



State of the Ecosystem Mid Atlantic and New England 2025

East Coast Climate Core Team
2 April 2025

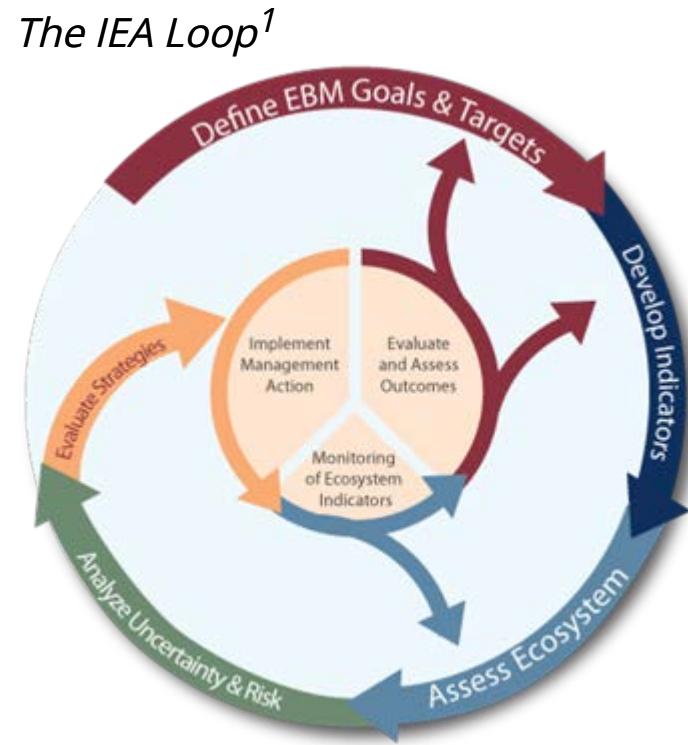
**NOAA
FISHERIES**

Sarah Gaichas and Joseph Caracappa, (editors),
Andy Beet, Brandon Beltz, Geret DePiper, Kimberly Hyde, Scott Large, Sean Lucey, Laurel Smith (data and section leads),
and all SOE contributors

State of the Ecosystem (SOE) reporting

Improving ecosystem information and synthesis for fishery managers

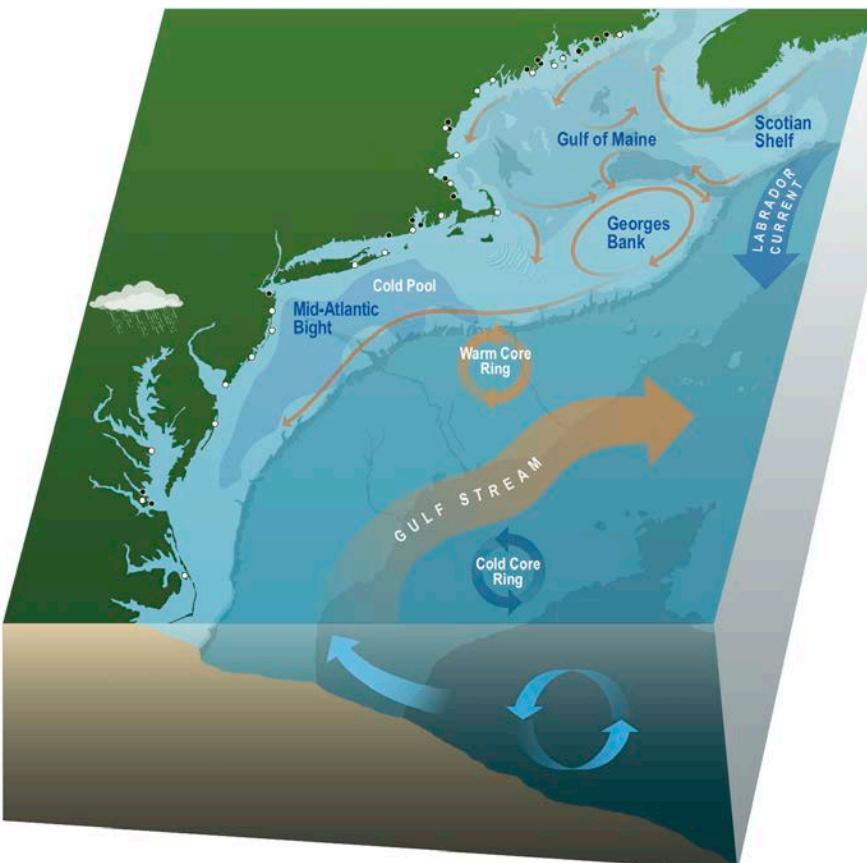
- Ecosystem indicators linked to management objectives (DePiper et al., 2017)
 - Contextual information
 - Report evolving since 2016
 - Fishery-relevant subset of full Ecosystem Status Reports
- Open science emphasis (Bastille et al., 2021)
- Used within MAFMC's Ecosystem Process (Muffley et al., 2021)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



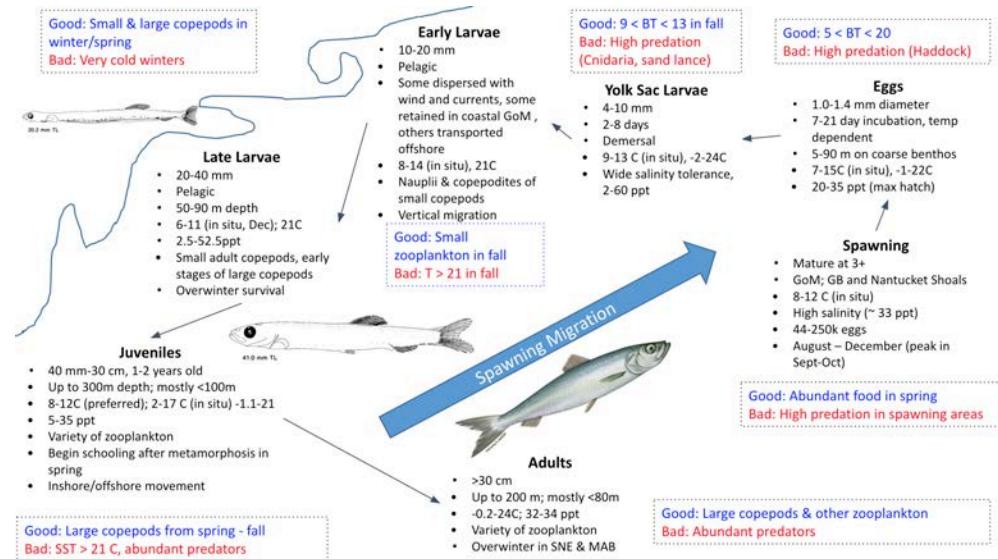
[1] <https://www.integratedecosystemassessment.noaa.gov/national/IEA-approach>

Ecosystem reporting at different levels of organization

Ecosystem Level → SOE

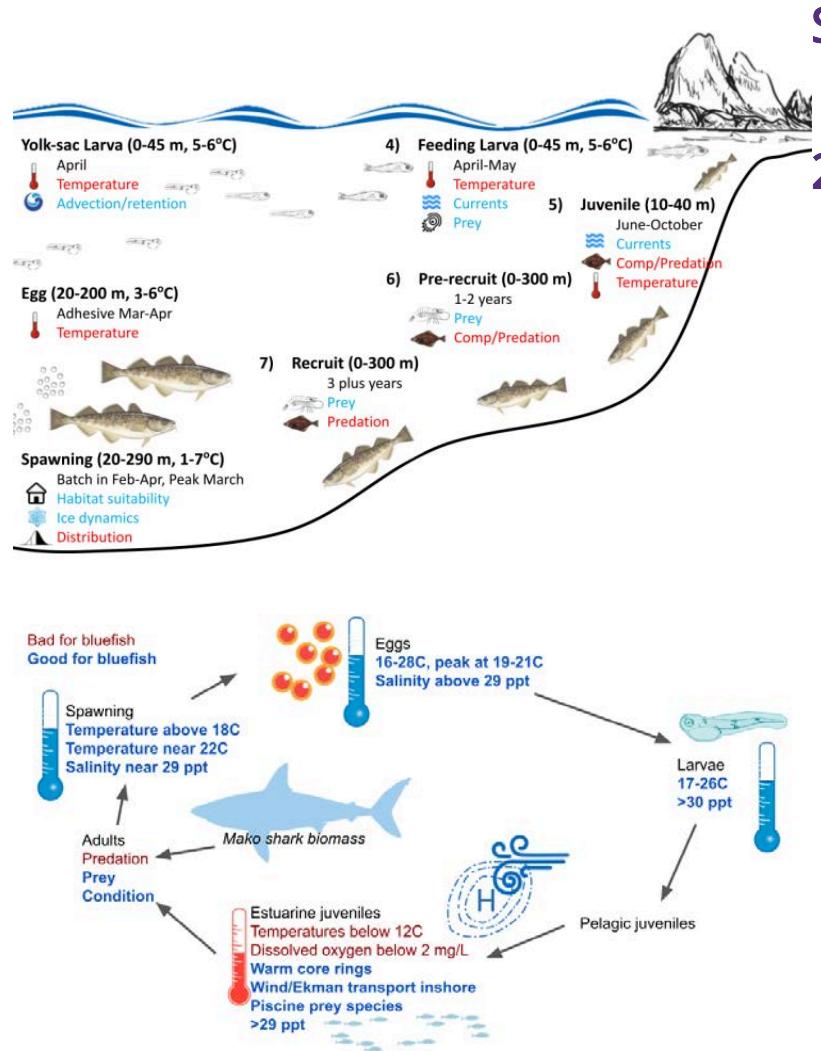


Stock Level → ESP



Ecosystem and Socioeconomic Profiles (ESPs)

Using ecosystem information at the stock level: Ecosystem Socioeconomic Profiles (ESPs)



Images courtesy ASFC, and Abigail Tyrell and Emily Liljestrand, NEFSC

State of the Ecosystem: Maintain 2024 structure for 2025

2025 Report Structure

1. Graphical summary

- Page 1 report card re: objectives →
- Page 2 risk summary bullets
- Page 3 2024 snapshot

2. Performance relative to management objectives

3. Risks to meeting management objectives

- Climate and Ecosystem risks
- Offshore wind development

4. 2024 Highlights



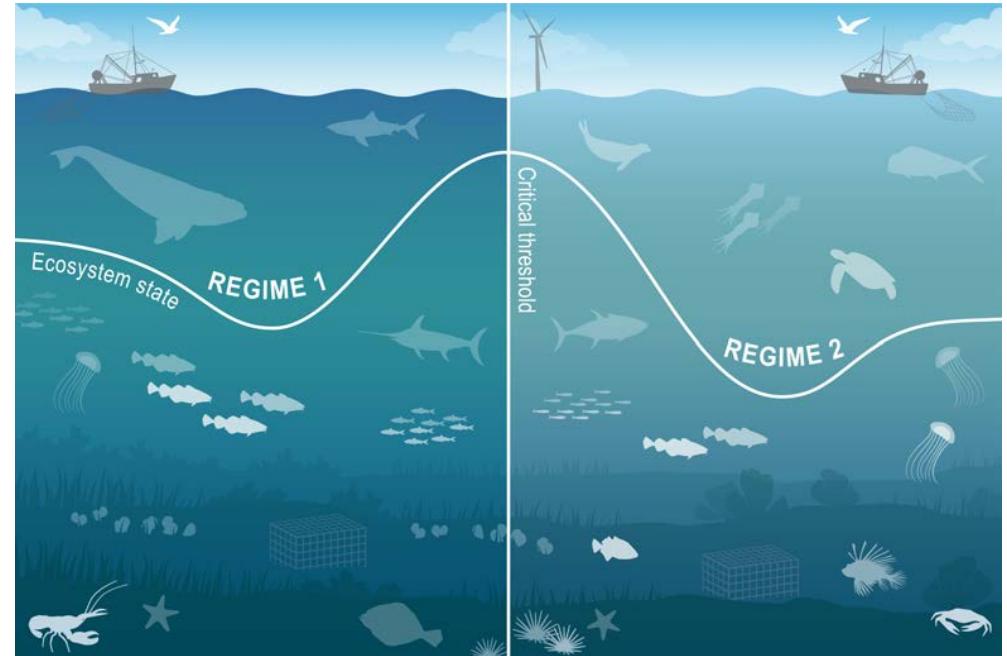
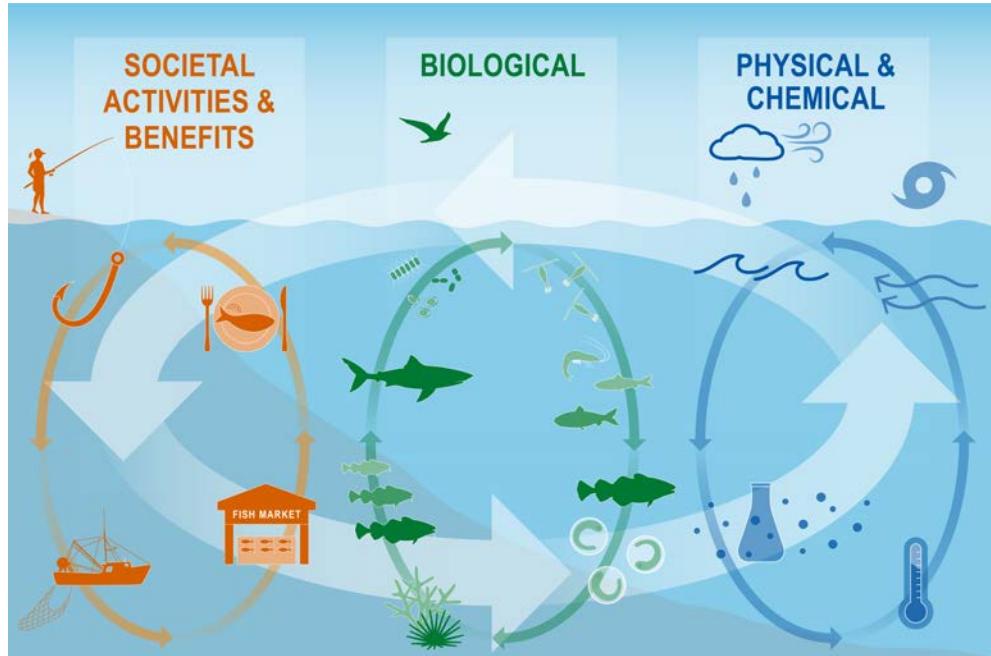
Updated Objectives and Risks tables aligning with indicators

Ecosystem-scale fishery management objectives in the Mid-Atlantic Bight		Risks to meeting fishery management objectives in the Mid-Atlantic Bight		
Objective categories	Indicators reported	Risk categories	Observation indicators reported	Potential driver indicators reported
Objectives: Provisioning and Cultural Services				
Seafood Production	Landings; commercial total and by feeding guild; recreational harvest	Risks to Managing Spatially	Managed species (fish and cetacean) distribution shifts	Benthic and pelagic forage distribution; ocean temperature, changes in currents and cold pool
Commercial Profits	Revenue decomposed to price and volume	Risks to Managing Seasonally	Managed species spawning and migration timing changes	Habitat timing: Length of ocean summer, cold pool seasonal persistence
Recreational Opportunities	Angler trips; recreational fleet diversity	Risks to Setting Catch Limits	Managed species body condition and recruitment changes	Benthic and pelagic forage quality & abundance: ocean temperature & acidification
Stability	Diversity indices (fishery and ecosystem)			
Social & Cultural	Community fishing engagement and social vulnerability status			
Protected Species	Bycatch; population (adult and juvenile) numbers; mortalities			
Potential Drivers: Supporting and Regulating Services				
Management	Stock status; catch compared with catch limits	Other Ocean Uses Risks		
Biomass	Biomass or abundance by feeding guild from surveys	Offshore Wind Risks	Fishery revenue and landings from wind lease areas by species and port	Wind development speed; Protected species presence and hotspots
Environment	Climate and ecosystem risk indicators listed in Table 2			

Ecosystem synthesis themes

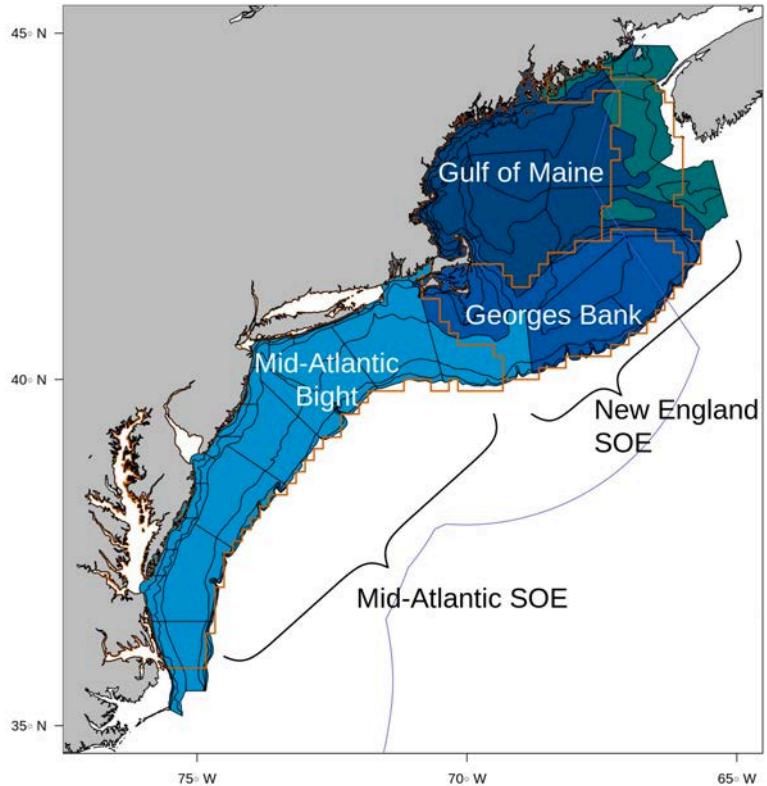
Characterizing ecosystem change for fishery management

- Societal, biological, physical and chemical factors comprise the **multiple system drivers** that influence marine ecosystems through a variety of different pathways.
- Changes in the multiple drivers can lead to **regime shifts** — large, abrupt and persistent changes in the structure and function of an ecosystem.
- Regime shifts and changes in how the multiple system drivers interact can result in **ecosystem reorganization** as species and humans respond and adapt to the new environment.

