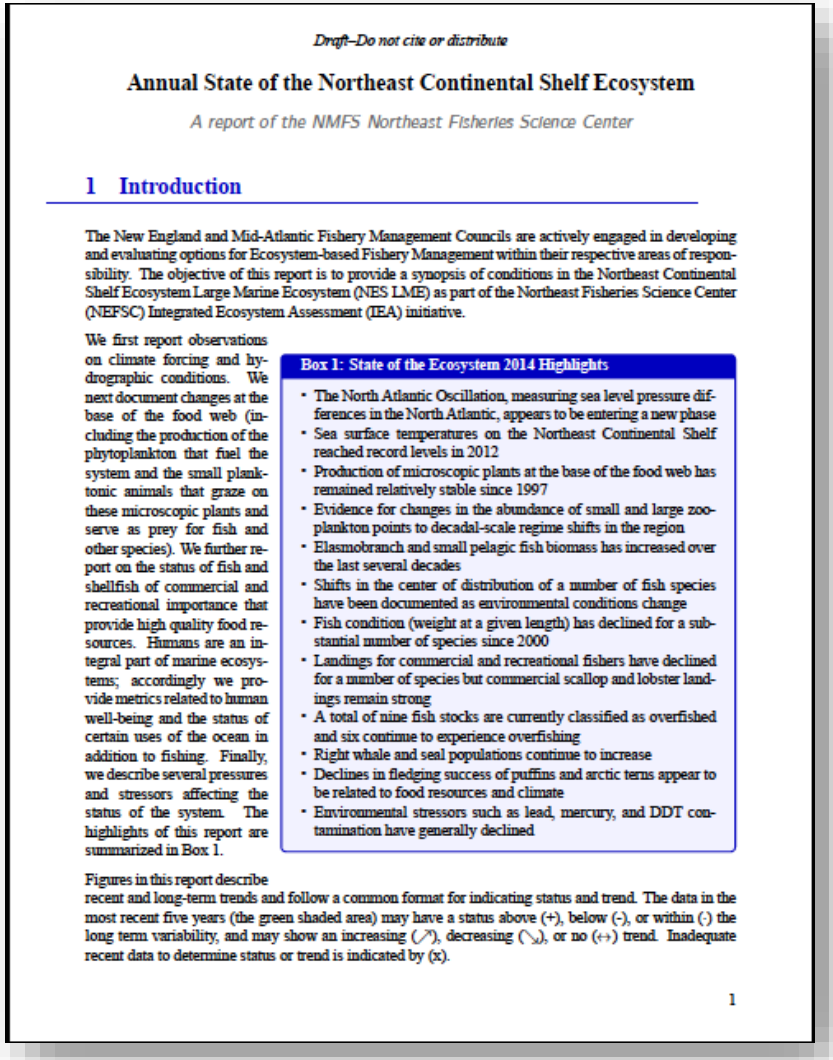
State of the Ecosystem Report: Mid-Atlantic

Sarah Gaichas, reporting on behalf of many
Northeast Fisheries Science Center contributors

Mid-Atlantic Fishery Management Council
11 April 2017

State of the Ecosystem reports, 2014-2016

- Shorter, targeted at fishery management councils
- Similar docs in other regions
- Presented to NEFMC 2014-2016
- Presented to MAFMC SSC September 2016
- To both Councils April 2017



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Annual State of the Northeast Continental Shelf Ecosystem

A report of the NMFS Northeast Fisheries Science Center

1 Introduction

The New England and Mid-Atlantic Fishery Management Councils are actively engaged in developing and evaluating options for Ecosystem-based Fishery Management within their respective areas of responsibility. The objective of this report is to provide a synopsis of conditions in the Northeast Continental Shelf Ecosystem Large Marine Ecosystem (NES LME) as part of the Northeast Fisheries Science Center (NEFSC) Integrated Ecosystem Assessment (IEA) initiative.

We first report observations on climate forcing and hydrographic conditions. We next document changes at the base of the food web (including the production of the phytoplankton that fuel the system and the small planktonic animals that graze on these microscopic plants and serve as prey for fish and other species). We further report on the status of fish and shellfish of commercial and recreational importance that provide high quality food resources. Humans are an integral part of marine ecosystems; accordingly we provide metrics related to human well-being and the status of certain uses of the ocean in addition to fishing. Finally, we describe several pressures and stressors affecting the status of the system. The highlights of this report are summarized in Box 1.

Box 1: State of the Ecosystem 2014 Highlights

- The North Atlantic Oscillation, measuring sea level pressure differences in the North Atlantic, appears to be entering a new phase
- Sea surface temperatures on the Northeast Continental Shelf reached record levels in 2012
- Production of microscopic plants at the base of the food web has remained relatively stable since 1997
- Evidence for changes in the abundance of small and large zooplankton points to decadal-scale regime shifts in the region
- Elasmobranch and small pelagic fish biomass has increased over the last several decades
- Shifts in the center of distribution of a number of fish species have been documented as environmental conditions change
- Fish condition (weight at a given length) has declined for a substantial number of species since 2000
- Landings for commercial and recreational fishers have declined for a number of species but commercial scallop and lobster landings remain strong
- A total of nine fish stocks are currently classified as overfished and six continue to experience overfishing
- Right whale and seal populations continue to increase
- Declines in fledging success of puffins and arctic terns appear to be related to food resources and climate
- Environmental stressors such as lead, mercury, and DDT contamination have generally declined

Figures in this report describe recent and long-term trends and follow a common format for indicating status and trend. The data in the most recent five years (the green shaded area) may have a status above (+), below (-), or within (·) the long term variability, and may show an increasing (↗), decreasing (↘), or no (↔) trend. Inadequate recent data to determine status or trend is indicated by (x).

1

Current revision: new outline

- Big picture
- Humans
- Resource species
- Protected species
- Ecosystem base
- Physics
- Climate

State of the Ecosystem - Mid-Atlantic

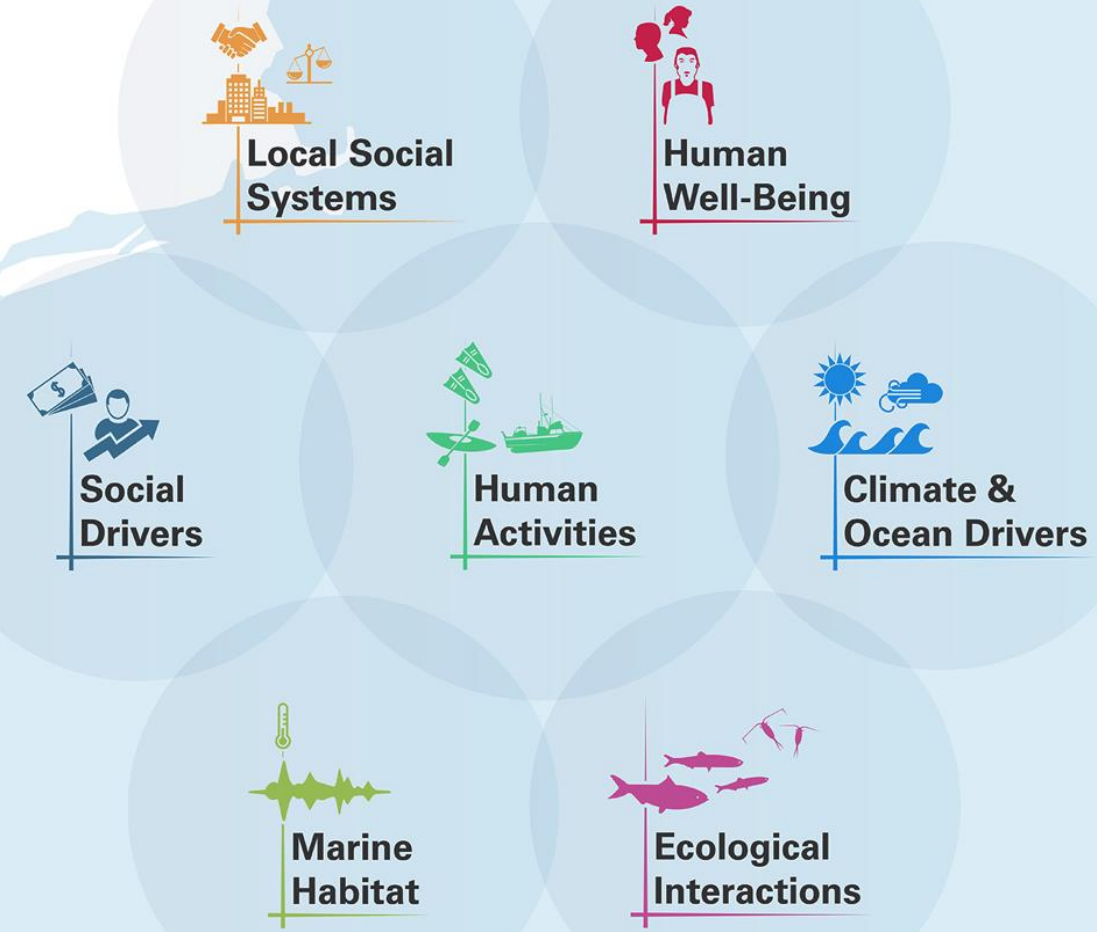
Ecosystem Dynamics and Assessment Branch, Northeast Fisheries Science Center

March 10, 2017

Contents

Start with an ecosystem conceptual model

- Highlight linkages
- Understand how human well-being is affected by changing conditions



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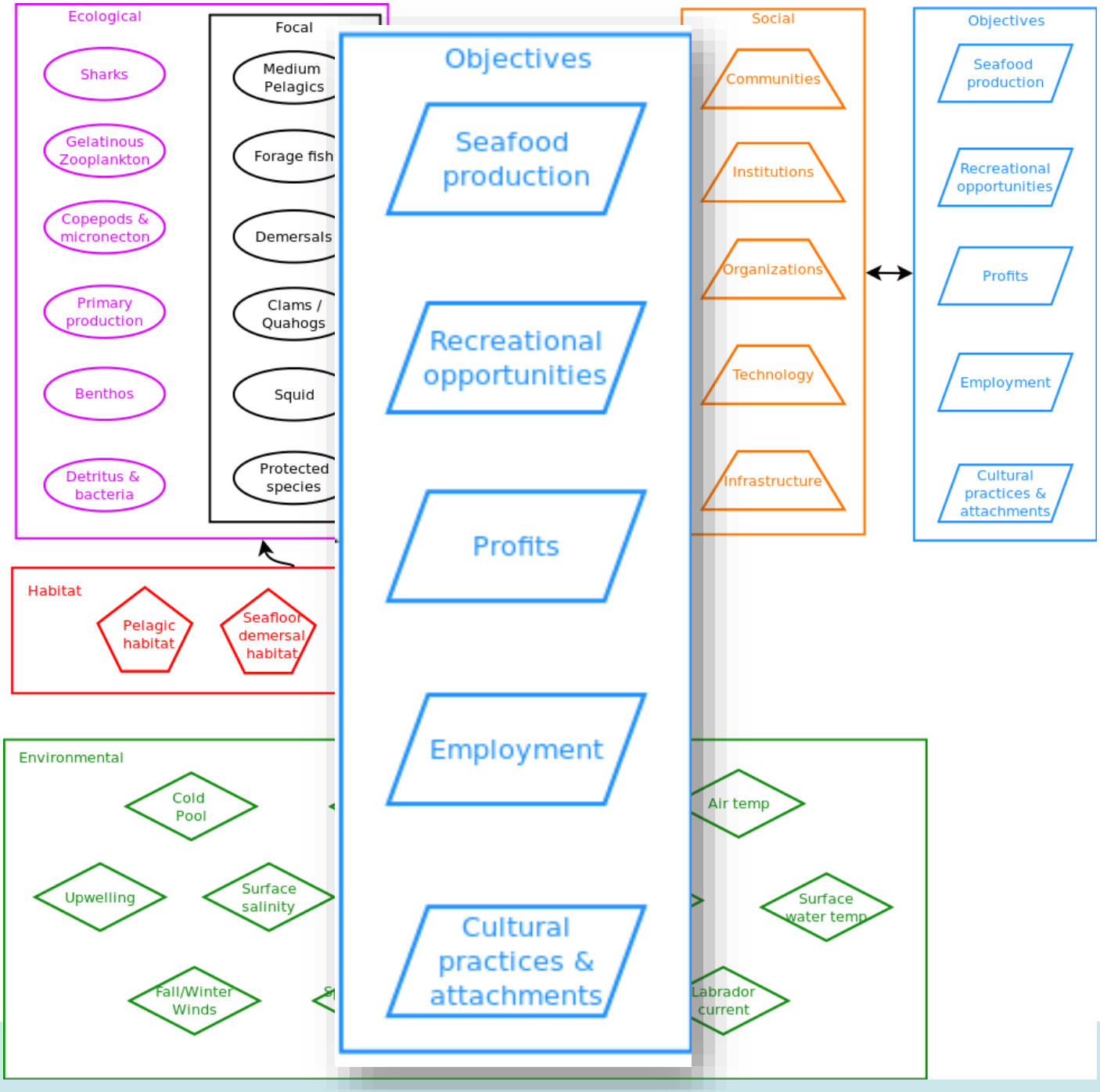
Northeast Fisheries Science Center

Mid Atlantic

The conceptual model outlines linkages between the environment, habitat, the food web, and managed species with human activities, social factors, and objectives. Many of the components and links are represented by indicators in the report.



