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Northeast Fisheries
Science Center

State of the Ecosystem Report: Georges Bank and Gulf of Maine

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many Northeast Fisheries Science Center
contributors

New England Fishery Management Council
17 April 2018



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State of the Ecosystem report, 2017

Background:

- SOE project began in 2014
- Built upon yearly with feedback from NEFMC and MAFMC
- Similar docs in other regions

Objectives:

- Provide relevant contextual information regarding ecosystem processes
- Accessible to general audiences familiar with fishing

State of the Ecosystem - Gulf of Maine and Georges Bank

Ecosystem Dynamics and Assessment Branch, Northeast Fisheries Science Center

April 06, 2017

The purpose of this report is to provide **ecosystem-scale information for fishery managers** to consider along with existing species-scale analyses. An overview of ecosystem relationships as represented by a **conceptual model helps place more detailed species-level management in context** by highlighting relationships between focal species groups, managed human activities, environmental drivers, habitats, and key ecological links. The activities link to high level strategic management objectives (described next). Many components of the conceptual model are represented by indicators in this report, and key paths connecting components and objectives are highlighted.

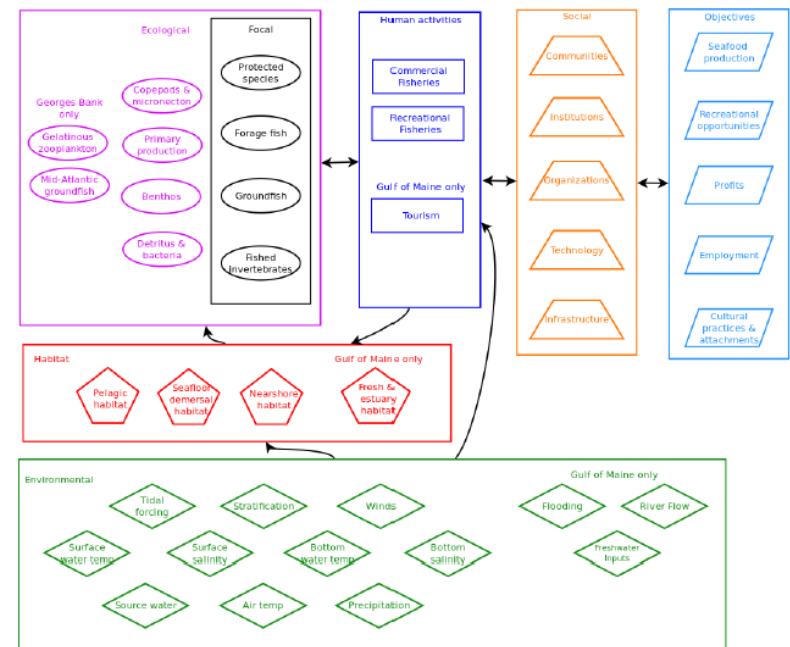
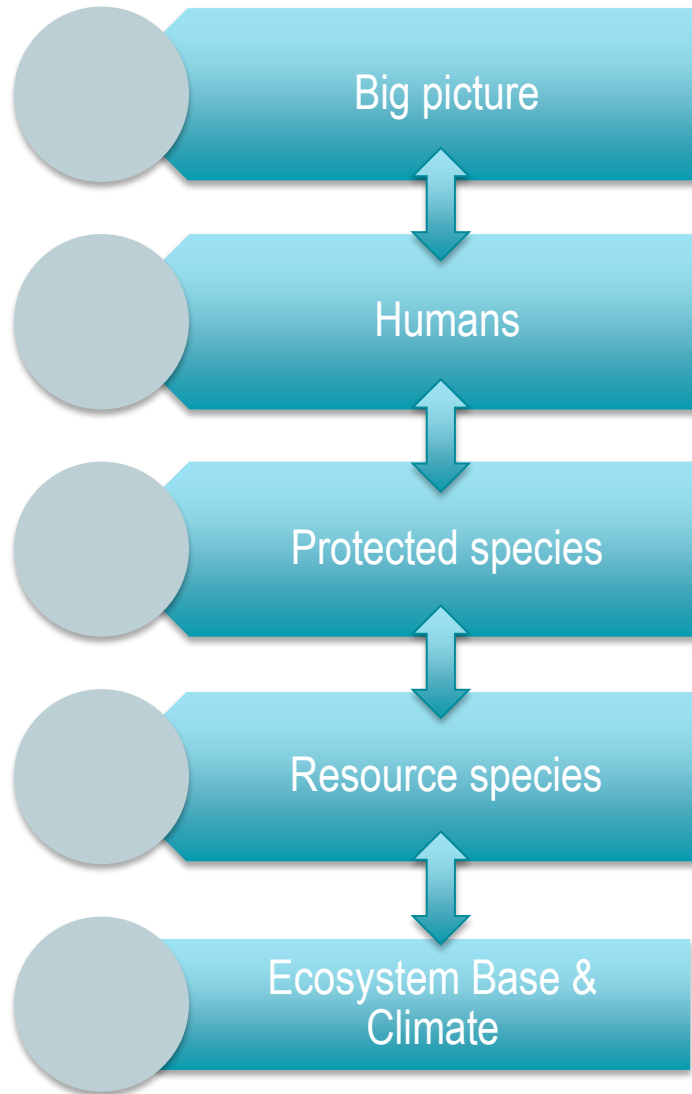


Figure 1: Gulf of Maine and Georges Bank Ecosystems

Current revision: Pushing for synthesis



SOE report components

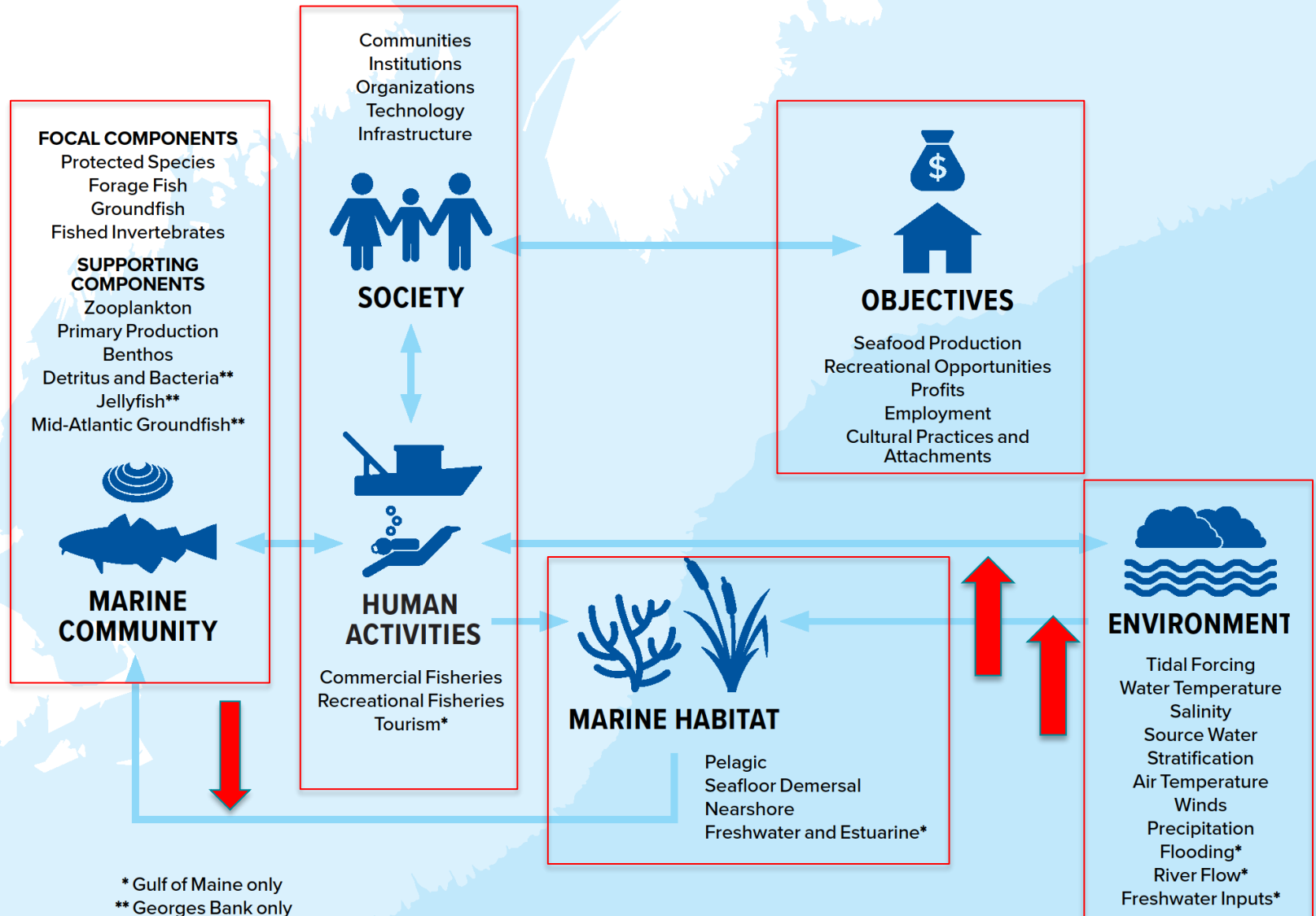
Reduce abstraction of ecosystem-scale processes

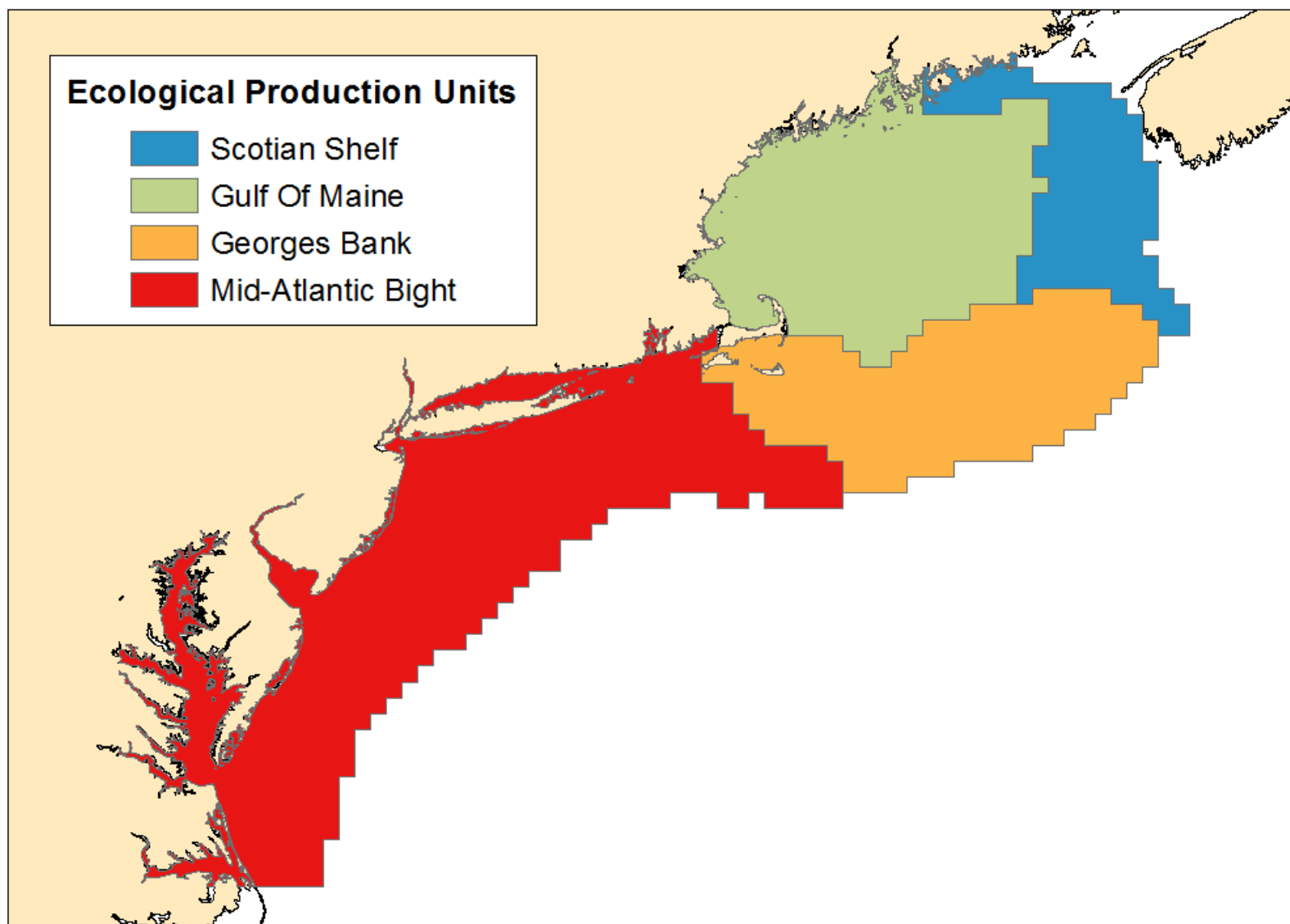
Greater focus on synthesis across indicators and regional specificity

Furthering collaboration

State of the Ecosystem

GEORGES BANK & GULF OF MAINE





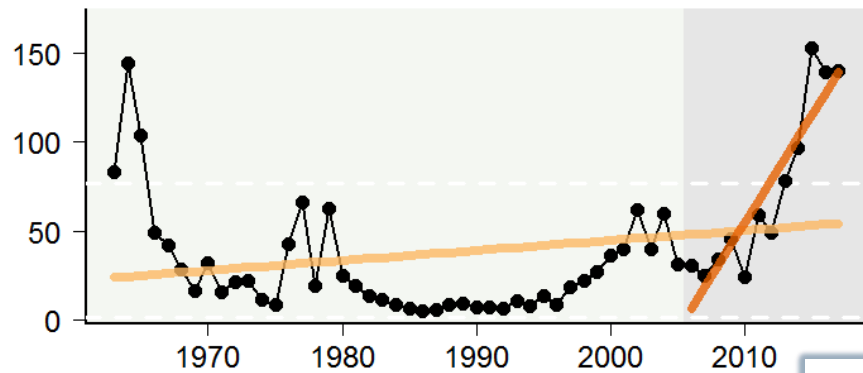
Objectives and Indicators

Objective Categories	Indicators reported here
Seafood production	Landings by feeding guild
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 NEFMC managed species
Trophic structure	Relative biomass of feeding guilds, primary productivity
Habitat	Thermal habitat projections, estimated habitat occurrence