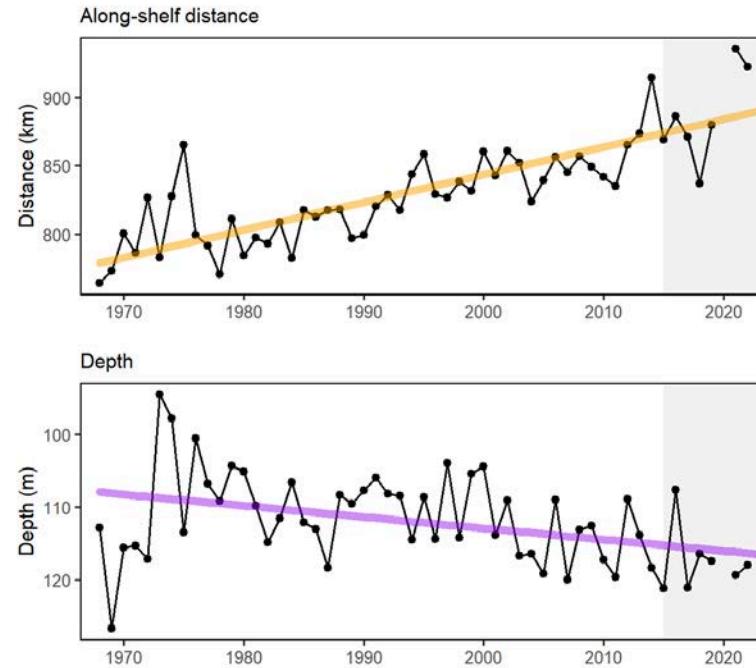


State of the Ecosystem report scale and figures

Spatial scale



Key to figures



Trends assessed only for 30+ years: [more information](#)

Orange line = significant increase

Purple line = significant decrease

No color line = not significant or < 30 years

Grey background = last 10 years

A [glossary of terms](#), detailed [technical methods documentation](#), and indicator [data](#) and [catalog](#) are available online.

Report structure 2024: same as 2021-2023 with more management risk emphasis

- Performance relative to management objectives
 - *What* does the indicator say--up, down, stable?
 - *Why* do we think it is changing: integrates synthesis themes
 - Multiple drivers
 - Regime shifts
 - Ecosystem reorganization
- Objectives
 - Seafood production
 - Profits
 - Recreational opportunities
 - Stability
 - Social and cultural
 - Protected species
- Risks to meeting fishery management objectives
 - Same *What* and *Why* as Performance Section
 - New structure for Climate section
 - Fishery risk indicator
 - Climate and ecosystem drivers of fishery risk
 - Future considerations
- Risk categories
 - *Climate and Ecosystem Change*
 - *Risk to spatial management*
 - *Risk to seasonal management*
 - *Risk to quota setting/rebuilding*
 - Other ocean uses
 - Offshore wind development

Mid Atlantic State of the Ecosystem Summary 2025:

Performance relative to management objectives

Seafood production ↘, -

Profits ↔, -

Recreational opportunities: Effort ↑ +; Effort diversity ↘ -

Stability: Fishery not stable; Ecological not stable

Social and cultural:

- Fishing engagement and social vulnerability status by community
- Revenue climate vulnerability ↔, majority high risk

Protected species:

- Maintain bycatch below thresholds (harbor porpoise, gray seals) ✗ ✓
- 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 (Indicator)	TREND	CURRENT STATUS	IMPLICATIONS
Seafood production (Total and MAFMC managed landings)	↘ Decline	- Below long-term average	Commercial landings were at a historic low in 2023, driven by menhaden fishery consolidation. MAFMC landings have declined since the mid-2000s. This is driven by surfclam and ocean quahog, and possibly by market conditions. Port landings combined across Mid-Atlantic states have moderate to high total climate vulnerability. Recreational harvest is declining due to multiple drivers.
Commercial profits (Total and managed revenue)	↔ No trend	- Below long-term average	Total revenue reached an all time low in 2022–2023, driven by both declining price and volume. Recent declining revenue is driven in part by managed clam species volume. Even when adjusting for inflation, falling prices are almost universal and due to market dynamics. Combined Mid-Atlantic port revenue has had high to very high total climate vulnerability for most of the period since 2000.
Recreational opportunities (Effort and fleet diversity)	↑ Increase ↘ Decline	+ Above long-term average - Below long-term average	Recreational effort shows an increasing long-term trend and is above 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 have access to different species/sizes of fish than vessel-based anglers.
Stability (Fishery and ecosystem diversity maintained over time)		FISHERY Not stable ECOSYSTEM Not stable	Commercial: Indicators suggest changing commercial fleet composition but similar species revenue diversity, for those fleets continuing to fish. Recreational: Species catch diversity has been maintained by a different set of species over time and continues to be above the long-term mean. Ecosystem: Multiple ecosystem indicators suggest instability. While fish species richness is stable, zooplankton diversity has been increasing, and changes in biological traits of the fish community have been observed.
Social and cultural (Community fishery engagement, social and climate vulnerability)	↔ No trend	Community social and climate vulnerability status varies by community.	Four Mid-Atlantic communities ranked among the top most engaged in both commercial and recreational fishing. Many of the top highly engaged fishing communities throughout the Mid-Atlantic region ranked medium-high or above for one or more of the social vulnerability indicators, including 4 commercial and 3 recreational communities, suggesting potential challenges for these communities adapting to change. A majority of Mid-Atlantic commercial fishing communities have high to very high revenue total climate vulnerability.
Protected species (Coastwide bycatch, population numbers, mortalities)	↔ Mixed trends ↘ Decline	BYCATCH Meeting objectives POPULATION NARW - Below recovery objective	Mixed bycatch trends through 2022 are related to fishery management, low observer coverage, shifts in population distribution combined with fishery shifts, and population increase for seals. Population drivers for North Atlantic Right Whales (NARW) include combined fishery interactions/vessel strikes and distribution shifts related to prey abundance and quality. Management measures to reduce adult mortality are reflected in more stable population numbers. Unusual mortality events continue for 3 large whale species.

New England State of the Ecosystem Summary 2025:

Performance relative to management objectives - Georges Bank

Seafood production Total , Managed , Both 

Profits , 

Recreational opportunities: Effort , ; Effort diversity , 

Stability: Fishery not stable; Ecological not stable

Social and cultural:

- Fishing engagement and social vulnerability status by community
- Revenue climate vulnerability , majority medium risk

Protected species:

- Maintain bycatch below thresholds (harbor porpoise, gray seals) 
- Recover endangered populations , NARW  Gray seal 

Performance Relative to Fishery Management Objectives

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



GEORGES BANK (GB)

OBJECTIVE (Indicator)	TREND	CURRENT STATUS	IMPLICATIONS
Seafood production (Total and NEFMC managed landings)	 No trend	 Below long-term average	New England managed species seafood production is significantly declining and currently below the long-term average. Total commercial landings are also below the long-term average. Recreational harvest in New England is slightly above the low observed in 2020, but still well below the long-term average. Both the commercial and recreational landings status are driven in part by management to address mandated rebuilding of depleted stocks.
	 Decline	 Below long-term average	Total Community Climate Vulnerability for landings is moderate with no long-term trend.
Commercial profits (Total and managed revenue)	 No trend	 Below long-term average	Despite high landings of scallops, lower prices drew total revenue down again in 2023. Despite substantial variability in volume of landings, price effects have kept revenue below 1982 levels over the past decade.
	 No trend	 Near long-term average	Total Community Climate Vulnerability for revenue is moderate with no long-term trend.
Recreational opportunities (Effort and fleet diversity)	 No trend	 Near long-term average	Recreational opportunities in the region are relatively stable recently, with respect to the types of trips (i.e., shore, private boat, charter/party) and numbers of species landed.
	 No trend	 Near long-term average	
Stability (Fishery and ecosystem diversity maintained over time)		FISHERY Not stable	Commercial: Fleet count is declining with 2023 below the long-term average, and species revenue diversity reflects a reliance on relatively few species.
		ECOSYSTEM Not stable	Recreational: Species diversity is increasing due to increases in southerly species and lower catch limits on traditional regional species.
Social and cultural (Community fishery engagement, social and climate vulnerability)	 Mixed trends	 Mixed trends	Ecosystem: Multiple ecosystem indicators suggest instability. Fish species richness is stable while zooplankton diversity has increased, indicating potential instability. Changes in biological traits of the fish community have been observed.
		 Mixed trends	Three New England communities ranked among the top engaged for both commercial and recreational fishing. Several of the top highly engaged fishing communities throughout the New England region ranked medium-high or above for one or more of the social vulnerability indicators, including 2 commercial communities (New Bedford, and Boston, MA) and 2 recreational communities (Provincetown and Falmouth, MA). This suggests potential challenges for these communities adapting to change.
Protected species (Coastwide bycatch, population numbers, mortalities)	 Mixed trends	 Meeting objectives	Communities climate risk on revenue is shifting from moderate to high/very high suggesting an increased dependence on climate vulnerable species.
	 Mixed trends	 Meeting objectives	Bycatch objectives are being met for harbor porpoise and gray seals. Mixed bycatch trends through 2022 are related to fishery management, shifts in porpoise distribution combined with fishery shifts, and population increase for gray seals.
POPULATIONS NARW	 Mixed trends	 Meeting objectives	Population drivers for North Atlantic Right Whales (NARW) include combined fishery interactions/vessel strikes and distribution shifts related to prey abundance and quality. Management measures to reduce adult mortality are reflected in more stable population numbers.
	 Mixed trends	 Above long-term average	Unusual mortality events continue for 3 large whale species.

New England State of the Ecosystem Summary 2025:

Performance relative to management objectives - Gulf of Maine

Seafood production ↘, -

Profits Total ↔, ≈; NEFMC Managed ↘, -

Recreational opportunities: Effort ↔, ≈; Effort diversity ↔, ≈

Stability: Fishery not stable; Ecological not stable

Social and cultural:

- Fishing engagement and social vulnerability status by community
- Revenue climate vulnerability ✖, majority medium risk

Protected species:

- Maintain bycatch below thresholds (harbor porpoise, gray seals) ✖ ✓
- Recover endangered populations ✖, NARW - Gray seal + Salmon -

Performance Relative to Fishery Management Objectives

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



GULF OF MAINE (GOM)

OBJECTIVE (Indicator)	TREND	CURRENT STATUS	IMPLICATIONS
Seafood production (Total and NEFMC managed landings)	↘ Decline	- Below long-term average	Seafood production from New England managed species is near the lowest levels observed with a long-term declining trend. Total commercial landings also show a significant long-term declining trend. Recreational harvest in New England is still well below the long-term average with a significant long-term declining trend. Both the commercial and recreational landings status are driven in part by management to address mandated rebuilding of depleted stocks. Total Community Climate Vulnerability for landings is moderate with no long-term trend.
Commercial profits (Total and managed revenue)	↔ No trend ↘ Decline	≈ Near long-term average - Below long-term average	Total GOM revenue exceeded 1982 baseline levels in all but 4 years. High prices and landings of lobster continue to drive total regional revenue. However, revenue from New England managed species is at the all-time low. Total Community Climate Vulnerability for revenue is moderate with no long-term trend.
Recreational opportunities (Effort and fleet diversity)	↔ No trend ↔ No trend	≈ Near long-term average ≈ Near long-term average	Recreational opportunities in the region are relatively stable, with respect to the types of trips (i.e., shore, private boat, charter/party) and numbers of species landed.
Stability (Fishery and ecosystem diversity maintained over time)	↘ Not stable	FISHERY ECOSYSTEM Not stable	Commercial: Fleet count is declining with 2023 below the long-term average, and species revenue diversity reflects a reliance on relatively few species, with 2023 below the long term average. Recreation: Species diversity is increasing due to increases in southerly species and lower catch limits on traditional regional species. Ecosystem: Fish species richness is increasing while zooplankton diversity has been variable without trend. Changes in biological traits of the fish community have been observed.
Social and cultural (Community fishery engagement, social and climate vulnerability)	Community total climate vulnerability trend Mixed trends	Community social and climate vulnerability status varies by community.	Three New England communities ranked in the top 20 most engaged for both commercial and recreational fishing. Several of the top highly engaged fishing communities throughout the New England region ranked medium-high or above for one or more of the social vulnerability indicators, including 2 commercial communities (New Bedford, and Boston, MA) and 2 recreational communities (Provincetown and Falmouth, MA). This suggests potential challenges for these communities adapting to change. Communities climate risk on revenue is shifting from moderate to high/very high suggesting an increased dependence on climate vulnerable species.
Protected species (Coastwide bycatch, population numbers, mortalities)	BYCATCH Mixed trends POPULATIONS NARW Gray seal Salmon Mixed trends Below recovery objective Above long-term average Below long-term average	Harbor porpoise Meeting objectives Gray seal Meeting objectives NARW Gray seal Salmon Unusual mortality events continue for 3 large whale species.	Bycatch objectives are being met for harbor porpoise and gray seals. Mixed bycatch trends through 2022 are related to fishery management, shifts in porpoise distribution combined with fishery shifts, and population increase for gray seals. Population drivers for North Atlantic Right Whales (NARW) include combined fishery interactions/vessel strikes and distribution shifts related to prey abundance and quality. Management measures to reduce adult mortality are reflected in more stable population numbers. Unusual mortality events continue for 3 large whale species.

State of the Ecosystem Summary 2025:

Risks to meeting fishery management objectives

Climate: risks to managing spatially, managing seasonally, and catch specification

- Fish and protected species distribution shifts
- Changing spawning and migration timing
- Multiple stocks with poor condition, declining productivity

Other ocean uses: offshore wind development

- Current revenue in proposed areas
 - 1-46% by Mid-Atlantic port
 - 2-16% by MAFMC managed species
- Overlap with important right whale foraging habitats, increased vessel strike and noise risks

Risks to Meeting Fishery Management Objectives

Environmental Change and Ecosystem Risks

Climate and ecosystem change can directly and indirectly create risks to meeting fisheries management objectives by affecting the distribution, seasonal timing, productivity, and physiology of marine species.

Risks to Managing Spatially

- **Observations:** Species distributions for many fish and marine mammals are trending to the northeast along the continental shelf and into deeper water.
- **Potential Impacts:** Spatial misallocation of quotas within and across jurisdictions, leading to unmet quotas and/or increased discards. Specification of gear management areas may not utilize quotas and minimize bycatch.

Risks to Managing Seasonally

- **Observations:** Seasonal timing of spawning has changed for some managed species. Migration timing of some tunas and large whales has changed.
- **Potential Impacts:** Spawning closures are less effective if peak spawning occurs outside the seasonal closure. Seasonal openings of exemption areas may be inconsistent with species presence. Seasonal quota allocations may be misaligned with availability.

Risks to Setting Catch Limits

- **Observations:** Productivity and fish condition has changed for multiple fish species.
- **Potential Impacts:** Changes in environmental conditions can affect stock reference points and short-term stock projections. When productivity changes are not accounted for, they can lead to misspecified quotas and rebuilding plans.

Other Ocean Uses: Offshore Wind Risks

In 2024, four offshore wind projects were under construction in New England and the Mid-Atlantic, with seven additional projects approved by BOEM that may be built in the future.

Currently approved lease areas cover more than 3.1 million acres on the Northeast shelf. Impacts at the wind project, local ocean, and regional scales are likely. Positive and negative effects are possible depending on species' preferred habitat. Wind energy updates include:

- Five lease areas within the Gulf of Maine, one research and four commercial, were leased in 2024 for floating offshore wind project development.
- 0-32% of New England port revenue (2008–2023) came from existing leased and proposed offshore wind areas.
- 1–20% and 1–19% of annual commercial revenue and landings, respectively, for New England Fishery Management Council managed species between 2008–2023 occurred within existing lease areas and may be displaced. Individual operators may depend on lease areas for even larger proportions of their annual landings or revenue.
- Lease areas overlap with North Atlantic right whale critical habitat in the Gulf of Maine. Development may alter local oceanography and prey availability, increase vessel traffic and therefore vessel strike risk, and result in pile driving noise impacts.
- Each project implements mitigation and monitoring measures to reduce impacts on trust resources during certain activities.



