 2023:

## Performance relative to management objectives

Seafood production  

Profits  

Recreational opportunities: Effort  ; Effort diversity  

Stability: Fishery  ; Ecological  

Social and cultural, trend not evaluated, status of:

- Fishing engagement and reliance by community
- Environmental Justice (EJ) Vulnerability by community

Protected species:

- Maintain bycatch below thresholds  
- Recover endangered populations (NARW)  

## Performance Relative to Fishery Management Objectives

Trends and status of indicators related to broad ecosystem-level fishery management objectives, with implications for the Mid-Atlantic Fishery Management Council (MAFMC)

| OBJECTIVE<br>(Indicator)                                                                                        | TREND                                                                                                 | CURRENT<br>STATUS                                                                                                | IMPLICATIONS                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
|-----------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Seafood production</b><br>(total and MAFMC managed landings)                                                 | <br>Decline        | <br>Below long term average   | Commercial landings are at the lowest point observed, driven by recent declines in species not managed by the Mid-Atlantic Council. Recreational harvest is declining due to multiple drivers. COVID-19 likely exacerbated existing trends, but impacts are not uniform across fisheries.<br>Biomass trends within the ecosystem continue to be stable. Climate indicators continue to exceed historical bounds, which affects stock distributions and will generate other ecosystem changes. |
| <b>Commercial profits</b>                                                                                       | <br>Decline        | <br>Below long term average   | Regional commercial revenue is the lowest that has been observed, driven in part by managed clam species. Falling prices are almost universal and due to market dynamics including COVID-19 impacts.<br>Monitor climate risks to surfclams and ocean quahogs.                                                                                                                                                                                                                                 |
| <b>Recreational opportunities</b><br>(effort and fleet diversity)                                               | <br>No trend       | <br>Near long term average    | Recreational effort shows no long term trend and is near average, but fleet diversity is decreasing because of a shift away from party/charter to shore-based fishing. This shift results in a decreased range of recreational fishing opportunities. Shore-based anglers will have access to different species/sizes of fish than vessel-based anglers.                                                                                                                                      |
|                                                                                                                 | <br>Decline        | <br>Below long term average   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| <b>Stability</b><br>(fishery and ecosystem diversity maintained over time)                                      | <br>No trend       | <br>Near long term average    | Commercial: Fleet diversity metrics suggest stable capacity to respond to the current range of fishing opportunities.<br>Recreational: Species catch diversity has been maintained by a different set of species over time and continues to be above the long-term mean.<br>Ecosystem: Adult fish diversity indices are stable, but several climate and oceanography metrics are changing and should be monitored as warning signs for potential regime shift or ecosystem restructuring.     |
|                                                                                                                 | <br>Mixed trends   | <br>Near long term average    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| <b>Social and cultural</b><br>(community fishery engagement, reliance, and environmental justice vulnerability) | <b>Status only indicator</b>                                                                          | <b>Environmental justice status for top commercial and recreational communities</b>                              | These indicators are used to identify top fishing communities and those with environmental justice concerns based on 2020 data. Highlighted communities may be vulnerable to changes in fishing patterns due to regulations and/or climate change. When any of these communities also experience environmental justice issues, they may have lower ability to successfully respond/adapt to change. The top Mid Atlantic recreational communities changed between 2019 and 2020.              |
| <b>Protected species</b><br>(coastwide bycatch, population numbers, mortalities)                                | <br>Mixed trends | <br>Meeting objectives      | Mixed bycatch trends through 2021 are related to fishery management, shifts in population distribution combined with fishery shifts, and population increase for seals. Recent bycatch data is uncertain.<br>Population drivers for North Atlantic Right Whales (NARW) include combined fishery interactions/vessel strikes, distribution shifts, and copepod availability.<br>Unusual mortality events continue for 3 large whale species.                                                   |
|                                                                                                                 | <br>Decline      | <br>Below long term average |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |

- Current revenue in proposed areas
  - 1-34% by port (some with EJ concerns)
  - up to 17% by managed species
- Different development impacts for species preferring soft bottom vs. hard bottom
- Overlap with important right whale foraging habitats, increased vessel strike and noise risks
- Rapid buildout in patchwork of areas
- Scientific survey mitigation required

## Risks to Meeting Fishery Management Objectives

## Climate and Ecosystem Productivity Risks

Climate change, most notably ocean warming and changes in the Gulf Stream, continue to affect the Mid-Atlantic ecosystem:

- 2022 was among the warmest years on record in the North Atlantic, with both long term surface and bottom warming observed in the Mid-Atlantic.
- The Gulf Stream is becoming less stable and moving further north, which can affect the physics, chemistry, and biology of the Northeast Shelf.
- The cold pool is becoming warmer, smaller, and shorter in duration, which affects habitat for multiple federally managed species.
- Ocean acidification in western Long Island Sound, nearshore to mid-shelf waters of the Mid-Atlantic

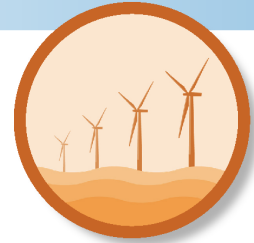


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- many managed fish and marine mammal species, complicating regional management by changing fishing patterns and risks.
- Fish condition was mixed in 2022, and fish productivity is declining for many managed species.

## Other Ocean Uses: Offshore Wind Risks

More than 31 offshore wind development projects are proposed for construction on the Northeast shelf, covering more than 2.4 million acres by 2030. Additional large areas are being considered. In existing and proposed leases of the Northeast:

- 
- 1–34% of port revenue from fisheries currently comes from areas proposed for offshore wind development.
    - Core medium- to long-term concerns and potential impacts include:
      - Displacement of fisheries and revenue loss in lease areas
      - Potential to affect species that prefer soft-bottom habitats and non-fishing species
      - Potential impacts on important right whale foraging and oceanography
      - Potential for increased vessel strike risk and the potential impacts of pile driving noise.
  - Scientific surveys are key to understanding the impacts of climate change and other drivers on managed species, and inform management advice. Planning for impacts to scientific surveys is in progress.
  - Current plans for rapid buildout in a patchwork of areas would spread the impacts differentially throughout the region.



## Implications: Climate change and Mid-Atlantic managed species

Climate\*: 6 low, 3 low-mod, 4 mod-high, 1 high risk

*Multiple drivers with different impacts by species*

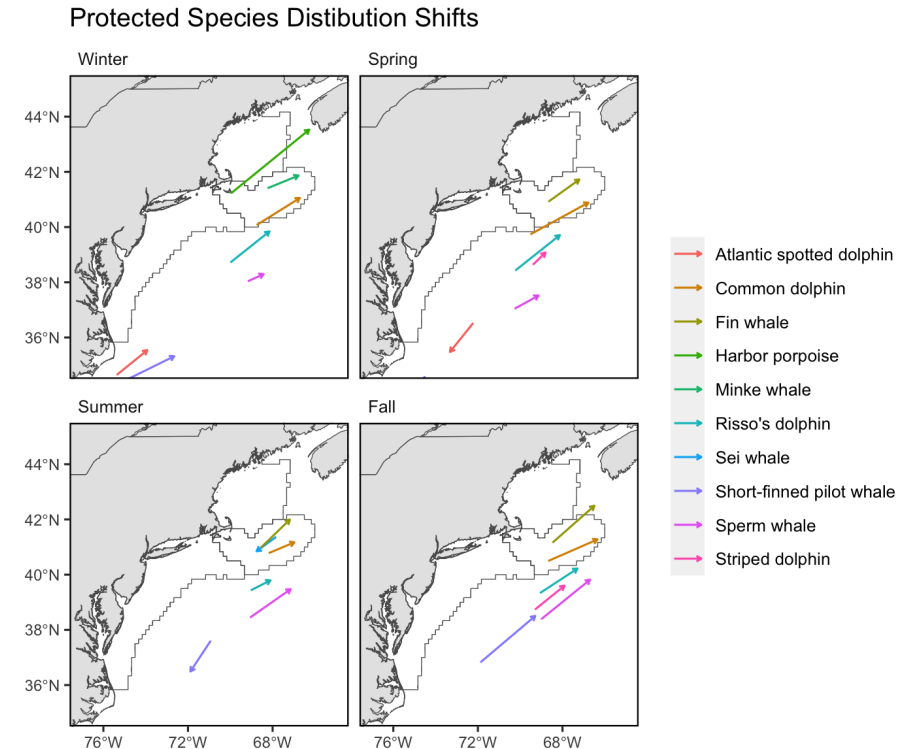
- Seasonal estuarine conditions affect life stages of striped bass, blue crabs, summer flounder, black sea bass differently
- Ocean acidification approaching sensitivity thresholds in commercial shellfish habitats
- Gulf stream warm core rings more abundant, important to shortfin squid availability

\*Climate vulnerability and Distribution Shift risk levels from climate vulnerability analysis (Hare et al., 2016)

