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**Northeast
Fisheries
Science Center**

State of the Ecosystem Report: Mid-Atlantic

Sarah Gaichas, reporting on behalf
of many contributors

Mid-Atlantic Fishery Management Council
11 April 2018

Ecosystem reporting: Big picture

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



State of the Ecosystem

Conceptual Model

MID-ATLANTIC

Sharks
Jellyfish
Zooplankton
Primary Production
Benthos
Detritus & Bacteria

FOCAL COMPONENTS

Medium Pelagics
Forage Fish
Demersals
Clams/Quahogs
Squid
Protected Species



Communities
Institutions
Organizations
Technology
Infrastructure

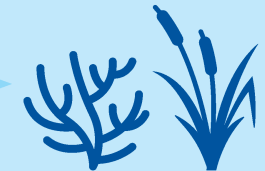


SOCIETY



HUMAN ACTIVITIES

Recreational Fisheries
Commercial Fisheries
Tourism
Energy Development



MARINE HABITAT

Palagic Habitat
Seafloor Demersal Habitat
Nearshore Habitat
Fresh & Estuary Habitat



OBJECTIVES

Seafood Production
Recreational Opportunities
Profits
Employment
Cultural Practices & Attachments



ENVIRONMENT

Cold Pool
Stratification
Freshwater Discharge
Air Temperature
Upwelling
Salinity
Water Temperature
Fall/Winter Winds
Spring/Summer Winds
Gulf Stream/Slope Water
Labrador Current



Summary: performance relative to objectives

Executive Summary

We have organized this report using a proposed set of **ecosystem-scale objectives** derived from US legislation and current management practices. We report indicators at the spatial scale of either the Mid-Atlantic Bight (MAB; Fig. 2), for Mid Atlantic states, or Northeast US coastwide where appropriate. Indicator spatial scale is noted in each section heading.

Table 1: Mid-Atlantic ecosystem objectives

Objective Categories	Indicators reported here
Seafood production	Landings by feeding guild, mariculture
Profits	Revenue by feeding guild
Recreation	Number of anglers and trips; recreational catch
Stability	Diversity indices (fishery and species)
Social-Cultural	Commercial and recreational reliance; social vulnerability
Biomass	Biomass or abundance by feeding guild from surveys
Productivity	Condition and recruitment of MAFMC managed species
Trophic structure	Relative biomass of feeding guilds, primary productivity
Habitat	Thermal habitat projections, estimated habitat occurrence

Revised outline; synthesis across indicators

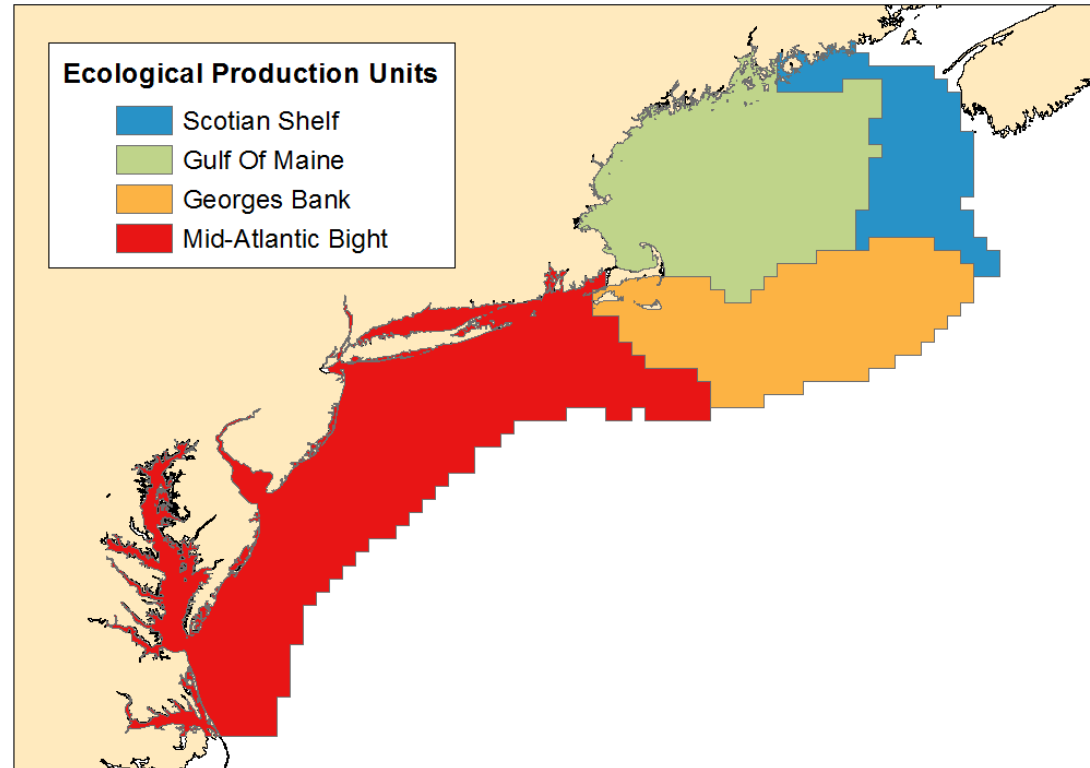
Big picture

Human dimensions

Protected species-
fishery interactions

Resource Species

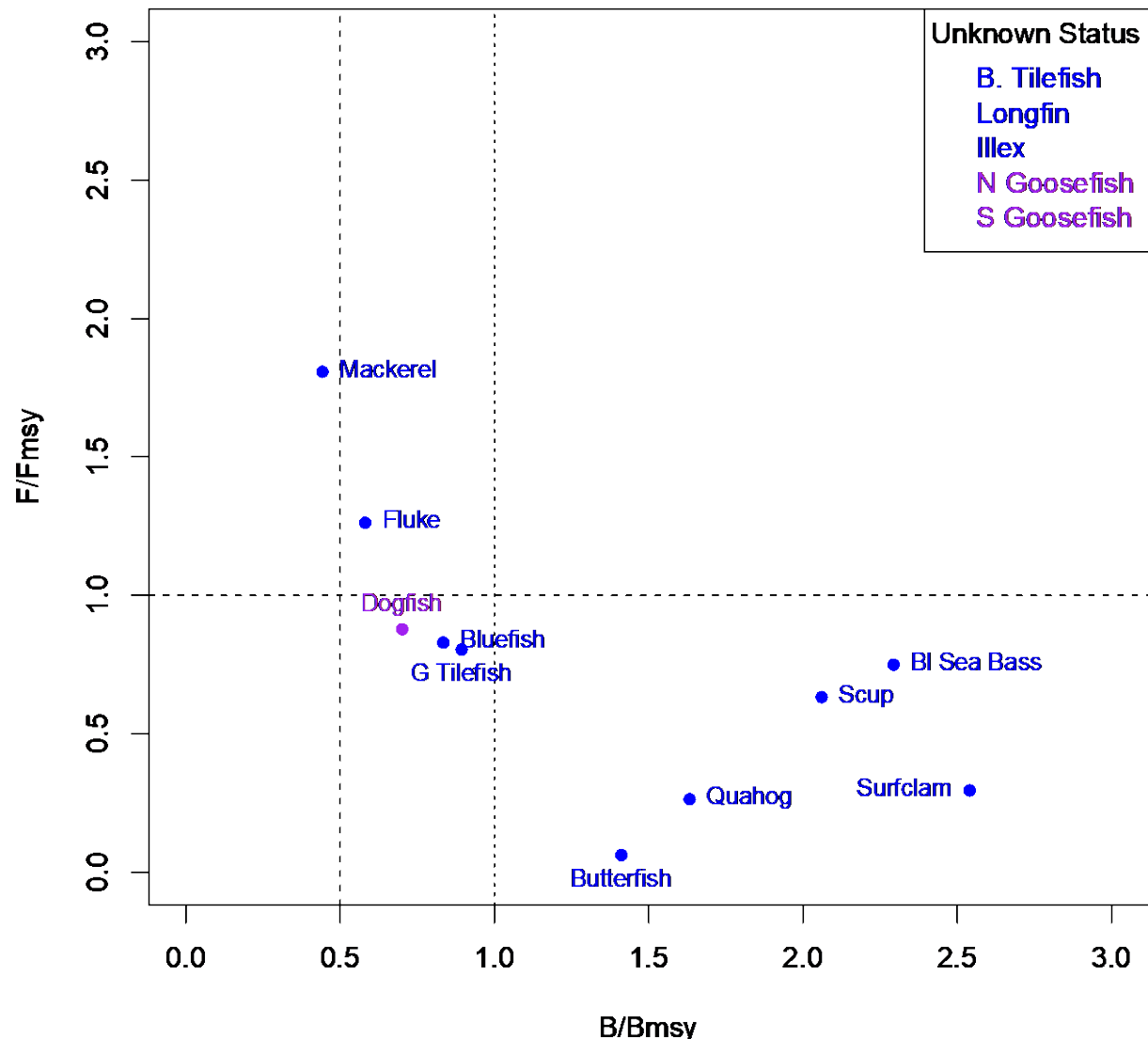
Ecosystem conditions
and productivity



Page 2-4 narrative synthesizes all key results. Single species objectives:



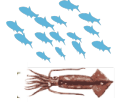


The MAFMC is meeting objectives at the managed species level for most stocks, with two exceeding the target F rate, one below the B threshold, and several having unknown status

MAFMC and Joint Stocks



Changes for 2018

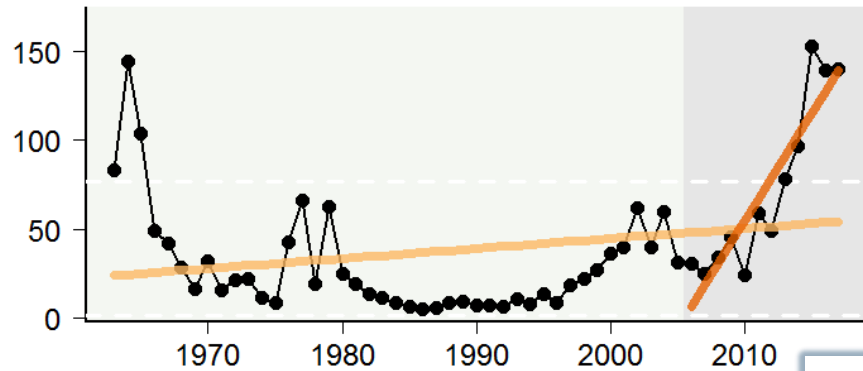
Table 2: Mid-Atlantic feeding guilds.