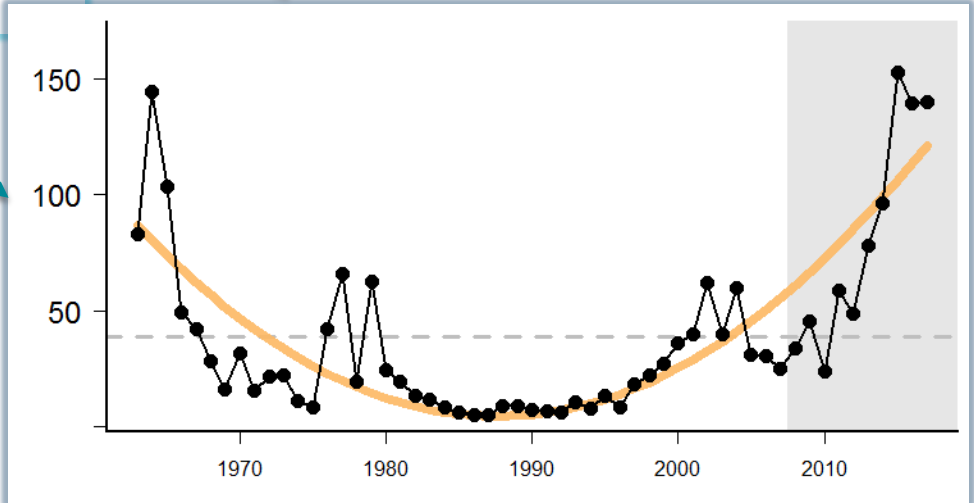
Pages 2-3 synthesize key results

Time series approach for SOE 2018

2016-2017








2017-2018



Updated statistical approach

- Mechanism to consider nonlinear trends
- Removal of “status” trendline

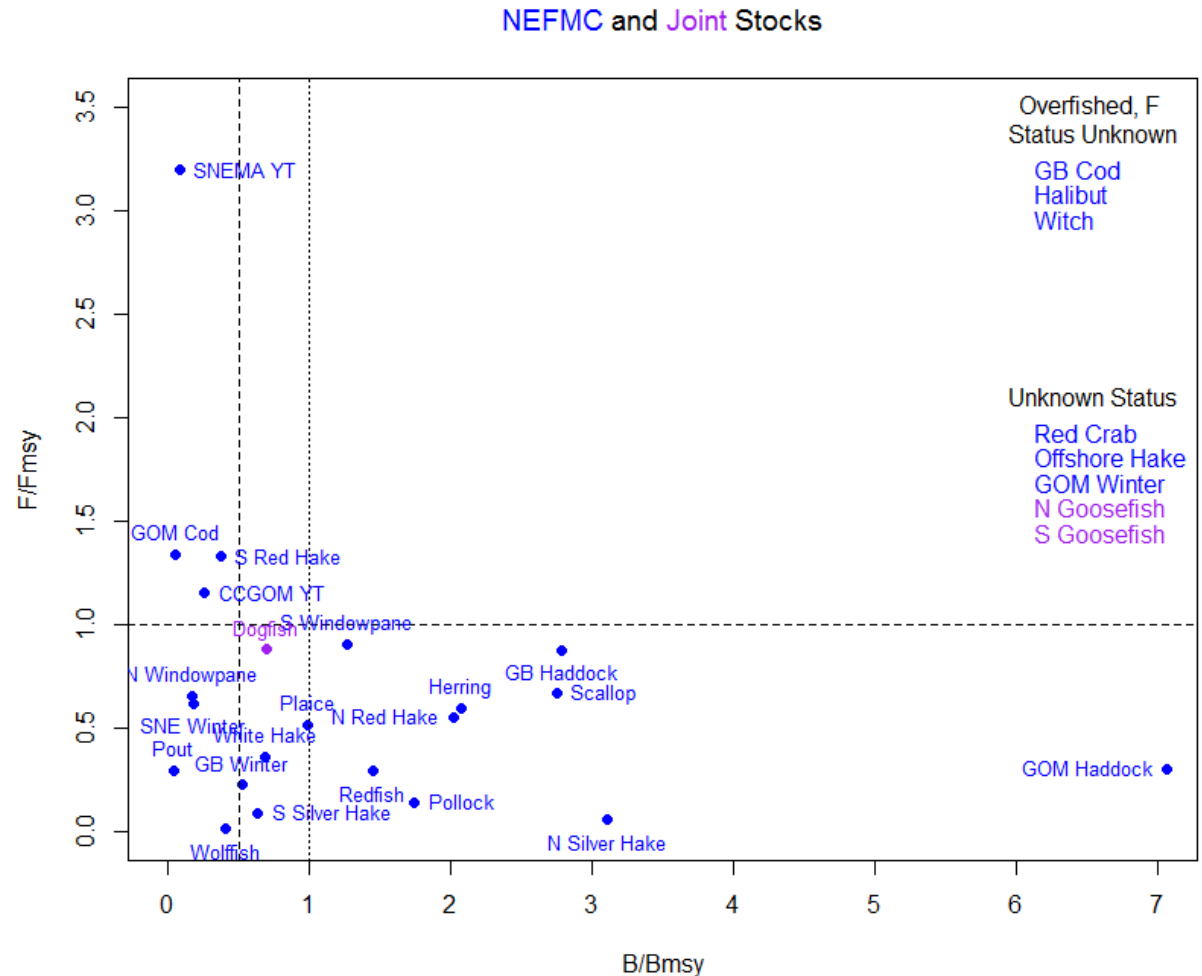
Updated functional groups

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		monkfish, winter and thorny skates, silver and offshore hake, Atlantic cod, halibut, fourspot flounder, spiny dogfish, summer flounder, bluefish, striped bass, weakfish
C: Planktivore (Eat plankton)	16		Atlantic herring, butterfish, Atlantic mackerel, menhaden, river herrings, shad, white hake, longfin and shortfin squids, searobins, sculpin, lumpfish
E: Benthivores (Eat bottom dwellers)	25		lobster, haddock, yellowtail, winter, and witch flounders, barndoor skate, ocean pout, black sea bass, scup, tilefish, tautog, cunner, blue crab, red crab, other crabs
F: Benthos (Filter feeders)	9		scallops, surfclam, quahog, mussels, whelks, conchs, sand dollars and urchins

Single species objectives

The NEFMC is meeting objectives at the managed species level for 15 out of 38 stocks

Stocks with **high F** and **low B** include Cape Cod/GOM/SNE yellowtail flounder, S red hake, and GOM cod



Seafood production objectives

Proportion managed by NEFMC

All landings figures show proportion of landings managed by NEFMC as well as total commercial landings

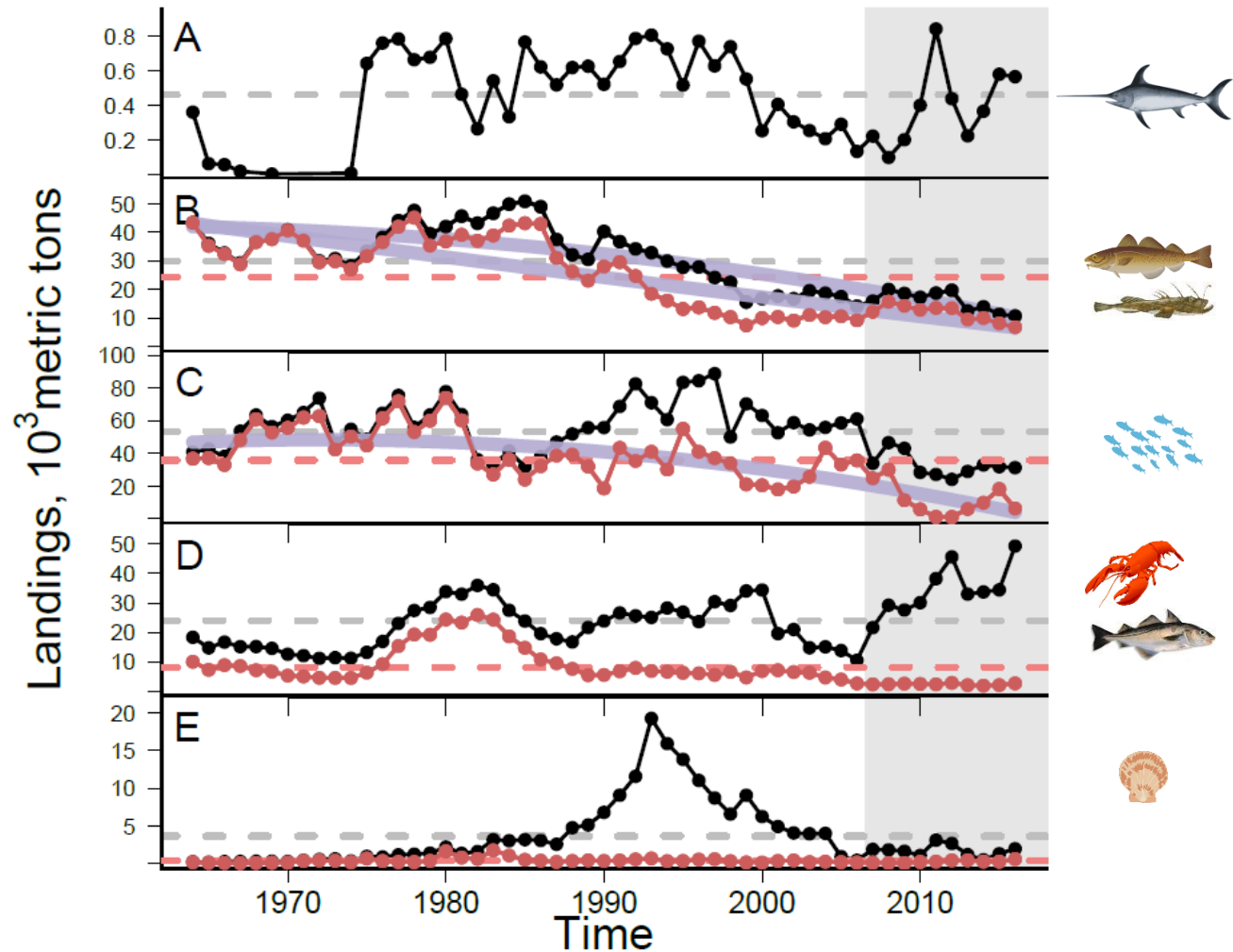
Table below shows proportion of managed stocks landings and revenue in 2016

Groups	GOM Landings	GB Landings	GOM Revenue	GB Revenue
Piscivore	0.98	0.98	0.93	0.91
Planktivore	0.88	0.90	0.89	0.26
Benthivore	0.05	0.42	0.03	0.77
Benthos	0.30	0.30	0.71	0.85