State of the Ecosystem Summary 2025: 2024 Highlights

Notable 2024 events and conditions

- 2024 warmest year on record globally. Again.

BUT

- Cooler conditions across the coast
- Well established Mid Atlantic Cold Pool
- Multiple summer upwelling events off NJ
- Extreme ocean acidification measured off NJ
- Many fishery observations of different spatial and timing patterns, changed abundance
- Good scallop recruitment in Nantucket lightship
- More red drum in Chesapeake Bay
- Arctic copepods in GOM
- Coccolithophore bloom off NY
- Large whale aggregations

We welcome your observations!

northeast.ecosystem.highlights@noaa.gov

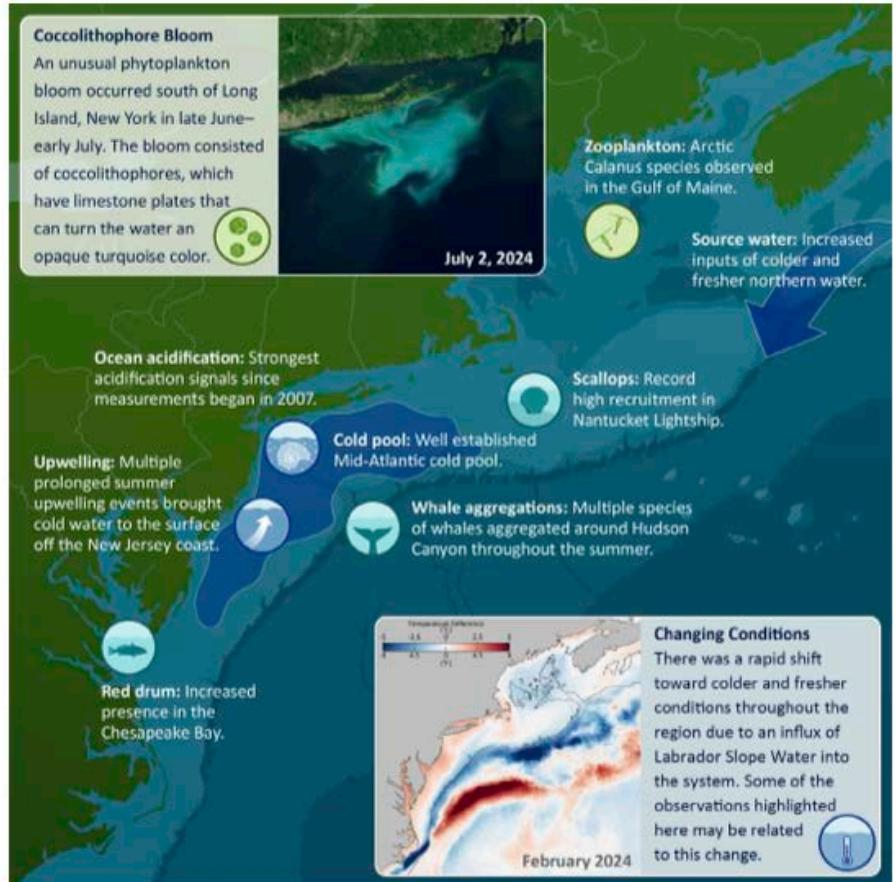
2024 Highlights

2024 global sea surface and air temperatures exceeded 2023 as the warmest year on record, but water temperatures in the Northeast U.S. shelf were colder than average. Oceanographic and ecological conditions in the Northwest Atlantic were markedly different in 2024 compared to recent years. Observations included inputs of colder and fresher northern water, delayed migration of many species, and redistribution of some species.

Fishing Observations

Members of the fishing community reported multiple unusual conditions during 2024 including:

- Low abundance of some species, such as longfin squid, in traditional fishing areas.
- Observations of some species, such as Atlantic mackerel, outside of the typical fishing grounds and in higher abundance compared to recent years.
- Some delayed fishing due to multiple species migrating into fishing areas later in the season.



SSC and Council Requests from 2024 and Prioritization

2025 State of the Ecosystem Request tracking memo

Request	Year	Rank	Source	Status	Progress
System level thresholds/ref pts					
Compare EOF (Link) thresholds to empirical thresholds (Large, Tam)	2021	Highest	MAFMC SSC	In progress	Analysis planning with Mid SSC
Simulation analysis to gauge effectiveness of indicators (e.g. EOF testing)	2024	Highest	MAFMC SSC	In progress for EOF	Analysis planning with Mid SSC
Trend Analysis / Inflection / Break points / Early warning variance	2019 - 2024	Highest	Both Councils and SSCs	In SOE (trends)	New short term trend analysis included
Optimum yield for ecosystem	2021	Highest	NEFMC	In progress	Analysis planning with Mid SSC
Include standardized language about uncertainty from e.g. IPCC or NCA applicable to each indicator or data input	2024	Highest	NEFMC SSC	Not started	Lacking resources this year
Establish more links between events and consequences (e.g. temp ranges for more species)	2024	Highest	MAFMC SSC	In progress	Temperature threshold analysis in progress
How does phyto size comp affect EOF indicator, if at all?	2021	High	MAFMC	In progress	Analysis planning with Mid SSC
Sum of TAC/ Landings relative to TAC	2021, 2023	Moderate	MAFMC SSC	In SOE-MAFMC, In progress-NEFMC	Seafood Production section
Nutrient input, Benthic Flux and POC (particulate organic carbon) to inform benthic productivity by something other than surface indicators	2021, 2023	Low	MAFMC SSC	In SOE	Benthos abundance and distribution indices included
Reduce indicator dimensionality with multivariate statistics	2020	Lowest	NEFMC	In progress	Analysis planning with Mid SSC
Management					

Priority categories in the Request Memo

The memo is organized into categories by topic, and categories are listed in descending order of overall (2022) priority based on approximate weighting within the category.

Therefore, a range of priority may be applied to individual requests within a category even though the entire category has an overall priority.

The subgroup agreed to keep this group priority ranking

SSC: [Link to current memo](#)

SSC: [Link to overview](#)

- System level thresholds/reference points: highest, much methods work in progress
- Management: high, resource limited
- Short term forecasts: high, CEFI should help
- Regime shifts: high, need system level framework
- Multiple system drivers: moderate-high, many unranked requests
- Functional group level status/thresholds/reference points: moderate, many in progress
- Stock level indicators: moderate, ESPs better venue
- SOE administration: unranked

Discussion of 2023 and 2024 requests (1 of 2)

These newer requests were ranked highest within each category

- System level thresholds/reference points: highest
 - maintain high priority on trend/threshold evaluation
 - express indicators relative to biological thresholds
 - standardize uncertainty language (IPCC)
 - longer term: simulation analysis of thresholds
- Management: high
 - include indicators for risk policy/risk assessment processes
- Short term forecasts: high
 - include CEFI projections
- Regime shifts: high
 - instead characterize current conditions in context of expected short term change

SSC: link to [full list](#), comments welcome!

Discussion of 2023 and 2024 requests (2 of 2)

These newer requests were ranked highest within each category

- Multiple system drivers: moderate-high
 - profits vs revenue: provide incomplete net revenue and index of costs
 - clarify objectives and terminology for fishing community engagement/reliance
 - time series of community indicators
 - social and economic linkages to climate
 - consider appropriate scale for indicators
- Functional group level status/thresholds/reference points: moderate
 - not specifically prioritized
 - include more aggregations for biomass and landings (Council-managed, status)
- Stock level indicators: moderate, ESPs
 - not specifically prioritized
 - cross reference ESP products where appropriate

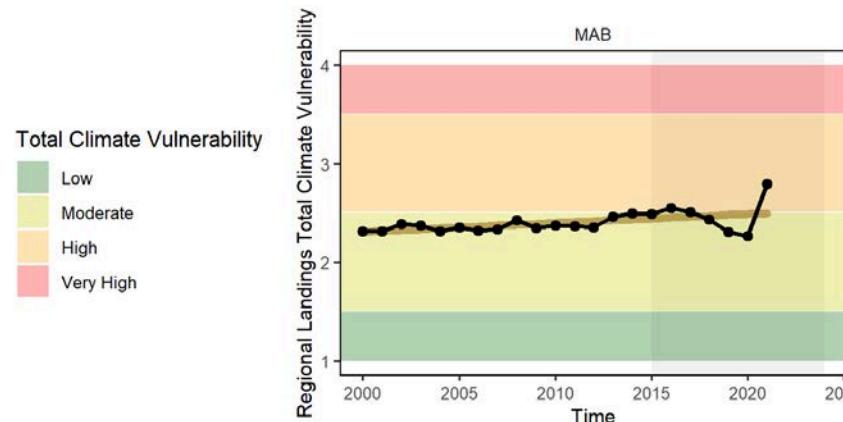
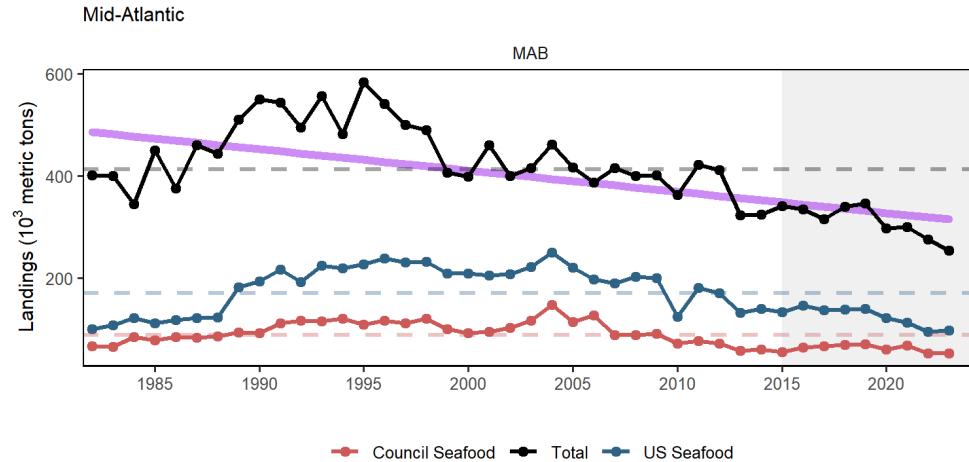
SSC: link to **full list**, comments welcome!

2025 Performance relative to management objectives



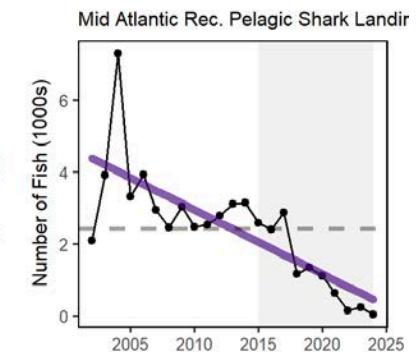
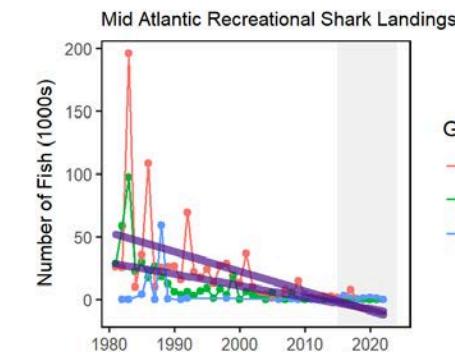
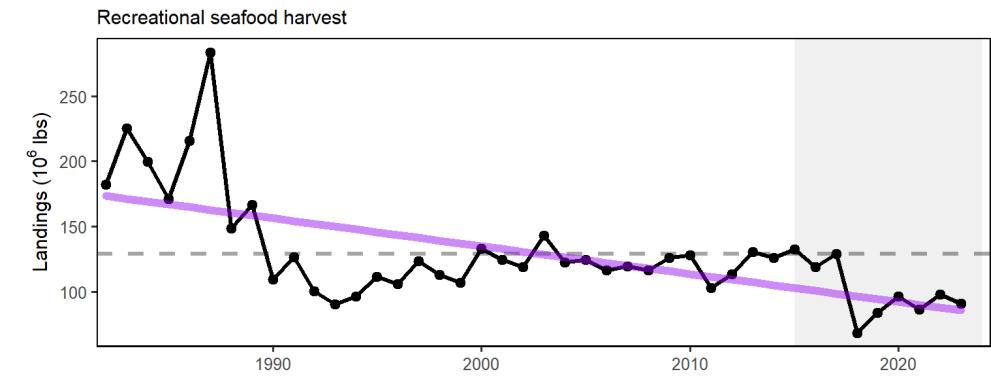
Objective: Mid Atlantic Seafood production

Indicators: Commercial landings, climate risk



Risk elements: ComFood and RecFood, unchanged

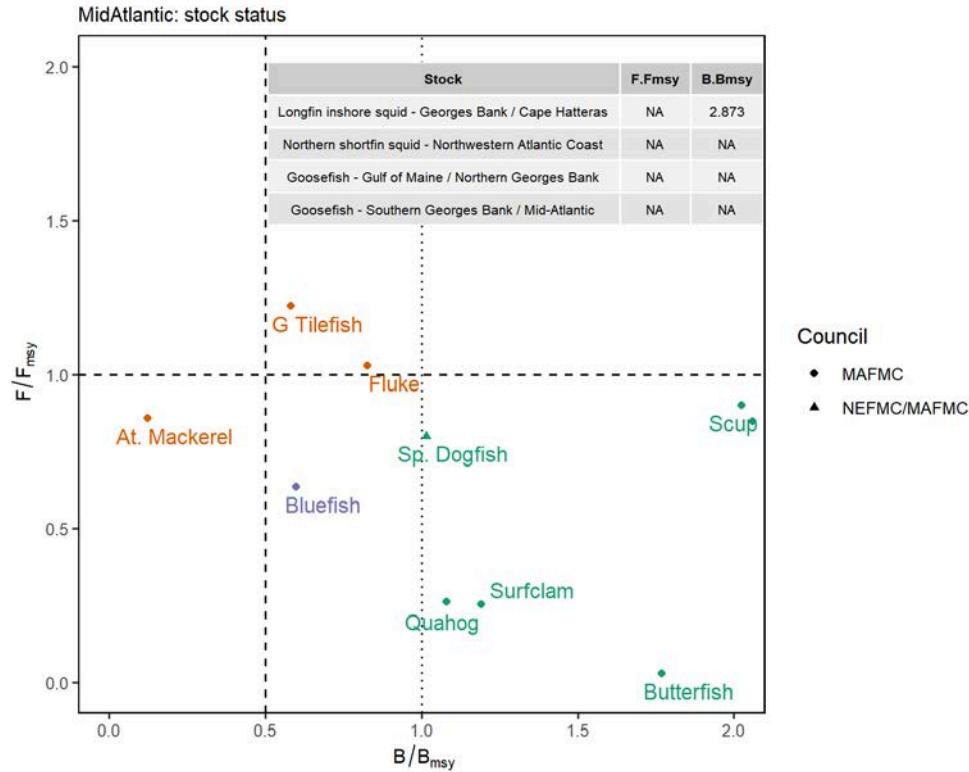
Indicators: Recreational harvest



Multiple potential drivers: ecosystem and stock production, management, market conditions, and environmental change.

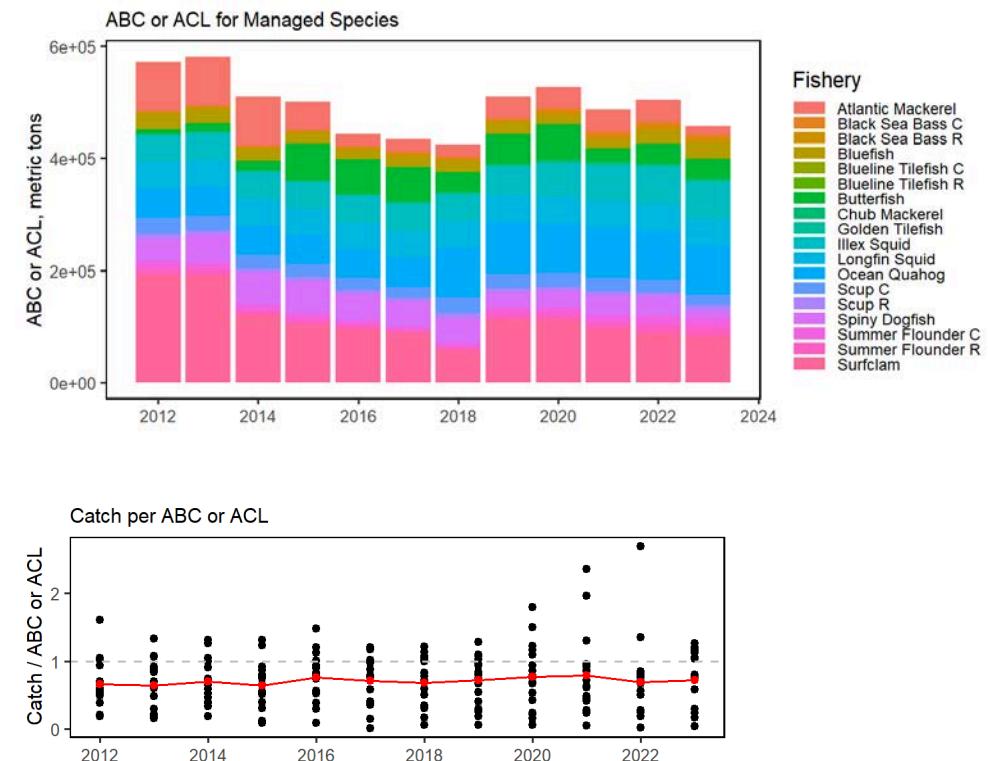
Mid Atlantic Landings drivers: Stock status? TAC?