Group	N species	Major species in the group
 A: Apex predator (Highest trophic level)	4	shark (Unc.), swordfish, yellowfin and bluefin tuna
 B: Piscivore (Eat fish)	23	spiny dogfish, summer flounder, bluefish, striped bass, weakfish, monkfish, winter and thorny skates, silver and offshore hake, Atlantic cod and halibut, fourspot flounder
 C: Planktivore (Eat plankton)	16	Atlantic and blueback herring, alewife, shad, menhaden, cusk, Atlantic mackerel, butterfish, blackbelly rosefish, sculpins, lumpfish, northern searobin, northern sand lance, northern shortfin and longfin squid
 E: Benthivore (Eat bottom dwellers)	25	black sea bass, scup, tilefish, tautog, cunner, blue crab, red crab, lobster, ocean pout, haddock, yellowtail, winter, and witch flounders, barndoor skate, American plaice, other crabs
 F: Benthos (Filter feeders)	9	scallops, surfclam, quahog, mussels, whelks, conchs, sand dollars and urchins

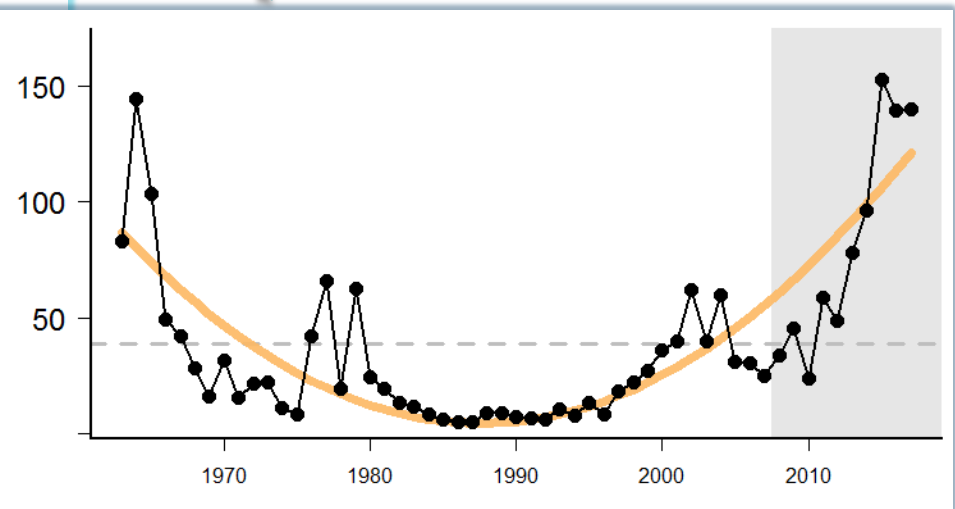
- Updated all indicators; additional info on HABs as requested by SSC
- Work in progress section (indicators requested by MAFMC)

Time series approach for SOE 2018

2016-2017



2017-2018

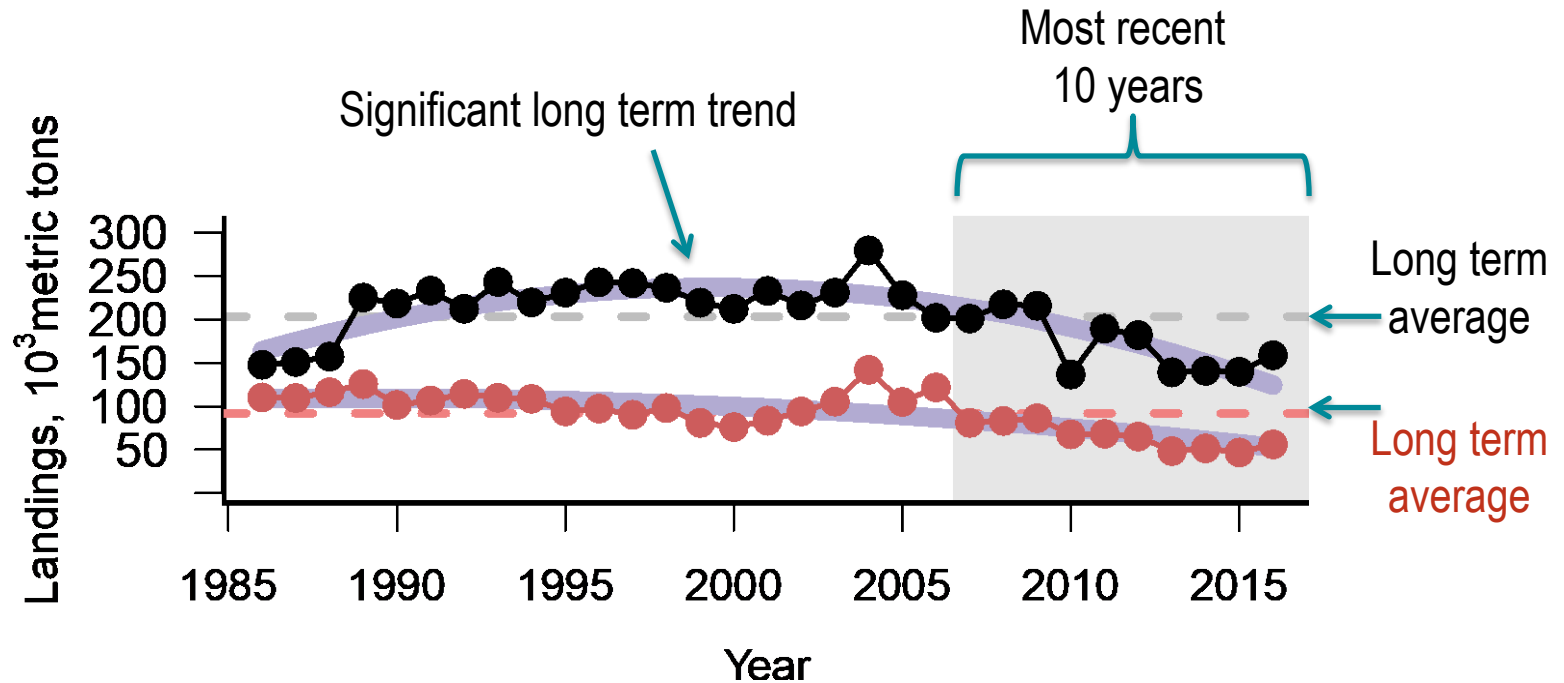


Updated statistical approach

- Mechanism to consider nonlinear trends
- Not assessing significance for less than 30 years



How to read the plots



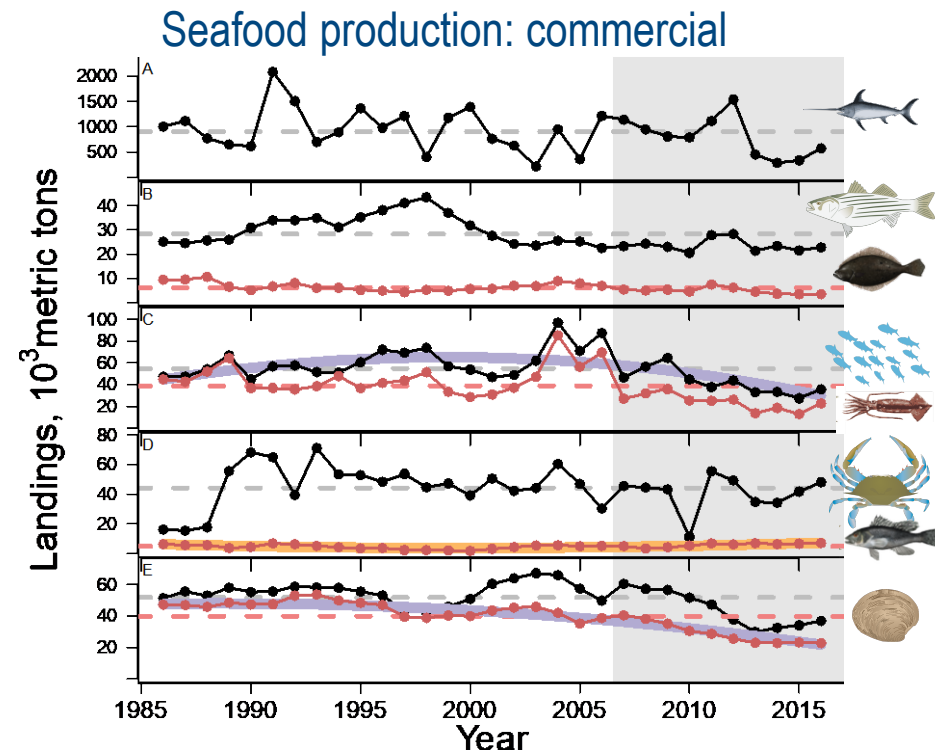
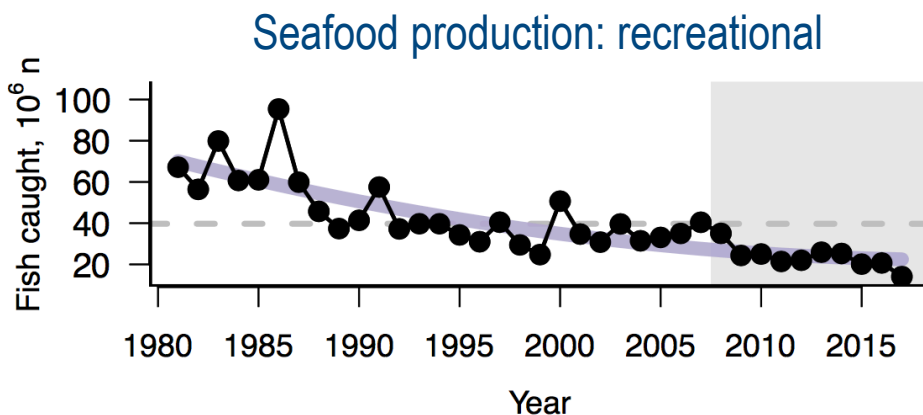
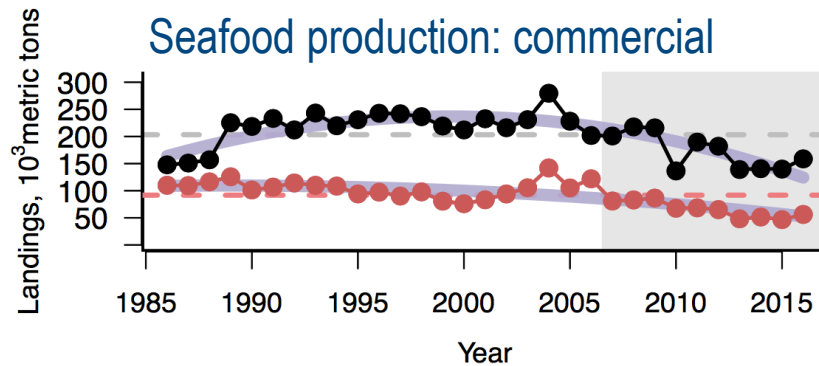
In some plots, such as this one, two series:

Total for indicator

Mid-Atlantic managed subset of indicator

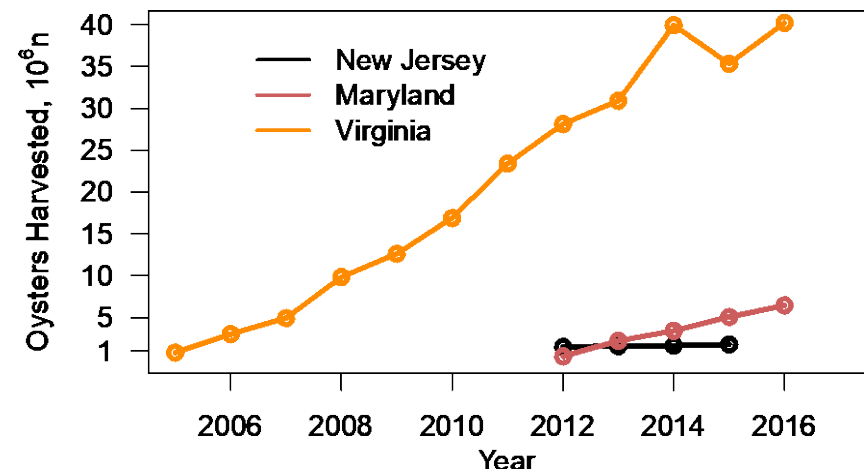
Seafood production objective

- Declines overall and in commercial planktivores, MAFMC benthos
- Increase MAFMC benthivores



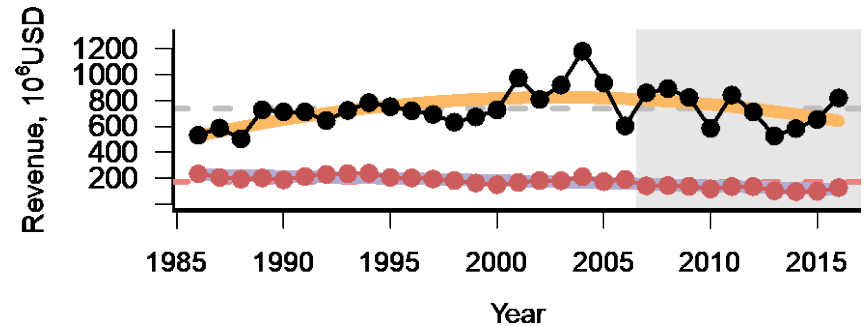
Seafood production objective

- Maryland and New Jersey aquaculture data added
- Virginia dominates aquaculture production of oysters, with production increasing in Maryland.
- Virginia leads the nation in hard clam aquaculture production, no trend



Profits objective

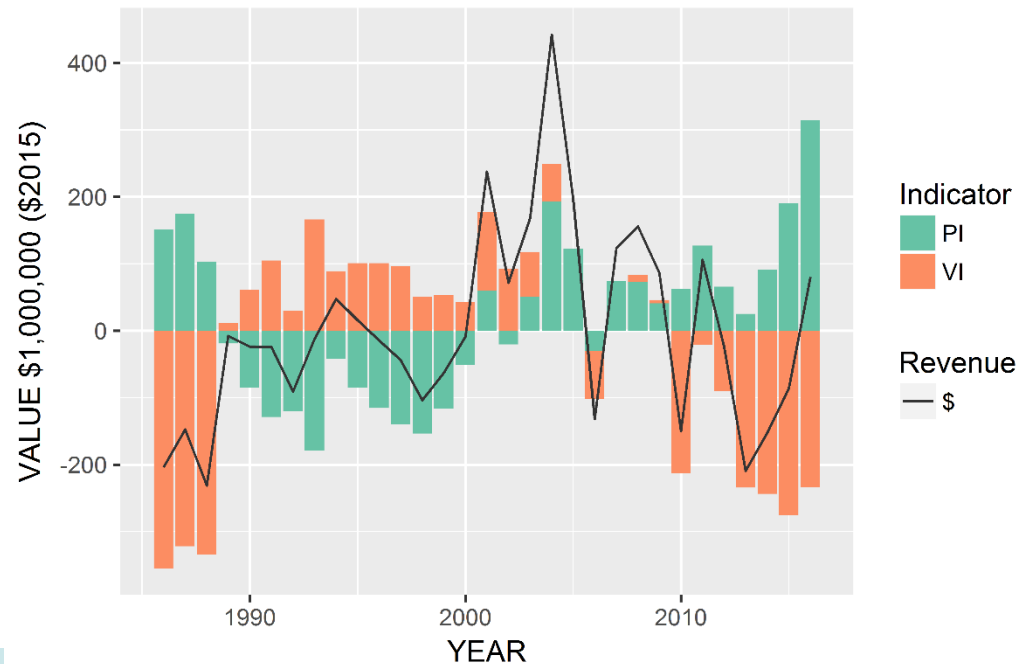
- Commercial revenues increased overall, decreased for MAFMC species.



Bennet indicator

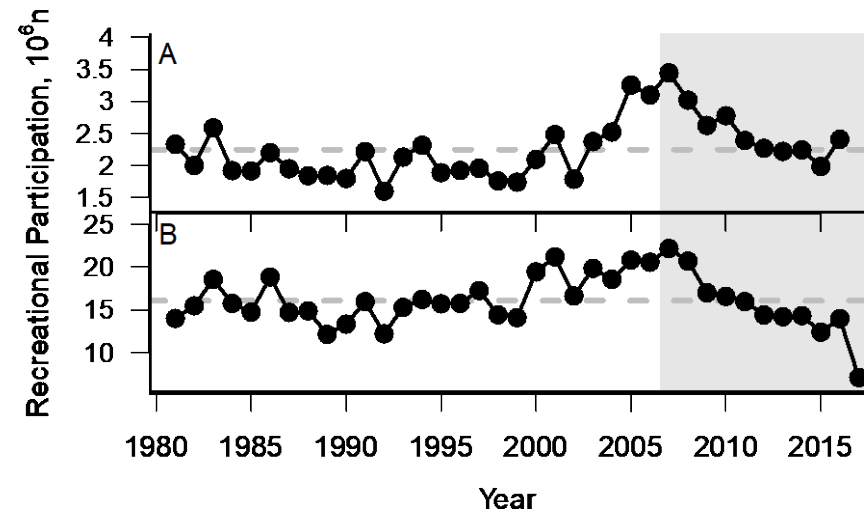
- Decomposes change due to **landings volume** and **price**
- Recent revenue increases driven by high price for benthos (clams, scallops)

Revenue Change (\$2015), Price (PI) and Volume Indicator (VI)
Mid-Atlantic Bight EPU 1986-2016 Compared to Average Year



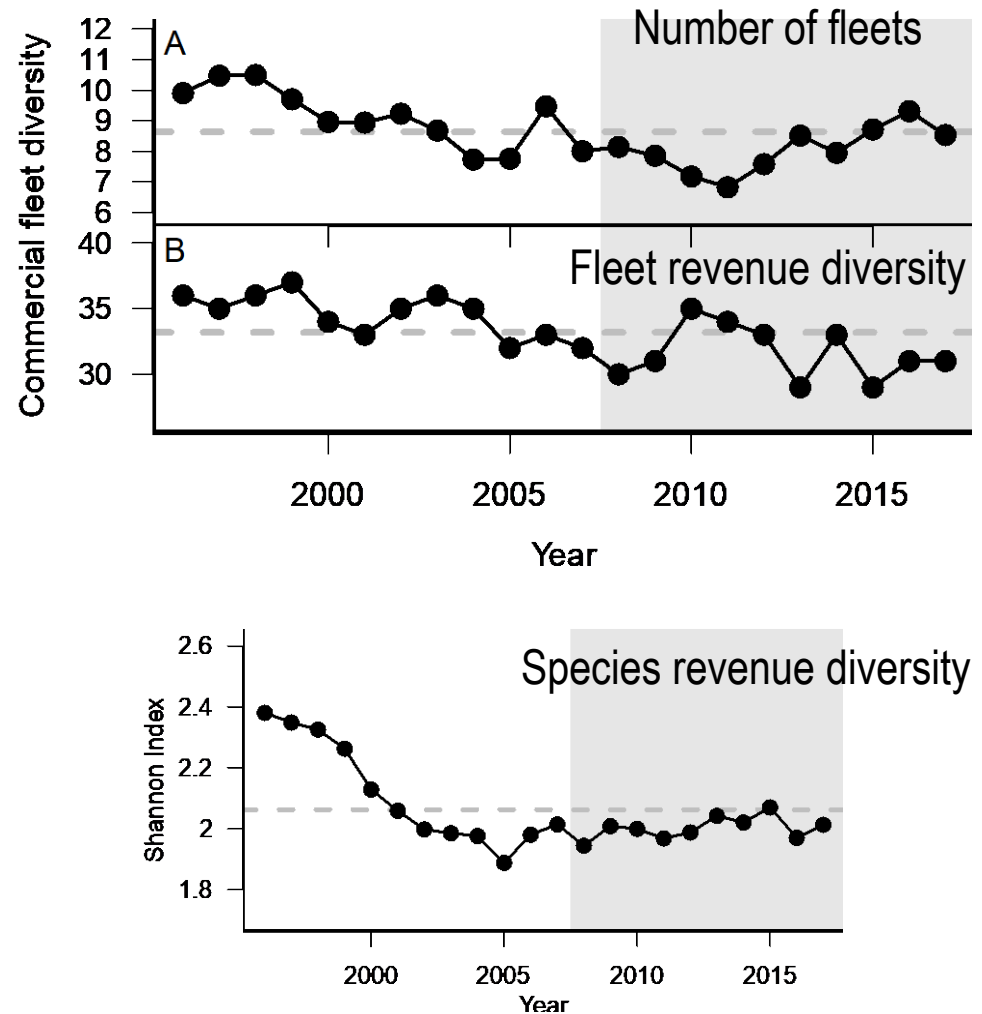
Recreational opportunities objective

- **Recreational opportunities** from fishing **increased from the 1990s to 2007**, according to numbers of anglers (A) and angler trips (B).
- However, there has been a **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.