Seafood production objective - GOM

Benthos landings show no long term trend

Managed landings of both piscivores and planktivores show long-term decreases

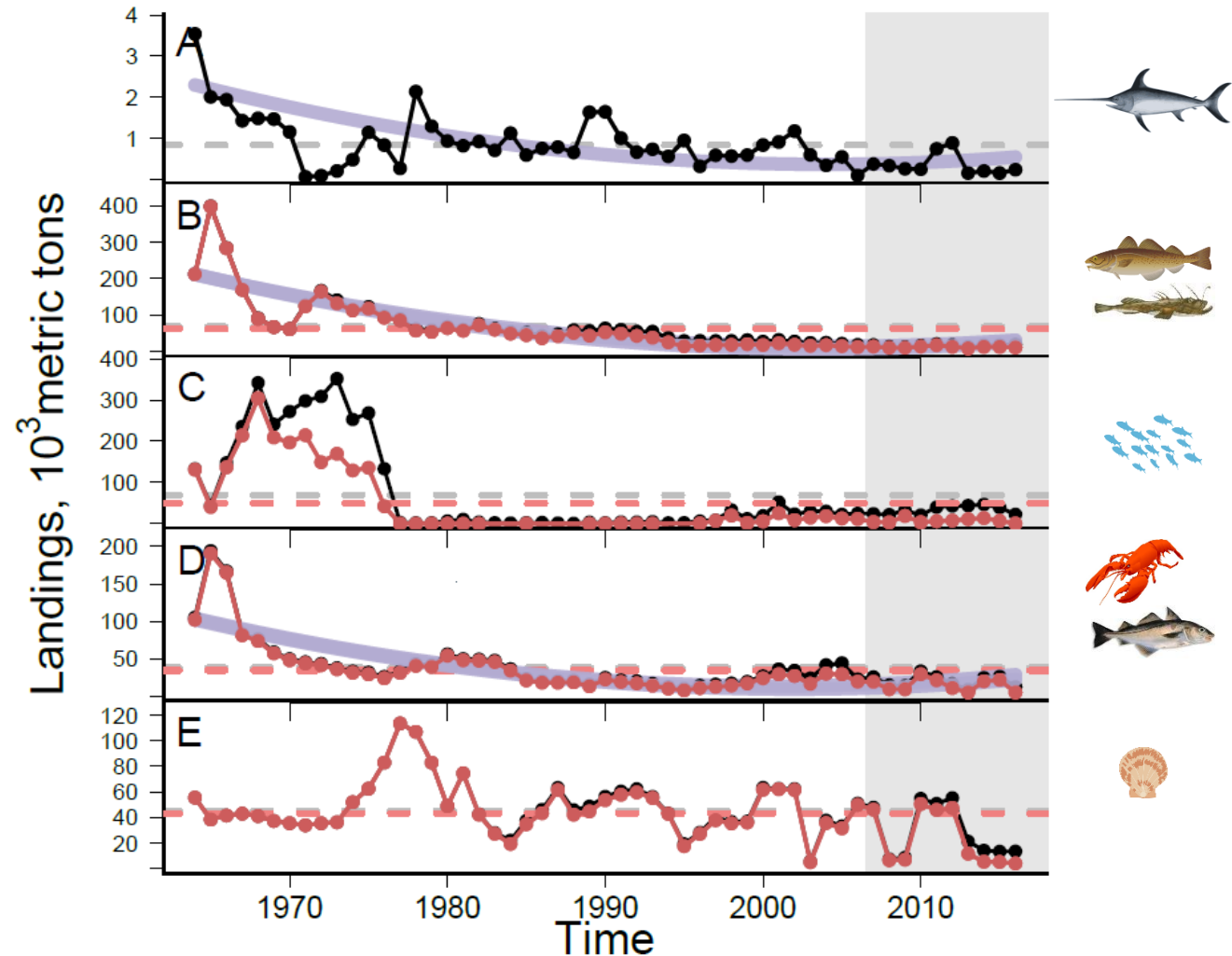


Total commercial landings and NEFMC managed species landings

Seafood production objective - GB

Benthos landings show no long term trend

Managed landings of both piscivores and benthivores show long-term decreases



Profits objective - GOM

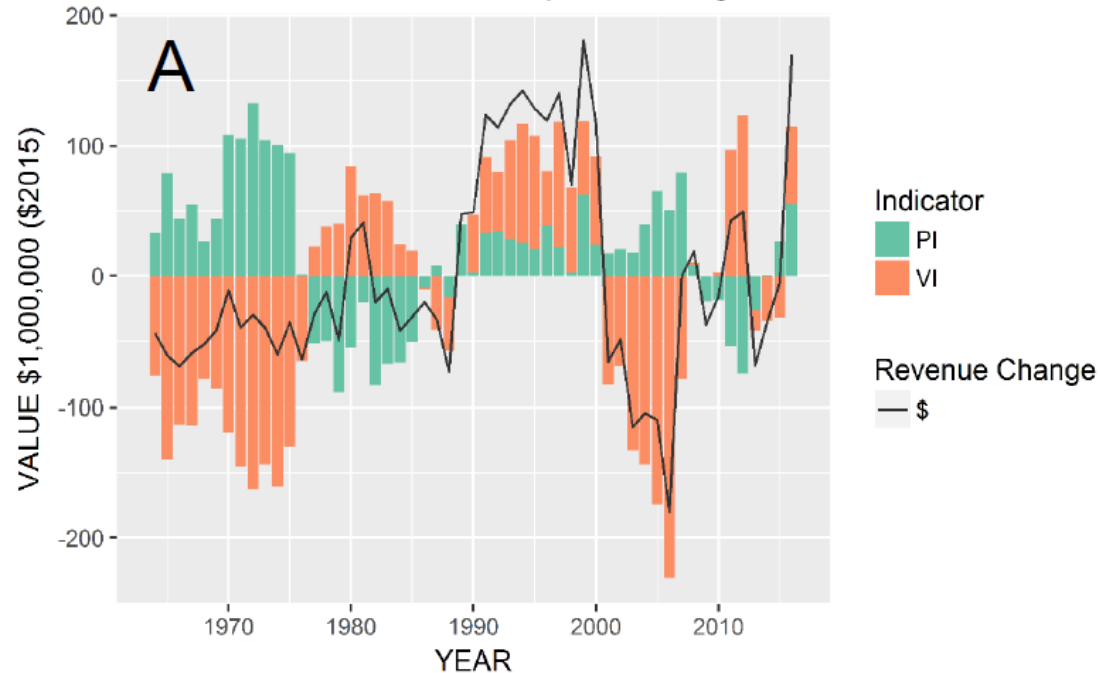
Bennet indicator

Compares revenue differences caused by changing quantities of landings and prices

For each year, we calculate a **volume indicator**, a **price indicator**, and **implicit revenue change**

Baseline value for comparison is the long-term average

Revenue Change (\$2015), Price (PI) and Volume Indicator (VI)
Gulf of Maine EPU 1964-2016 Compared to Average Year



Profits objective - GB

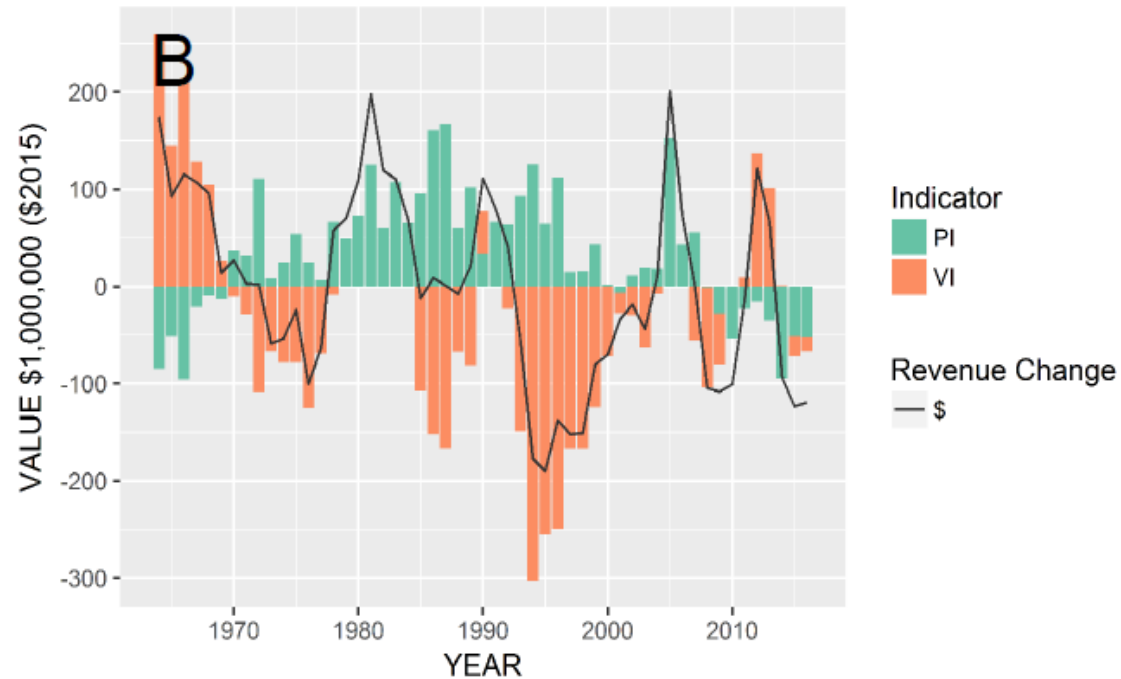
Cyclical pattern of revenue change compared to average

Revenue decreases caused by lower volumes rather than prices

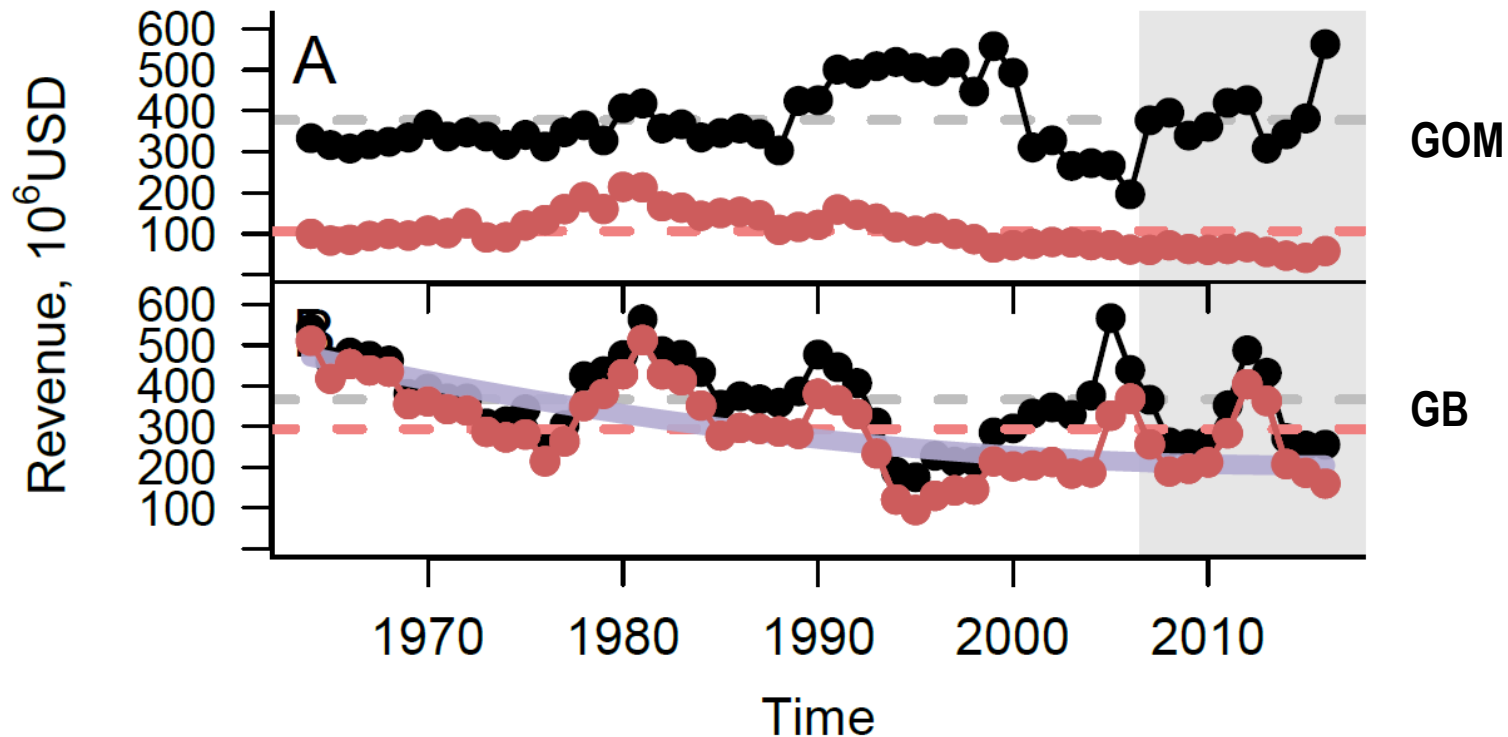
Positive price growth for most years helped offset negative volume changes

Feeding guild breakdown in report

Revenue Change (\$2015), Price (PI) and Volume Indicator (VI)
Georges Bank EPU 1964-2016 Compared to Average Year



Profits objective



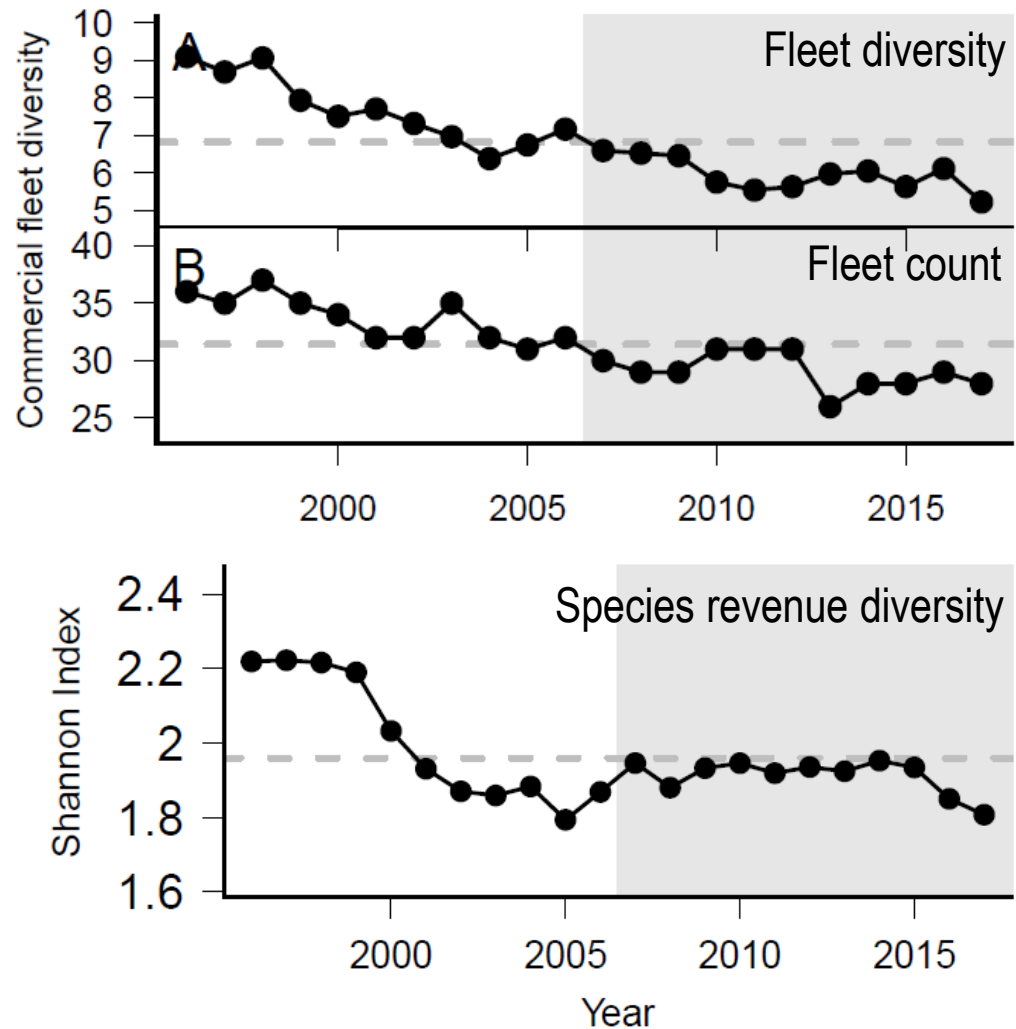
Total revenue by NEFMC managed species (red) ranged from 3-93% of total revenue from commercial fishing (black)

Stability objective

Stability is addressed with indices of commercial fleet and species revenue diversity