DistShift\*: 2 low, 9 mod-high, 3 high risk species

- Managed species shifts already impacting allocation discussions

### *New Indicator: protected species shifts*

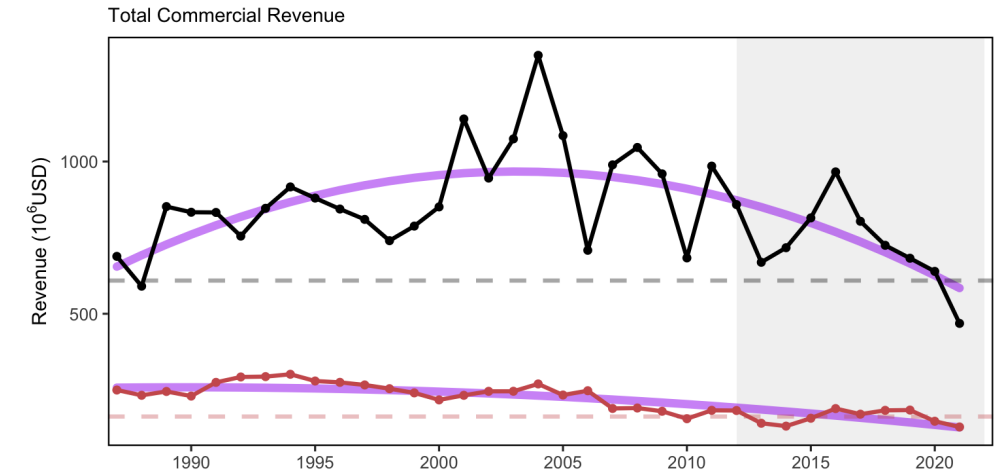


## State of the Ecosystem → MAFMC Risk assessment example: Commercial revenue

This element is applied at the ecosystem level. Revenue serves as a proxy for commercial profits.

| 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    |

Ranked moderate-high risk due to the significant long term revenue decrease



Key: Black = Revenue of all species combined; Red = Revenue of MAFMC managed species

Risk element: **CommRev**, unchanged

SOE Implications: Recent change driven by benthos. Monitor changes in climate and landings drivers:

- Climate risk element: **Surfclams** and **ocean quahogs** are sensitive to ocean warming and acidification.
- pH in surfclam summer habitat is approaching, but not yet at, pH affecting surfclam growth

# EAFM Risk Assessment: 2023 Update (all methods to be reviewed/revised this year)

## Species level risk elements

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

- RT assessment decreased Spiny dogfish **Assess**, risk to low and increased **Fstatus** risk to high
- RT assessment decreased bluefish **Bstatus** risk from high to low-moderate
- RT assessment increased Illex **Assess** risk from low-moderate to high

## Ecosystem level risk elements

| System       | EcoProd | CommRev | RecVal | FishRes1 | FishRes4 | FleetDiv | Social | ComFood | RecFood |
|--------------|---------|---------|--------|----------|----------|----------|--------|---------|---------|
| Mid-Atlantic | lowmod  | modhigh | lowest | lowest   | modhigh  | lowest   | lowmod | highest | modhigh |

- Recreational value risk decreased from low-moderate to low

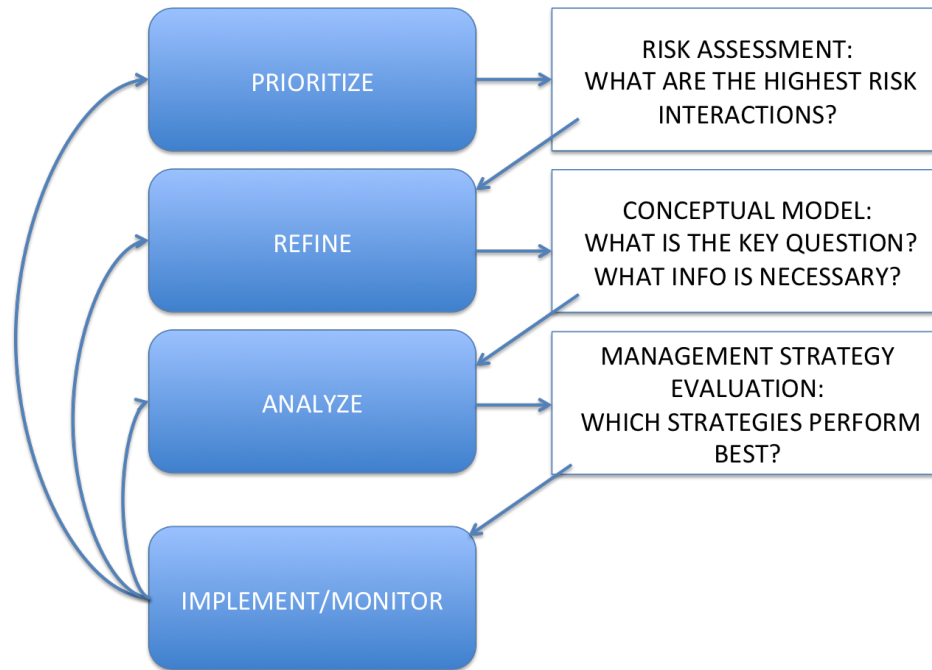
## Species and Sector level risk elements