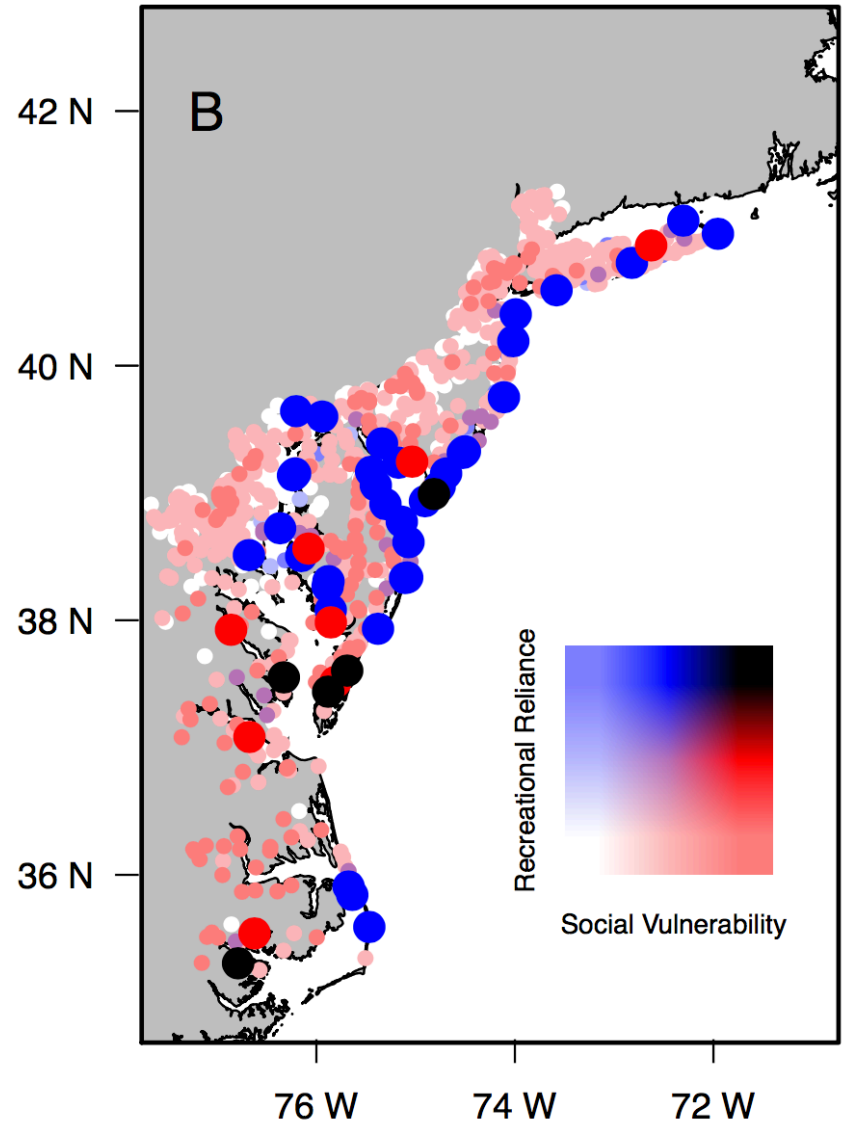
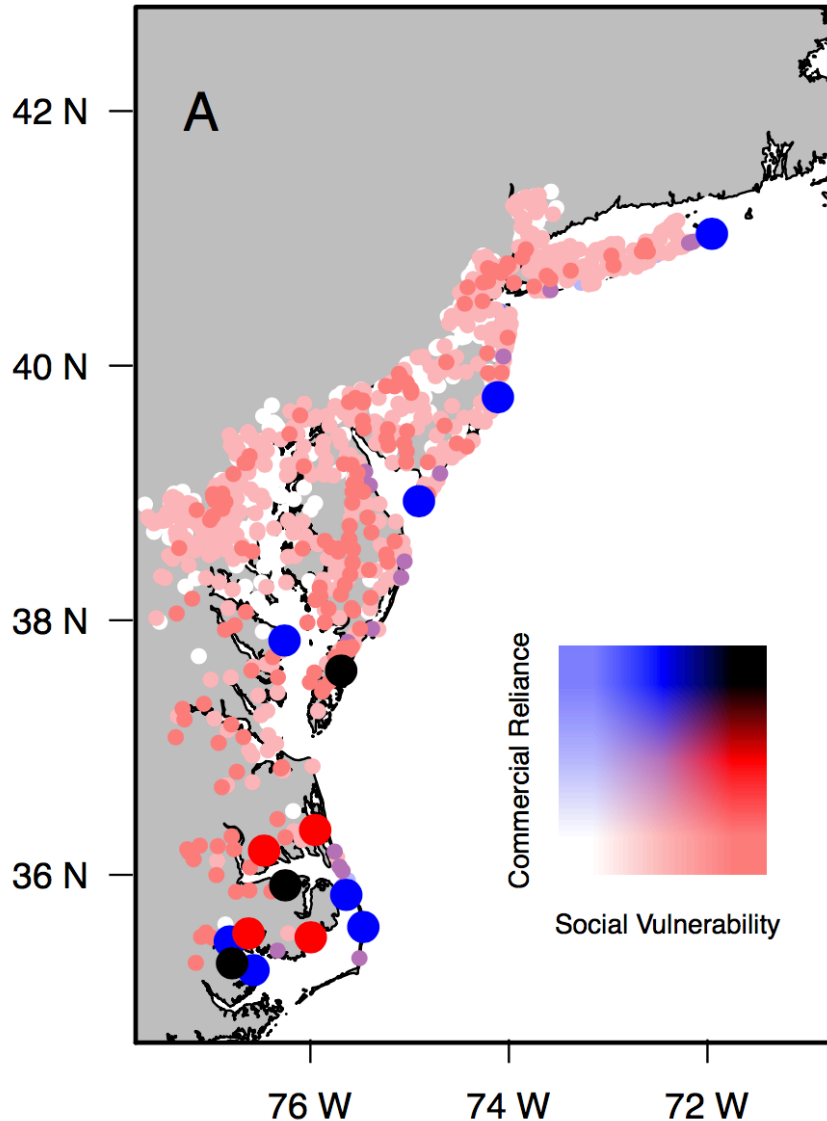


Stability objective

- Stability is addressed with indices of **commercial fleet and species revenue diversity**.
- These show **no significant trends** in the Mid-Atlantic, with relative stability in species revenue recently.



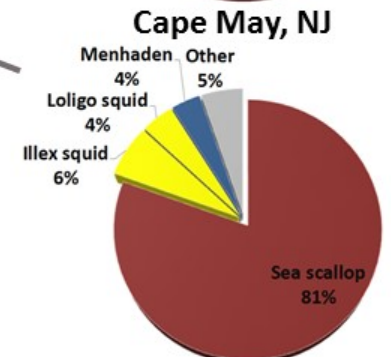
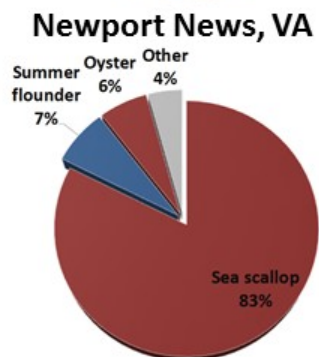
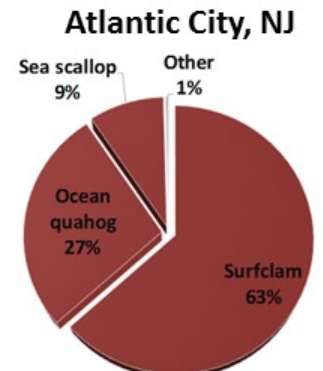
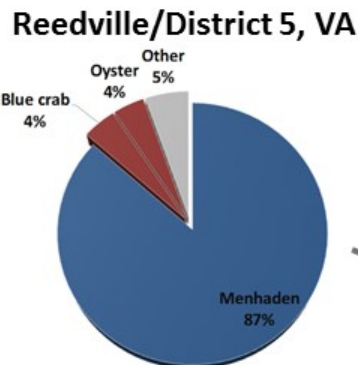
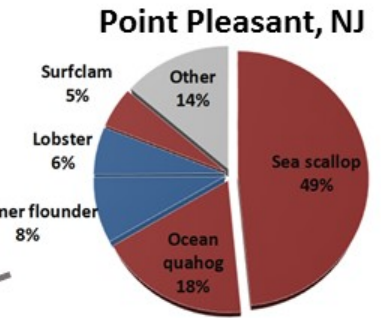
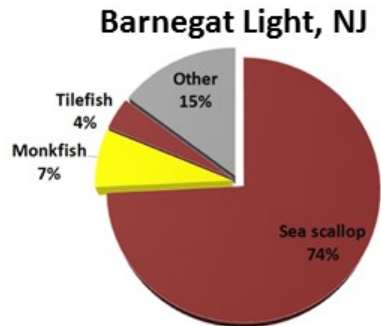
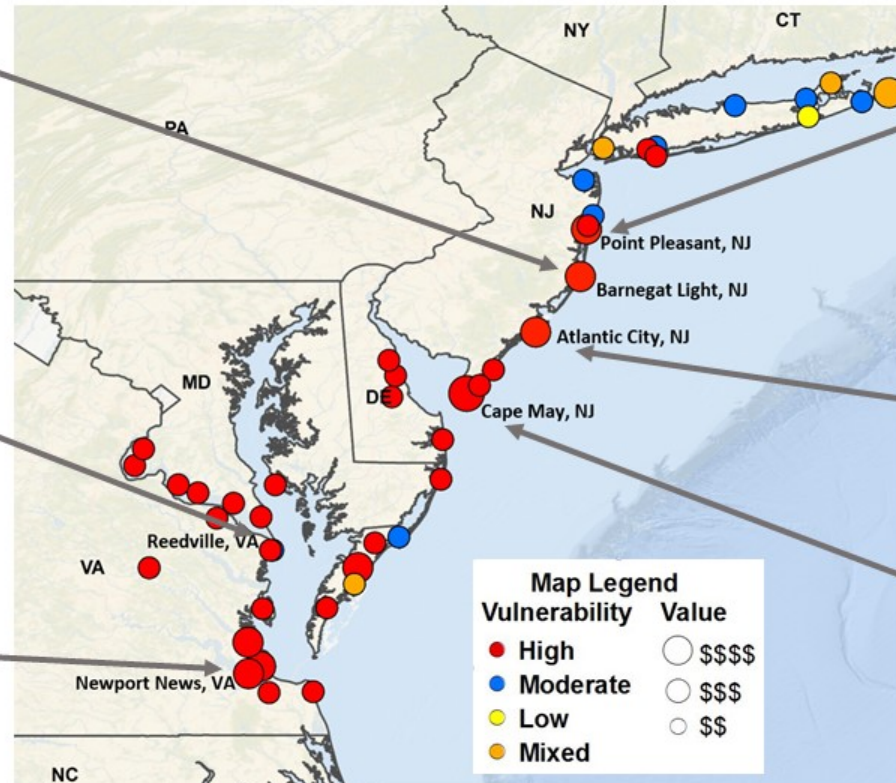
Fishery reliant and socially vulnerable communities