Summary: performance relative to objectives

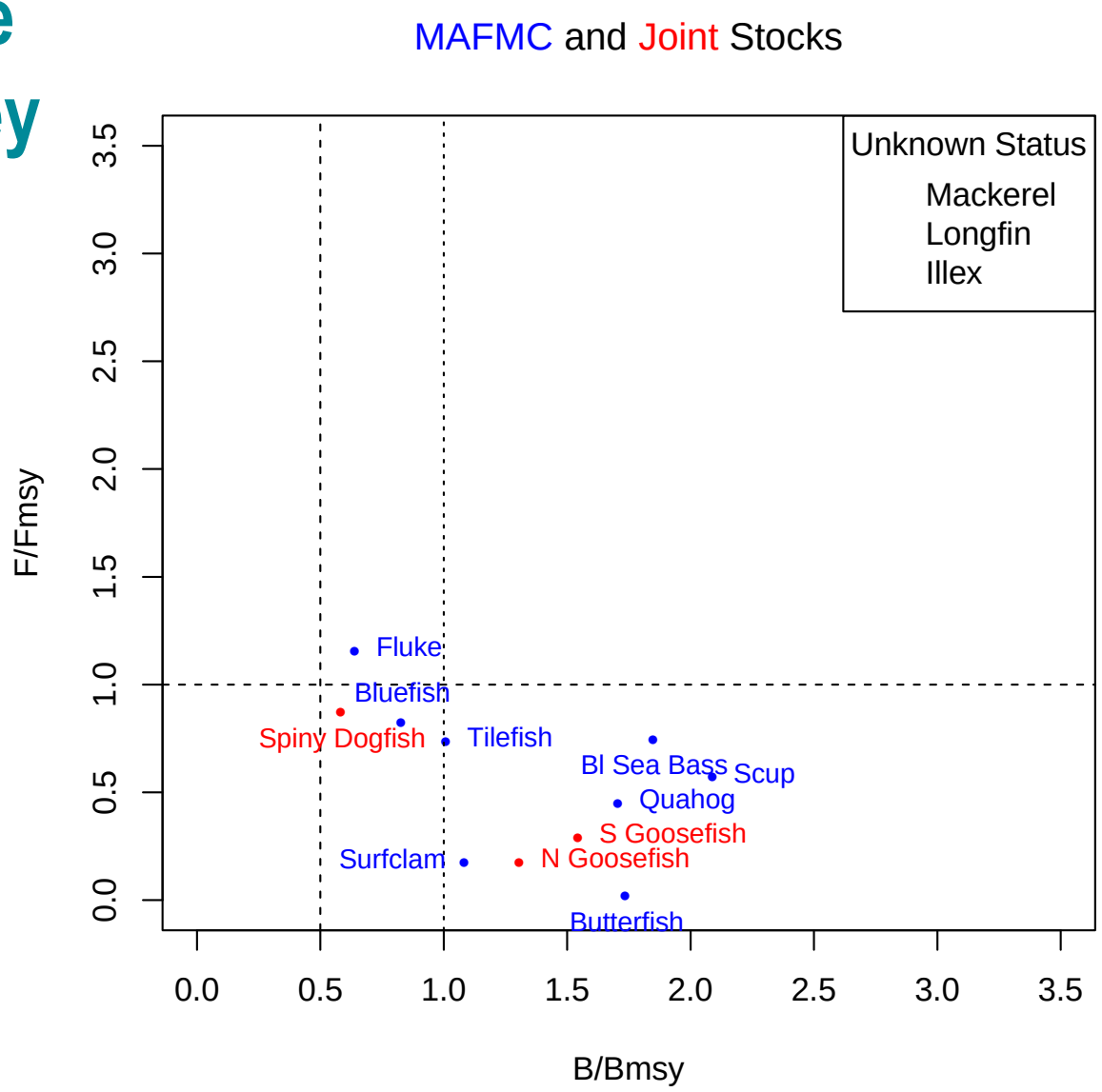
Ecosystem status: Executive summary

We have organized this report using a proposed set of **ecosystem-scale objectives** derived from US legislation and current management practices. We also report single-species status relative to established objectives and reference points.

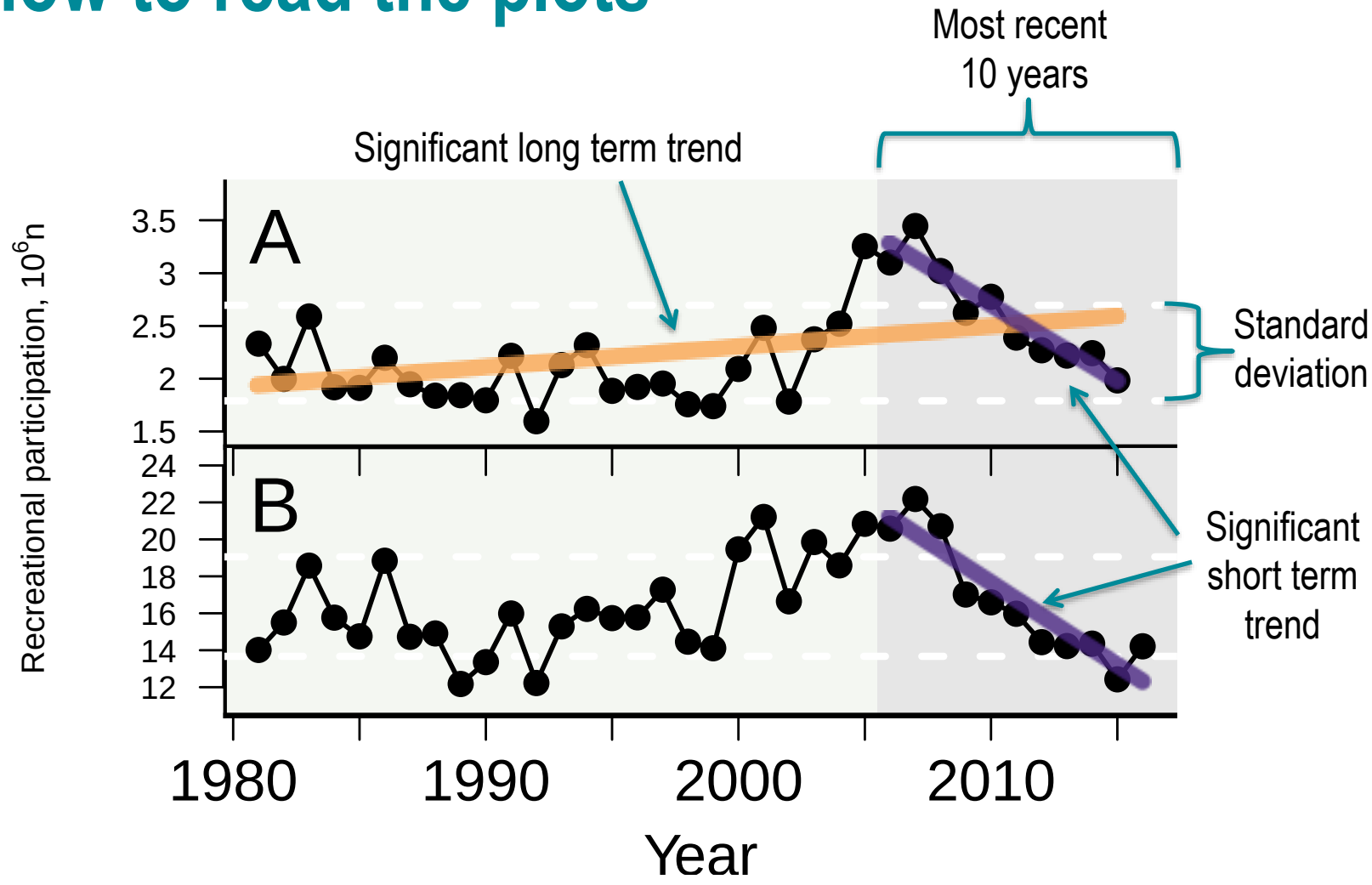
Objective Category	Indicators reported here
Seafood production	Landings by functional group, mariculture
Profits	Revenue by functional group
Recreation	Numbers of anglers and trips
Employment	Indicator under development (see p. 4)
Stability	Diversity indices (fishery and species)
Social-Cultural	Community vulnerability, fishery engagement and reliance
Biomass	Biomass or abundance from surveys, biomass relative to reference
Productivity	Condition and recruitment, fishing mortality relative to reference
Trophic structure	Relative biomass of trophic groups
Habitat	Thermal habitat volume, physical properites

Page 2-3 narrative synthesizes all key results. Single species objectives:

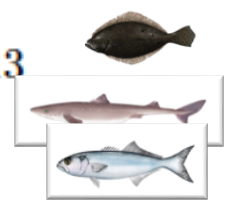
The MAFMC is meeting objectives at the managed species level for most stocks, with one exceeding the target F rate and several having unknown status