All indices show declines in New England

Could indicate a decrease in the stability of the system

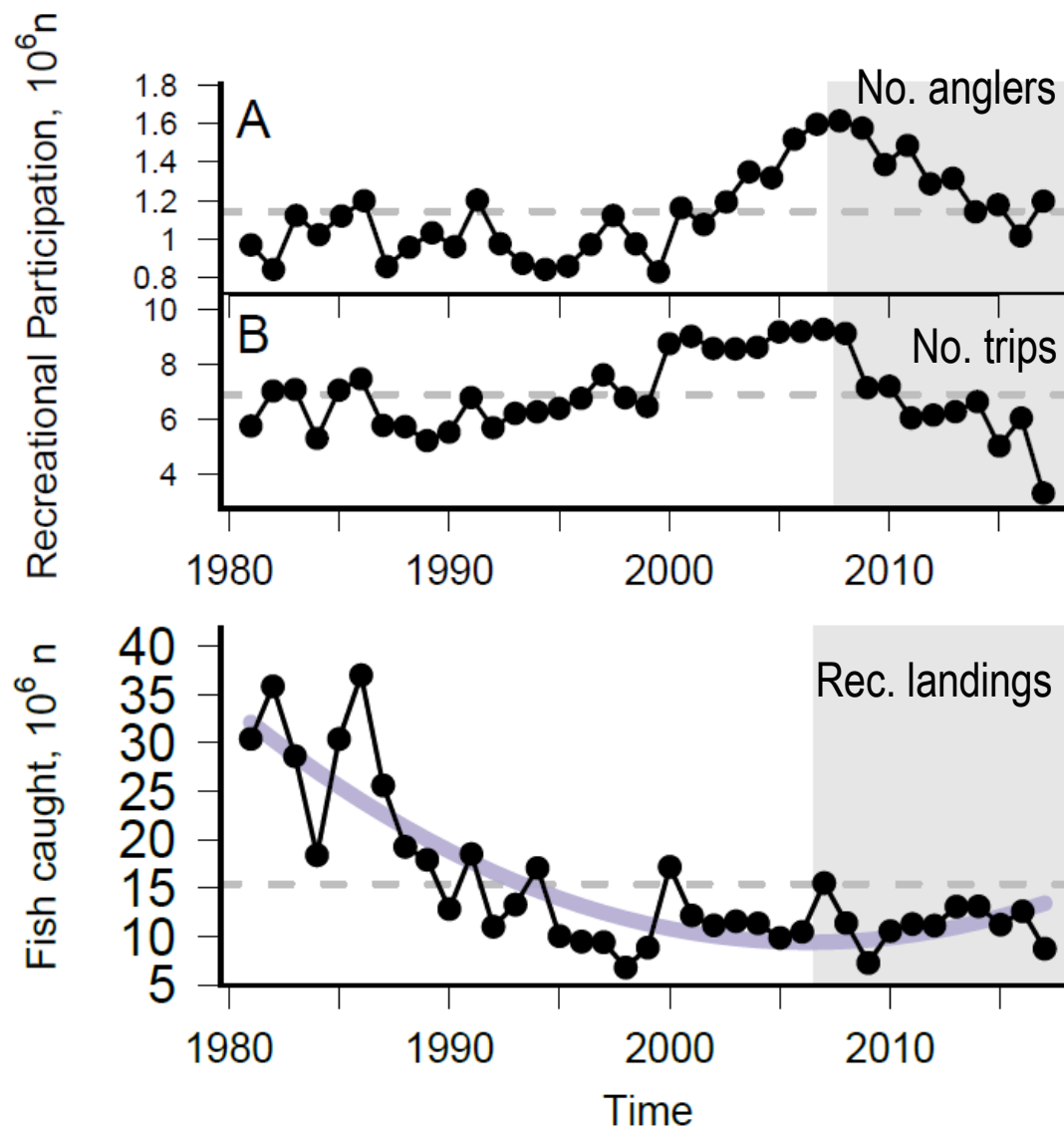


Recreation objective

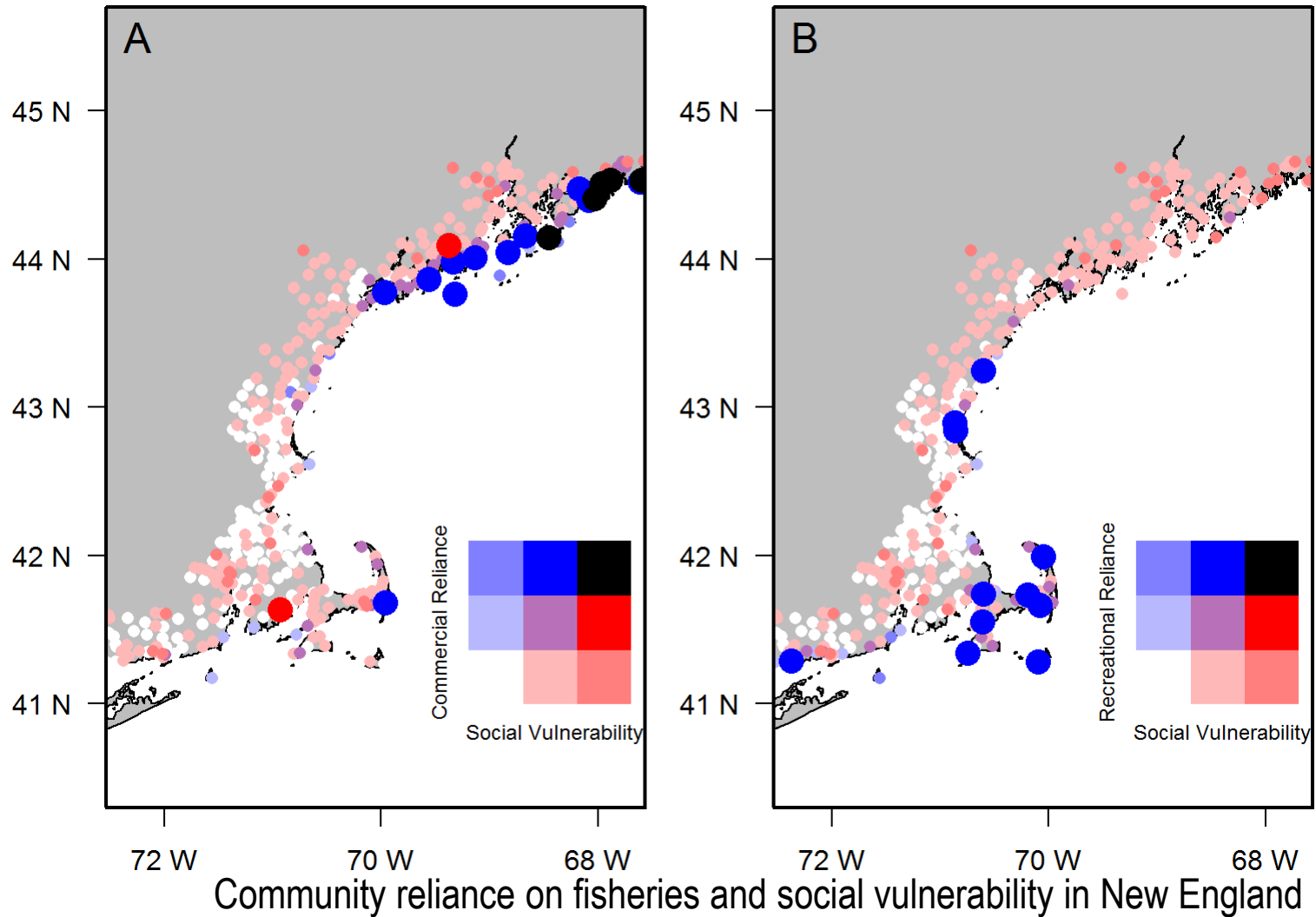
Many communities around Cape Cod are dependent on recreational fisheries

Recent declines in both number of trips and number of anglers

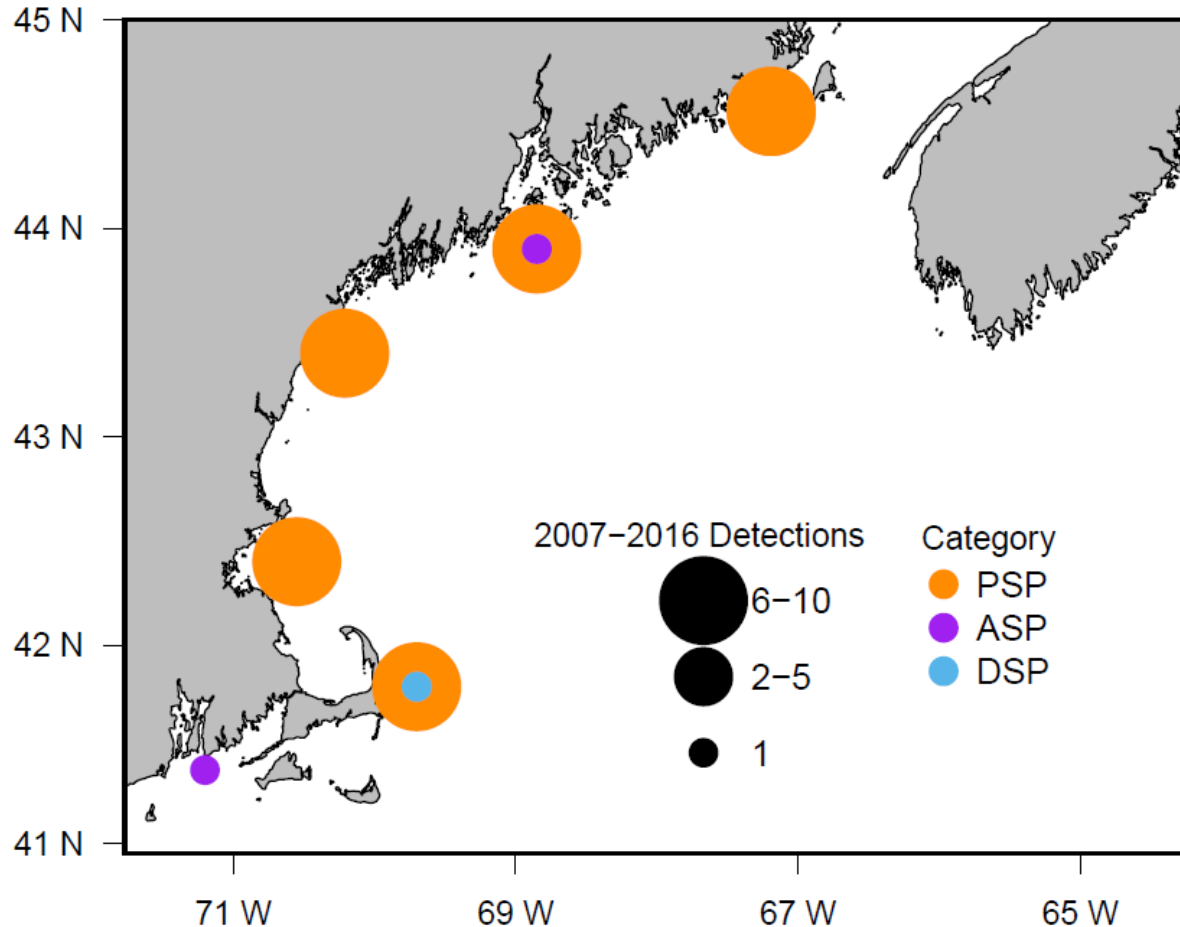
Long-term declines in recreational landings



Socio-cultural objective



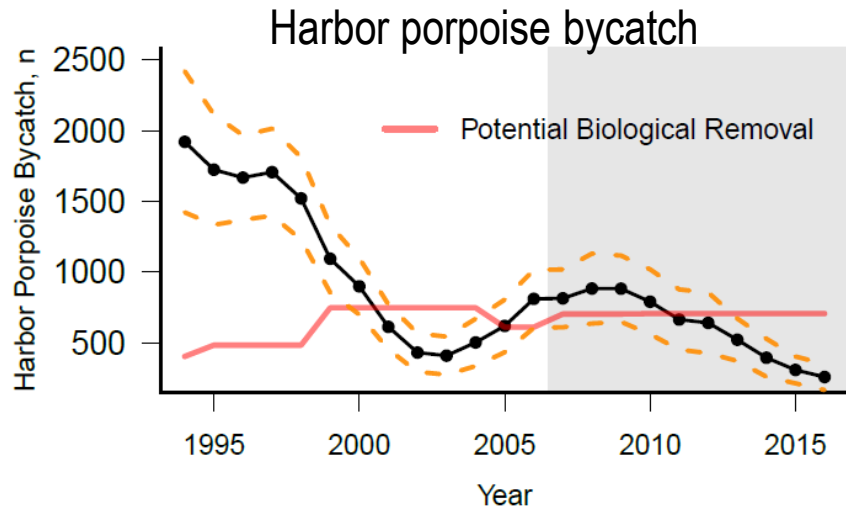
Profits/Socio-cultural objectives - HABs



At least 30 shellfish bed closures in New England due to threat of paralytic shellfish poisoning between 2007-2016

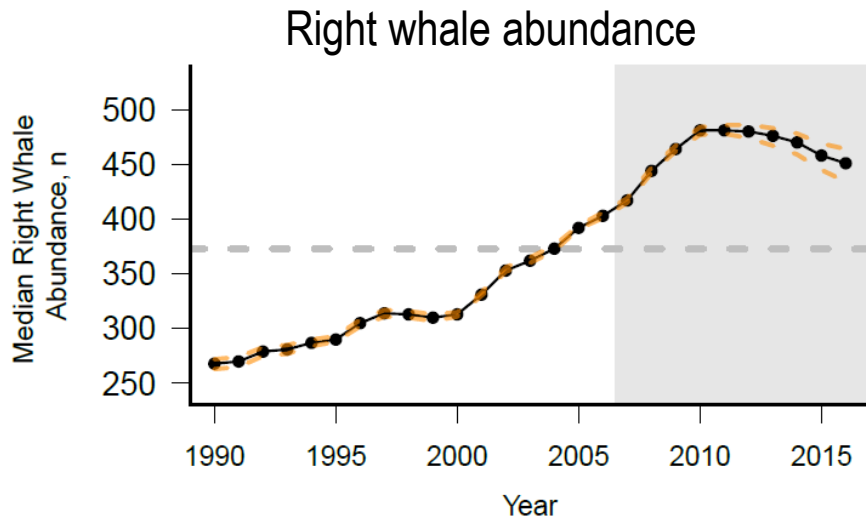
Recent increase in late-season *Pseudo-nitzschia* blooms