Community reliance on climate-vulnerable species

Species vulnerability in Mid-Atlantic fishing communities

(2009-2014 average landings value)

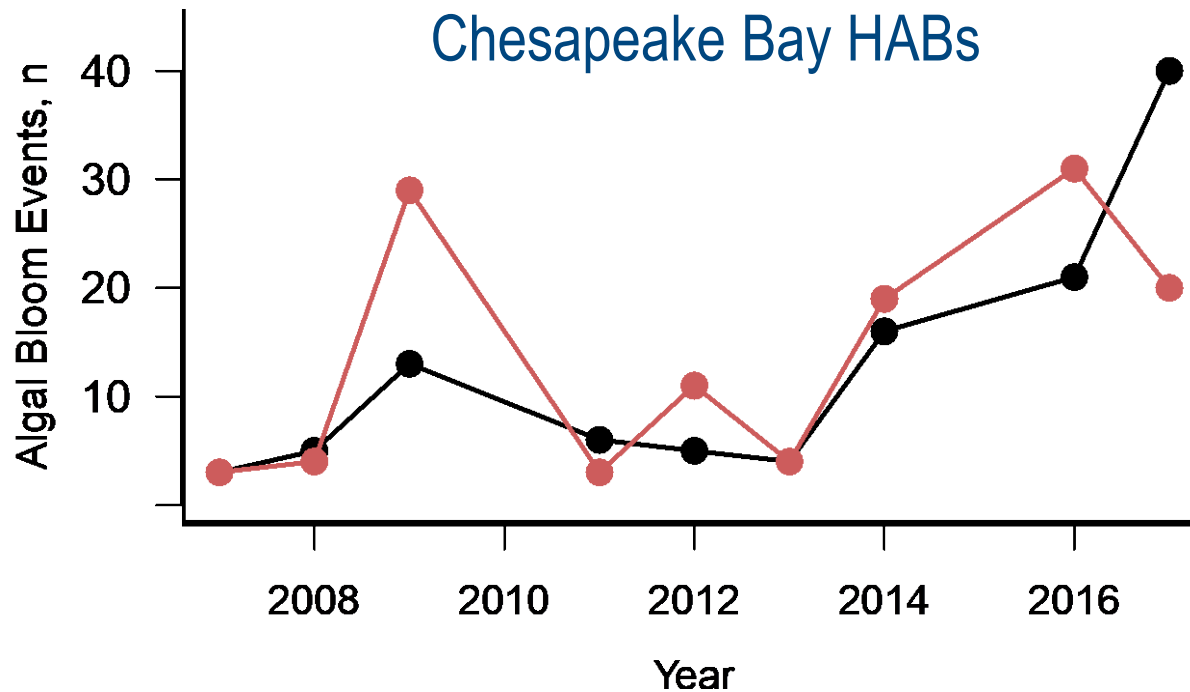


Pie Chart Vulnerability Legend:



*species with small percentages and/or non-ranked species

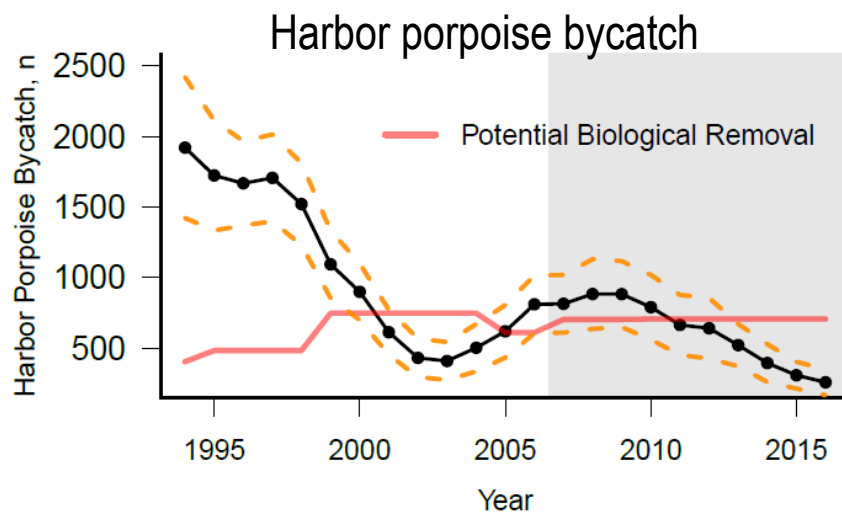
Risks to communities: Harmful Algal Blooms (HABs)



Occurrence of all blooms at concentrations warranting action by the Virginia Department of Health

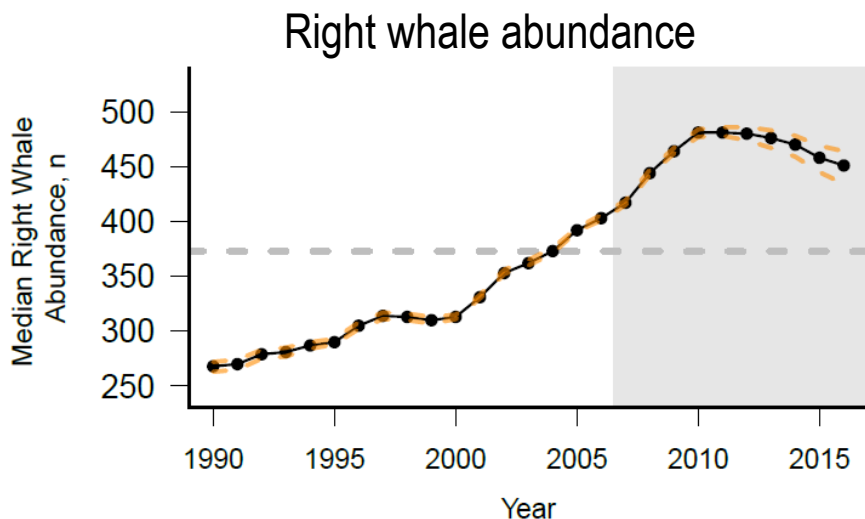
Occurrence of *C. polykrikoides* in Chesapeake Bay at concentrations lethal to fish (>300,000 cells per L)

Protected species - fishery interactions



2017 Harbor porpoise bycatch is lowest in time series

Likely due to increased compliance and reduced fishing efforts



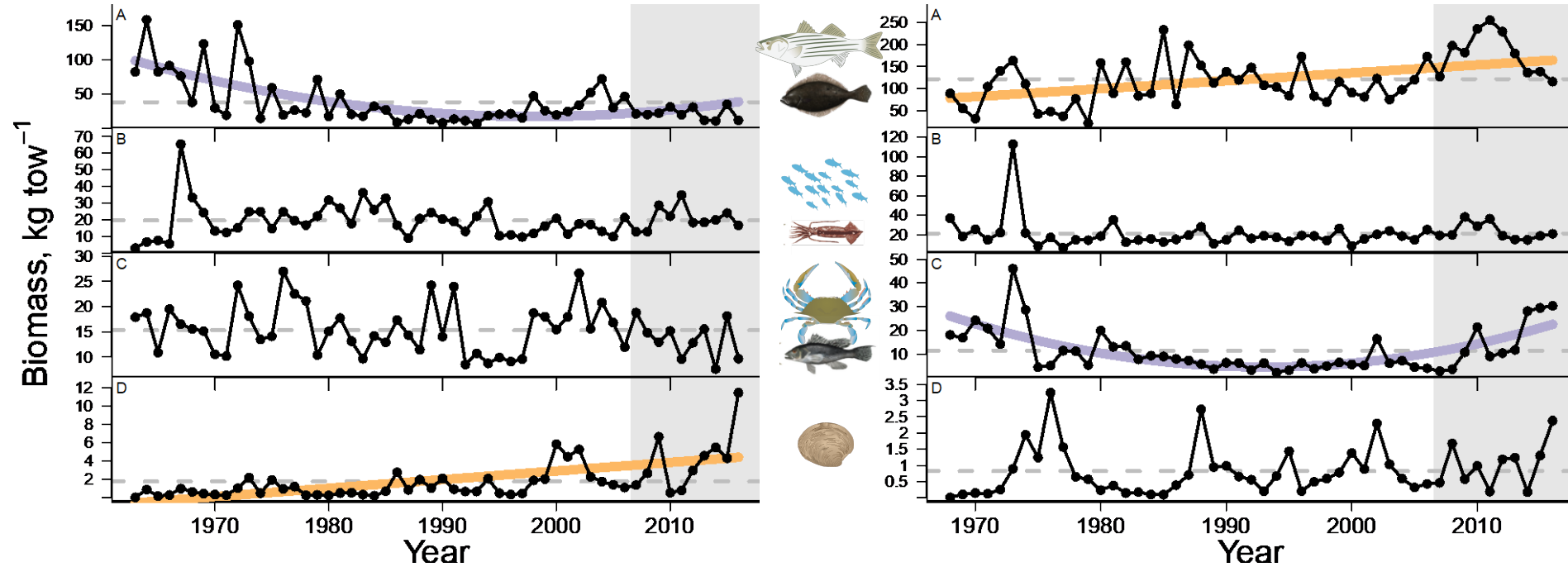
North Atlantic right whale population is declining