How to read the plots

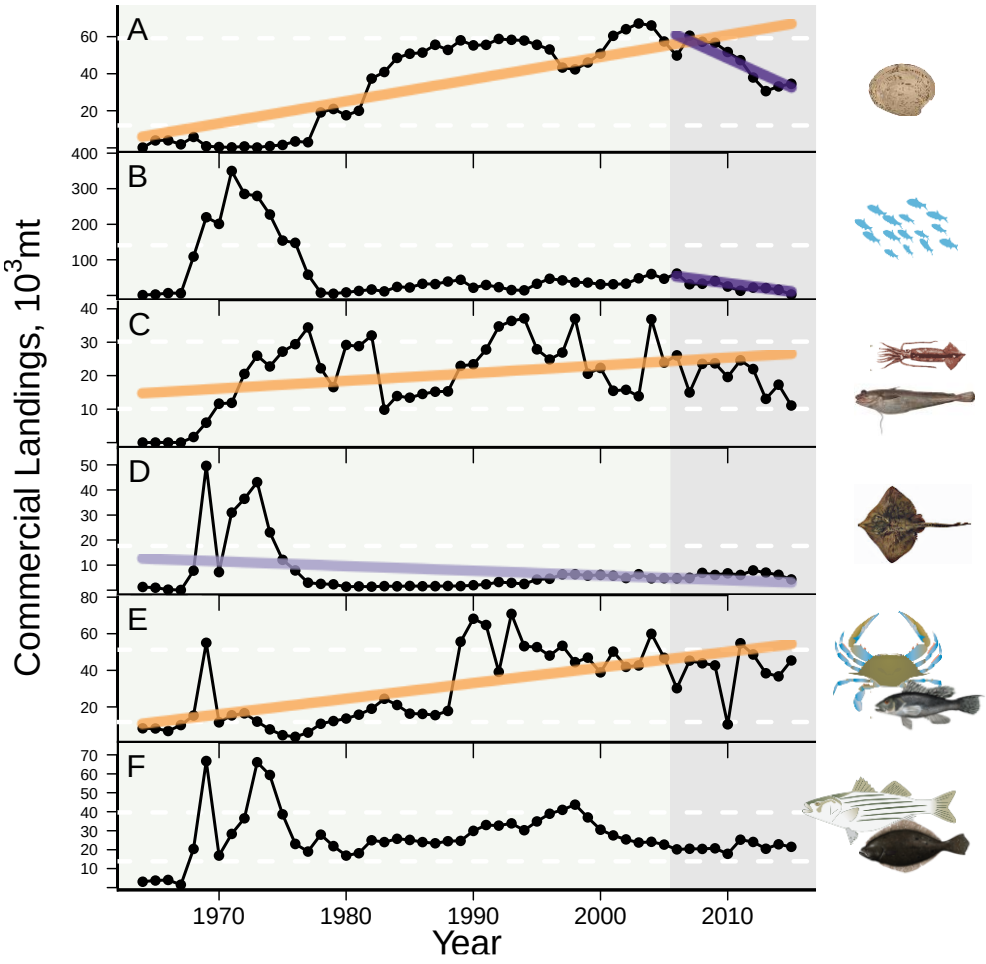


Functional groups of species

Group	N species	Major species in the group
A: Benthos 	7 	scallops, surfclam, quahog, mussels, whelks, conchs, sand dollars and urchins
B: Mesoplanktivores 	6 	Atlantic mackerel, butterfish, Atantic herring, river herrings and shad
C: Macroplanktivore 	6 	longfin and shortfin squids, white hake, searobins, sculpin, lumpfish
D: Macrozoo-piscivores 	12	clearnose, little, and smooth skates, smooth dogfish, buckler dory, blackbelly rosefish, redfish, windowpane, cusk, pollock, red hake, cancer crabs
E: Benthivores 	24 	black sea bass, scup, tilefish, tautog, cunner, blue crab, red crab, lobster, ocean pout, haddock, yellowtail winter and witch flounders, barnoor skate, other crabs
F: Piscivores 	13 	spiny dogfish, summer flounder, bluefish, striped bass, weakfish, monkfish, winter and thorny skates, silver and offshore hake, Atlantic cod and halibut, fourspot flounder

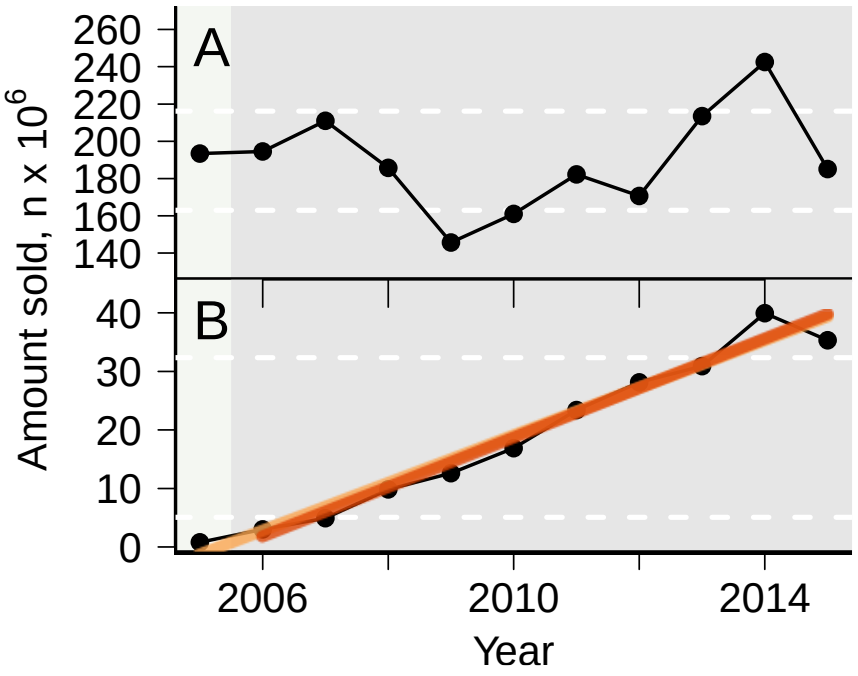
Seafood production objective

- **Long term increases with recent stability across trophic levels**, with the exception of forage fish (mackerel are at a historic low; menhaden are not included).
- **These increases are only partially driven by MAFMC managed species, underlining the need to work across jurisdictions to address ecosystem-level objectives**.



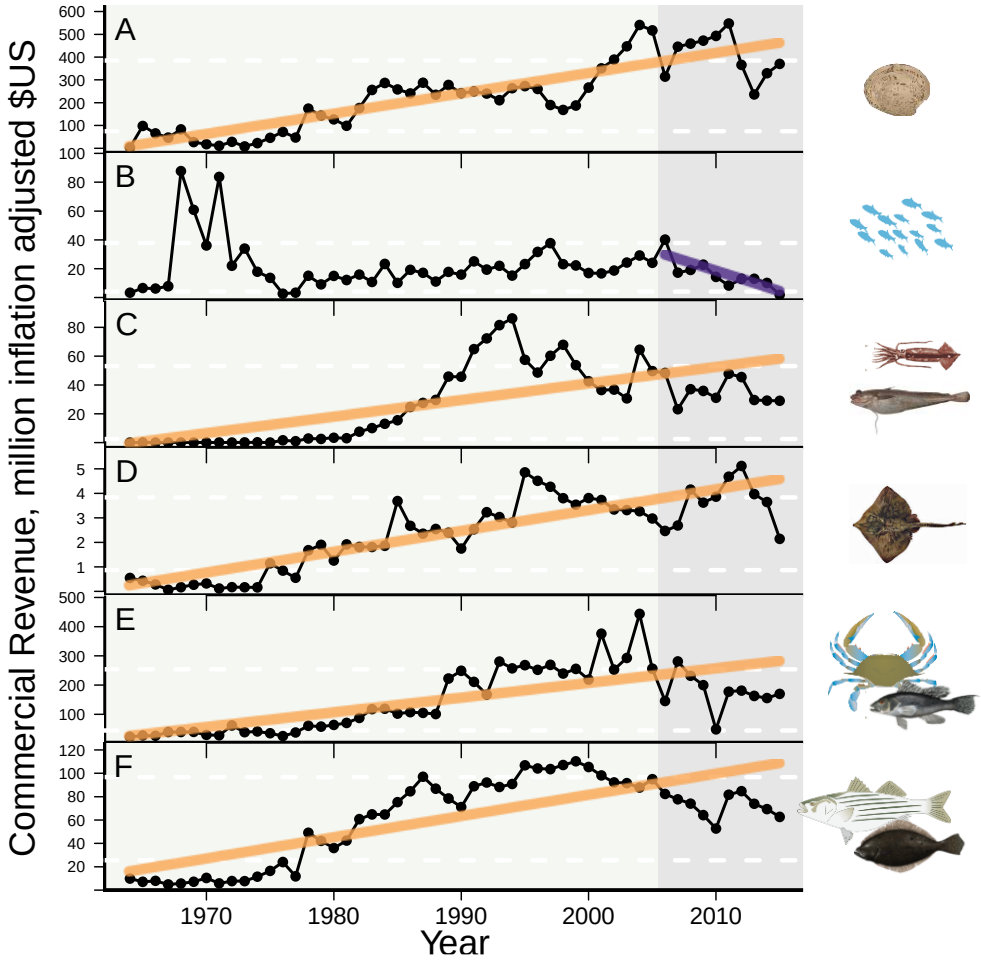
Seafood production objective

- The single state (Virginia) with aquaculture information shows steady production of hard clams (A) and increasing production of oysters (B). VA leads the nation in hard clam aquaculture production



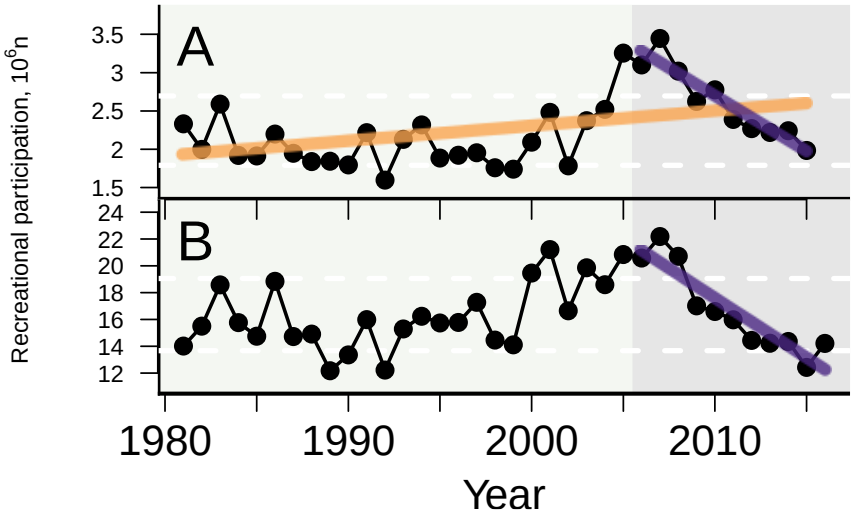
Profits objective

- **Commercial revenues** in the region mainly **show long-term increases**.
- **However, these increases are only partially driven by MAFMC managed species, underlining the need to work across jurisdictions to address ecosystem-level objectives**.