| Species             | MgtControl | TecInteract | OceanUse | RegComplex | Discards | Allocation |
|---------------------|------------|-------------|----------|------------|----------|------------|
| Ocean Quahog-C      | lowest     | lowest      | lowmod   | lowest     | modhigh  | lowest     |
| Surfclam-C          | lowest     | lowest      | lowmod   | lowest     | modhigh  | lowest     |
| Summer flounder-R   | modhigh    | lowest      | lowmod   | modhigh    | highest  | highest    |
| Summer flounder-C   | lowmod     | modhigh     | lowmod   | modhigh    | modhigh  | lowest     |
| Scup-R              | lowmod     | lowest      | lowmod   | modhigh    | modhigh  | highest    |
| Scup-C              | lowest     | lowmod      | modhigh  | modhigh    | modhigh  | lowest     |
| Black sea bass-R    | highest    | lowest      | modhigh  | modhigh    | highest  | highest    |
| Black sea bass-C    | highest    | lowmod      | highest  | modhigh    | highest  | lowest     |
| Atl. mackerel-R     | lowmod     | lowest      | lowest   | lowmod     | lowest   | lowest     |
| Atl. mackerel-C     | lowest     | lowmod      | modhigh  | highest    | lowmod   | highest    |
| Butterfish-C        | lowest     | lowmod      | modhigh  | modhigh    | modhigh  | lowest     |
| Longfin squid-C     | lowest     | modhigh     | highest  | modhigh    | highest  | lowest     |
| Shortfin squid-C    | lowmod     | lowmod      | lowmod   | modhigh    | lowest   | highest    |
| Golden tilefish-R   | na         | lowest      | lowest   | lowest     | lowest   | lowest     |
| Golden tilefish-C   | lowest     | lowest      | lowest   | lowest     | lowest   | lowest     |
| Blueline tilefish-R | lowmod     | lowest      | lowest   | lowmod     | lowest   | lowest     |
| Blueline tilefish-C | lowmod     | lowest      | lowest   | lowmod     | lowest   | lowest     |
| Bluefish-R          | lowmod     | lowest      | lowest   | lowmod     | modhigh  | highest    |
| Bluefish-C          | lowest     | lowest      | lowmod   | lowmod     | lowmod   | lowest     |
| Spiny dogfish-R     | lowest     | lowest      | lowest   | lowest     | lowest   | lowest     |
| Spiny dogfish-C     | lowest     | modhigh     | modhigh  | modhigh    | lowmod   | lowest     |
| Chub mackerel-C     | lowest     | lowmod      | lowmod   | lowmod     | lowest   | lowest     |
| Unmanaged forage    | lowest     | lowest      | modhigh  | lowest     | lowest   | lowest     |
| Deepsea corals      | na         | na          | modhigh  | na         | na       | na         |