17 right whale deaths reported during 2017

Biomass and trophic structure: survey trends

Fall

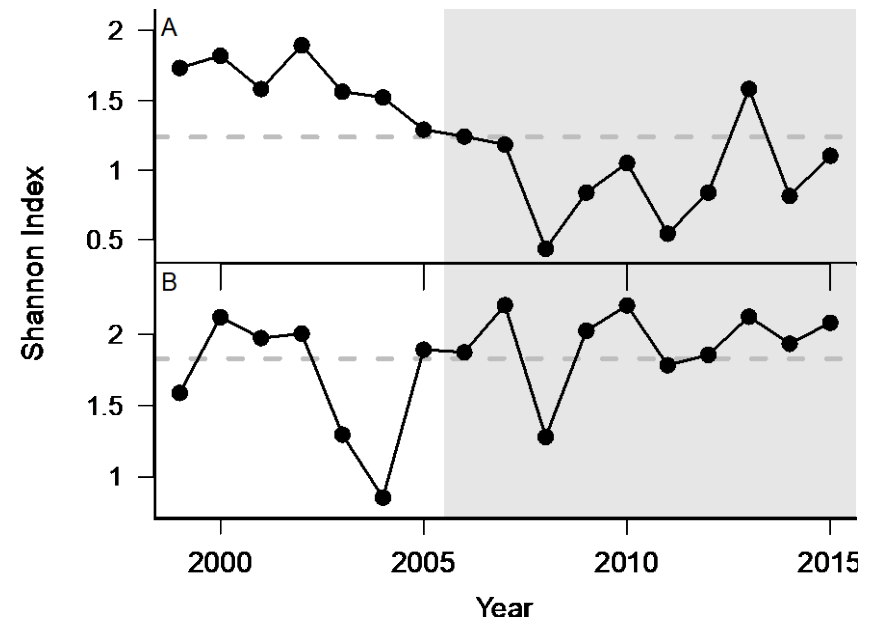
Spring



- Survey biomass trends for aggregated trophic groups differ in the fall and spring. Piscivores have conflicting long term trends depending on the season sampled. Seasonally divergent aggregate trends require further investigation.

Biomass and trophic structure: diversity

- Species diversity based on larval fish shows a possible decrease only during the spring survey, with general stability in the fall survey
- The decrease in spring larval diversity coincides with an increase in the spring abundance of sand lance larvae, an important prey species.

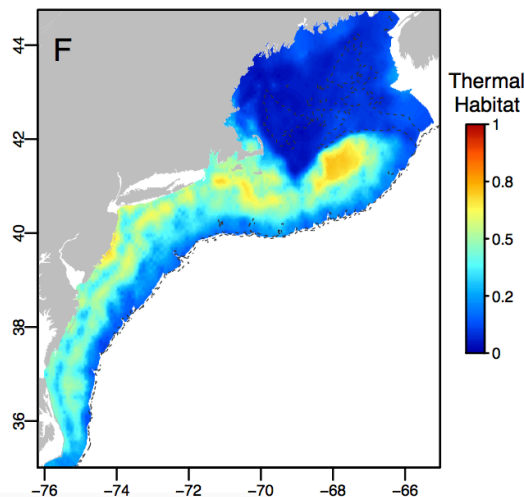
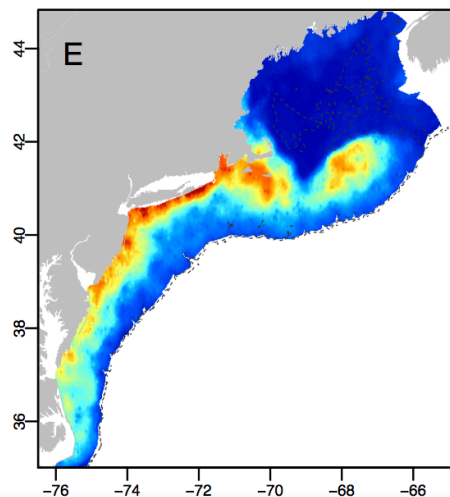
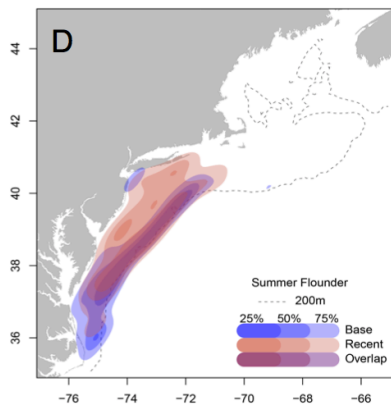
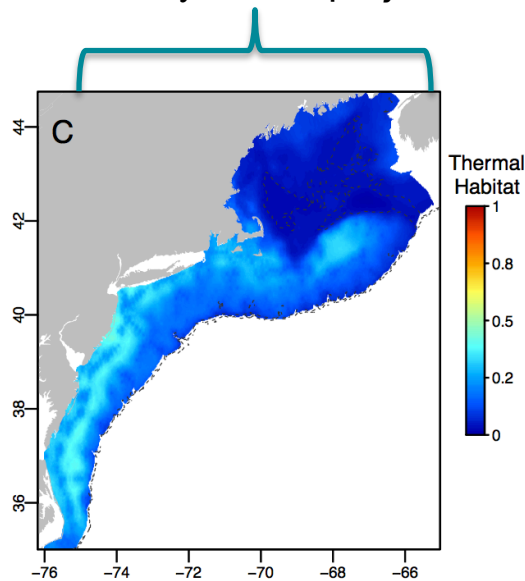
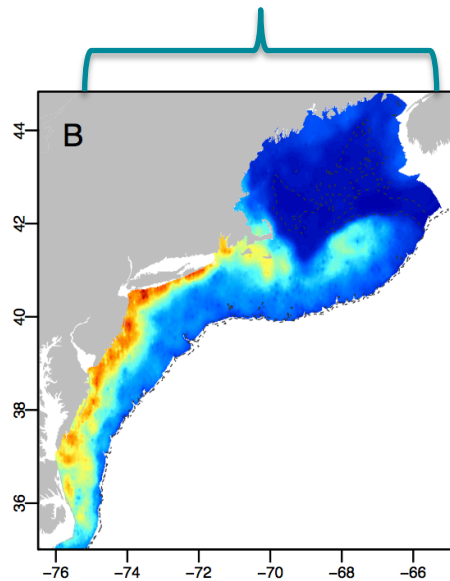
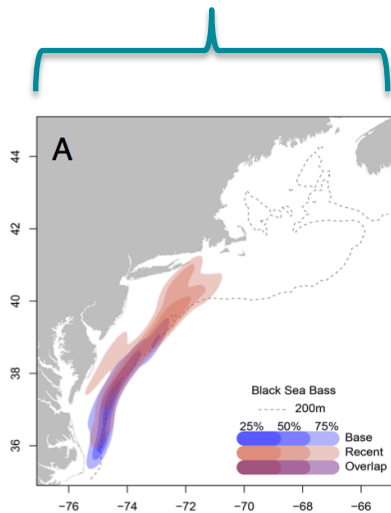


Indicators for shifting species and habitats

Current/past density

Current thermal habitat

20-40 year TH projection



Indicators for shifting species and habitats

- New this year at MAFMC request: which species may come into the Mid-Atlantic?
- Further information from fishermen on new and uncommon species is welcome for this report.