Indicator: Stock status



Risk elements: Fstatus, Bstatus, MgtControl

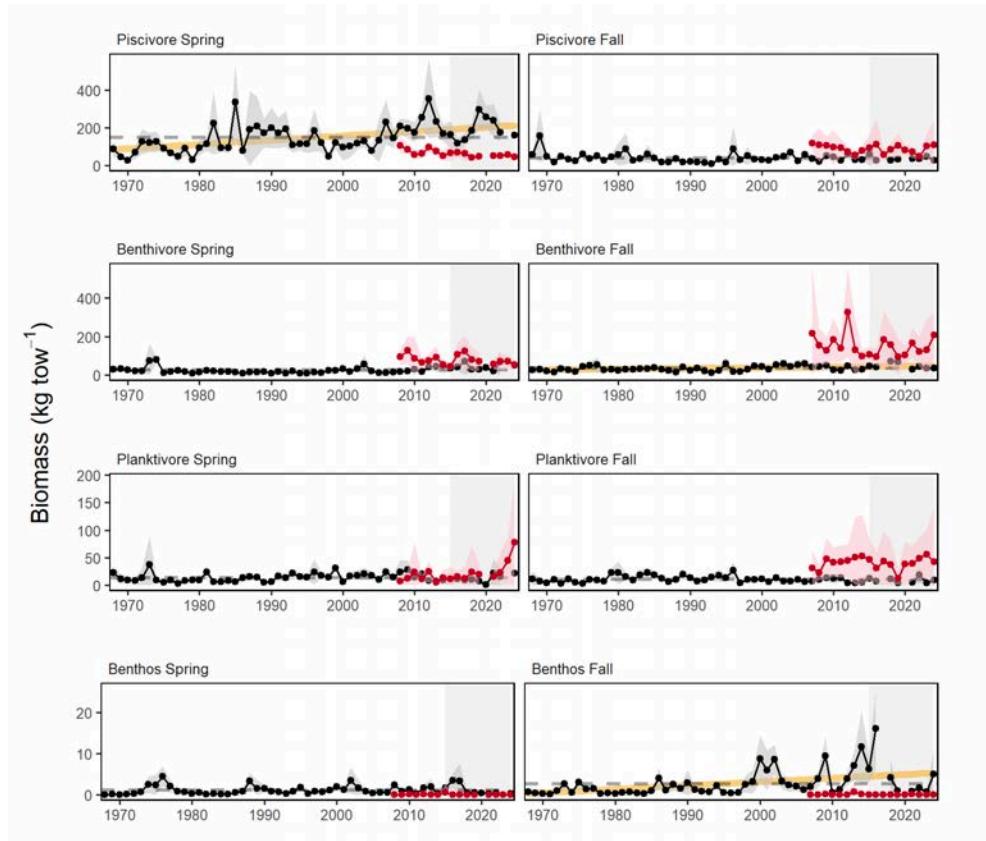
Indicators: Total ABC or ACL, and Realized catch relative to management target



Few managed species have binding limits; Management less likely playing a role

Implications: Mid Atlantic Seafood Production Drivers

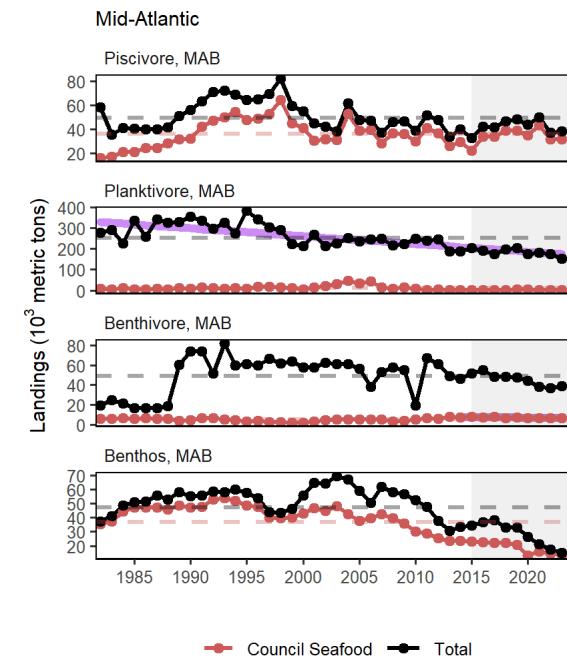
Biomass does not appear to drive landings trends



Key: Black = NEFSC survey;

Red = NEAMAP survey

- Declining aggregate planktivores, benthos?



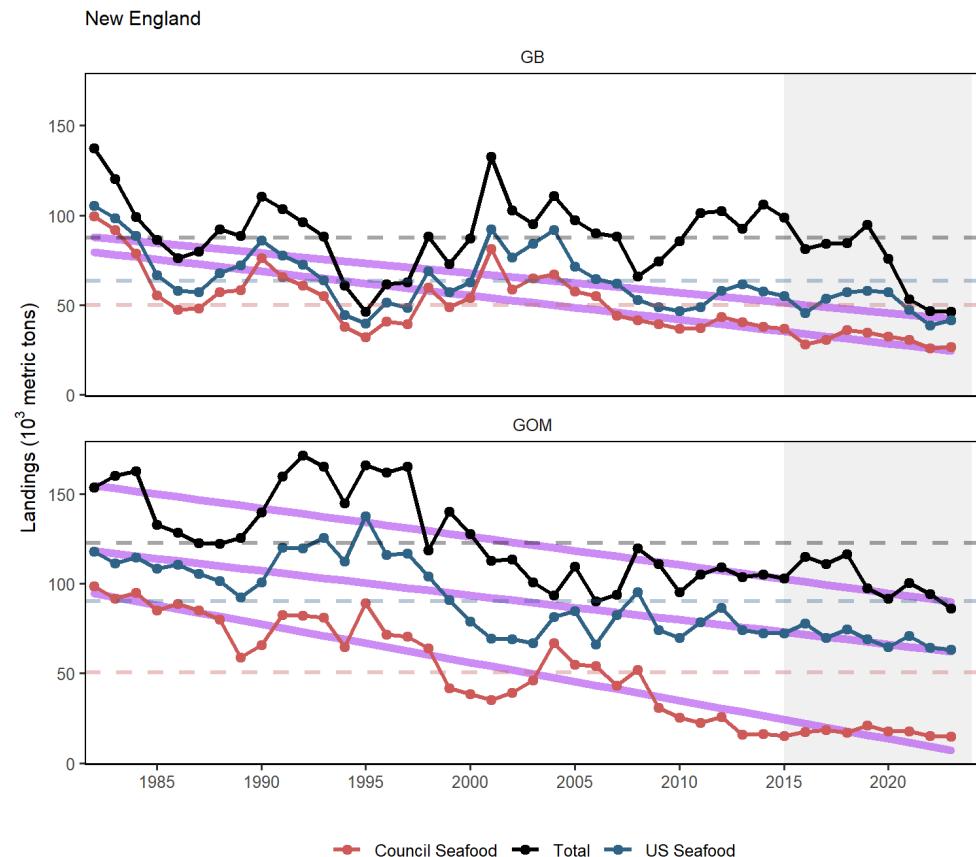
- Recreational drivers differ: shark fishery management, possibly survey methodology

Monitor:

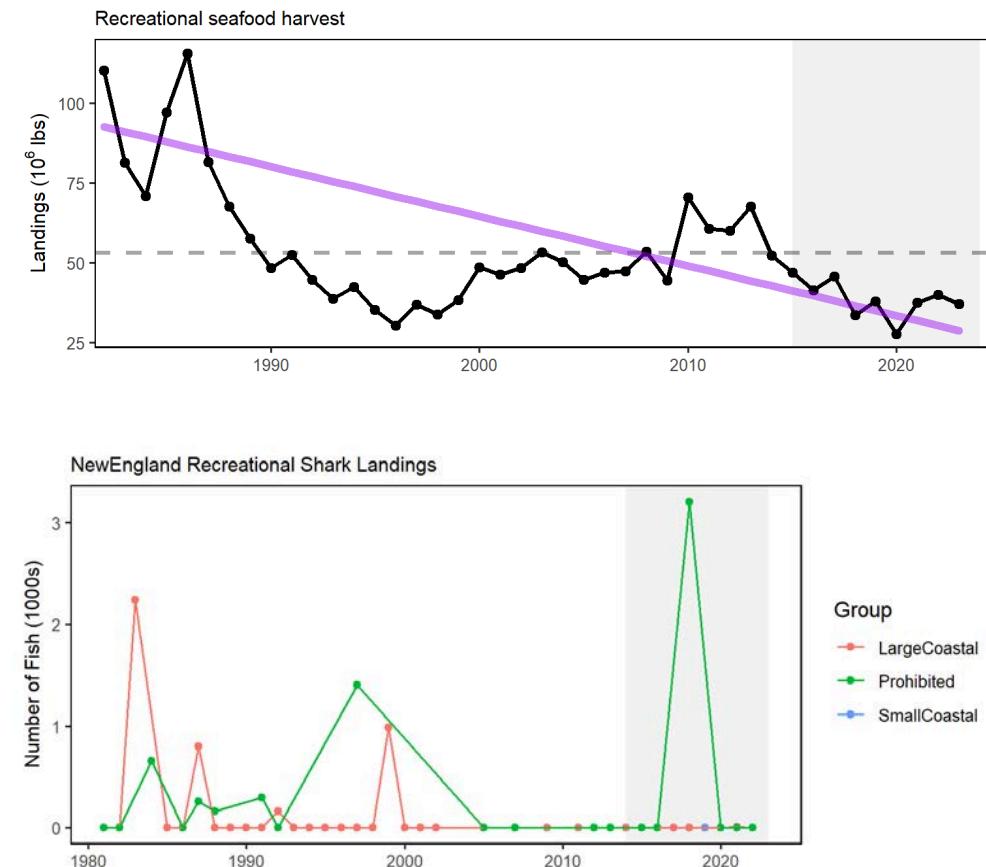
- climate risks including warming, ocean acidification, and shifting distributions
- ecosystem composition and production changes
- fishing engagement

Objective: New England Seafood production ↴/↔-

Indicators: Commercial landings



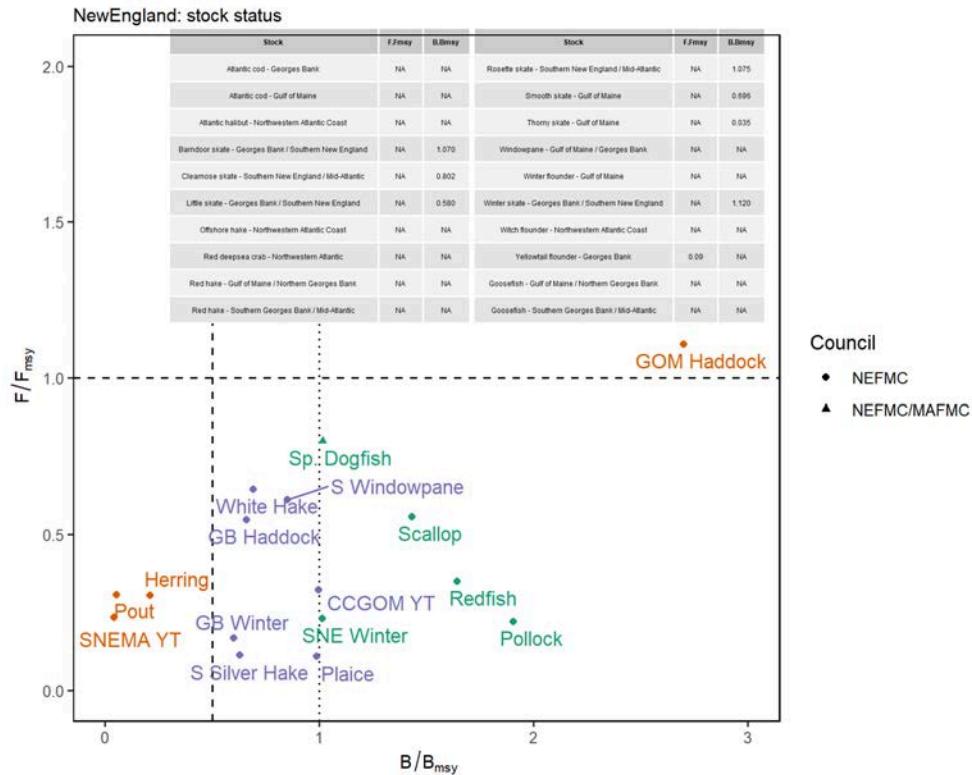
Indicators: Recreational harvest



Multiple drivers: ecosystem and stock production, management actions (stock rebuilding), market conditions (including COVID-19 disruptions), and environmental change

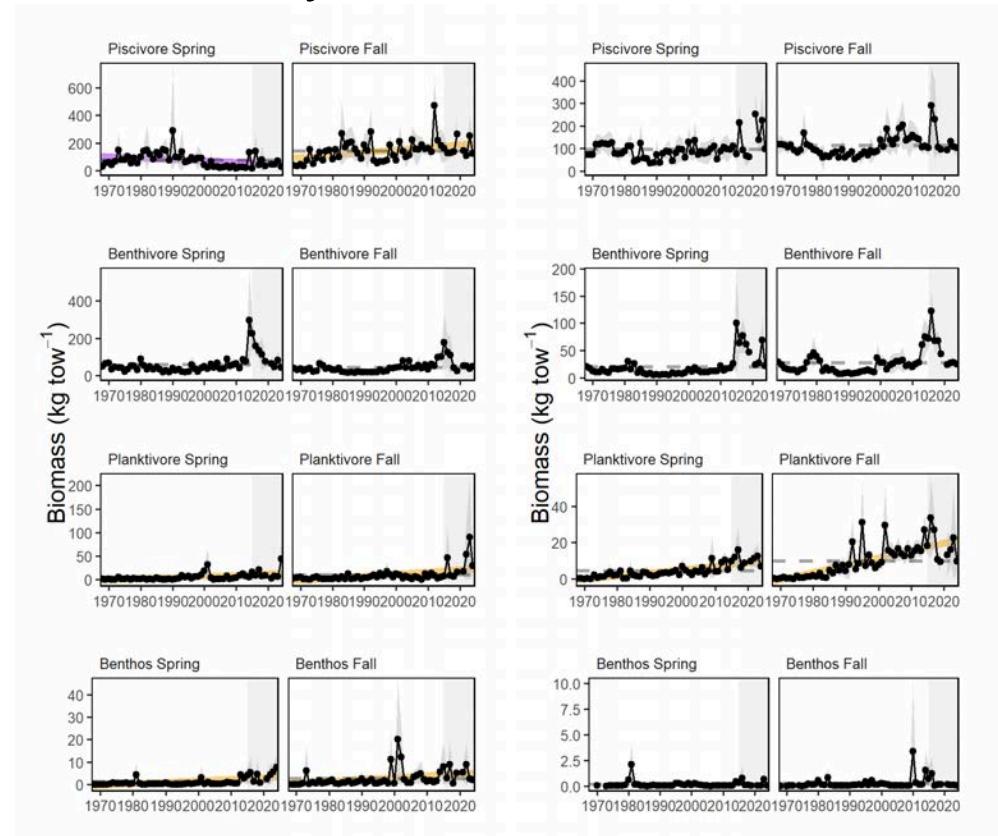
New England Landings drivers: Stock status? Survey biomass?

Indicator: Stock status



One more stock below BMSY from last year (S Silver Hake). No change in stocks below 1/2 BMSY. Stock status and required management actions still likely playing large role in seafood declines.