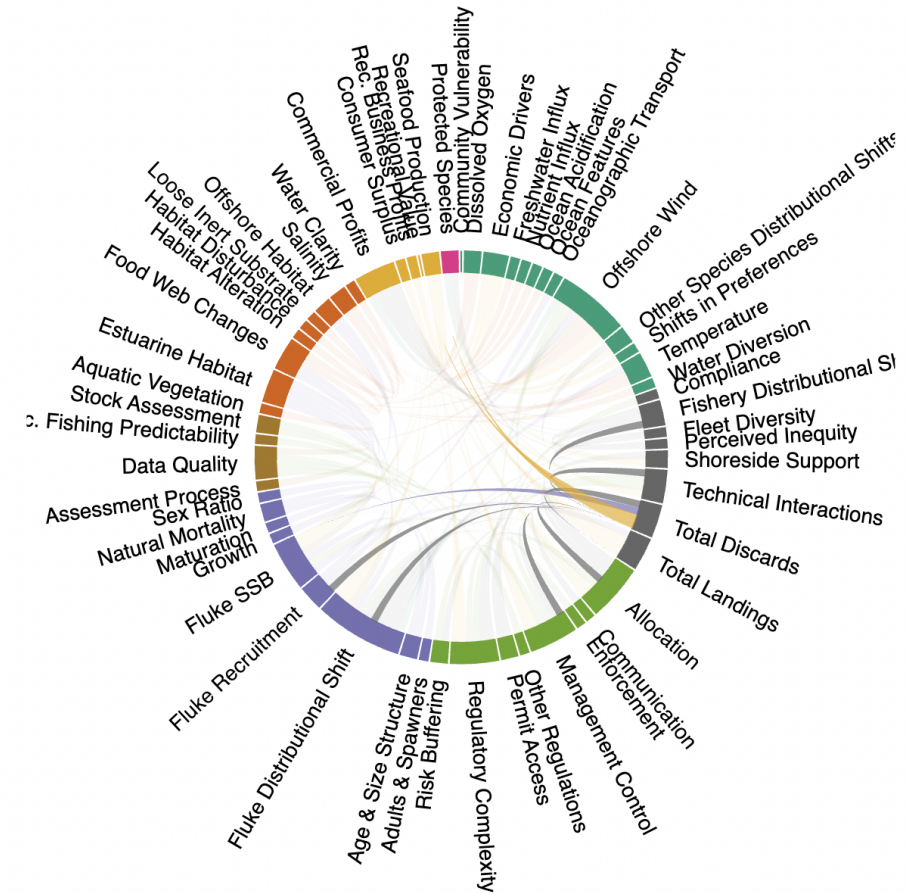
- Management section not updated--to be revised this year

## How is MAFMC using the risk assessment?

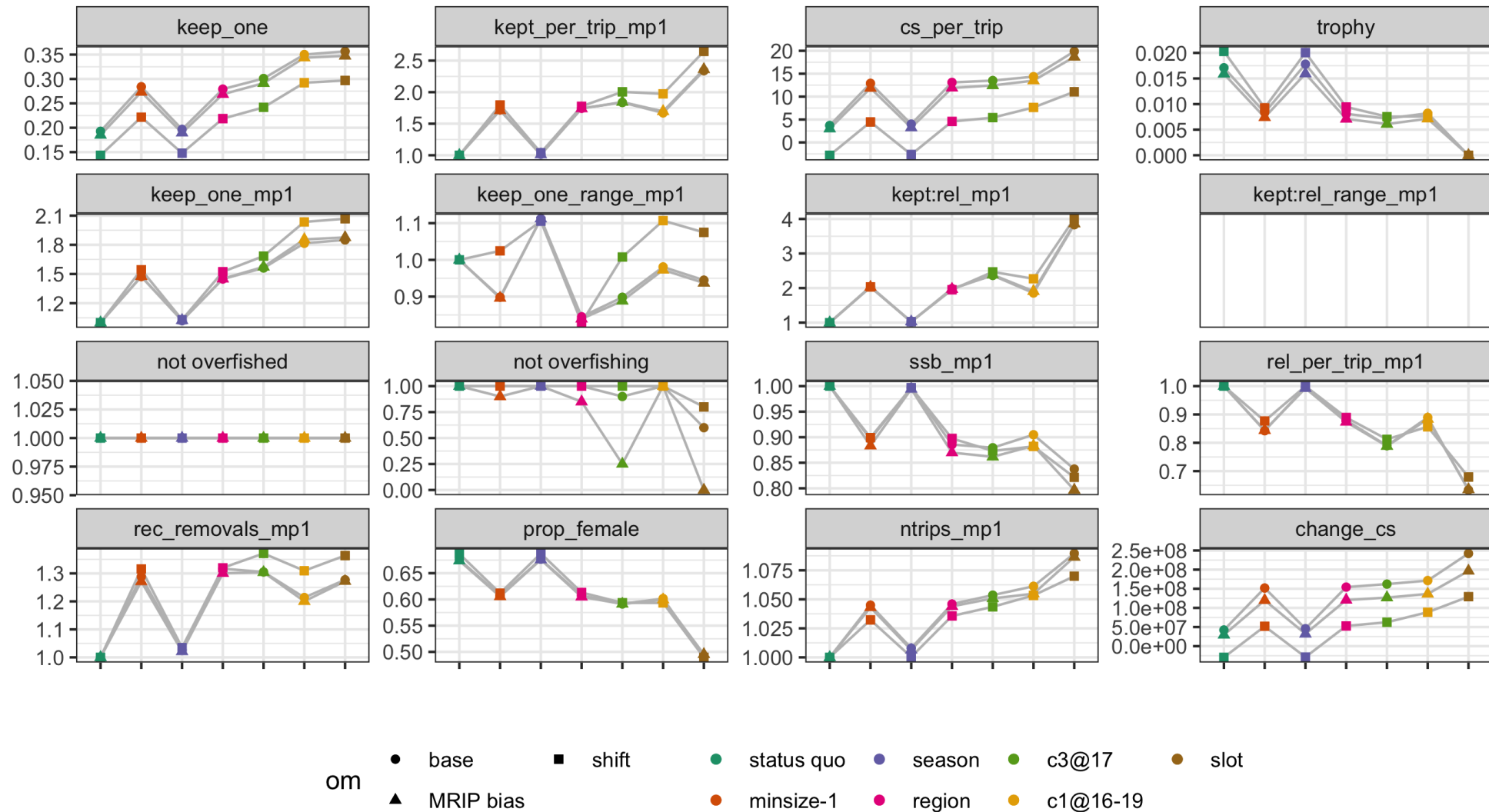
- Based on risk assessment, the Council selected summer flounder as high-risk fishery for conceptual modeling