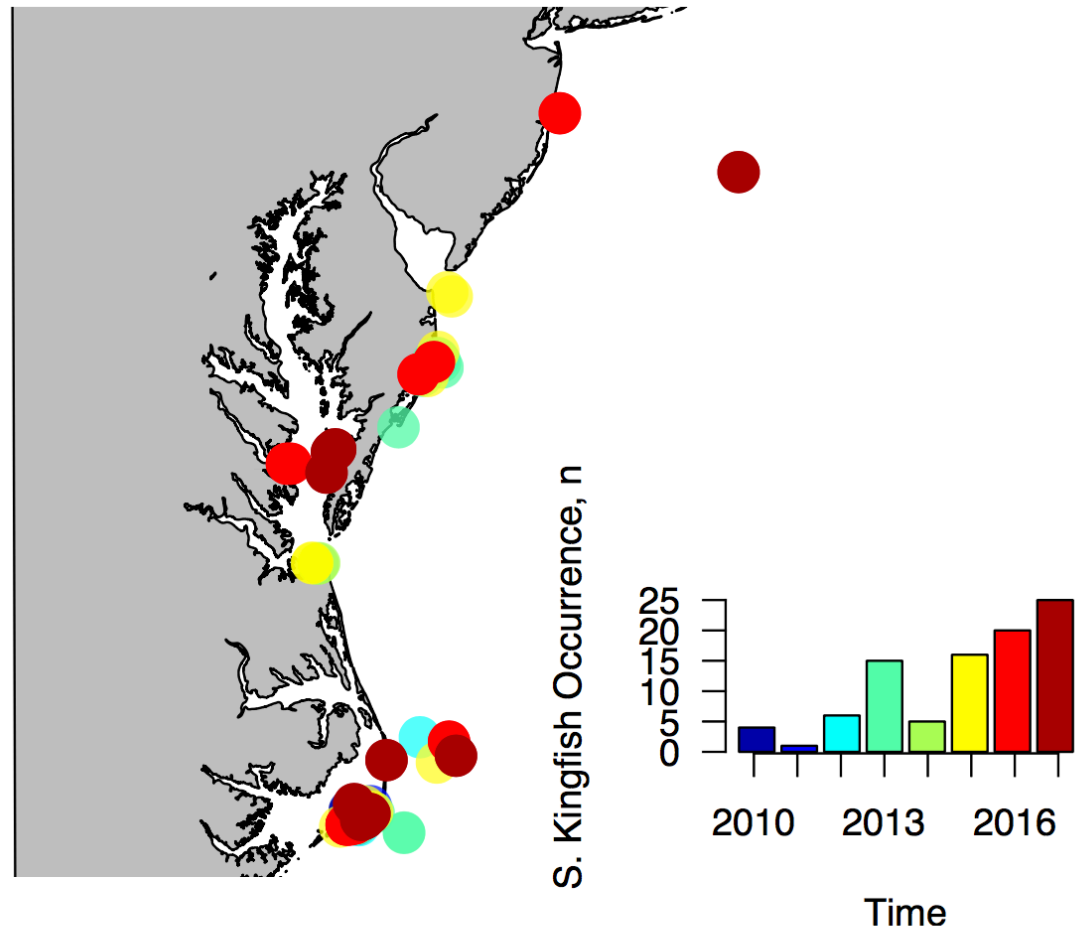
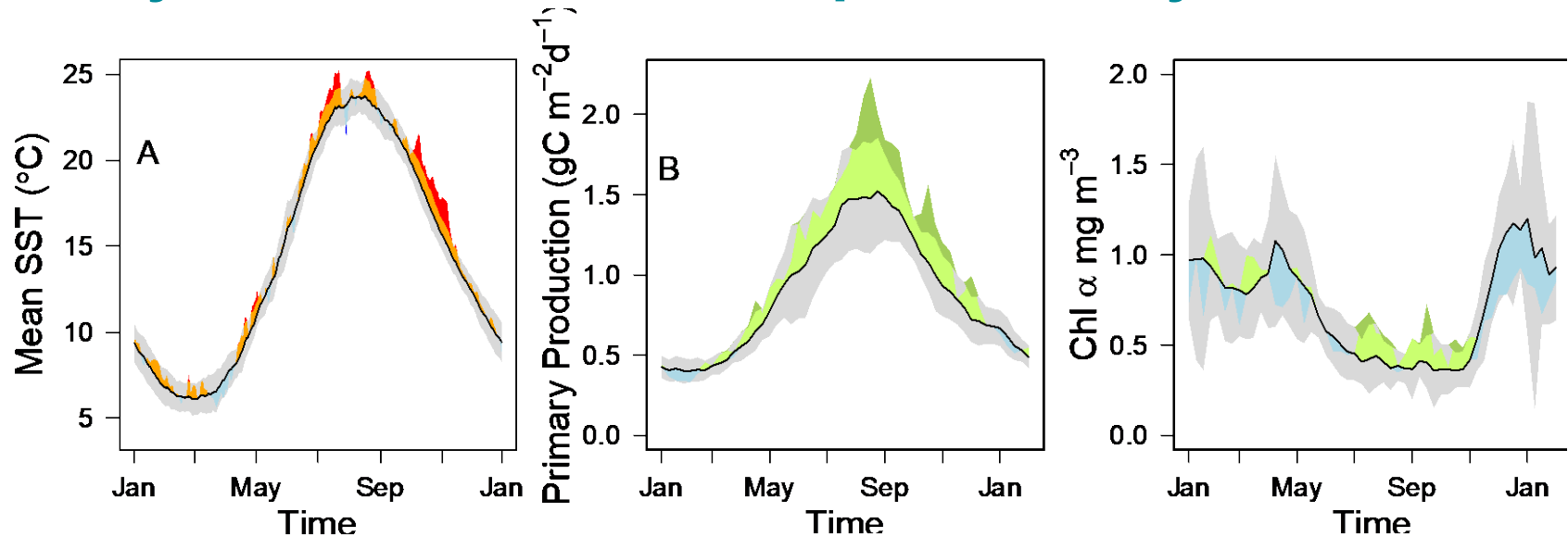
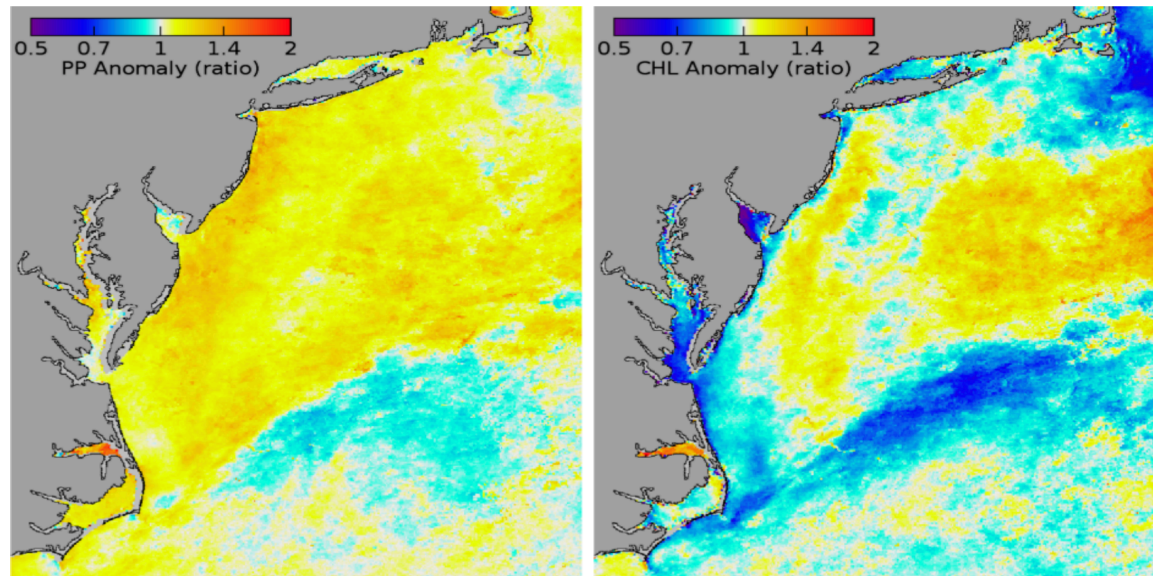


Figure 24: Southern kingfish occurrences in the observer database

Ecosystem conditions and productivity: 2017

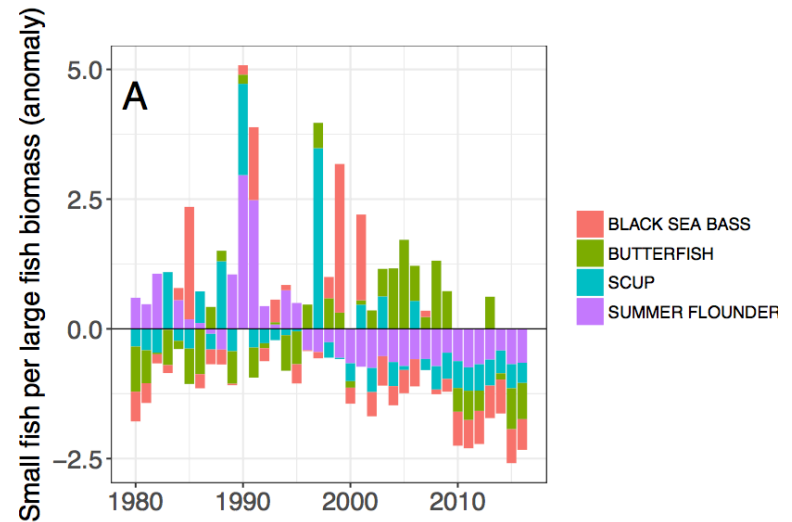
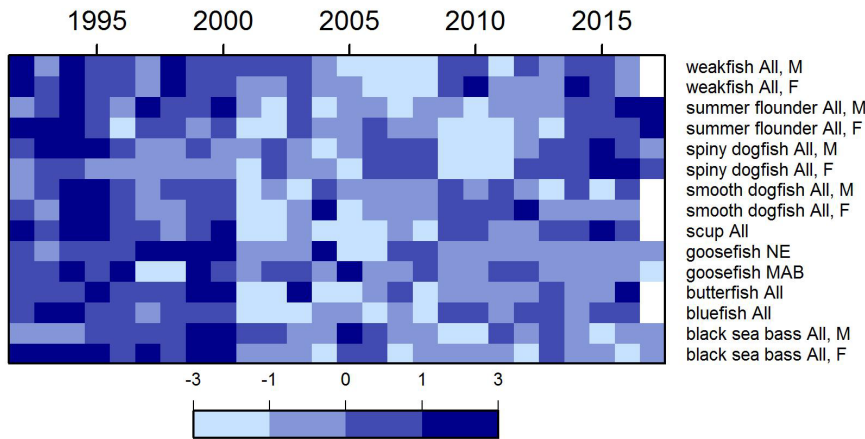


- Warm winter, moderate summer, very warm fall
- High primary production (PP) during most of 2017 with an upward trend since 2004.
- Not all increased PP may be available to higher trophic levels.

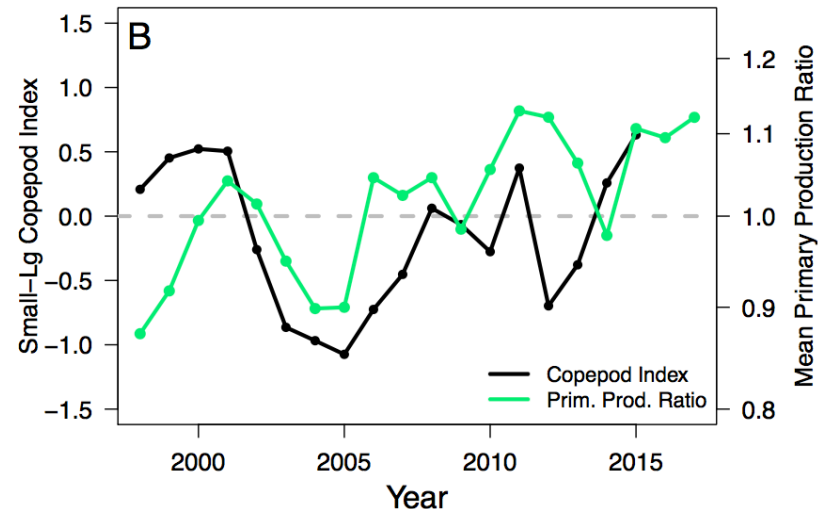
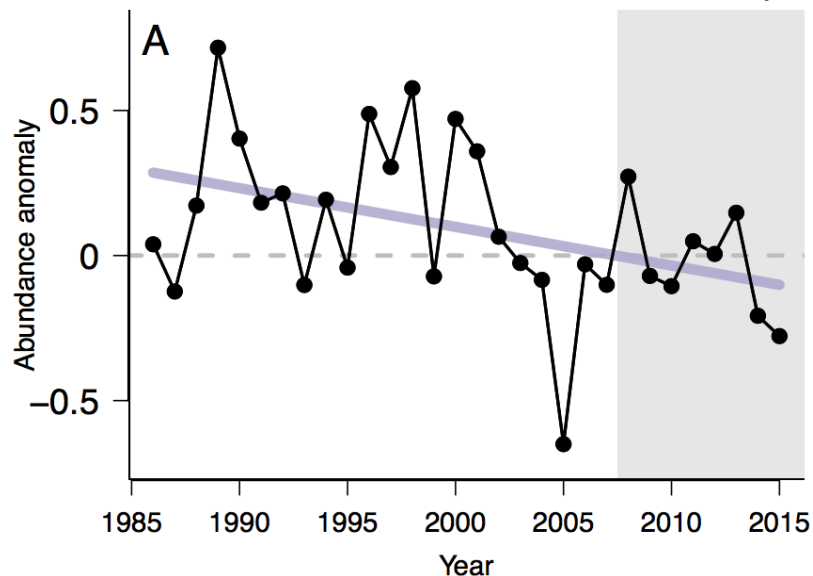