Protected species



Recent harbor porpoise bycatch is among lowest in time series

Likely due to increased compliance and reduced fishing efforts

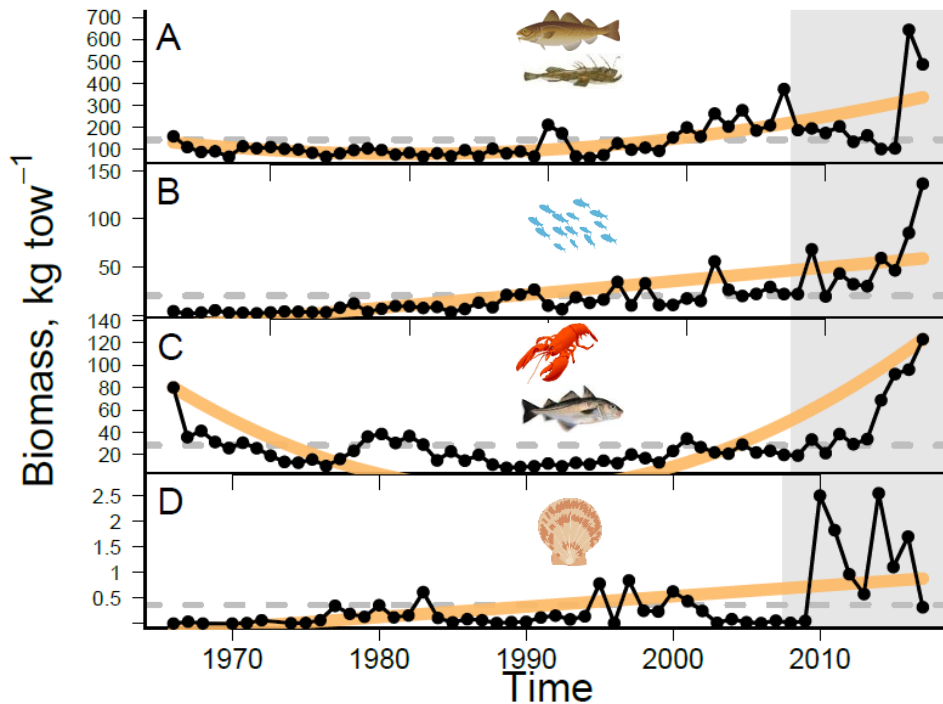


North Atlantic right whale population is declining

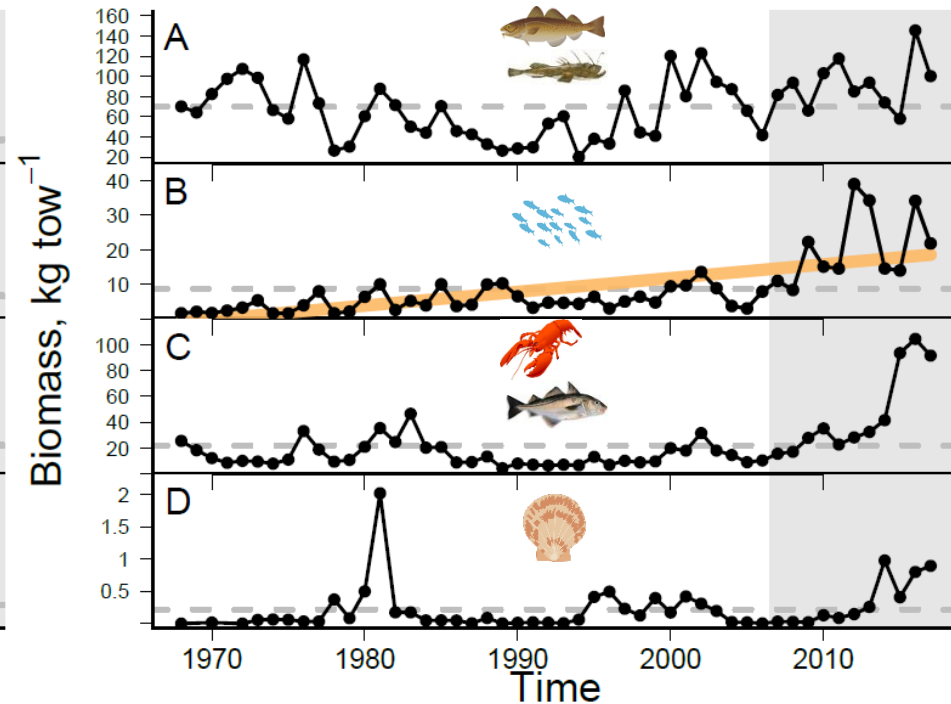
17 right whale deaths reported during 2017

Biomass objective - GOM

Fall survey



Spring survey

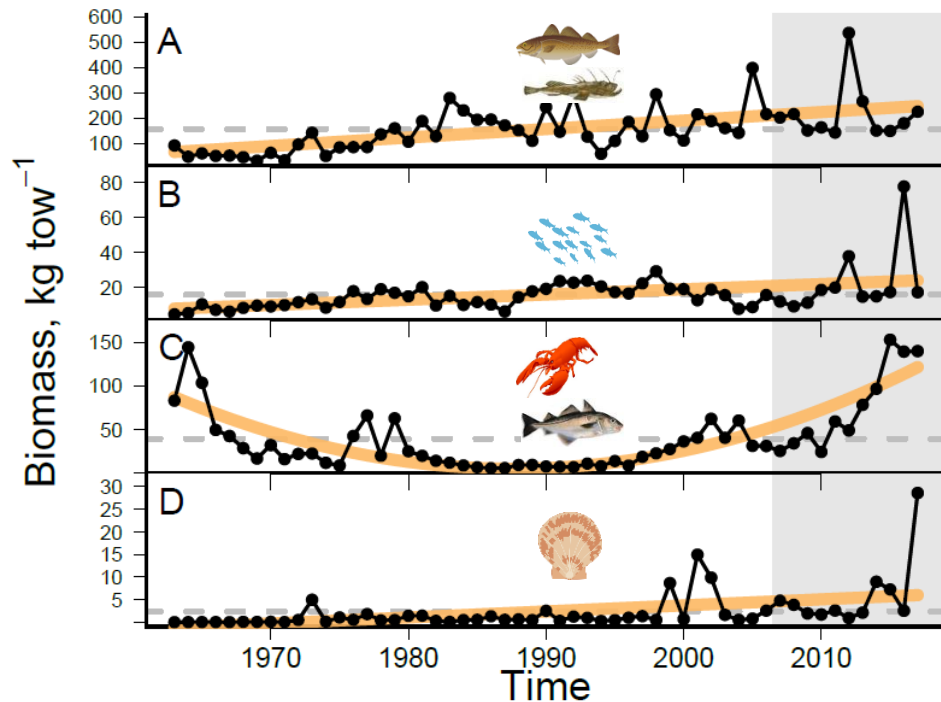


Survey data show significant biomass increases of planktivores for both fall and spring surveys

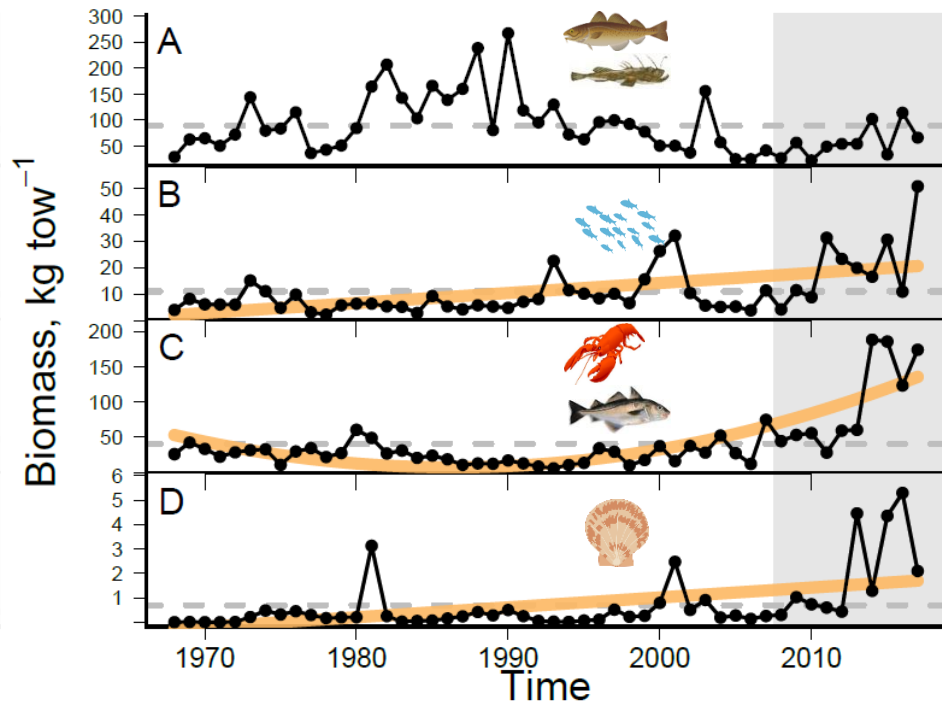
Fall survey data show significant long-term increases across feeding guilds

Biomass objective - GB

Fall survey

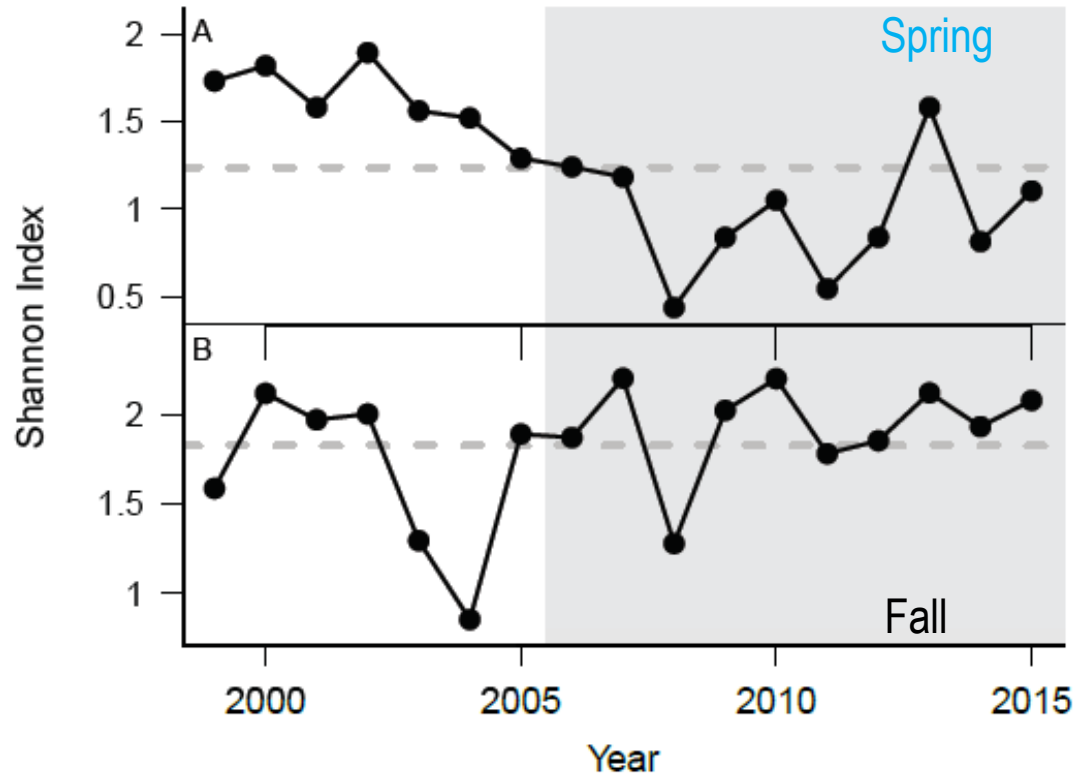


Spring survey



Biomass in Georges Bank shows significant increases across feeding guilds and survey seasons, except for spring survey piscivores

Biomass objective – Community diversity



Species composition measured through Shannon diversity of planktonic larvae

Slight decline in **spring larval diversity** in past decade

Possibly indicative of species shifts and changes in spawn timing

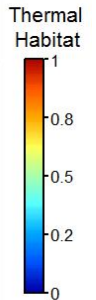
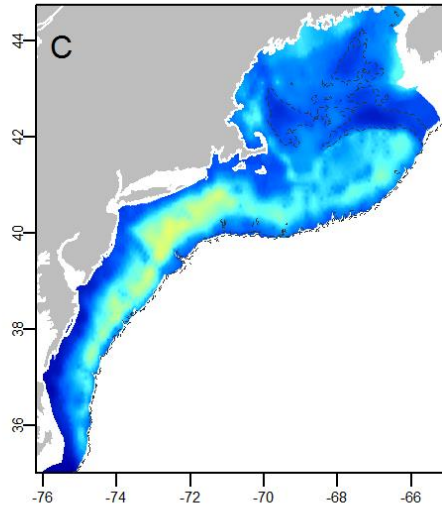
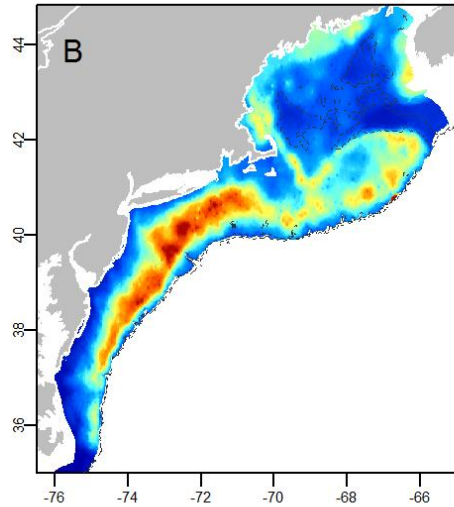
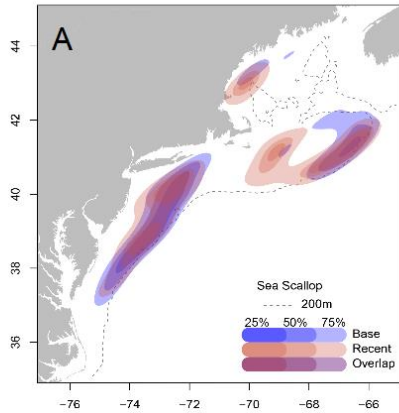
Habitat/species distribution objective