- Council proceeding with management strategy evaluation (MSE) addressing **recreational fishery discards** using information from conceptual modeling.

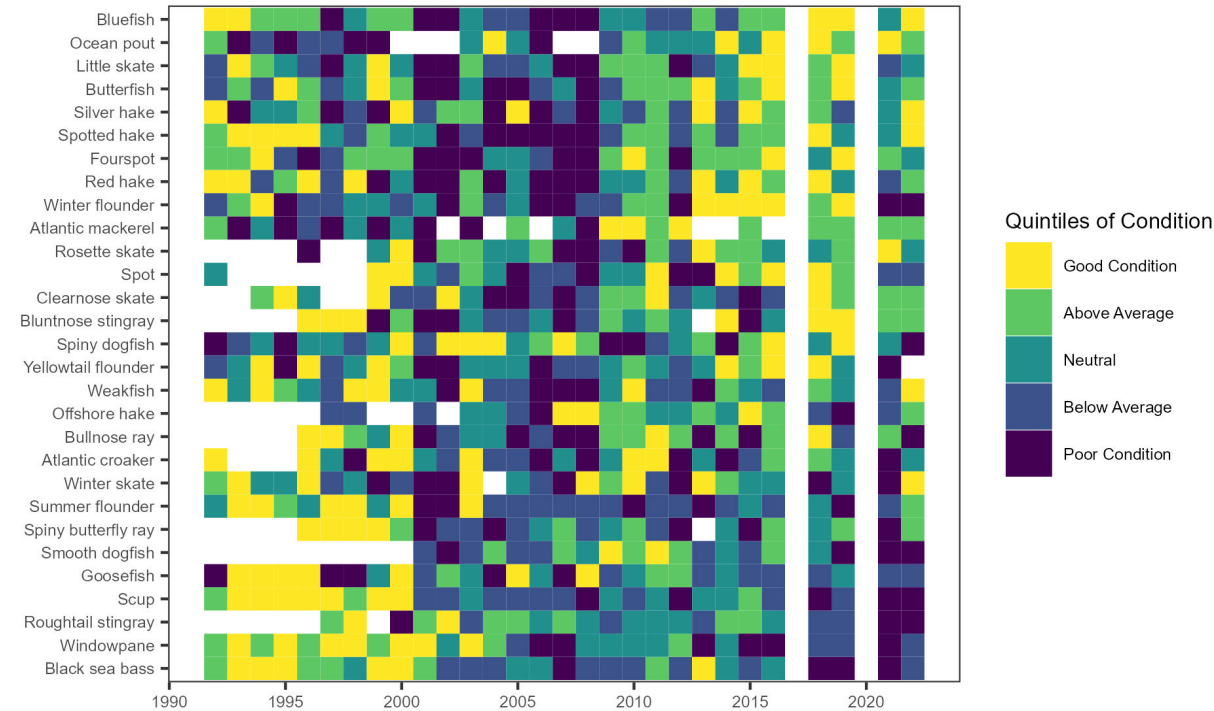


## MSE results: can improve on current management, but distribution shifts lower expectations



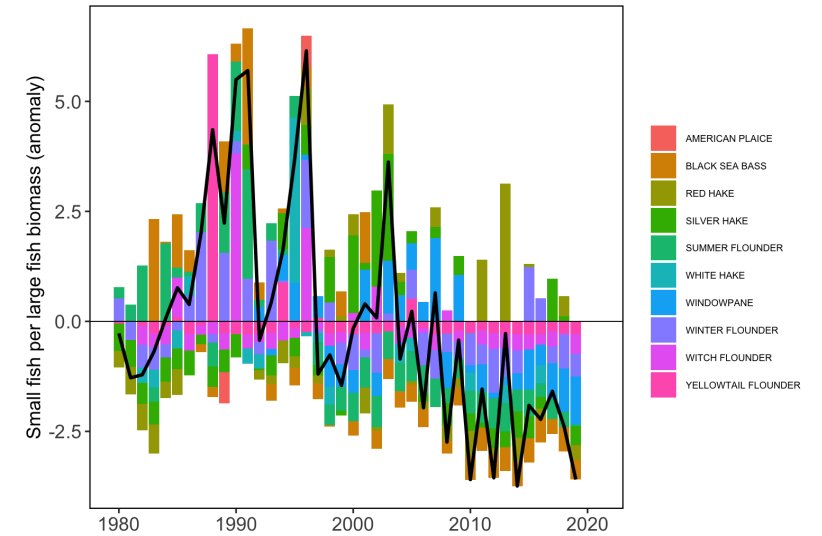
# System level decisions: Are we observing multispecies shifts?

## Indicator: fish condition

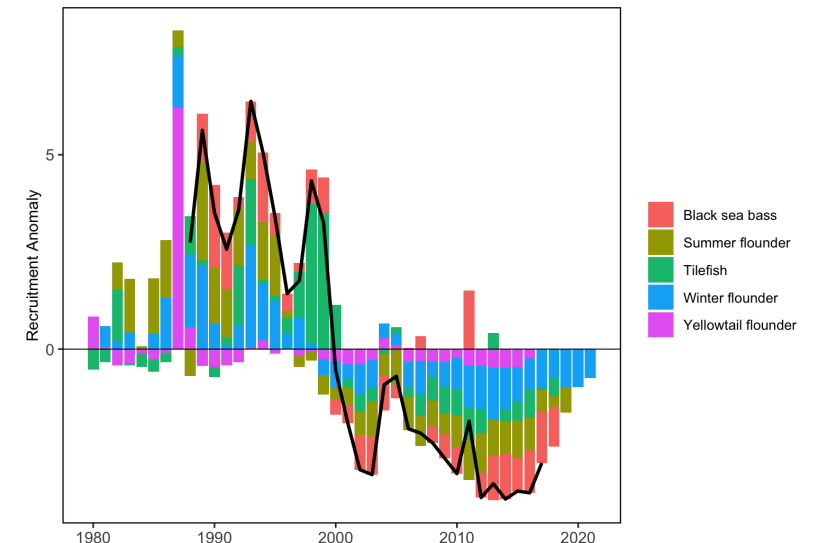