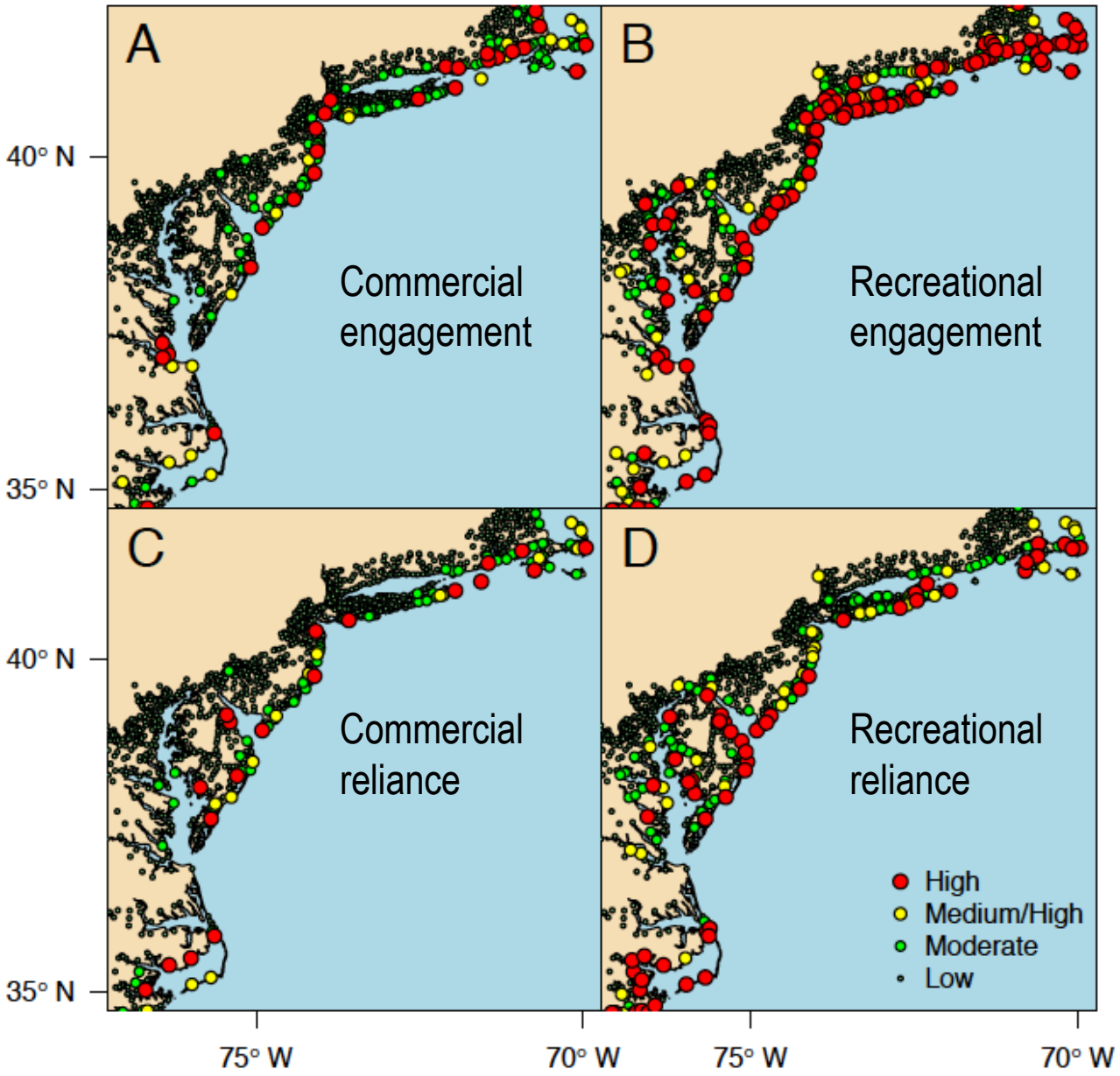
Recreational opportunities objective

- **Recreational opportunities** from fishing have also **increased over the long term**, according to numbers of anglers (A) and angler trips (B).
- However, there has been a **significant decline over the past 10 years** which may have started with the 2008 economic collapse, though recovery of recreational indices has not matched recovery in the wider economy.



Human community characteristics and risks

- **Mid Atlantic communities have a high reliance on both commercial and recreational fisheries.**



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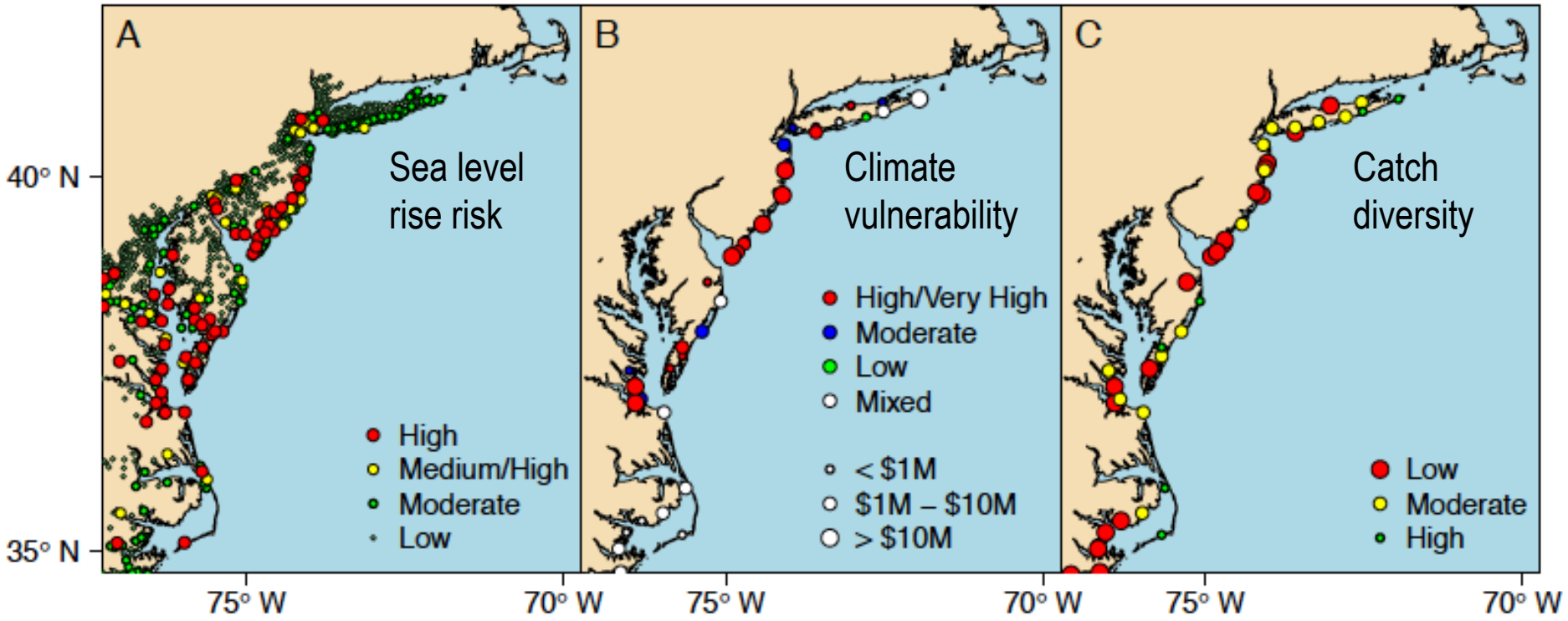
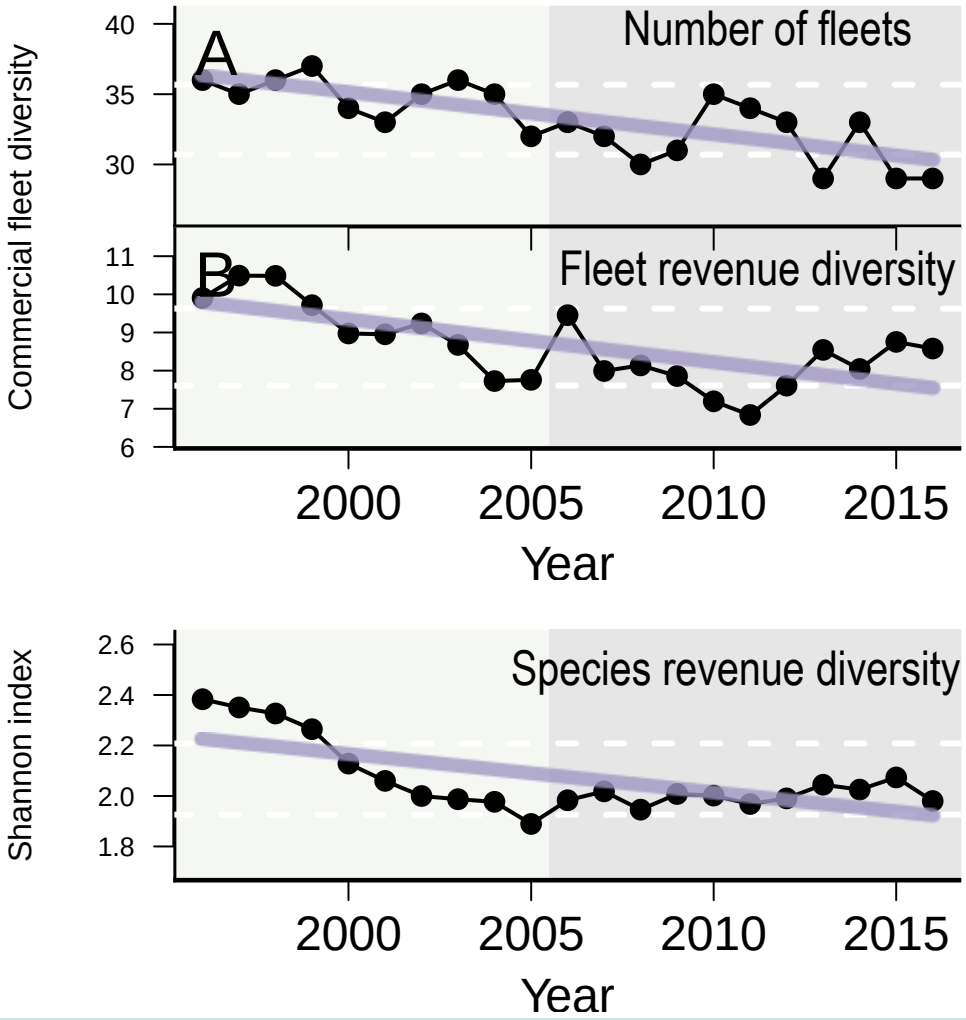
Human community characteristics and risks



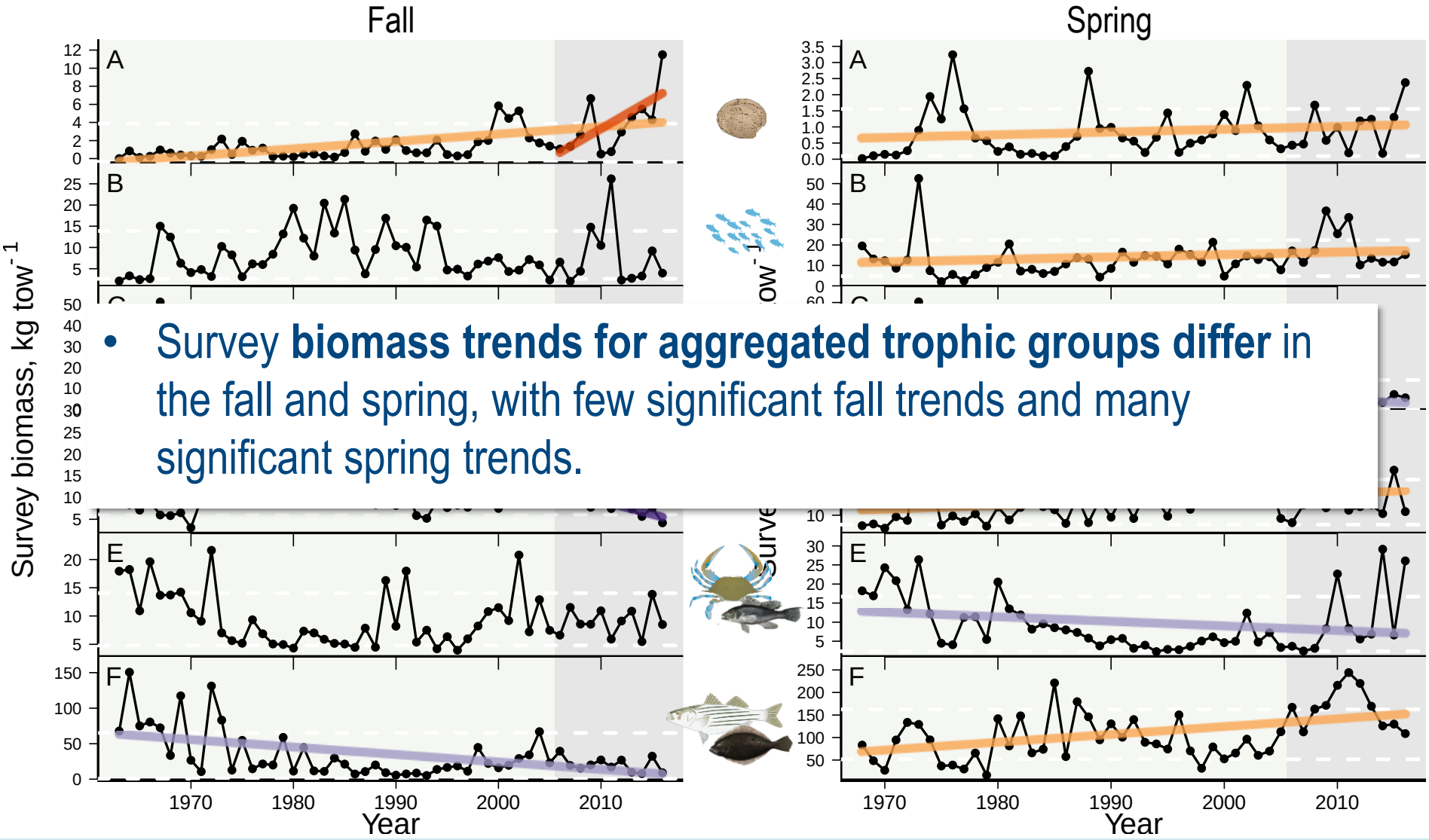
- Species managed by the MAFMC have lower vulnerability to climate impacts than other Northeast species.
- Many of the **fishing communities in the region are vulnerable to sea level rise**, for which exposure is expected to increase.