Current/past density

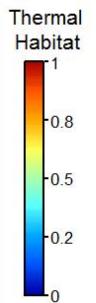
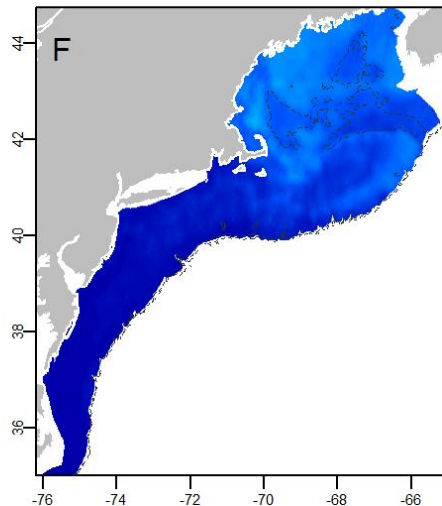
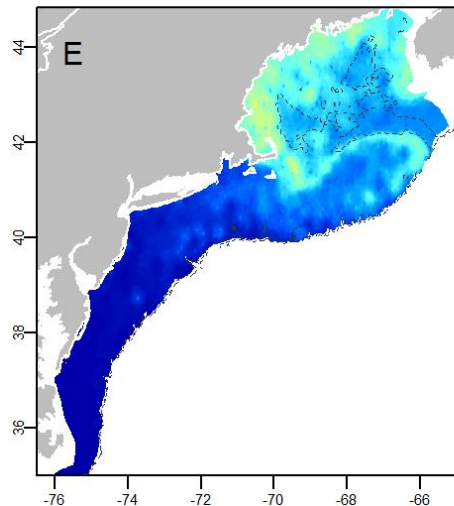
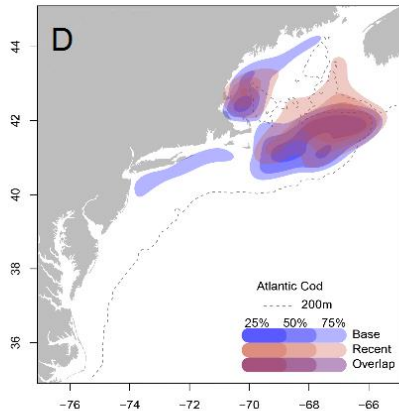
Current thermal habitat

20-40 year TH projection

Sea scallop



Atlantic cod



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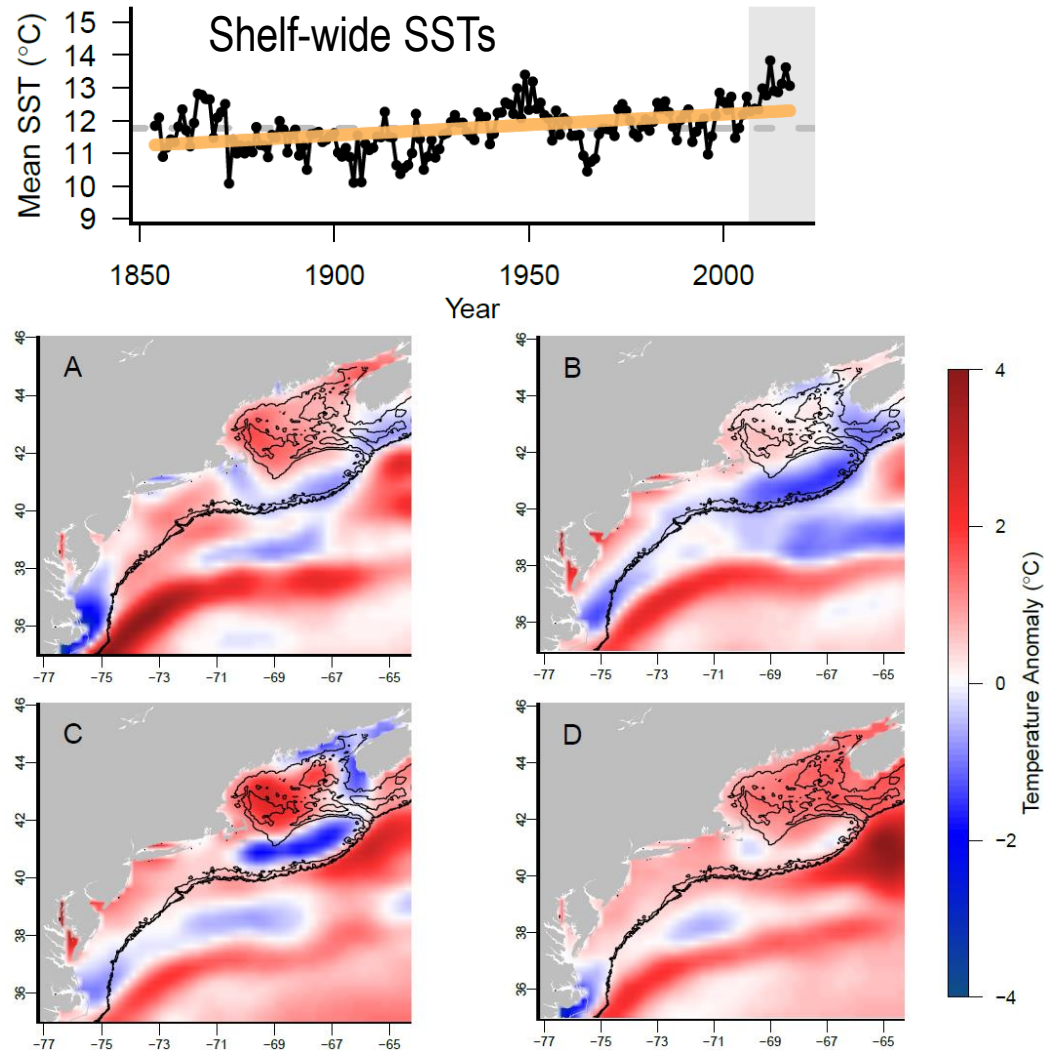
Sea surface temperature

Long-term increases in sea-surface temperatures across northeast continental shelf

Relative to 1982-2017, GOM SSTs were well above the mean in 2017

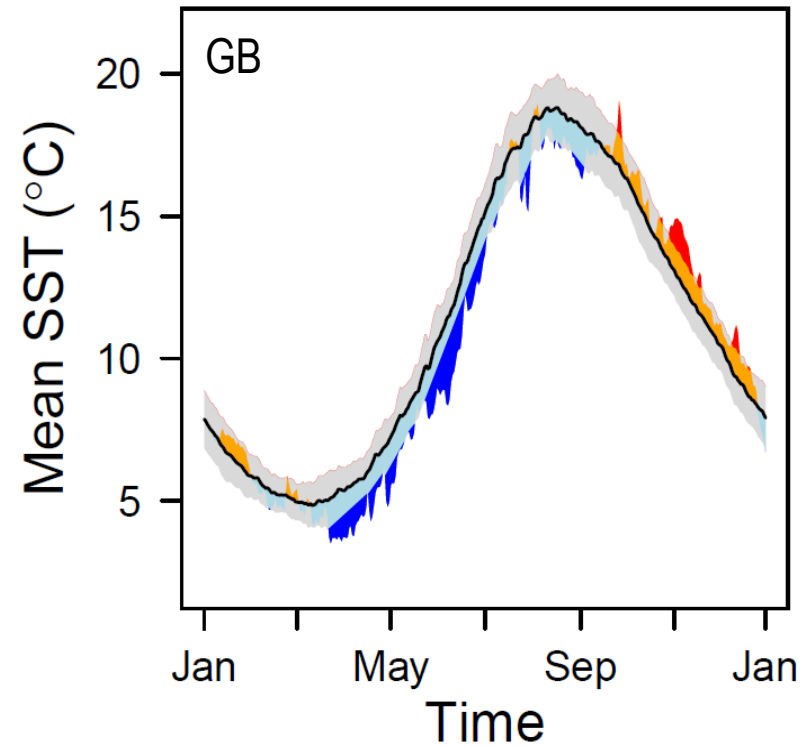
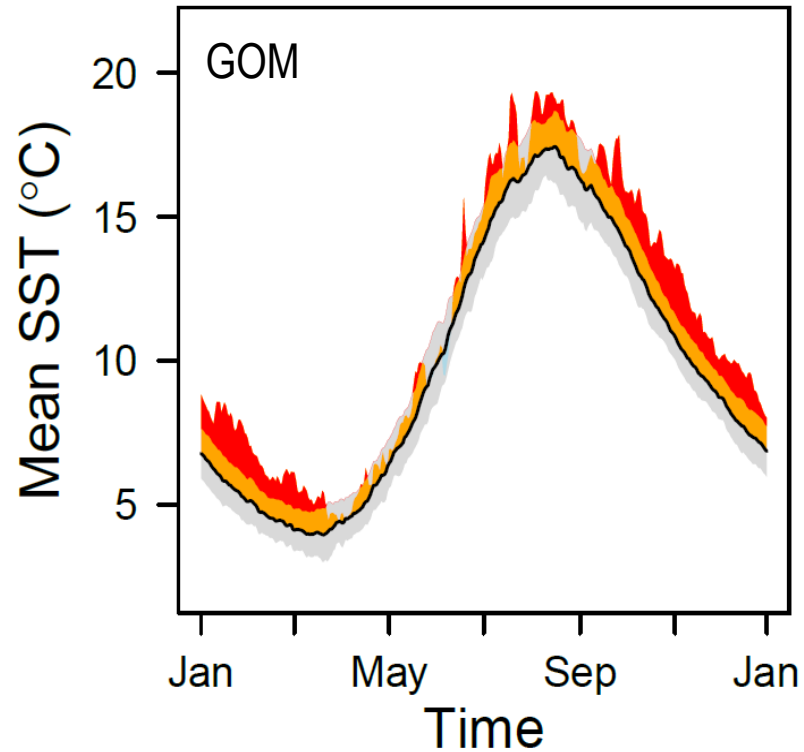
GB SSTs were below mean for most of 2017

High spatial variability

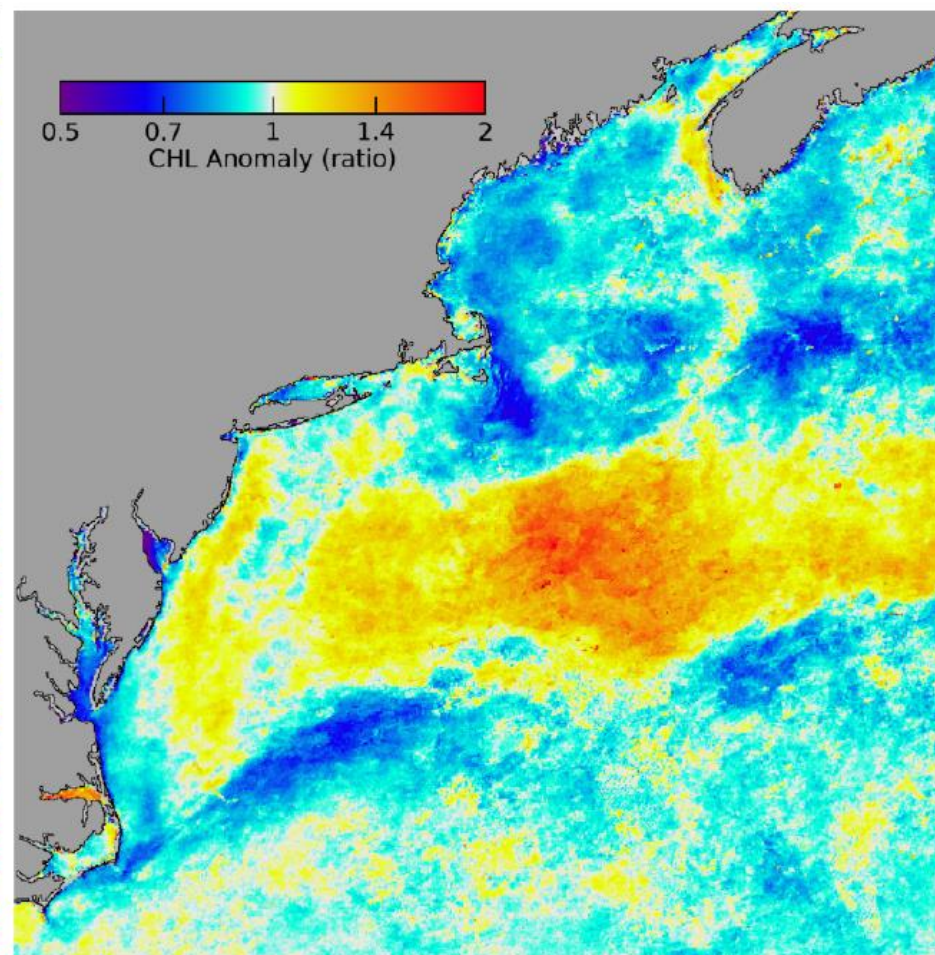
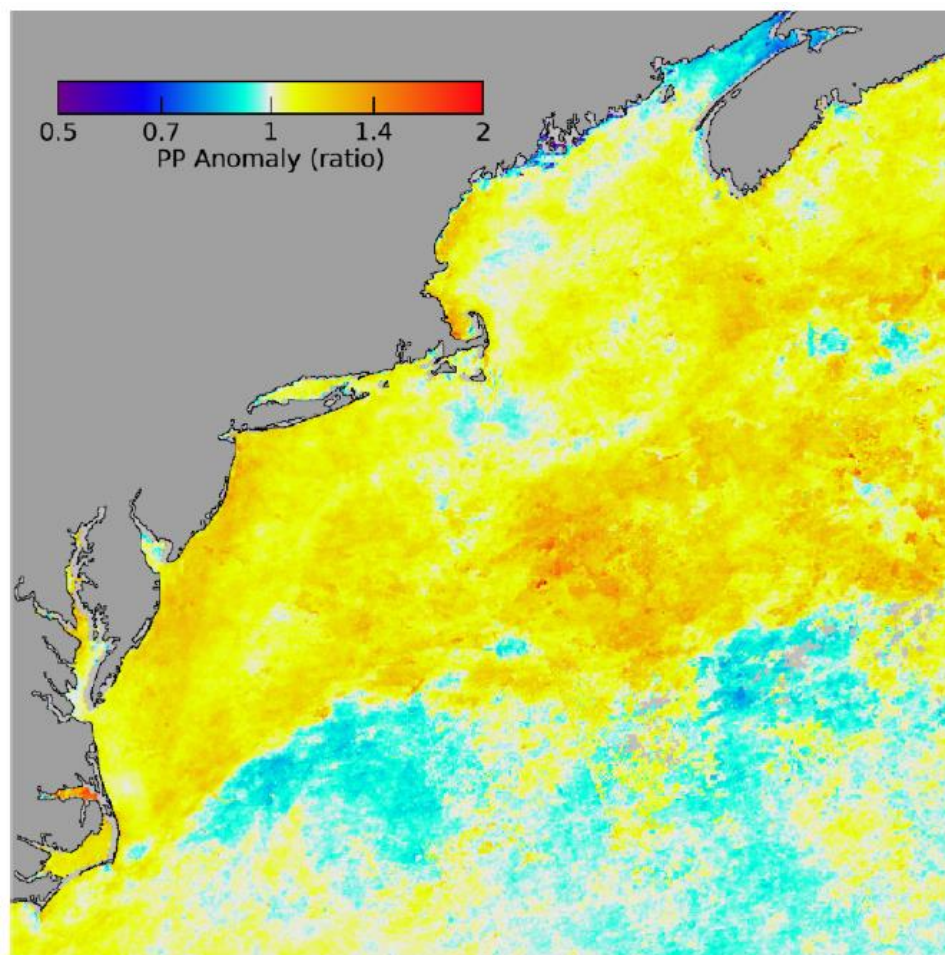