## Indicator: fish productivity anomaly →

Implications: Species in the MAB had mixed condition in 2022. Fish productivity based on surveys and assessments has been below average.



MAB Recruitment Anomaly from Stock Assessments



# System level decisions: Ecosystem Overfishing Indicators

## Operational thresholds for management?

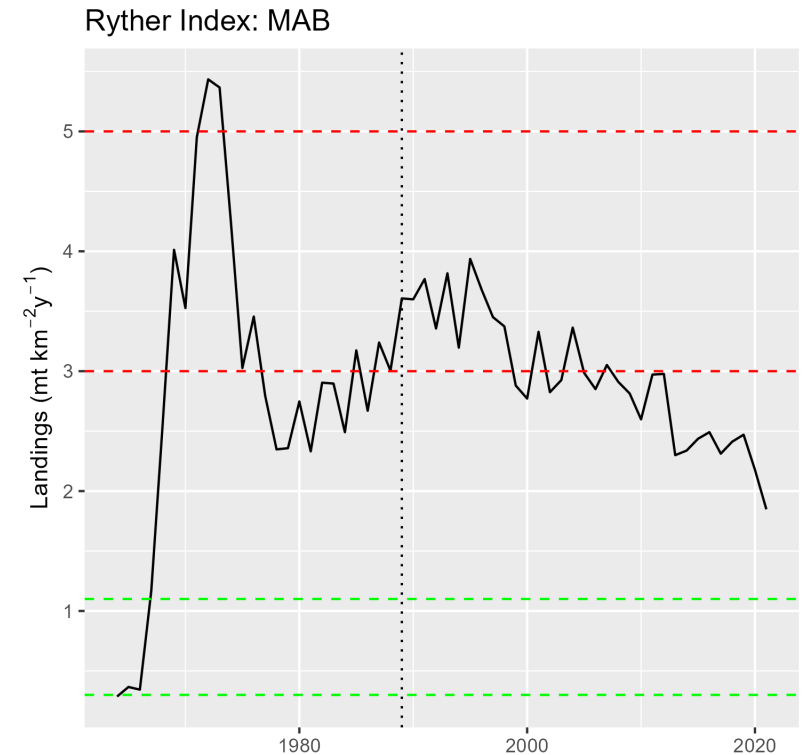
Reviewed new information and agreed with proposals:

- Updated data inputs (menhaden)
- Discard estimation still in progress
- Comparisons of data sources
- Calculate new thresholds using regional ecosystem productivity
- Simulation test thresholds within ecosystem model Atlantis

Previous SSC discussion:

- Thresholds define a "safe operating space"
  - Define the bounds where fishing causes poor system performance
  - Identify tradeoffs across species within the safe zone
- Provide advice on options to correct ecosystem overfishing
- Use social benefits to measure outcomes

What information would be most useful in decision making?



# Entry points for ecosystem information in management decisions: where to start?

## *Management decisions*

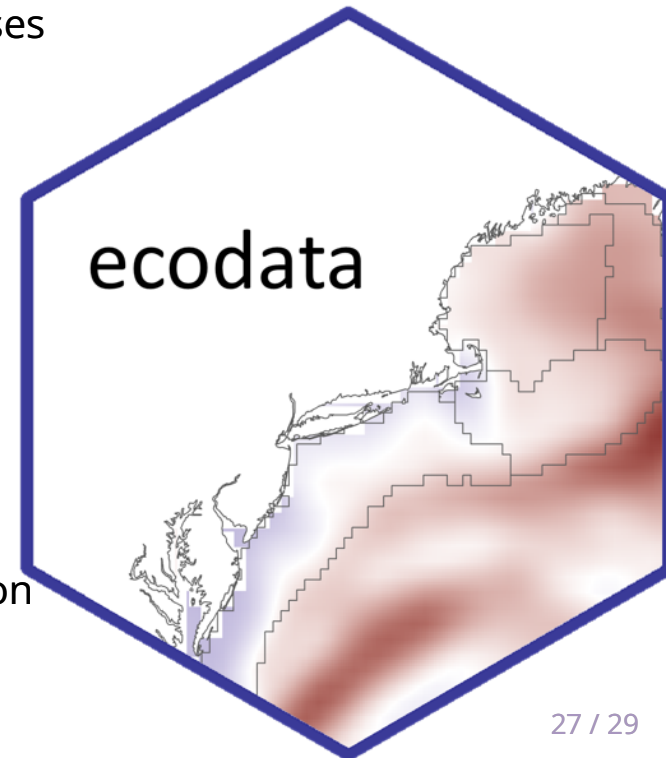
1. What are our issues and goals?
2. Current decisions
  - Stock assessments
  - Advice on catch levels
  - Harvest control rules
3. New (current) decisions
  - Habitat change or restoration
  - Changing species distribution and interactions
  - Tradeoffs between fisheries
  - Tradeoffs between ocean use sectors

## *Methods and tools*

1. Stakeholder engagement, surveys, strategic planning
2. Add information to current process
  - Ecosystem ToRs, overviews, ESP, SOE
  - Risk or uncertainty assessments
  - Management strategy evaluation
3. Integrate across current processes
  - Risk assessment
  - Conceptual models
  - Scenario planning
  - MSE (again)

Focus on developing *decision processes* that are able to use ecosystem information

- Collaborative, iterative process between scientists, managers, stakeholders
- Multispecies and system level indicators of productivity change or overexploitation



## Additional resources

- US EBFM Policy, US EBFM Roadmap
- US Integrated Ecosystem Assessments
- Northeast US Ecosystem Reports
- Ecosystem Report Technical Documentation
- ecodata R package
- MAFMC SSC
- MAFMC EAFM
- MAFMC EAFM Summer Flounder MSE
  - Slides available at <https://noaa-edab.github.io/presentations>
  - Contact: [Sarah.Gaichas@noaa.gov](mailto:Sarah.Gaichas@noaa.gov)

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Questions?

Thank you