Stability objective

- Stability is addressed with indices of **commercial fleet and species revenue diversity**.
- These **show long term declines** in the Mid-Atlantic, which may raise a caution flag for stability within the industry, but requires further investigation into mechanisms.



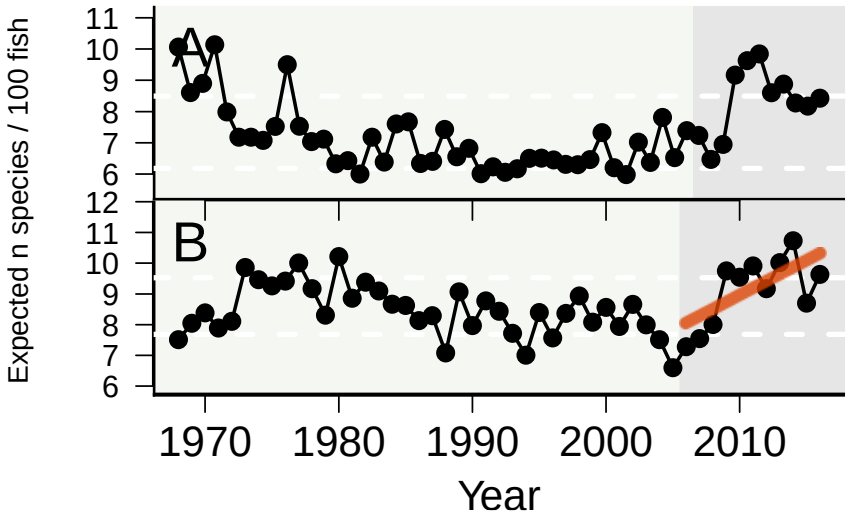
Biomass and trophic structure: survey trends



- Survey **biomass trends for aggregated trophic groups differ** in the fall and spring, with few significant fall trends and many significant spring trends.

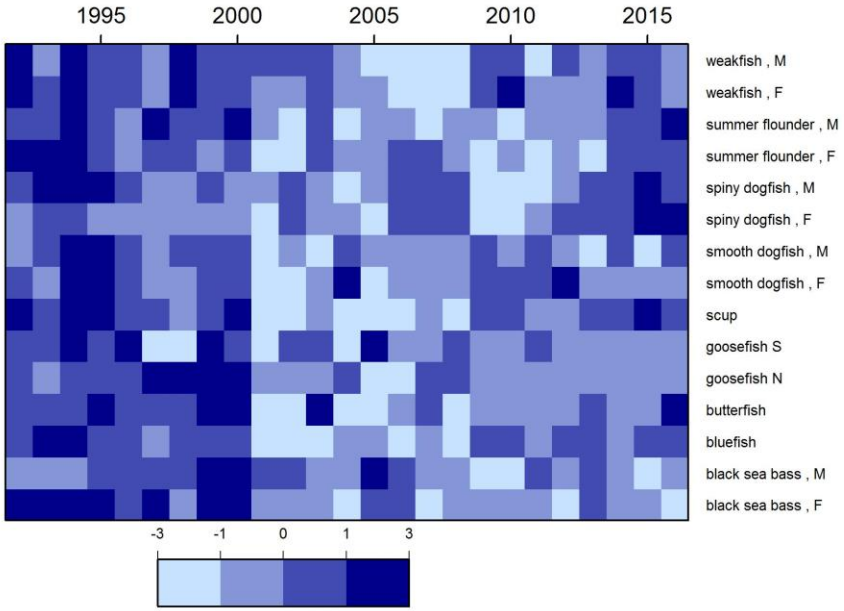
Biomass and trophic structure: diversity

- Species diversity also has a significant recent increase only during the spring survey (although patterns are similar between seasons).

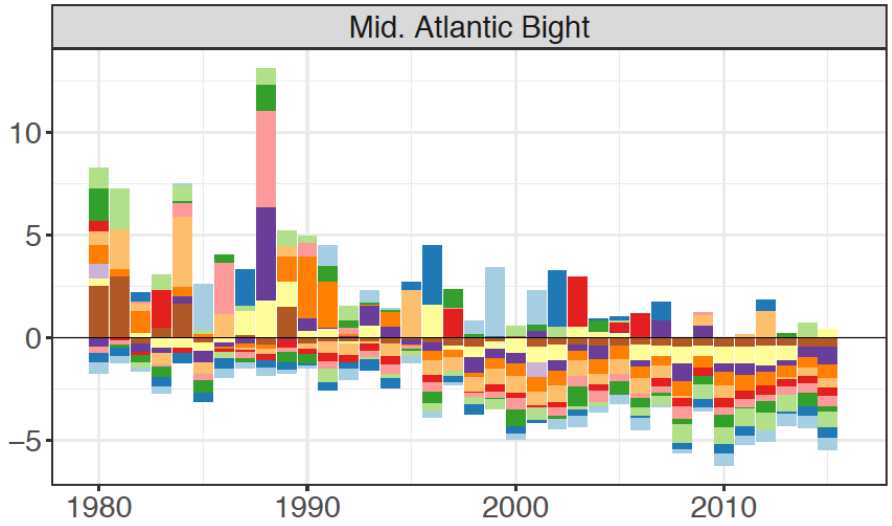


Fish productivity: condition, reproduction

Fish weight per length dropped in 2000, recovering recently?



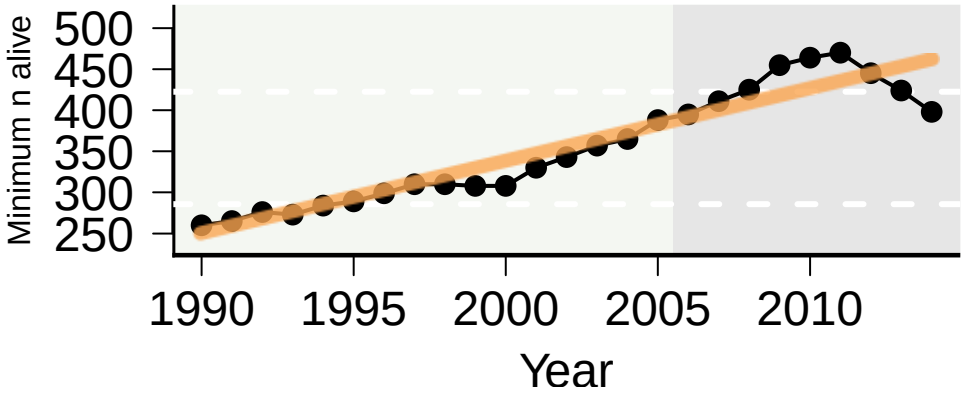
Aggregate numbers of small fish per large fish biomass on the survey declining?

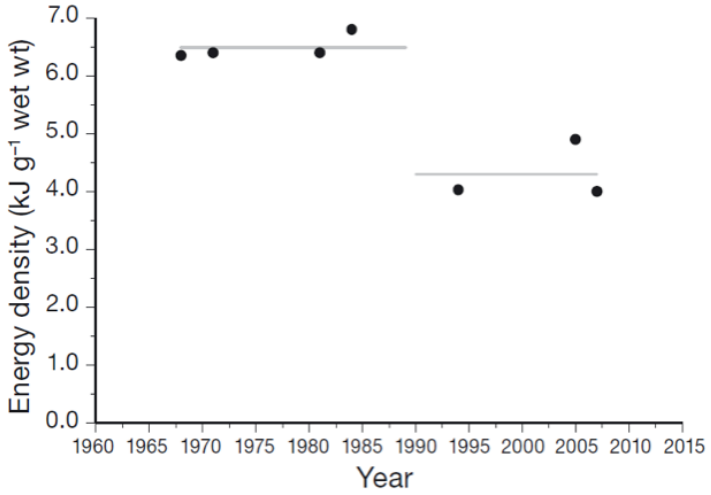


- Additional indicators in this report suggest **a note of caution for the aggregate productivity of commercial fish species in the region**.

Protected species productivity

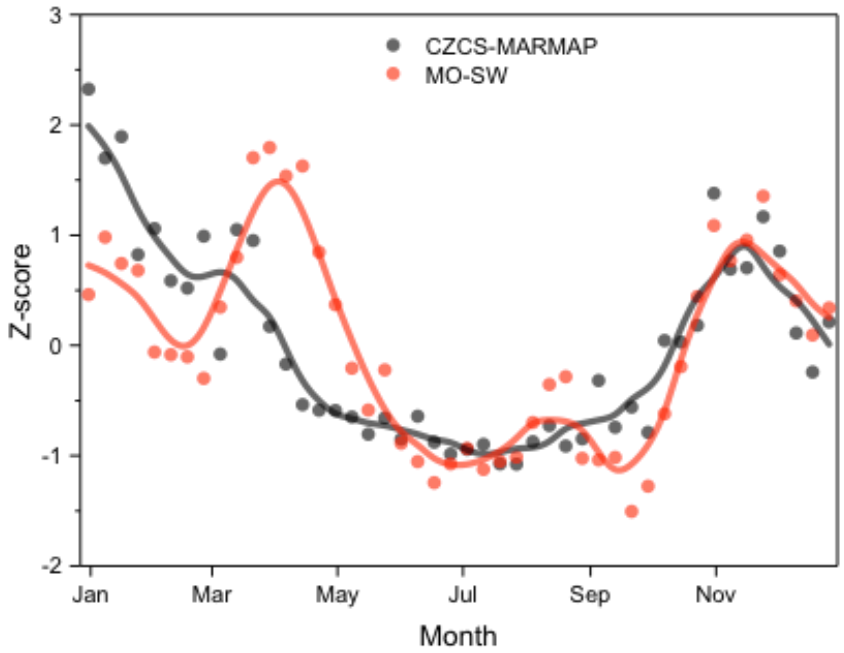
- While there are few time series for protected species, **the North Atlantic right whale may be declining** over the most recent few years after a slow but steady increase.
- Further, signals from the wider northwest Atlantic suggest a **decrease in forage fish energy content**.