Indicator: Survey biomass



Biomass availability still seems unlikely driver

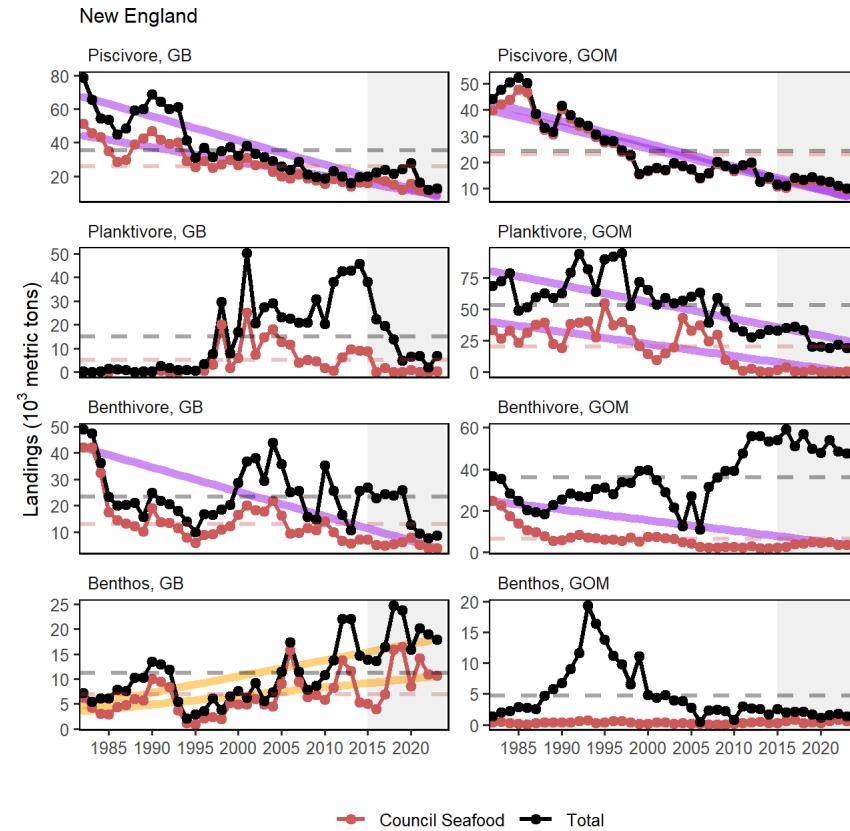
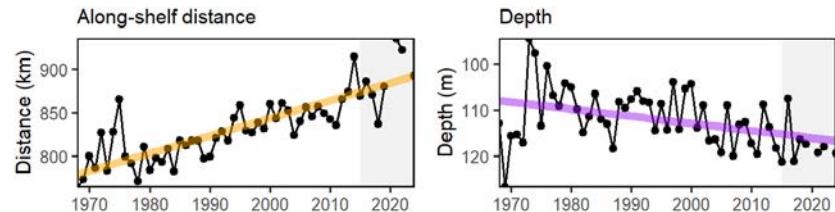
Implications: New England Seafood Production

Drivers:

- Decline in commercial landings is most likely driven by actions to rebuild individual stocks (lower quotas) as well as market dynamics
- other drivers affecting recreational landings: tighter shark fishery regulations, changing demographics and preferences of anglers

Monitor:

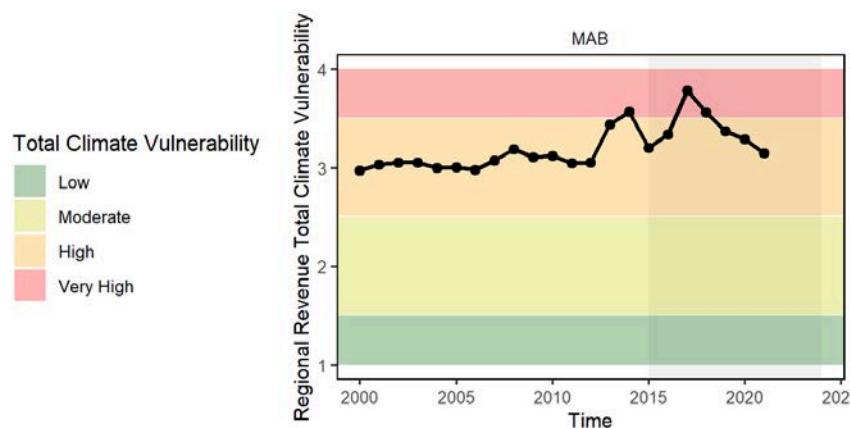
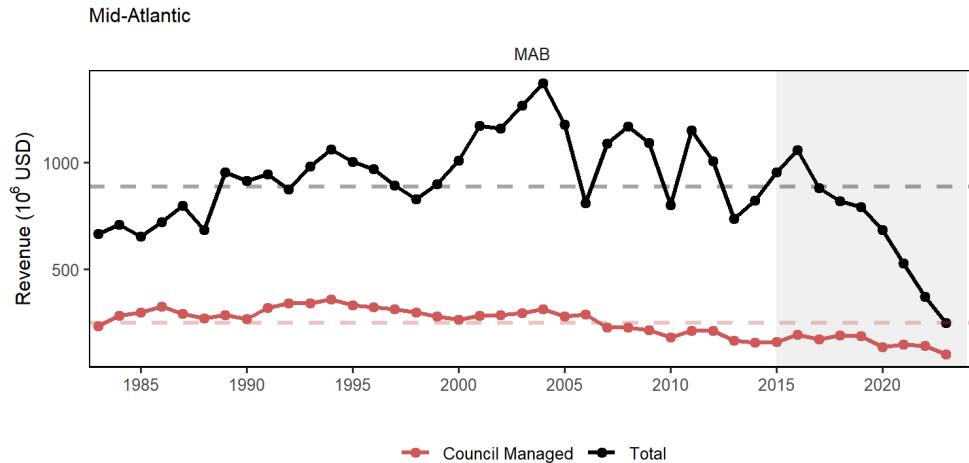
- Climate risks including warming, ocean acidification, and shifting distributions
- Ecosystem composition and production changes
- Fishing engagement



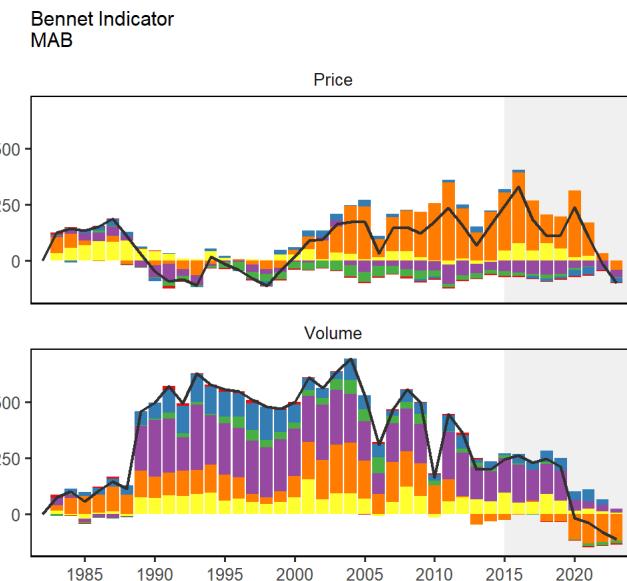
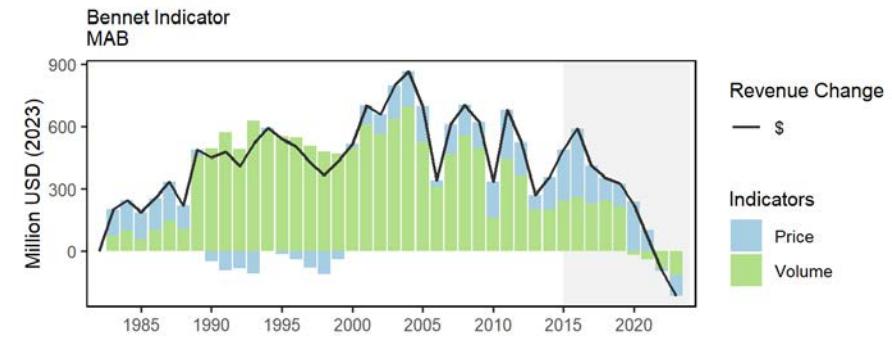
Objective: Mid Atlantic Commercial Profits

Risk element: **CommRev**, unchanged

Indicator: Commercial Revenue

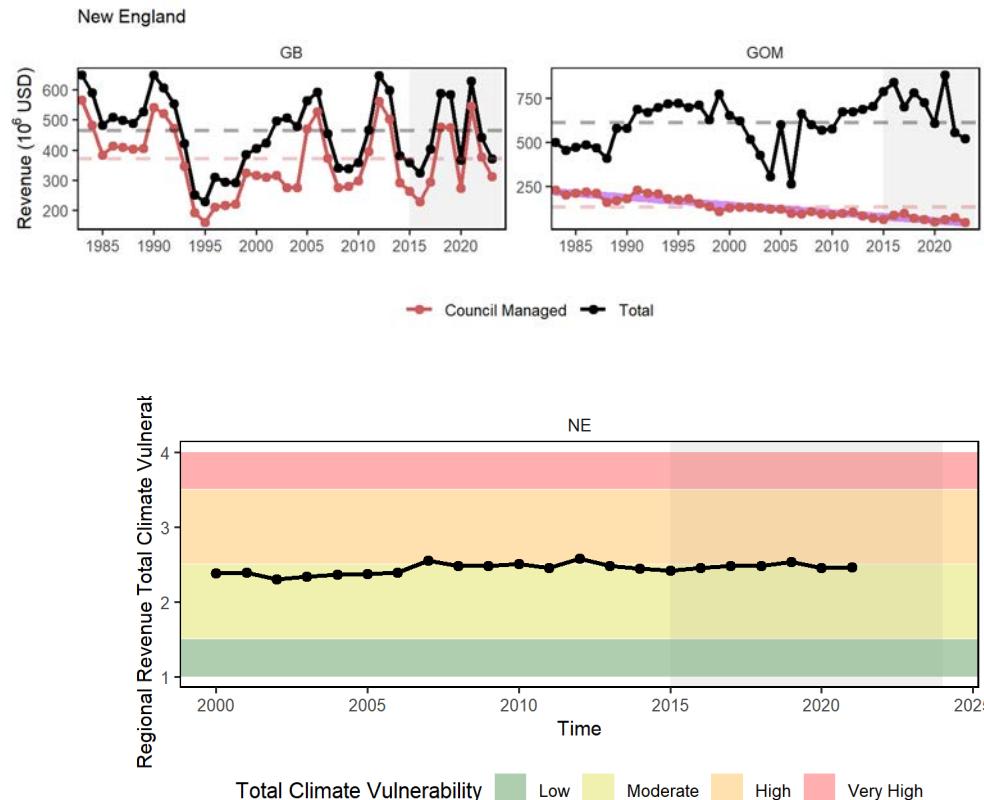


Indicator: Bennet--price and volume indices



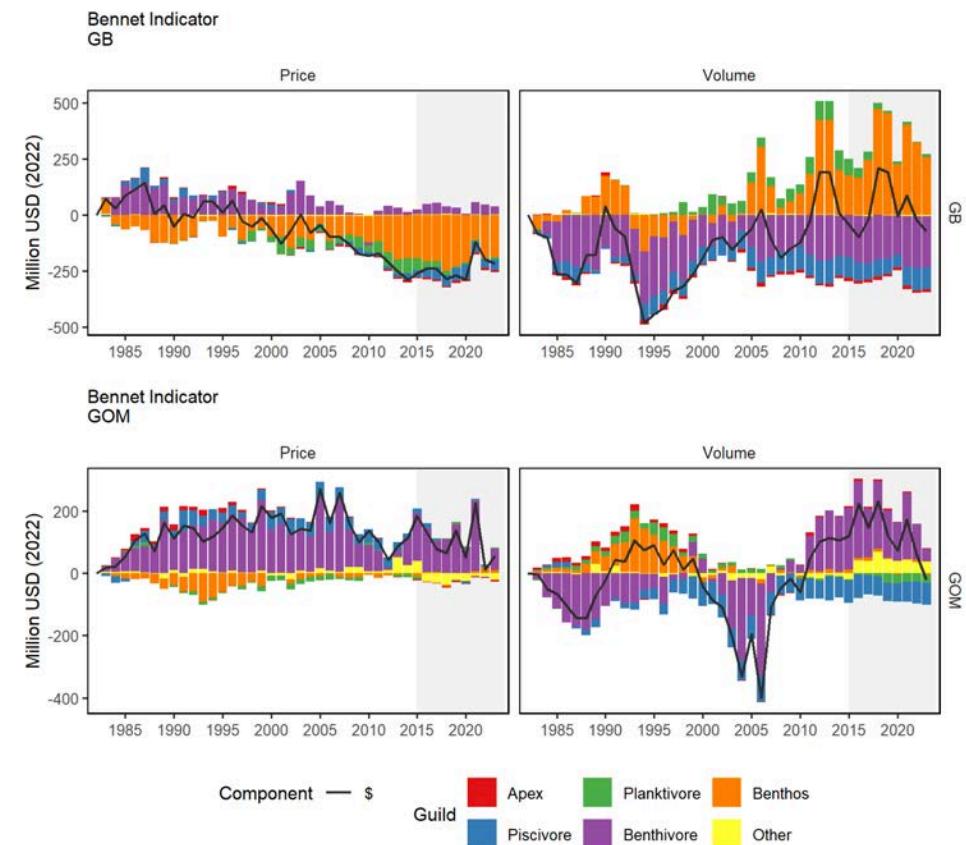
Objective: New England Commercial Profits

Indicator: Commercial Revenue



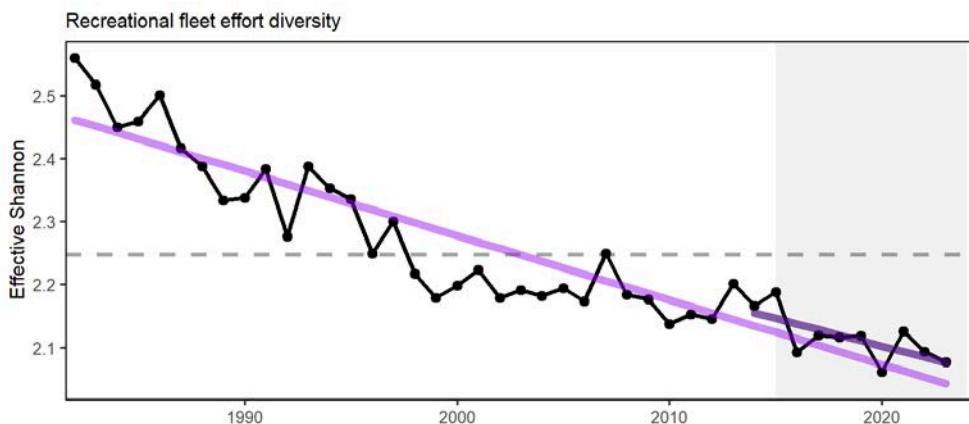
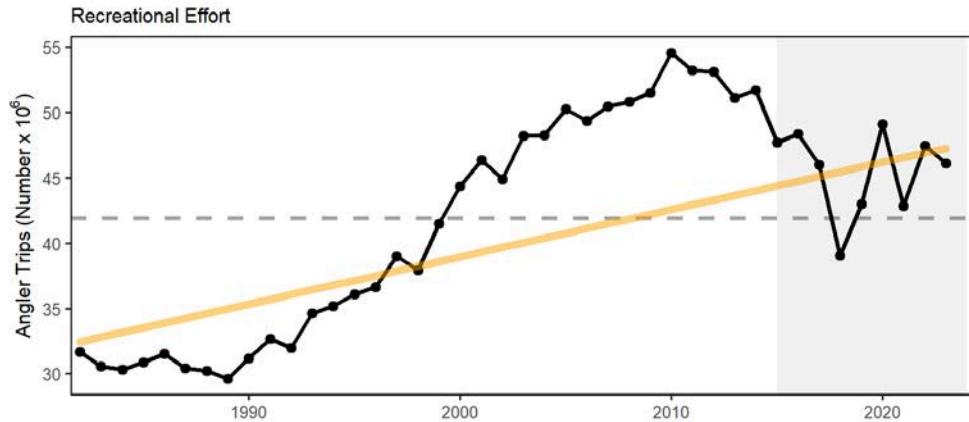
Both regions dependent on single climate-vulnerable species

Indicator: Bennet--price and volume indices



GOM high revenue despite low volume

Indicators: Recreational effort and fleet diversity

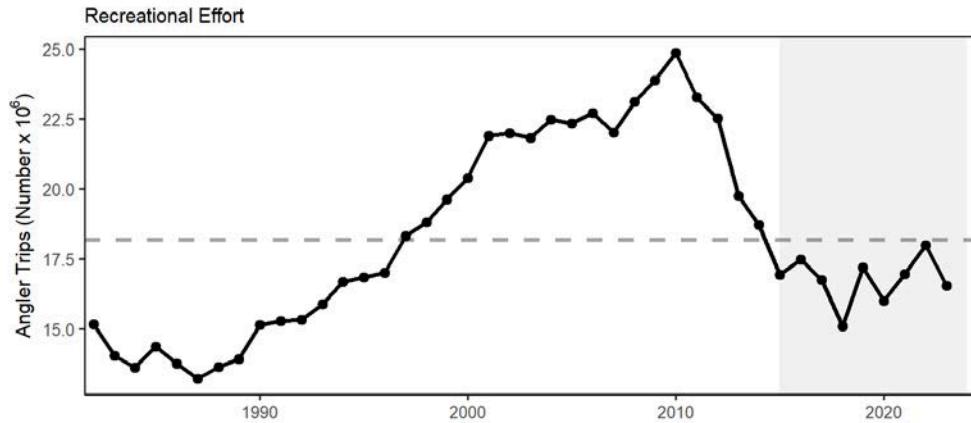


Implications

- Adding 2023 data, recreational effort (angler trips) retains the long term increase.
- The increasing long term trend changed the risk category for the RecValue element back to low-moderate (previously ranked low risk).
- *New risk element:* Decline in recreational fleet diversity suggests a potentially reduced range of opportunities.
- Driven by party/charter contraction and a shift toward shore based angling.