Ecosystem indicators for system productivity

Groundfish condition and productivity



Base of the food web: Copepods and primary production



Species level

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

Species and Sector level

Ecosystem level

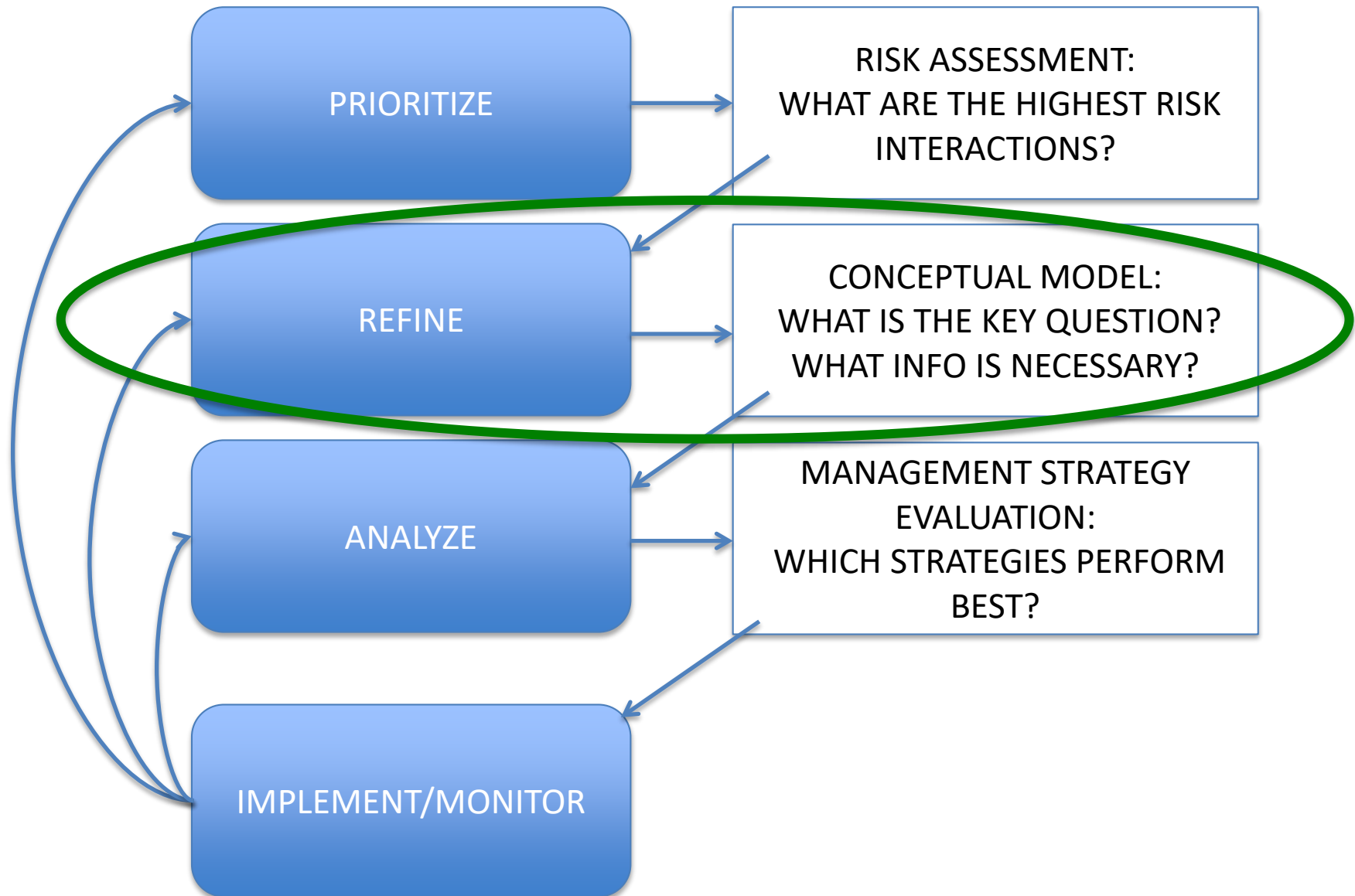
System	EcoProd	CommProf	RecVal	FishResI	FishRe
Mid-Atlantic	lm	nh	h	l	nh

Species	MgtControl	TecInteract	OceanUse	RegComplex	Discards	Allocation
Ocean Quahog-C			lm			
Surfclam-C			lm			
Summer flounder-R	nh		lm	h	h	h
Summer flounder-C	lm	nh	lm	nh	lm	h
Scup-R			lm	nh	nh	
Scup-C		nh	lm	nh	nh	
Black sea bass-R	h		nh	h	nh	h
Black sea bass-C	lm	lm	h	nh	lm	h
Atl. mackerel-R						h
Atl. mackerel-C		lm	nh	h	lm	h
Butterfish-C		lm	nh	h	nh	
Longfin squid-C		nh	h	h	h	h
Shortfin squid-C		lm	lm	lm		
Atl. mackerel-R						h
Atl. mackerel-C						h
Butterfish-C						h
Longfin squid-C						h
Shortfin squid-C						h
Spiny dogfish-R						h
Spiny dogfish-C		nh	nh	nh	lm	h
Unmanaged forage	na	na	na	na	na	na
Deepsea corals	na	na	nh	na	na	na

EAFM Risk Assessment, approved December:

http://www.mafmc.org/s/SOE_MAB_RiskAssess-lzyt.pdf

Framework for addressing interactions



Additional information available

- Historical and current distributions:

<https://www.nefsc.noaa.gov/ecosys/current-conditions/kernel-density.html>

- Thermal habitat projections

<https://www.nefsc.noaa.gov/ecosys/climate-change/projected-thermal-habitat/>

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

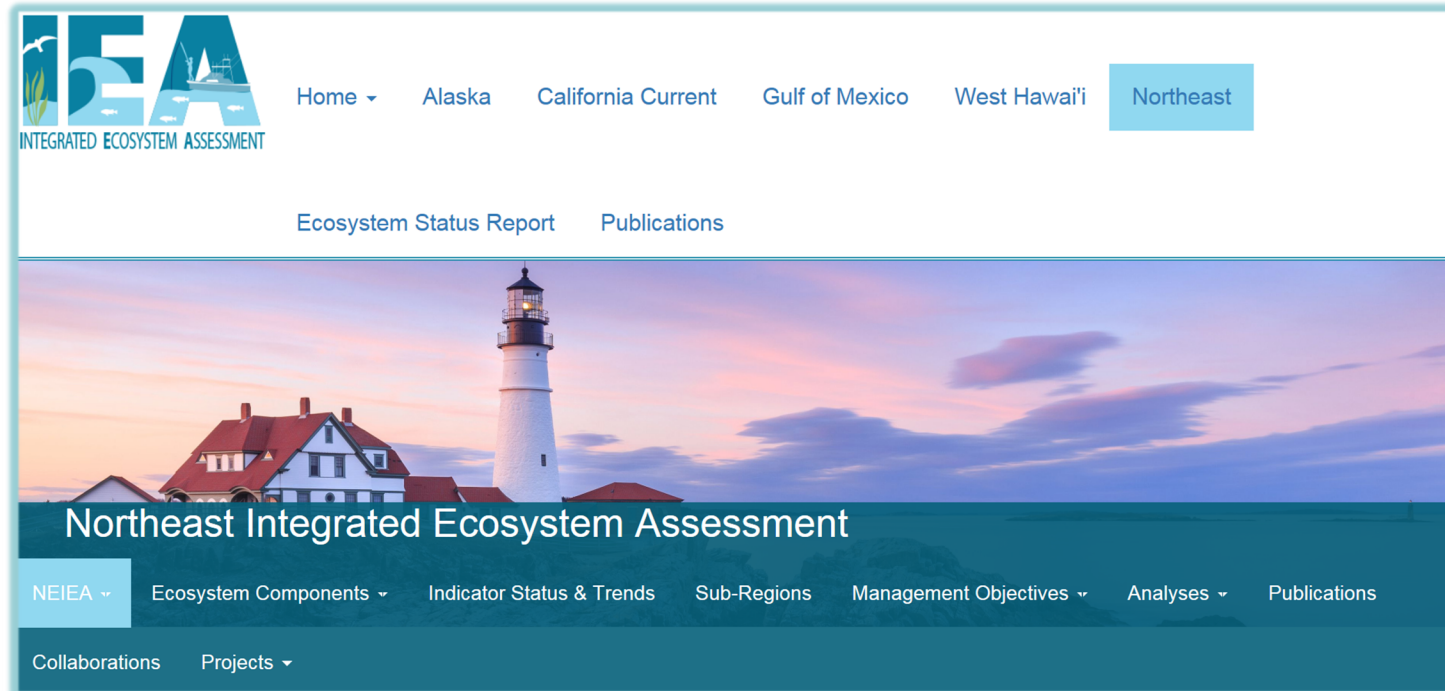
The screenshot displays the NOAA Fisheries Service Northeast Fisheries Science Center (NEFSC) website. The main heading is "Ecosystems Dynamics & Assessment Program". Below this heading, there are several navigation buttons: "Ecology of the Northeast Continental Shelf", "Climate Change", "Ecosystem Status", "Current Conditions", "Spatial Analyses", and "Modeling Approaches". The page contains text explaining the importance of implementing marine Ecosystem-based Management (EBM) in the United States, highlighting the adoption of a new National Ocean Policy and the role of Coastal and Marine Spatial Planning. A map of the Northeast U.S. Continental Shelf is shown on the right side of the page, with a caption: "Figure 1. Examples of some important ecosystem services (blue stars), 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 website footer includes the NOAA logo and the text "NOAA FISHERIES".

Next steps

New IEA website
incoming

Accessible data for
all indicators

Analyses, projects,
and collaborations
hosted here



How can we better serve the Mid-Atlantic Council?
Always looking for feedback



Thank you!

Questions?