2017 SST anomaly for winter (a), fall (b), spring (c) and summer (d)

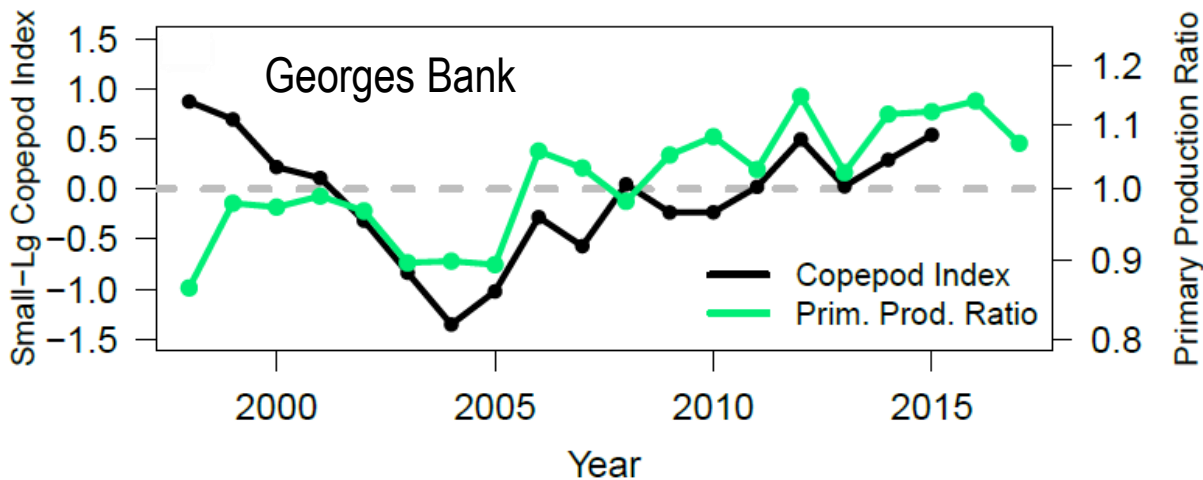
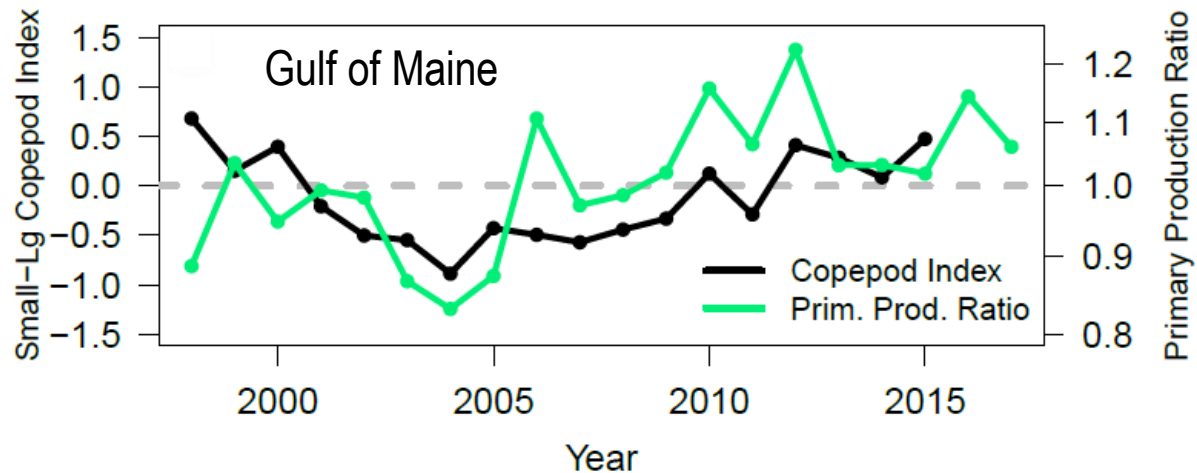
Sea surface temperature



Trophic structure objective – Phytoplankton

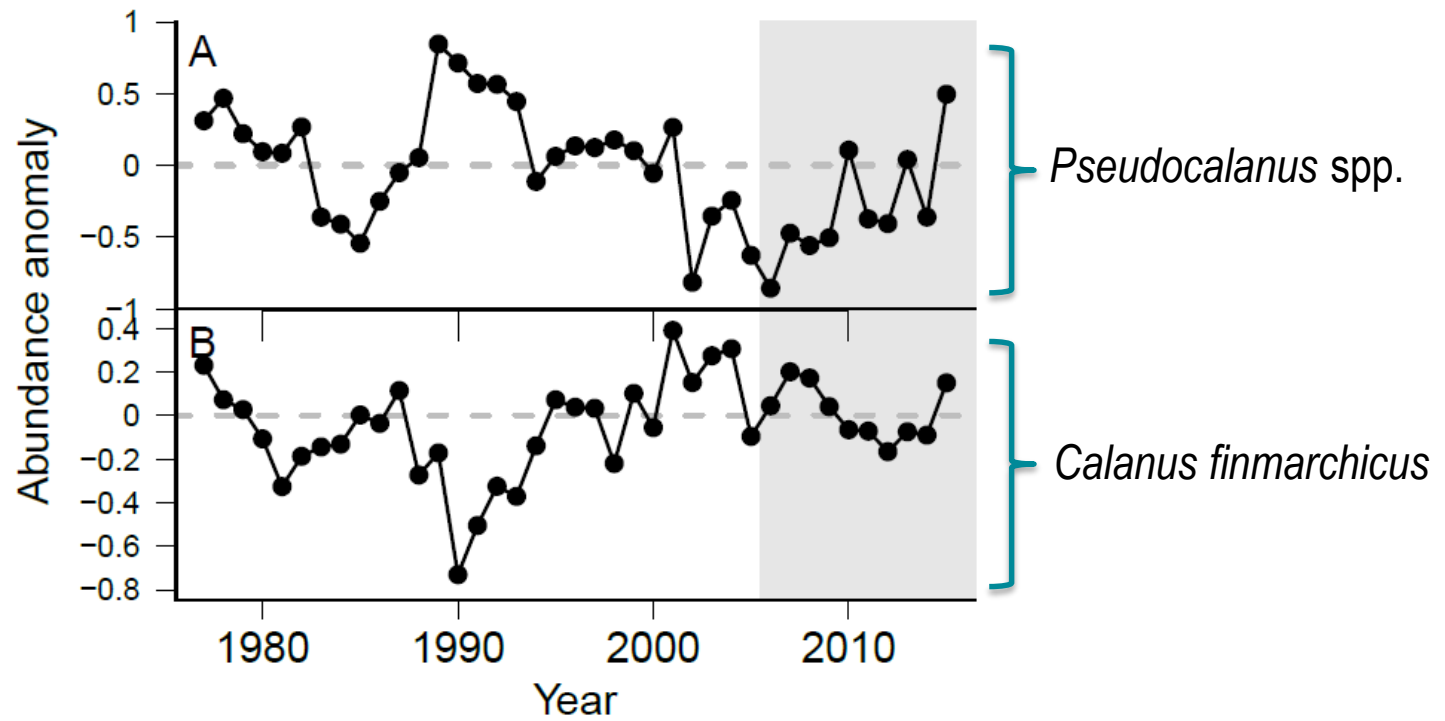


Copepod size index and PP



Primary productivity correlated with copepod body size

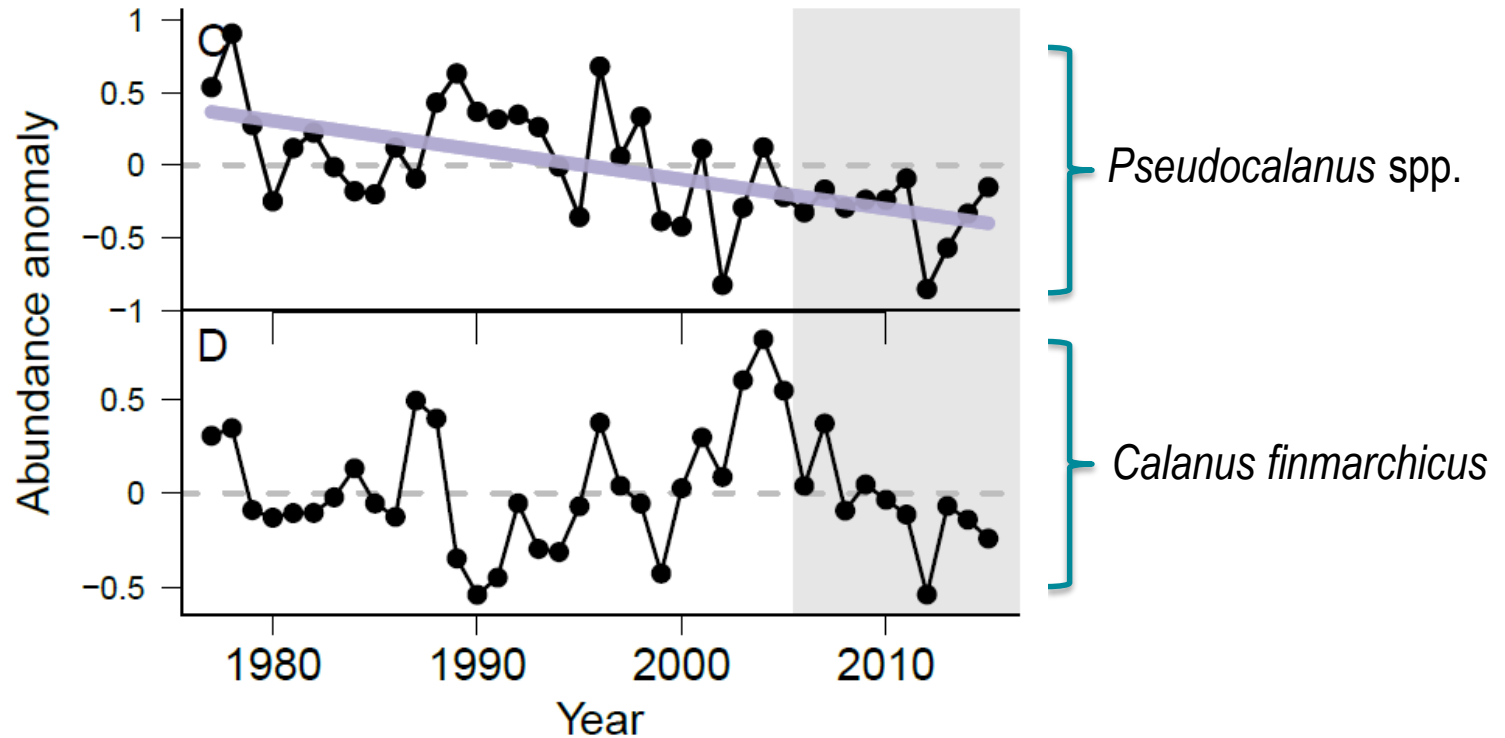
Trophic structure objective – Zooplankton GOM



Changes in *Calanus* abundance can affect feeding habits of North Atlantic right whale

In GOM, recent increases in small-bodied *Pseudocalanus* spp. abundance; no significant changes in *Calanus*