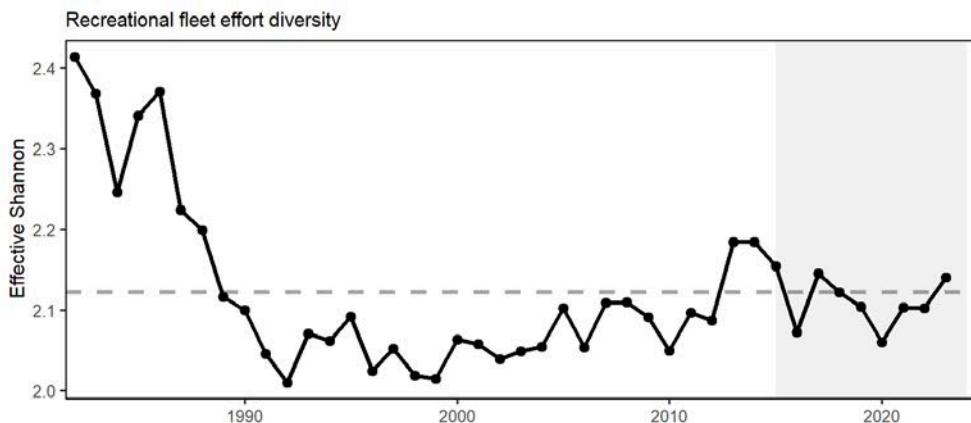
Objective: New England Recreational opportunities

Indicators: Recreational effort and fleet diversity



Implications

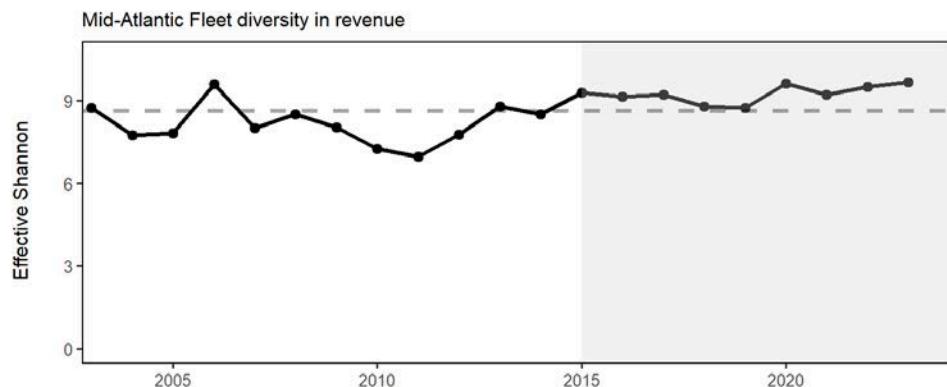
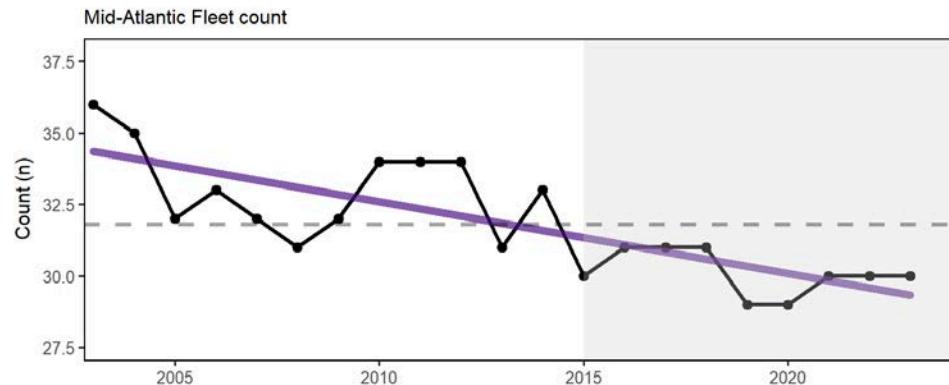
- Absence of a long-term trend in recreational effort suggests relative stability in the overall number of recreational opportunities in New England



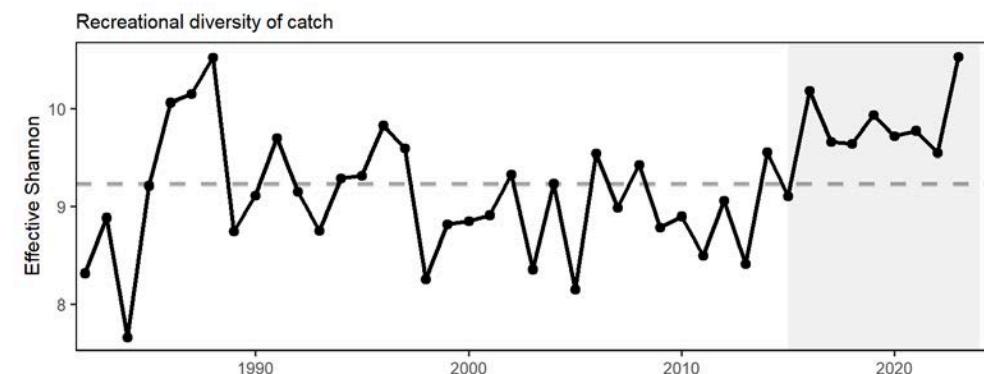
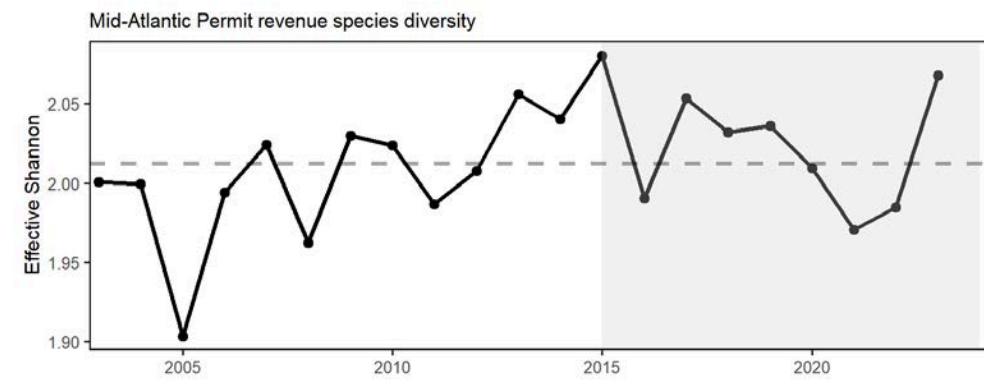
Objective: Mid Atlantic Fishery Stability: Not Stable

Risk elements: **FleetDiv** and **FishRes1**

Fishery Indicators: Commercial fleet count, fleet diversity

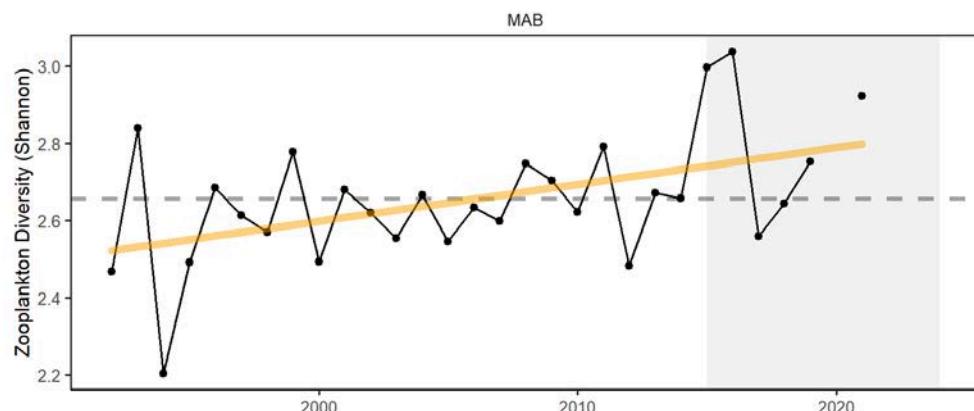
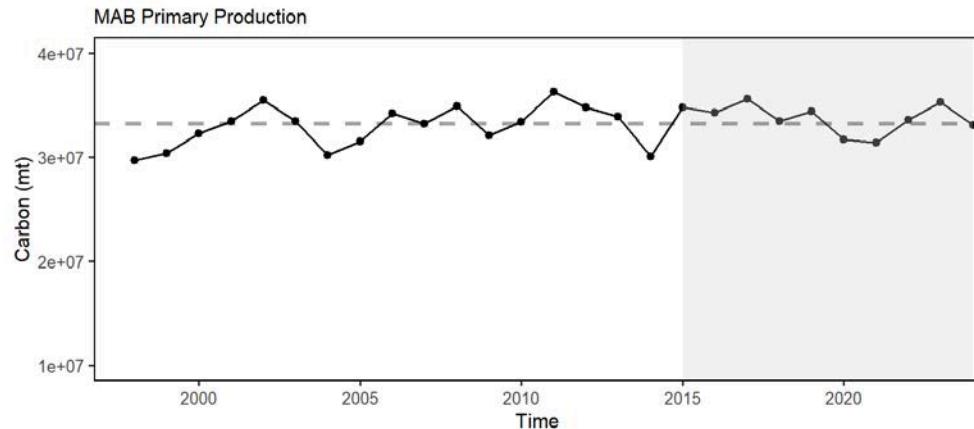


Fishery Indicators: commercial species revenue diversity, recreational species catch diversity

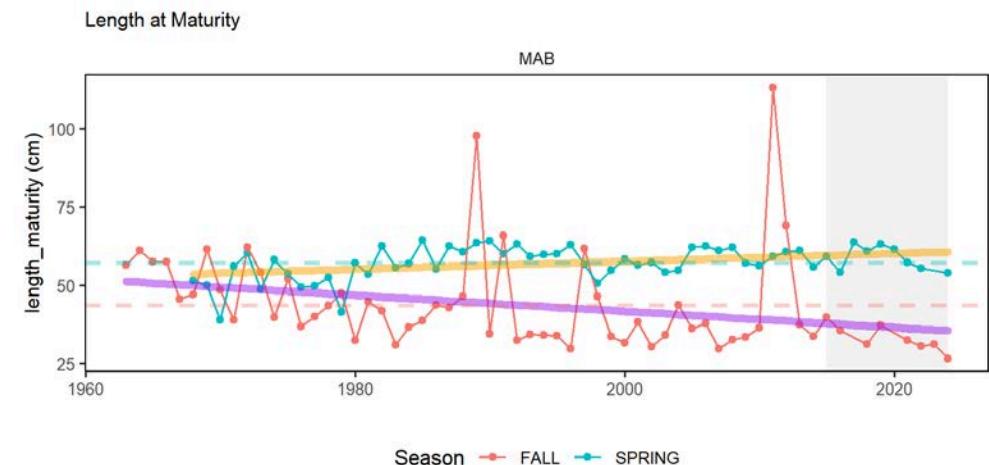
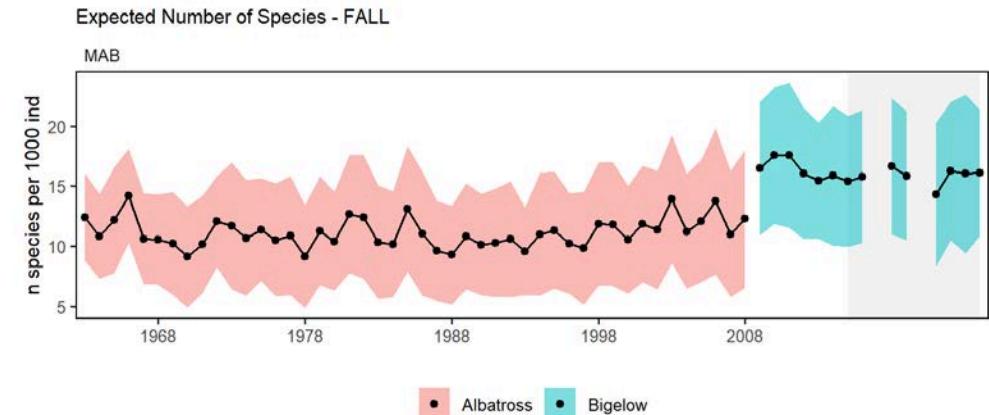


Objective: Mid Atlantic Ecological Stability: Not Stable

Ecological Indicators: PP and zooplankton

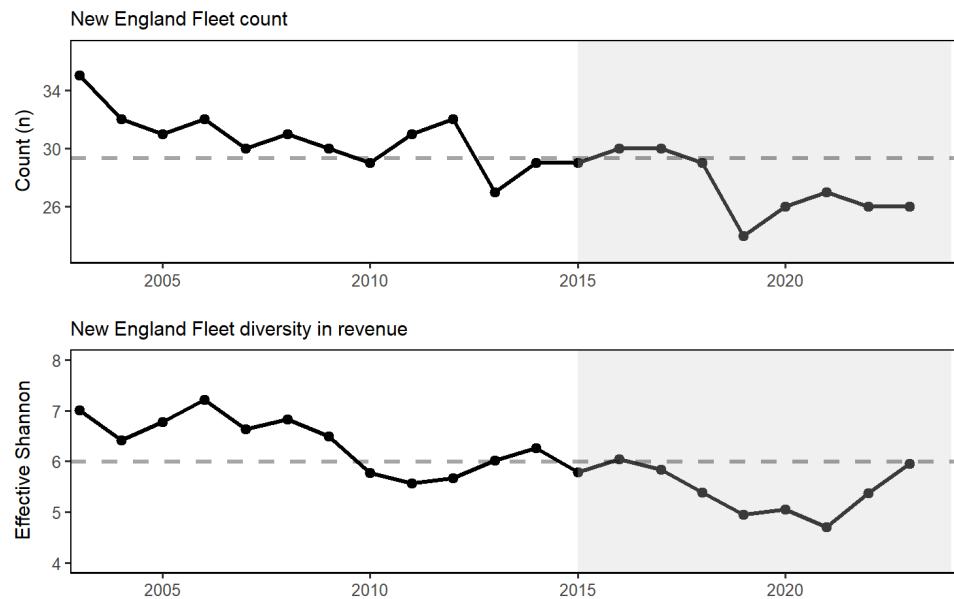


Ecological Indicators: fish richness and traits

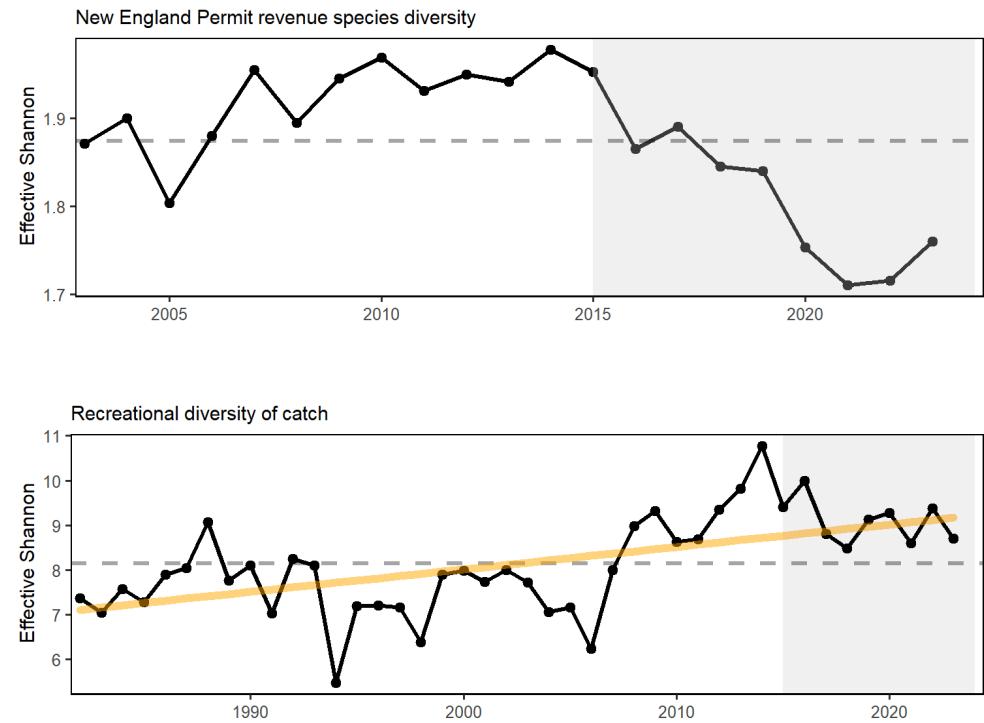


Objective: New England Fishery Stability: Not Stable

Fishery Indicators: Commercial fleet count, fleet diversity



Fishery Indicators: commercial species revenue diversity, recreational species catch diversity