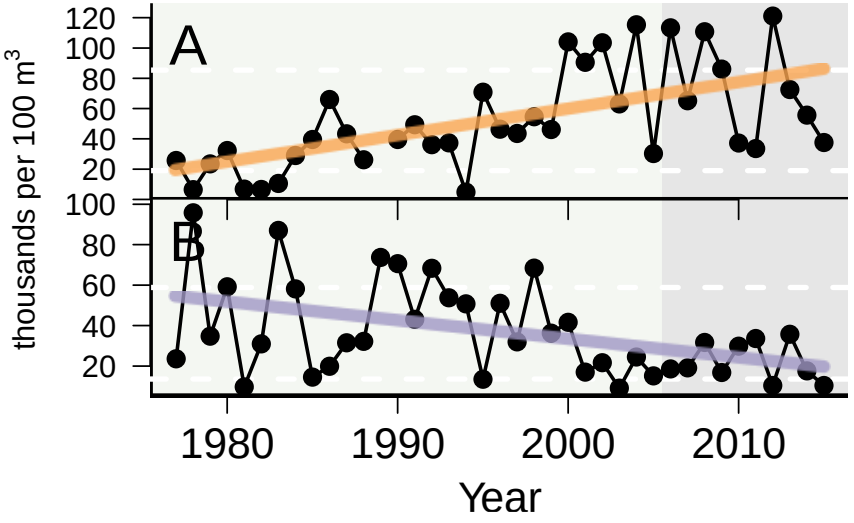


Base of the food web: shifts in timing

1970s versus Recent bloom timing



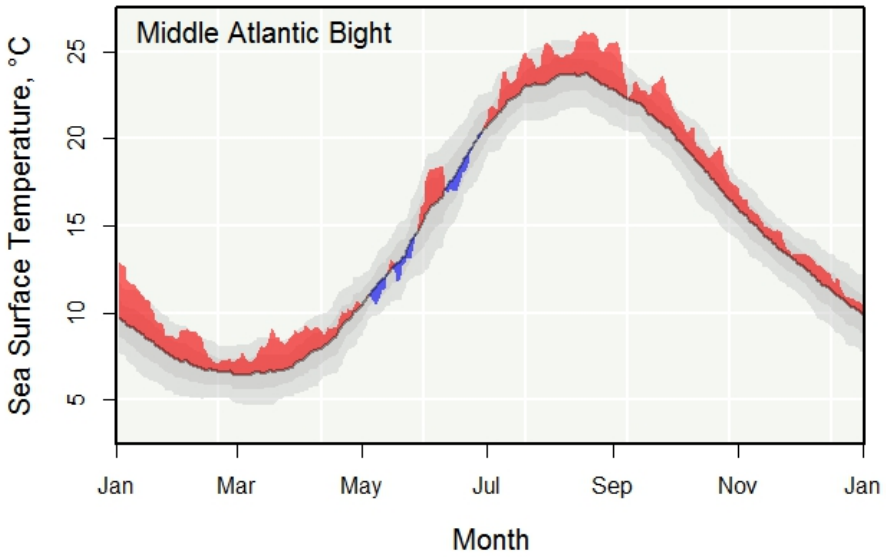
Centropages typicus abundance over time: A spring, B fall



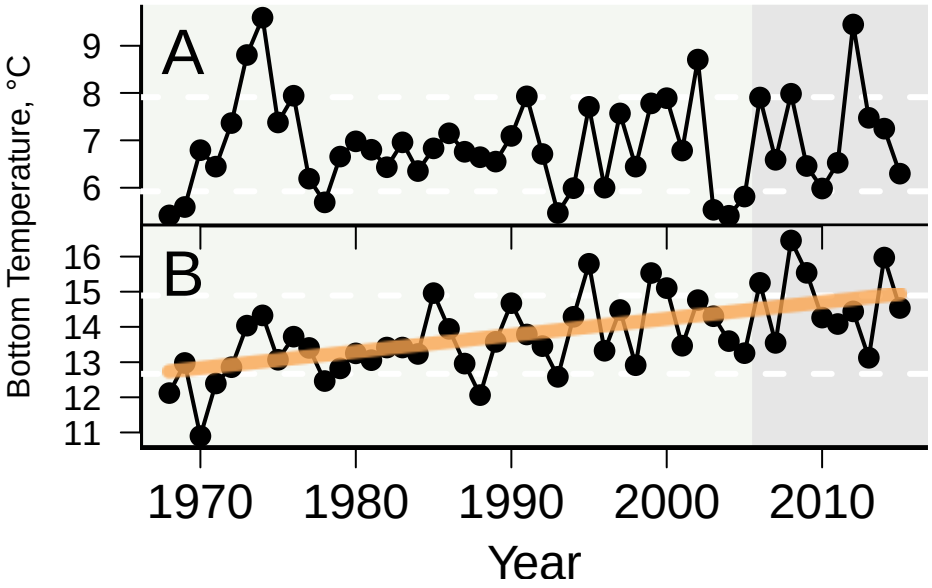
- Timing of primary production and zooplankton in the Mid-Atlantic may be shifting during the year, with a **later bloom and increasing spring abundance** of a major Mid-Atlantic zooplankton species, *C. typicus*.

Temperature and Climate conditions

Mid-Atlantic 2016 seasonal surface temperature

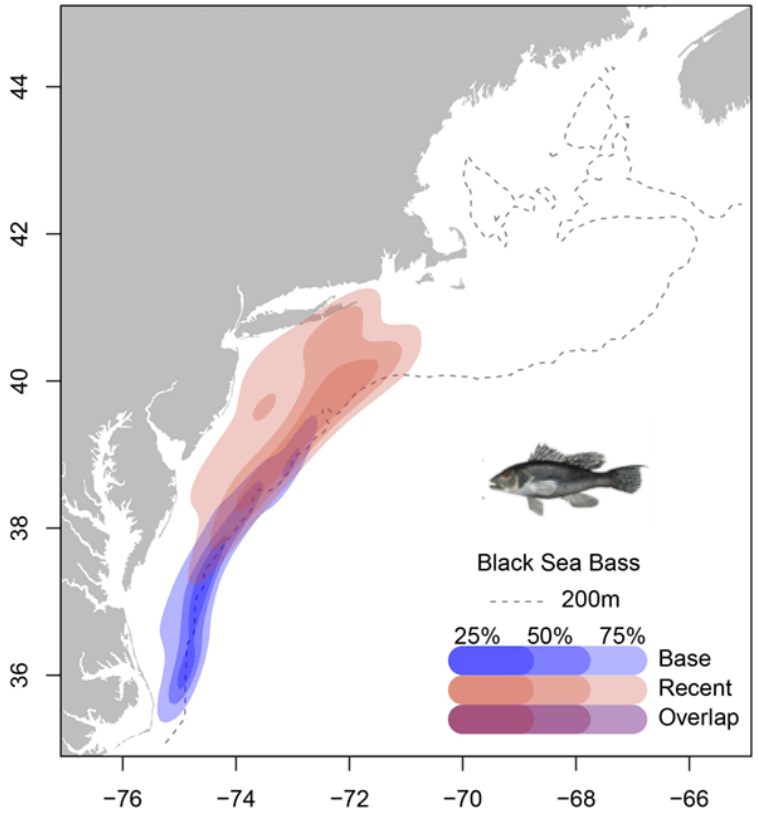


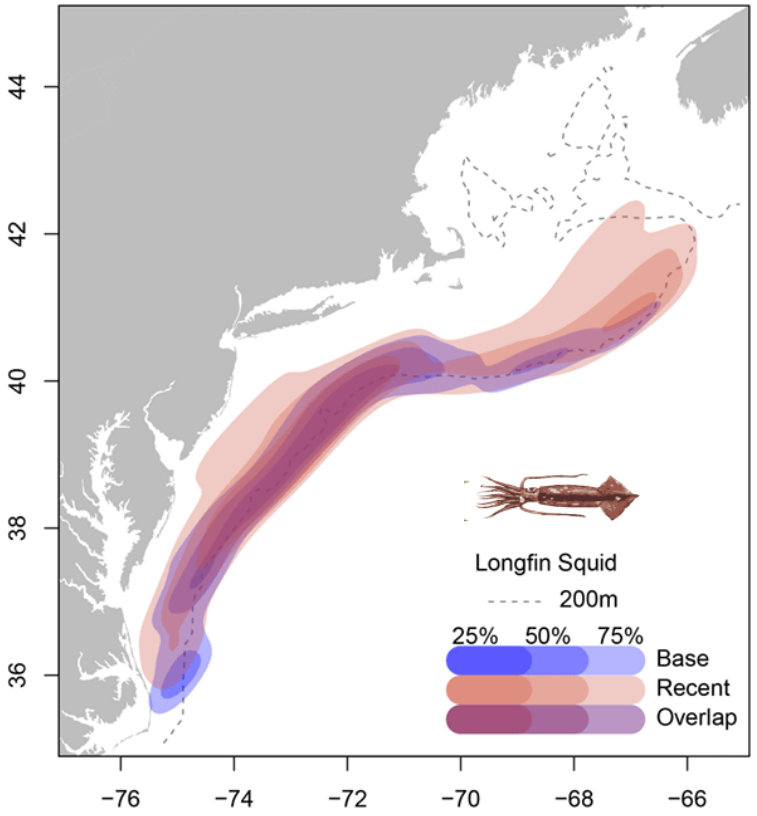
Mid-Atlantic bottom temperature
A: April and B: October



- **Temperature is increasing** in long term sea surface records as well as surface and bottom measurements from surveys. The seasonal temperature signal also shows sustained warming.

Temperature and Climate conditions

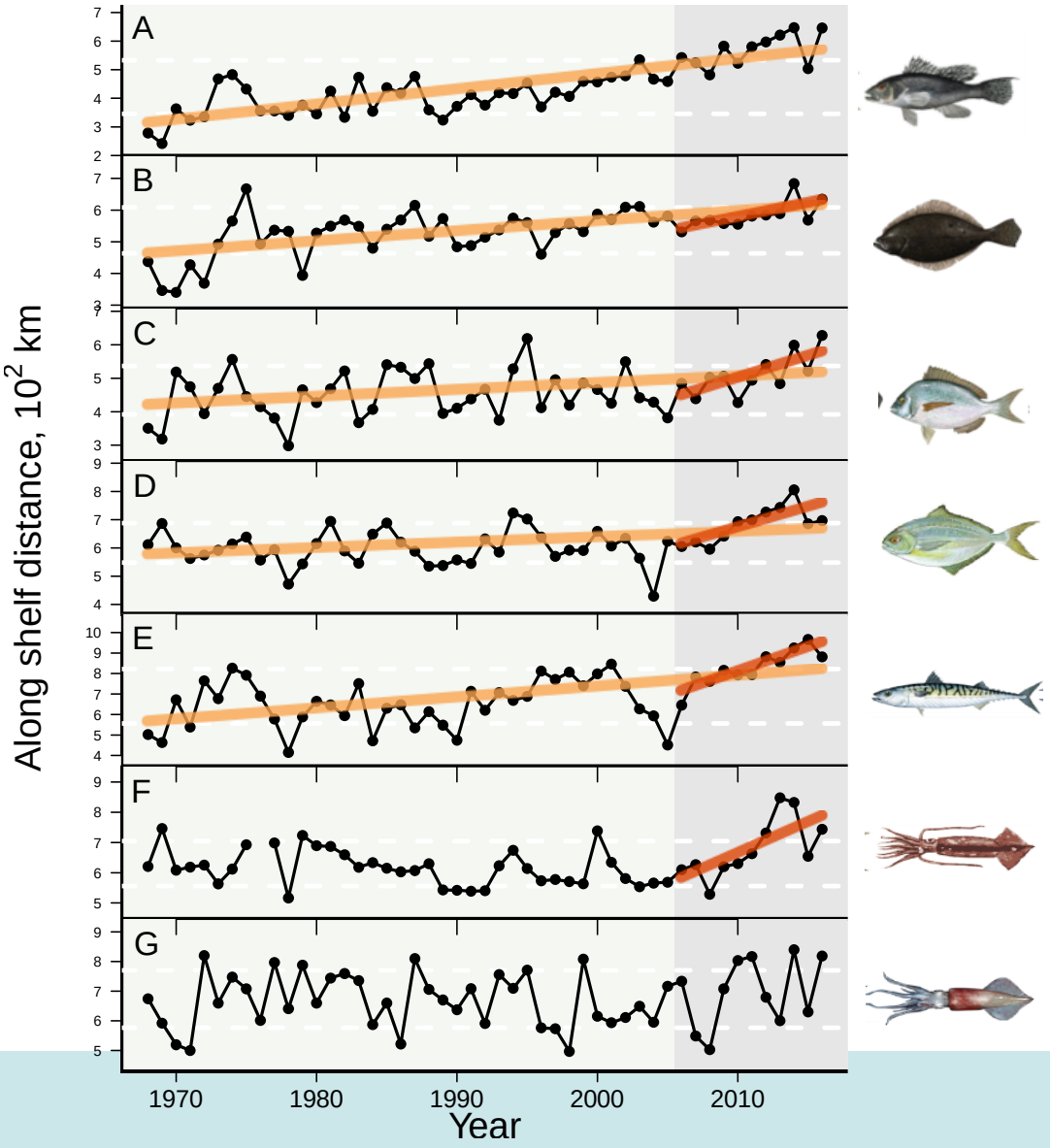




- **Warming waters have impacts** on the ecosystem that can be complex due to differential impacts at the species level, **including observed shifts in species distribution and changes in productivity** as thermal habitats shift.