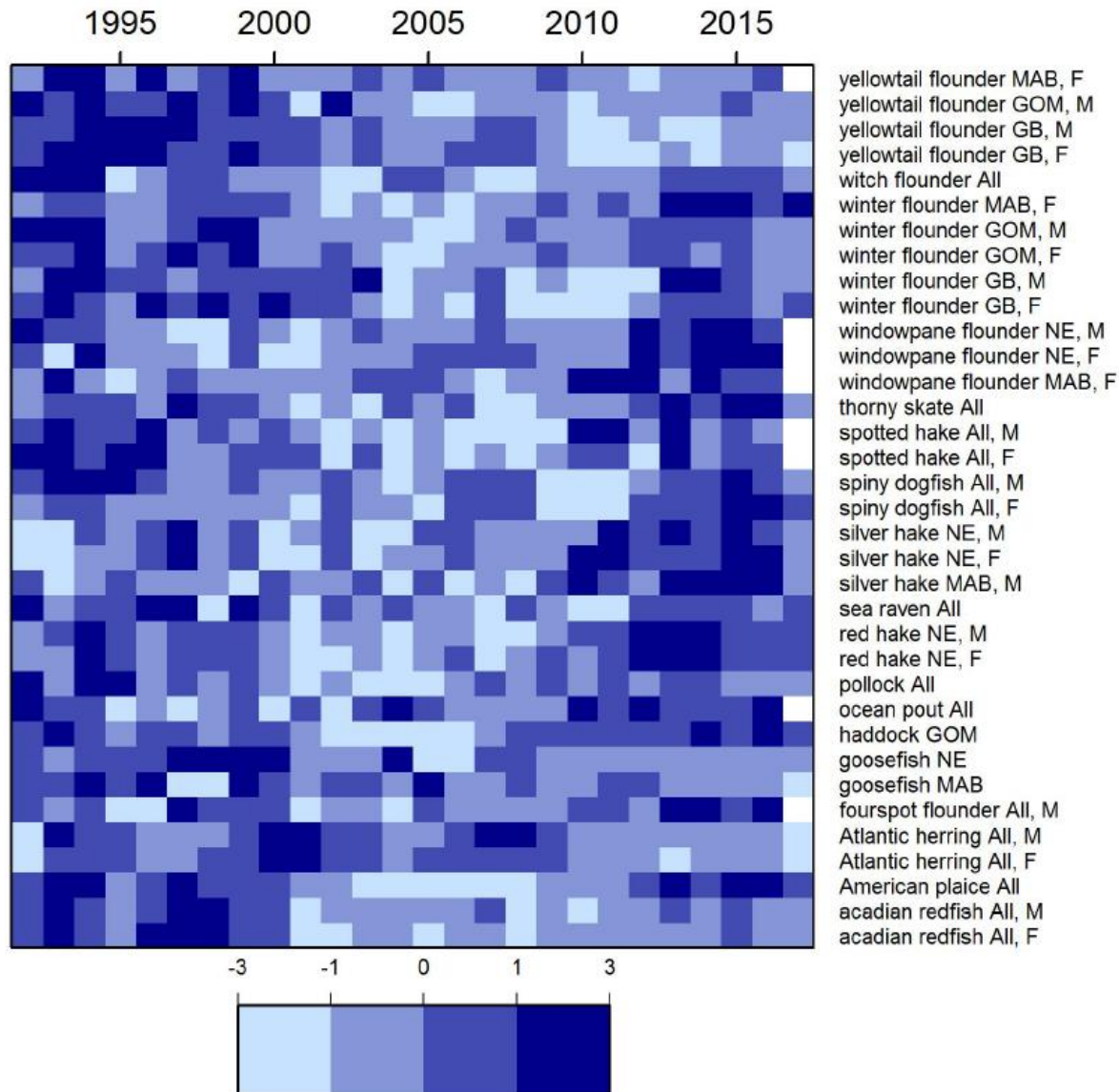
Trophic structure objective – Zooplankton GB



Pseudocalanus spp. abundance in Georges Bank shows long-term decline

Calanus abundance has been at or below mean abundance since 2008

Productivity objective – Groundfish condition



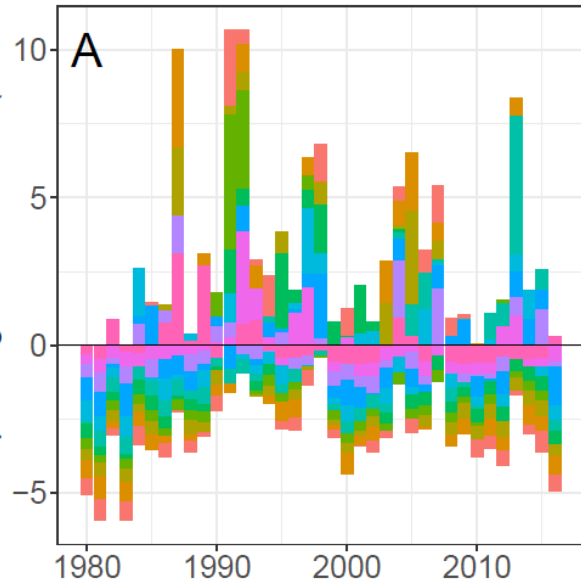
Depicts fish weight-per-length

Groundfish productivity declined after 2000, but is showing signs of recovery

Poor condition could reflect poor larval feeding conditions during these years

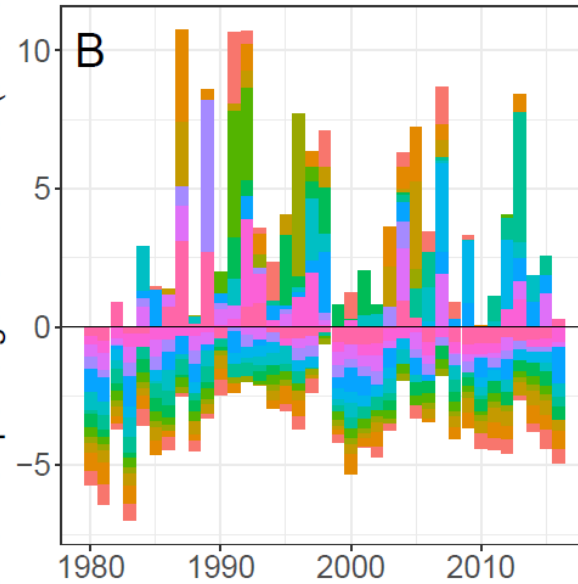
Productivity objective - Recruitment

Small fish per large fish biomass (anomaly)



NEFMC managed species

Small fish per large fish biomass (anomaly)

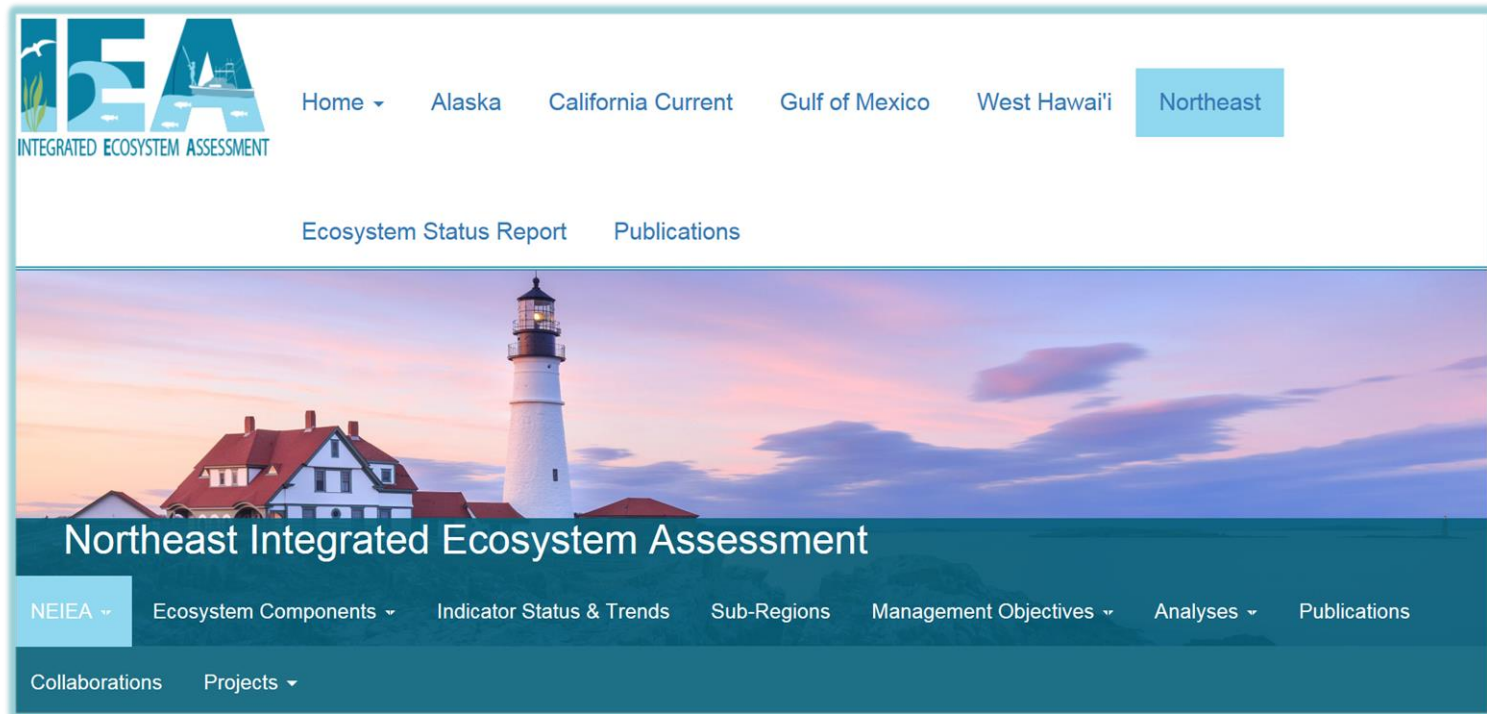


All commercial species

Figures show small fish per large fish biomass

No clear trends across GOM and GB, but decline may be occurring in MAB

Next steps



New IEA website incoming

Accessible data for all indicators

Analyses, projects, and collaborations hosted here

Next steps – SOE 2018-2019

MAFMC recommendations

Direct relationships between productivity and fish biomass?

Greater focus on phytoplankton size fractionation

Incorporation of wind farm locations on maps

Greater focus on FW input, alkalinity, and bottom temperatures

NEFMC recommendations?

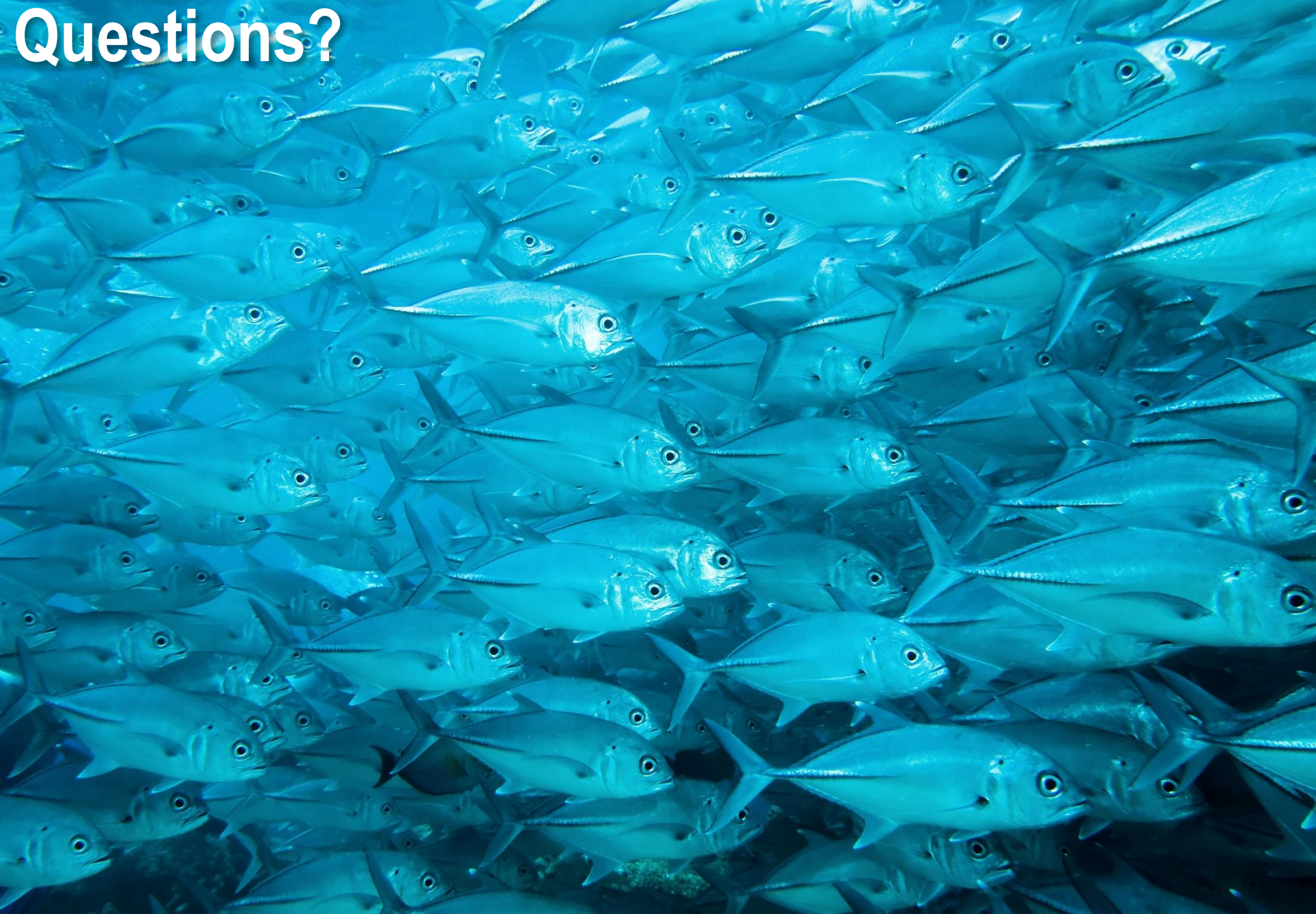
What would you like to see in this report?

How can we better support NEFMC management efforts?

Moving towards a more actionable product



Questions?



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