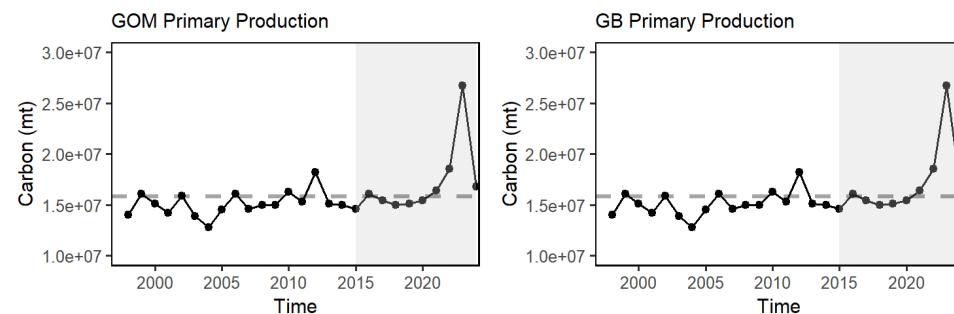
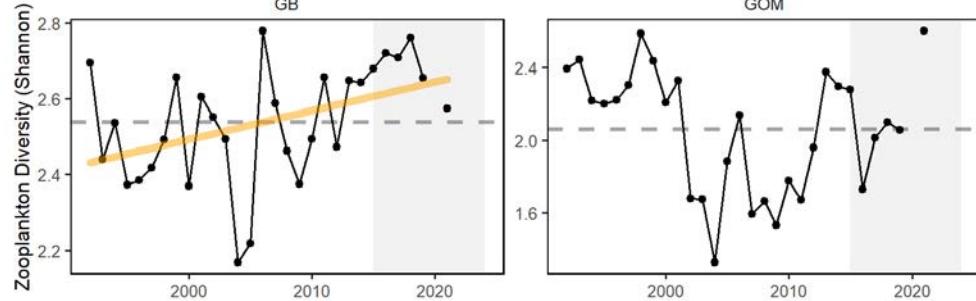
Fishery Implications:

- Commercial fishery diversity driven by small number of species -> less capacity to respond to new opportunities

- Recreational diversity increase due to increase in ASFMC and MAFMC managed species

Objective: New England Ecological Stability

Ecological Indicators: zooplankton diversity (*not updated*) and total primary production

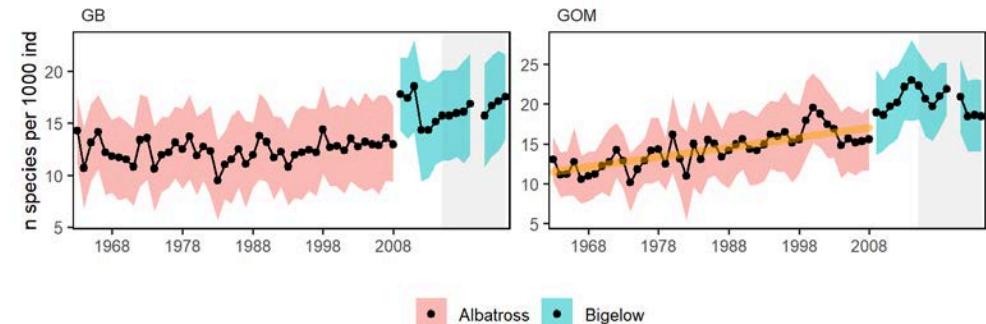


Ecological Implications:

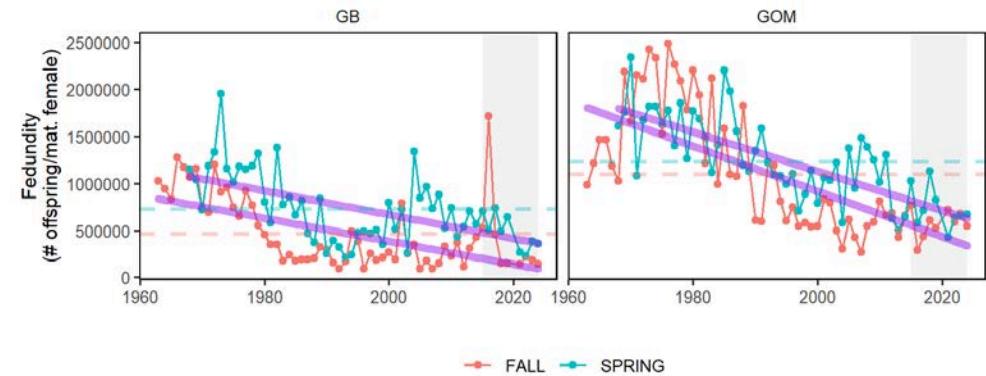
- Adult diversity in GOM suggests increase in warm-water species

Ecological Indicators: fish richness and traits

Expected Number of Species - FALL



Fecundity

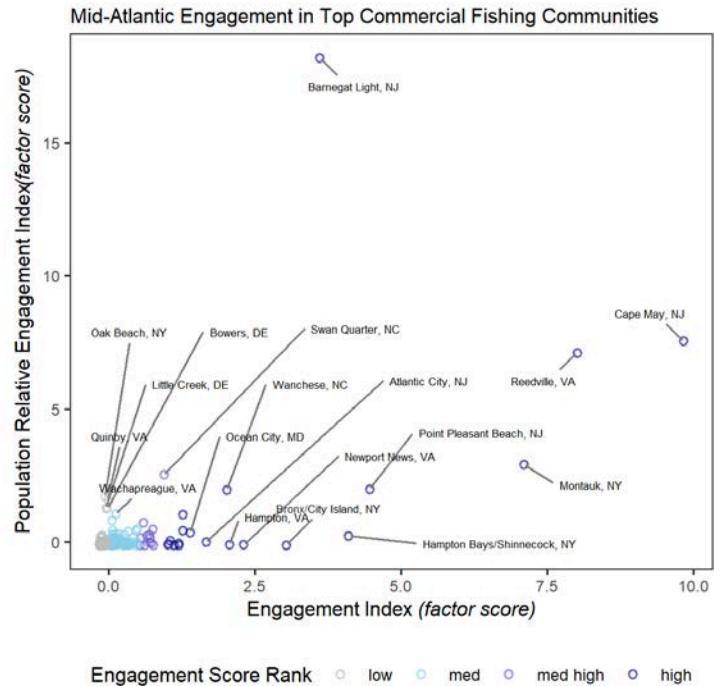


- Declines in species fecundity & other life history traits suggests changing ecology

Mid-Atlantic Social and Climate Vulnerability

Risk element: Social

Indicators: Commercial fishery engagement, social vulnerability, revenue climate vulnerability

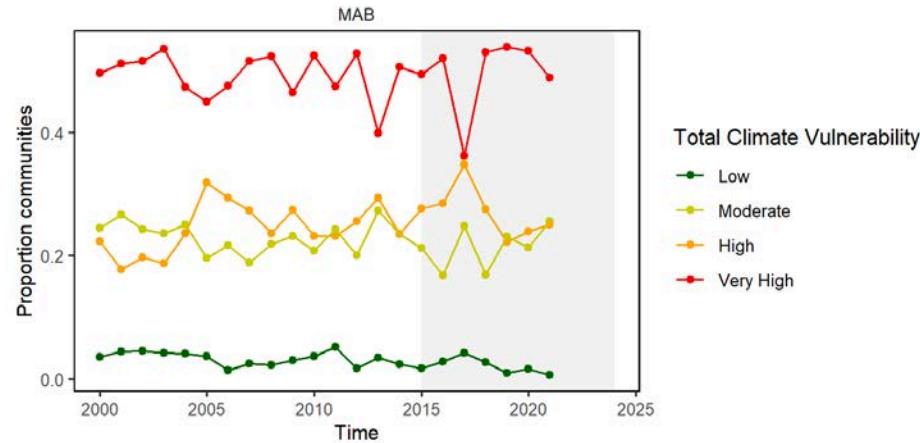


Time	EPU	Town	Eng	Eng_ct	Rel	Rel_ct	Personal Disruption	Population Composition	Poverty
2022	MAB	Cape May, NJ	9.828	4	7.546	4	1	2	1
2022	MAB	Reedville, VA	8.005	4	7.105	4	1	1	1
2022	MAB	Montauk, NY	7.095	4	2.903	4	1	1	1
2022	MAB	Point Pleasant Beach, NJ	4.455	4	1.987	4	2	1	1
2022	MAB	Hampton Bays/Shinnecock, NY	4.097	4	0.226	2	1	4	1
2022	MAB	Barneget Light, NJ	3.606	4	18.175	4	1	1	1
2022	MAB	Bronx/City Island, NY	3.037	4	-0.120	1	4	4	4
2022	MAB	Newport News, VA	2.301	4	-0.101	1	2	1	2
2022	MAB	Hampton, VA	2.059	4	-0.092	1	2	1	2
2022	MAB	Wanchese, NC	2.014	4	1.955	4	1	1	1

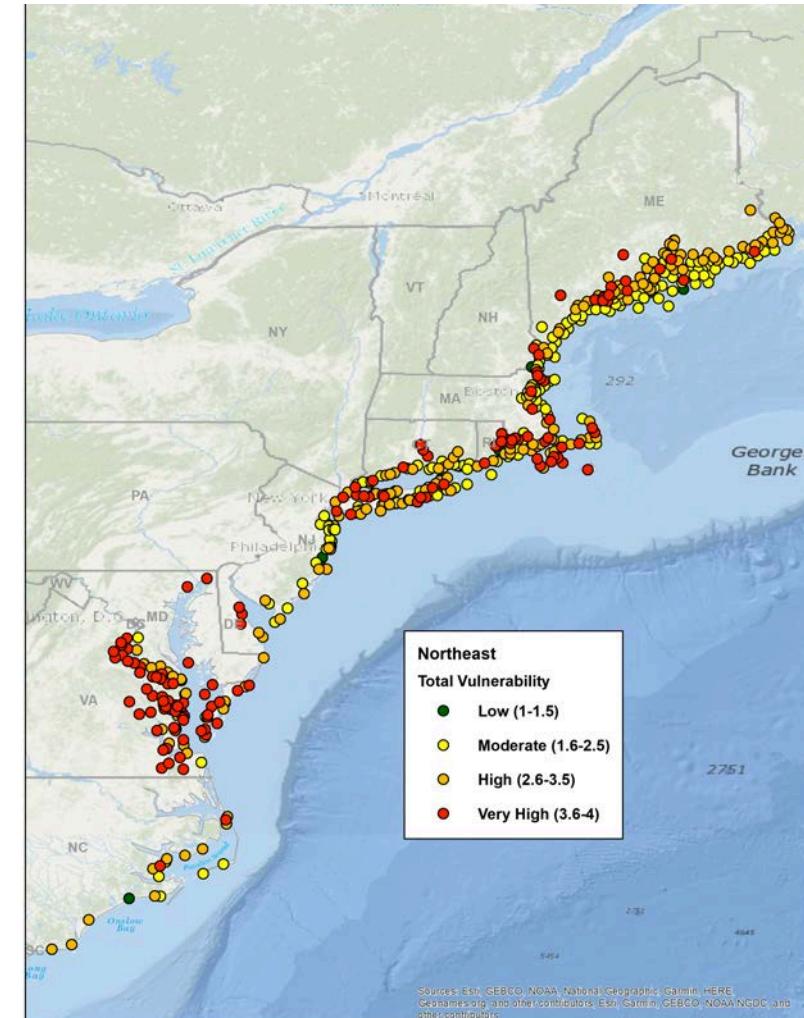
Mid-Atlantic Social and Climate Vulnerability

Risk element: Social

Indicators: Commercial fishery revenue climate vulnerability



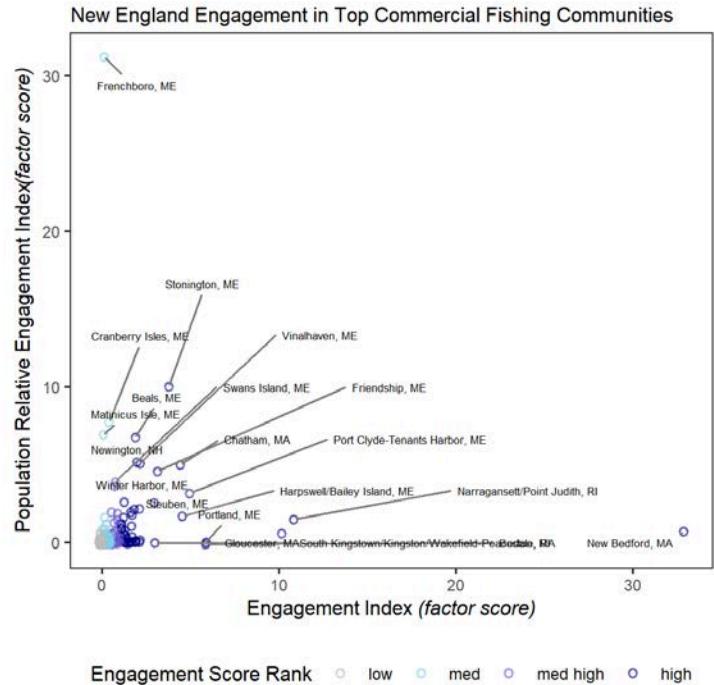
The **Community Climate Change Risk Indicators** are calculated by multiplying the percent contribution of species to the total value landed in a community by their respective Total Vulnerability scores (based on NOAA's Climate Vulnerability Assessment) for different sensitivity and exposure factors and then summing the resulting values by year.



Sources: Esri, GEBCO, NOAA National Geographic, Garmin, HERE, Geodatenzug, and other contributors; Esri, Garmin, GEBCO, NOAA, NGDC, and other contributors

New England Community Social and Climate Vulnerability

Indicators: Commercial fishery engagement, social vulnerability, revenue climate vulnerability

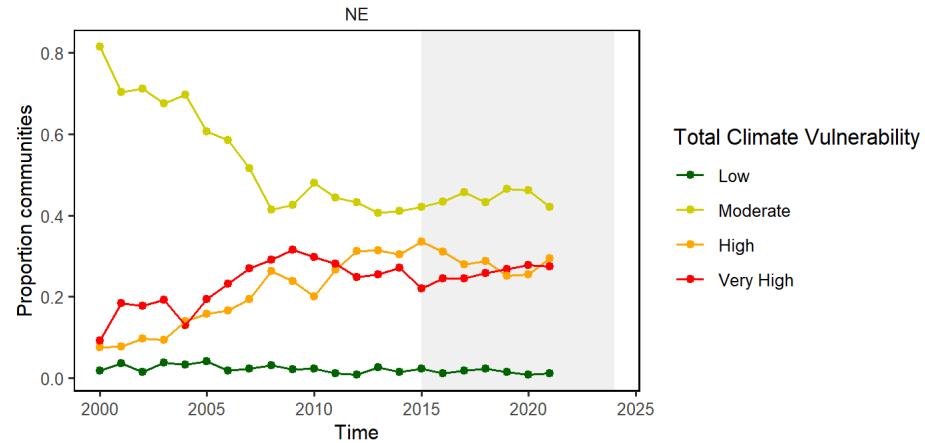


Time	EPU	Town	Eng	Eng_ct	Rel	Rel_ct	Personal	Population	Poverty
							Disruption		
2022	NE	New Bedford, MA	32.873	4	0.702	3	3	4	3
2022	NE	Narragansett/Point Judith, RI	10.842	4	1.476	4	1	1	1
2022	NE	Gloucester, MA	10.126	4	0.570	3	1	1	1
2022	NE	Portland, ME	5.870	4	0.010	2	1	1	1
2022	NE	Boston, MA	5.860	4	-0.109	1	2	4	3
2022	NE	Port Clyde-Tenants Harbor, ME	4.940	4	3.147	4	2	1	2
2022	NE	Harpswell/Bailey Island, ME	4.533	4	1.660	4	1	1	1
2022	NE	Chatham, MA	4.404	4	5.002	4	1	1	1
2022	NE	Stonington, ME	3.773	4	10.002	4	1	1	1
2022	NE	Friendship, ME	3.107	4	4.573	4	1	1	1

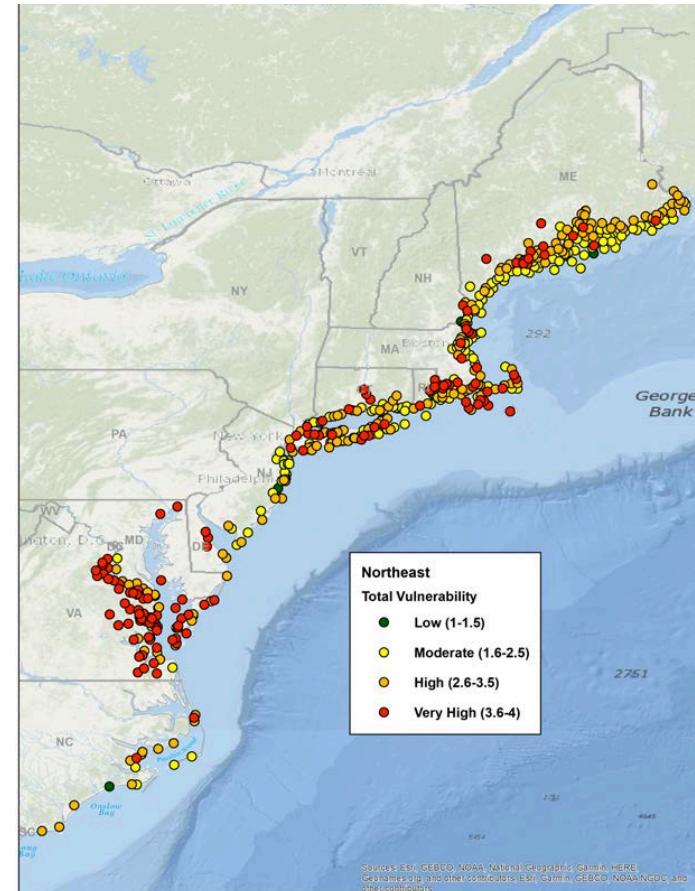
Implications: Highlighted communities may be vulnerable to changes in fishing patterns due to regulations and/or climate change. When also experiencing environmental justice issues, they may have lower ability to successfully respond to change.