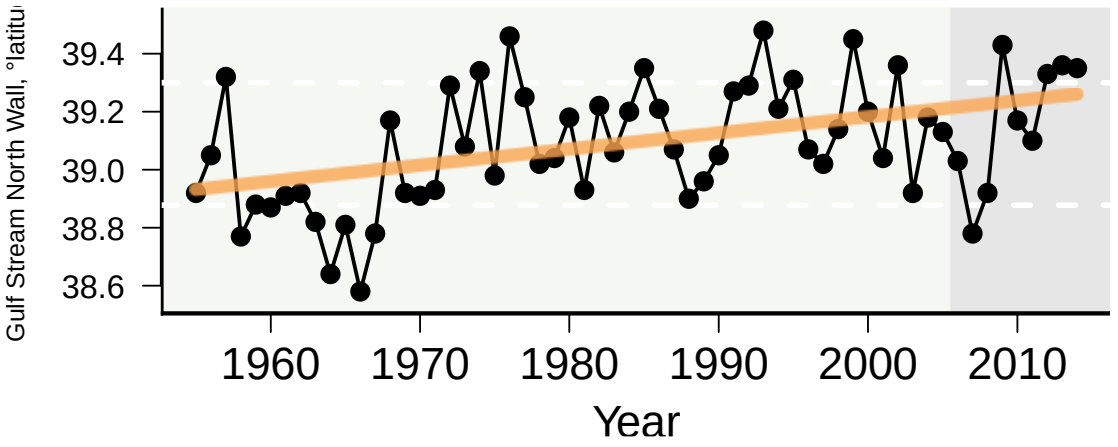
Temperature and Climate conditions

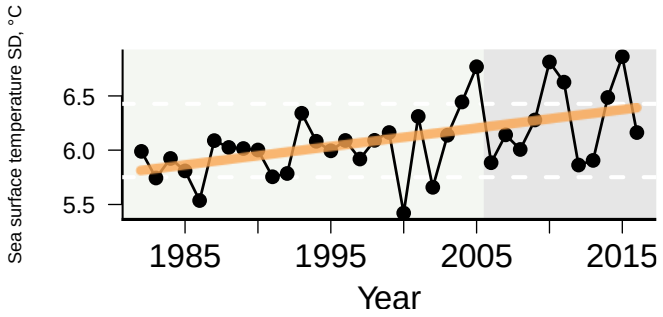
- **Many MAFMC managed species have shifted northeastward along the coast.**



Temperature and Climate conditions

- Regional climate indices show a **northward movement of the Gulf Stream north wall** which can be a local mechanism for increased temperature and species redistribution.
- **Daily variation in sea surface temperature is increasing**.
- **Deep ocean circulation is weakening**, leading to the northward Gulf Stream shift and enhancing sea level rise.





Website: http://www.nefsc.noaa.gov/ecosys/

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Ecosystems Dynamics & Assessment Program

- Ecology of the Northeast Continental Shelf
- Climate Change
- Ecosystem Status
- Current Conditions
- Spatial Analyses
- Modeling Approaches

There is now broad agreement that we need to adopt a more holistic approach to marine resource management at both the national and international levels. To accomplish this goal, the foundation of marine Ecosystem-based Management is now being developed and refined. Virtually all specifications of marine EBM share at least three common elements: (1) a commitment to establishing spatial management units based on ecological rather than political boundaries, (2) consideration of the relationships among ecosystem components, the physical environment, and human communities, and (3) the recognition that humans are an integral part of the ecosystem. We need to account for the important goods and services derived from marine ecosystems and the diverse and cumulative impacts of human activities in these systems (Figure 1) to forge a sustainable future.

Figure 1. Examples of some important ecosystem services (blue icons), stressors (red), adverse effects (yellow), and issues of special concern (green) that will be considered in Ecosystem-Based Management on the Northeast U.S. Continental Shelf (adapted from image by Barbara Ambrose, National Coastal Data Development Center).

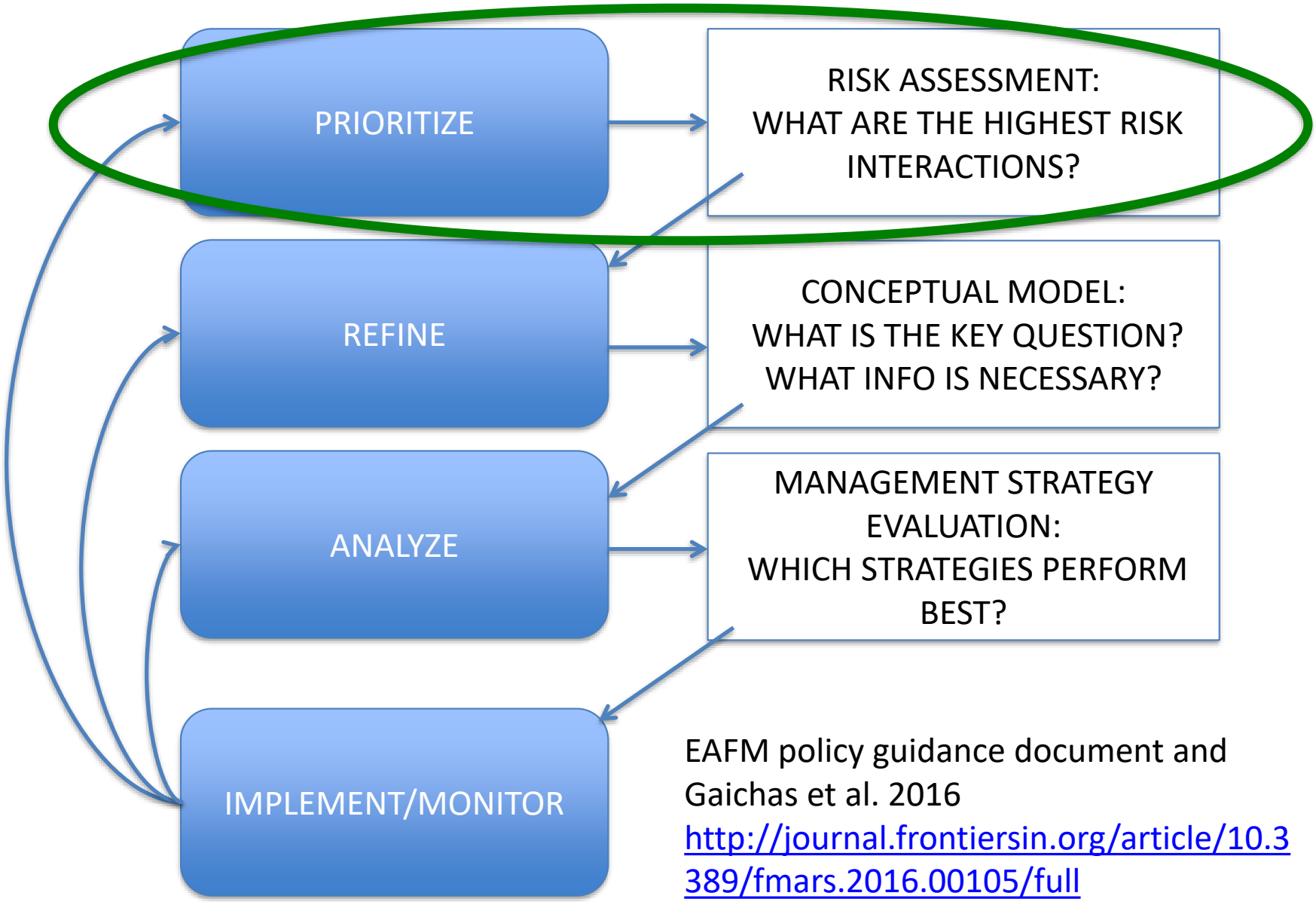
The importance of implementing marine Ecosystem-based Management in the United States has recently been highlighted with the adoption of a new National Ocean Policy, established under presidential order on July 19, 2010. This policy identifies nine objectives, the first of which establishes Ecosystem-based Management (EBM) as its guiding principle. The second priority highlights the importance of Coastal and Marine Spatial Planning as a tool for EBM. It is clear that the impetus toward adopting the basic tenets of EBM is gaining momentum. We need to establish the scientific architecture in support of EBM in the region to meet these emerging challenges and opportunities. The objective of our Ecosystem Considerations website is to provide a broad overview of the ecology of the Northeast U.S. Continental Shelf to support this overarching need. This region as a whole is recognized as one of more than 60 Large Marine Ecosystems distributed throughout the world ocean.

This site comprises several inter-related components designed to address different issues and needs. We seek to provide basic information on fundamental ecological properties of the system to the broad spectrum of stakeholders who will be engaged in the discussion of policy alternatives to meet the needs for Ecosystem-Based Management in the region. We build on the longstanding commitment of the Northeast Fisheries Science Center to understand and monitor changes in ecosystem structure and function in this region with the objective of informing management decisions.

Next steps for EAFM

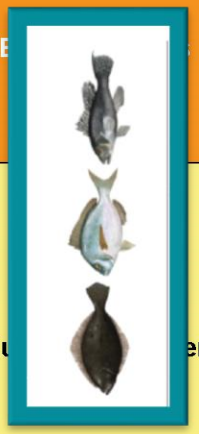
(Rich Seagraves sends his regards)

Framework for addressing interactions



EAFM policy guidance document and Gaichas et al. 2016
http://journal.frontiersin.org/article/10.3389/fmars.2016.00105/full

Climate risk by FMP



Ocean Quahog

Atl Mackerel

Su er

quid

Biological Sensitivity

Very High

High

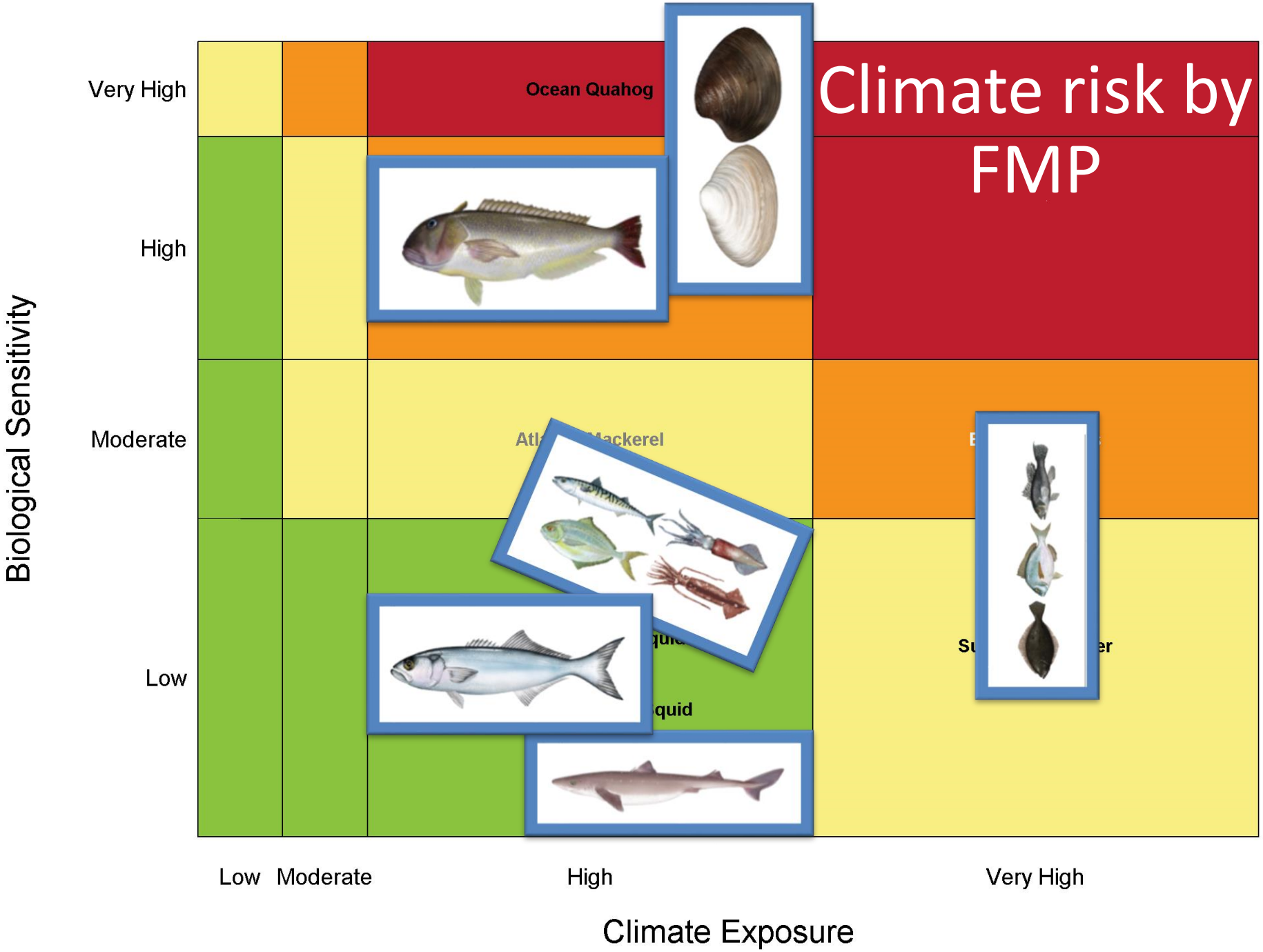
Moderate

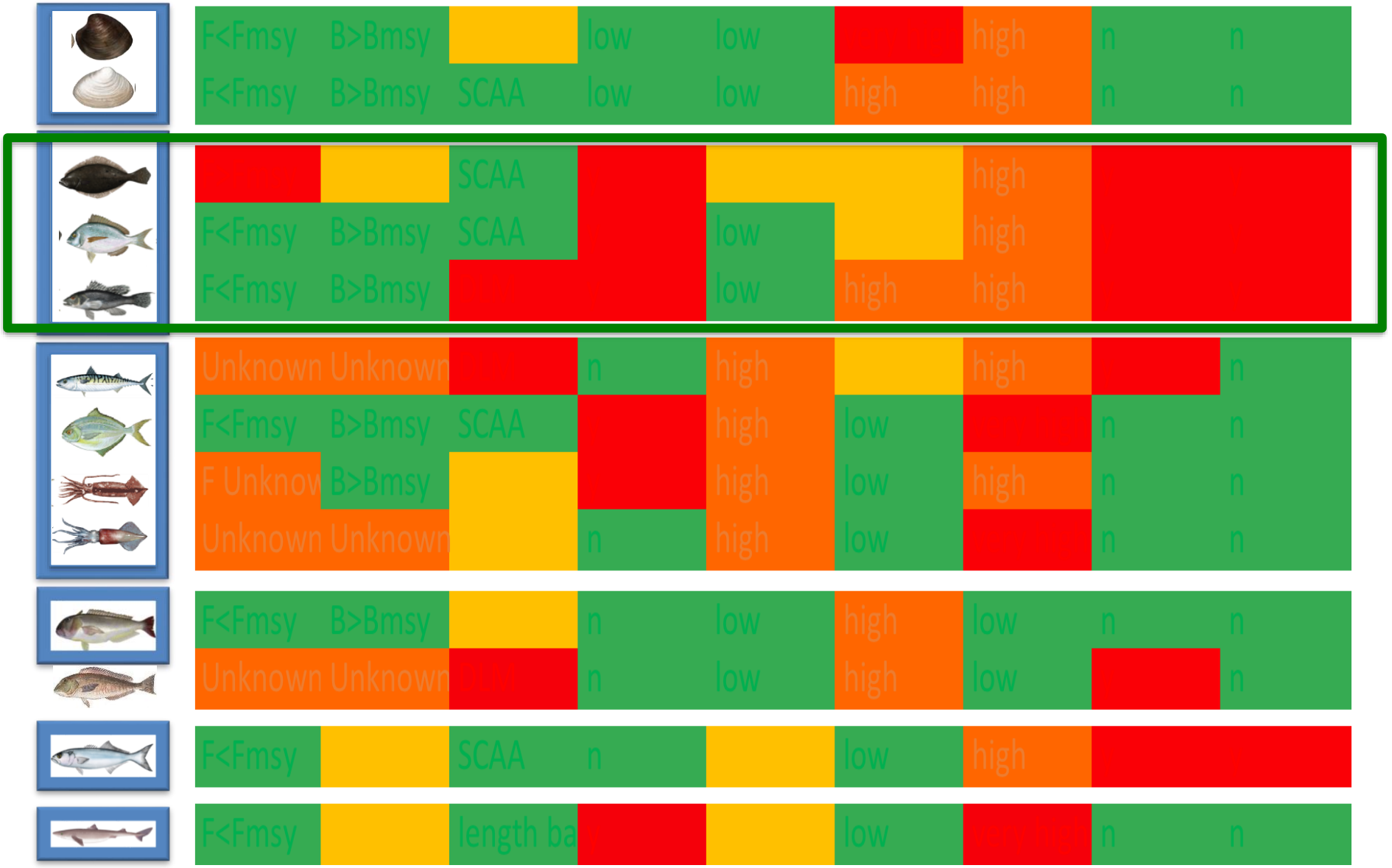
Low

Low Moderate High Very High

Climate Exposure

Climate risk by FMP




F status
B status
assess type
discards
food web
climate
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habitat
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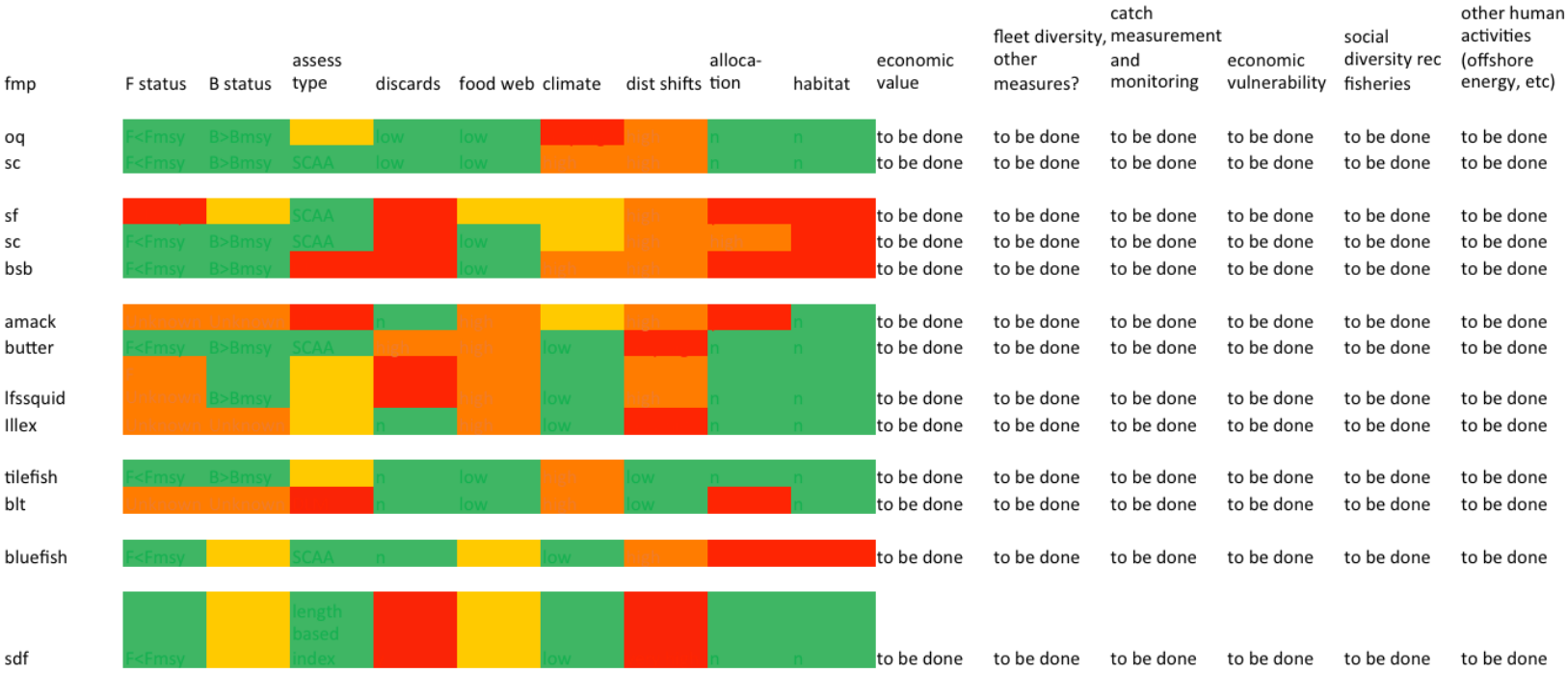
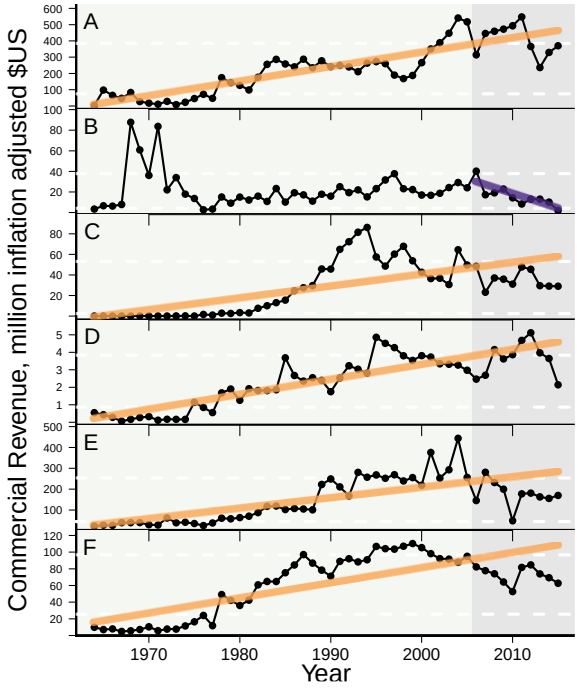
Advancing the risk assessment

- EOP met July 2016, added risk categories
- NEFSC SSB documented risks specific to Mid Atlantic communities in January 2017



Advancing the risk assessment

- Opportunity: use indicators from State of the Ecosystem to inform further risk assessment
- Work with ICES WGNARS group this year



Indicator	Risk
Revenue	
Employment	
Seafood	
Production	
Habitat	
Climate	