New England Social and Climate Vulnerability

Indicators: Commercial fishery revenue climate vulnerability



The **Community Climate Change Risk Indicators** are calculated by multiplying the percent contribution of species to the total value landed in a community by their respective Total Vulnerability scores (based on NOAA's Climate Vulnerability Assessment) for different sensitivity and exposure factors and then summing the resulting values by year.

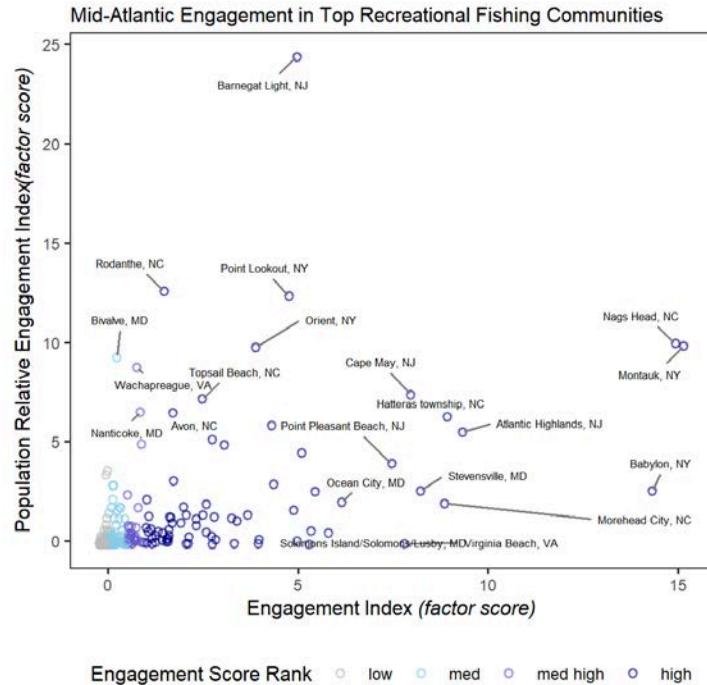


New England communities shifting towards High/Very High climate vulnerability. Consolidating Species

Mid-Atlantic Community Social and Climate Vulnerability

Risk element: Social

Indicators: Recreational fishery engagement, social vulnerability

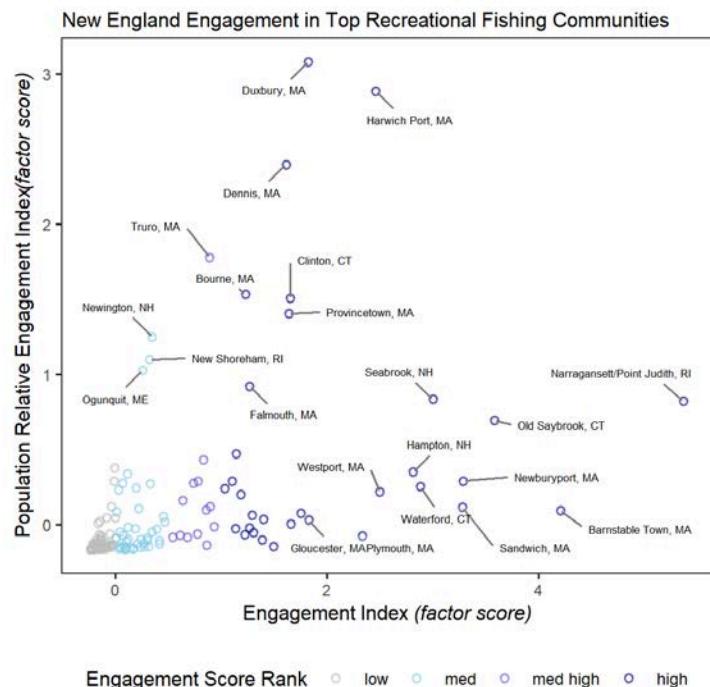


Time	EPU	Town	Eng	Eng_ct	Rel	Rel_ct	Personal Disruption	Population Composition	Poverty
2022	MAB	Montauk, NY	15.146	4	9.803	4	1	1	1
2022	MAB	Nags Head, NC	14.922	4	9.951	4	1	1	1
2022	MAB	Babylon, NY	14.322	4	2.510	4	1	1	1
2022	MAB	Atlantic Highlands, NJ	9.326	4	5.486	4	1	1	1
2022	MAB	Hatteras township, NC	8.928	4	6.265	4	1	1	1
2022	MAB	Morehead City, NC	8.854	4	1.899	4	2	1	2
2022	MAB	Stevensville, MD	8.214	4	2.522	4	2	1	1
2022	MAB	Cape May, NJ	7.961	4	7.369	4	1	2	1
2022	MAB	Virginia Beach, VA	7.792	4	-0.120	1	1	1	1
2022	MAB	Point Pleasant Beach, NJ	7.457	4	3.896	4	2	1	1

New England Community Social and Climate Vulnerability

Risk element: Social

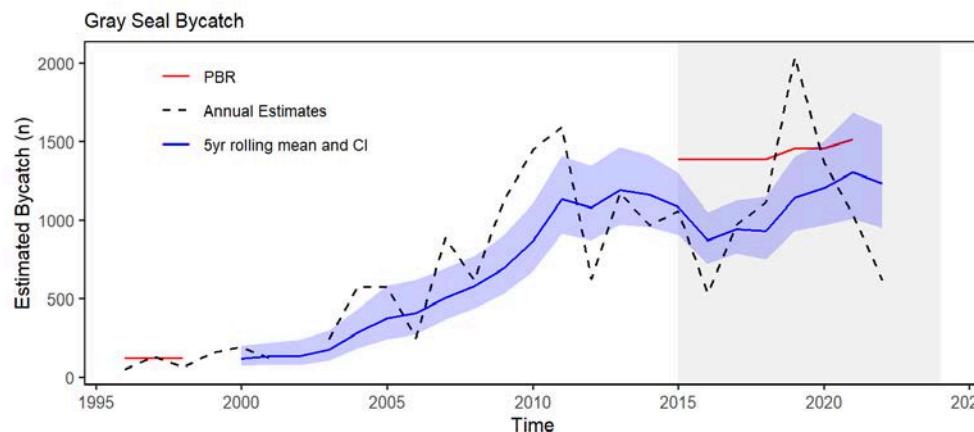
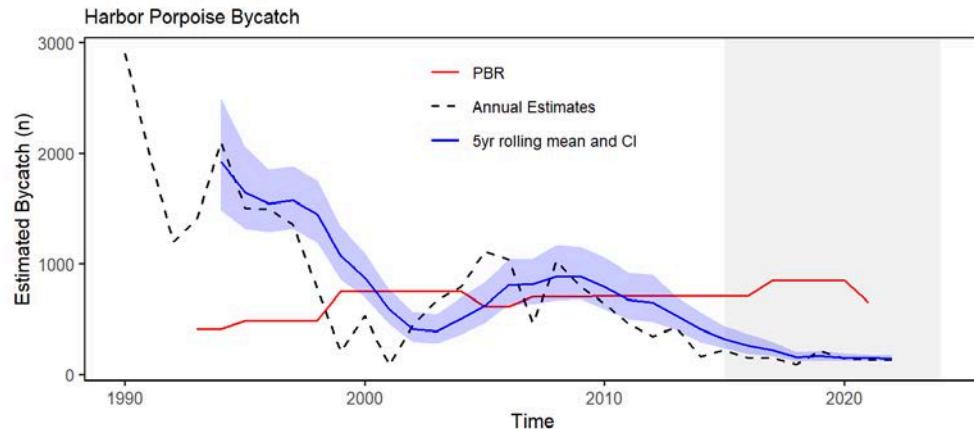
Indicators: Recreational fishery engagement, social vulnerability



Time	EPU	Town	Eng	Eng_ct	Rel	Rel_ct	Personal Disruption	Population Composition	Poverty
2022	NE	Narragansett/Point Judith, RI	5.365	4	0.822	3	1	1	1
2022	NE	Barnstable Town, MA	4.204	4	0.094	2	1	2	1
2022	NE	Old Saybrook, CT	3.581	4	0.696	3	1	1	1
2022	NE	Newburyport, MA	3.284	4	0.292	2	1	1	1
2022	NE	Sandwich, MA	3.280	4	0.116	2	1	1	1
2022	NE	Seabrook, NH	3.000	4	0.835	3	2	1	1
2022	NE	Waterford, CT	2.884	4	0.253	2	1	1	1
2022	NE	Hampton, NH	2.815	4	0.350	2	1	1	1
2022	NE	Westport, MA	2.499	4	0.221	2	1	1	1
2022	NE	Harwich Port, MA	2.460	4	2.883	4	1	1	1

Objectives: Coastwide Protected species *Maintain bycatch below thresholds* ✘ ✓

Indicators: Harbor porpoise and gray seal bycatch

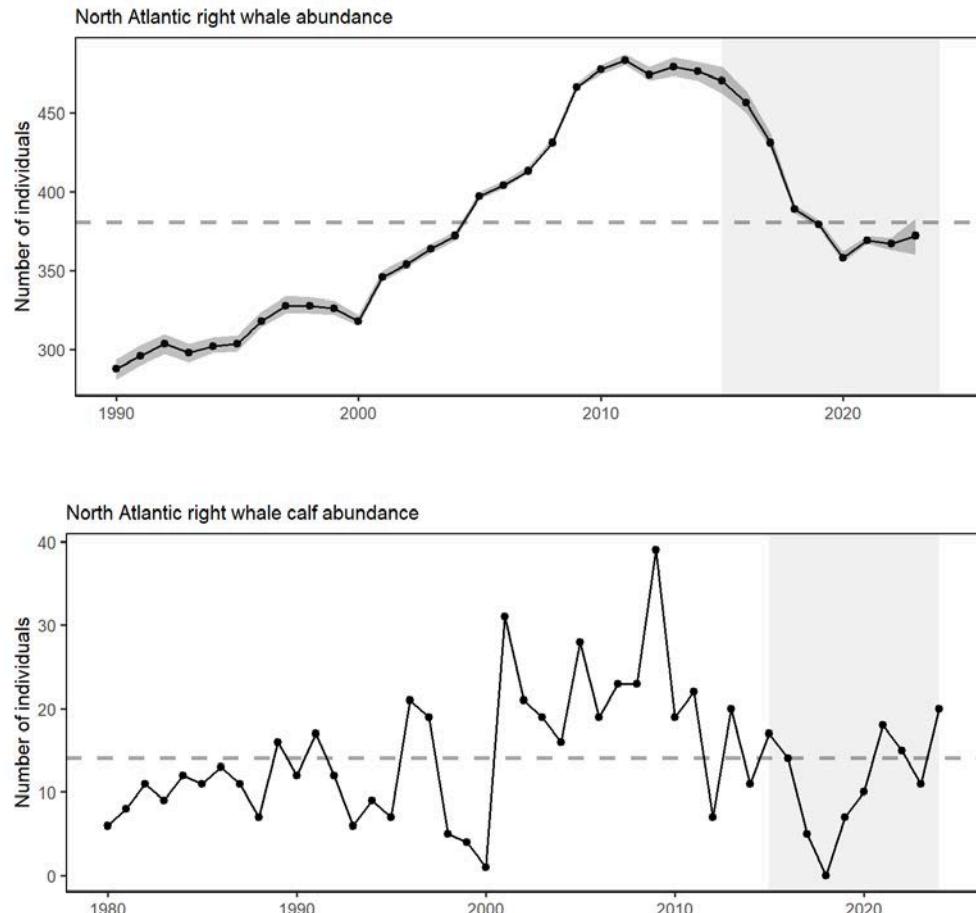


Implications:

- Currently meeting objectives, but uncertainty in gray seal estimates
- Risk element: TechInteract, evaluated by species and sector: 14 low, 7 low-mod, 2 mod-high risk
- The downward trend in harbor porpoise bycatch can also be due to a decrease in harbor porpoise abundance in US waters, reducing their overlap with fisheries, and a decrease in gillnet effort.
- Gray seal among the highest bycatch of any U.S. marine mammal. The increasing trend in gray seal bycatch may be related to an increase in the gray seal population (U.S. pup counts).

Objectives: Coastwide Protected species *Recover endangered populations* ⏪ -

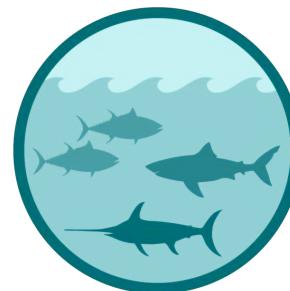
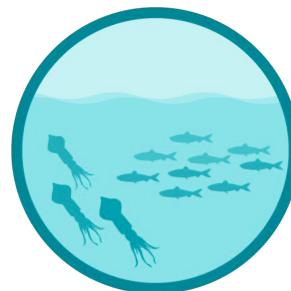
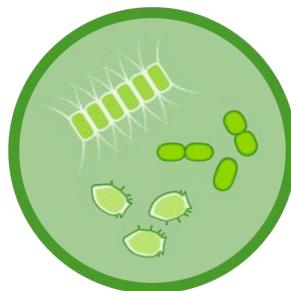
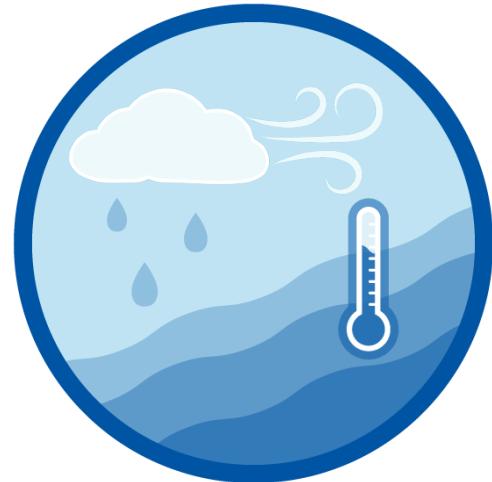
Indicators: North Atlantic right whale population, calf counts



Implications:

- Signs the adult population stabilized 2020-2023
- Population drivers for North Atlantic Right Whales (NARW) include combined fishery interactions/ship strikes, distribution shifts, and copepod availability.
- Additional potential stressors include offshore wind development, which overlaps with important habitat areas used year-round by right whales, including mother and calf migration corridors and foraging habitat.
- Unusual mortality events continue for 3 large whale species.

2025 Risks to meeting fishery management objectives



Revised Risks: Climate and Ecosystem Change

Risks to meeting fishery management objectives in the Mid-Atlantic Bight

Risk categories	Observation indicators reported	Potential driver indicators reported
Climate and Ecosystem Risks		
Risks to Managing Spatially	Managed species (fish and cetacean) distribution shifts	Benthic and pelagic forage distribution; ocean temperature, changes in currents and cold pool
Risks to Managing Seasonally	Managed species spawning and migration timing changes	Habitat timing: Length of ocean summer, cold pool seasonal persistence
Risks to Setting Catch Limits	Managed species body condition and recruitment changes	Benthic and pelagic forage quality & abundance: ocean temperature & acidification
Other Ocean Uses Risks		
Offshore Wind Risks	Fishery revenue and landings from wind lease areas by species and port	Wind development speed; Protected species presence and hotspots

Risks to Managing Spatially

Potential Impacts: Spatial misallocation of quotas within and across jurisdictions, leading to unmet quotas and/or increased discards. Specification of gear management areas may not utilize quotas and minimize bycatch.

Risks to Managing Seasonally

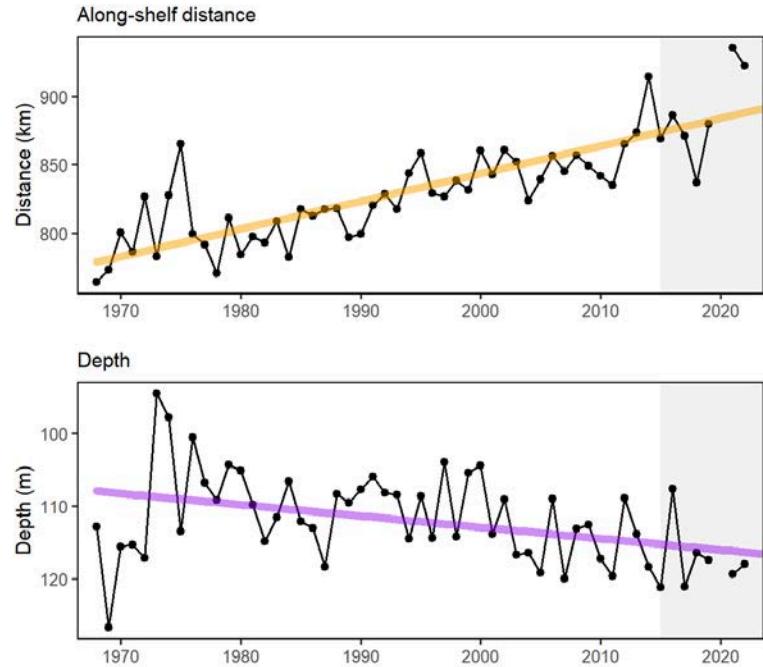
Potential Impacts: Spawning closures are less effective if peak spawning occurs outside the seasonal closure. Seasonal openings of exemption areas may be inconsistent with species presence. Seasonal quota allocations may be misaligned with availability.

Risks to Setting Catch Limits

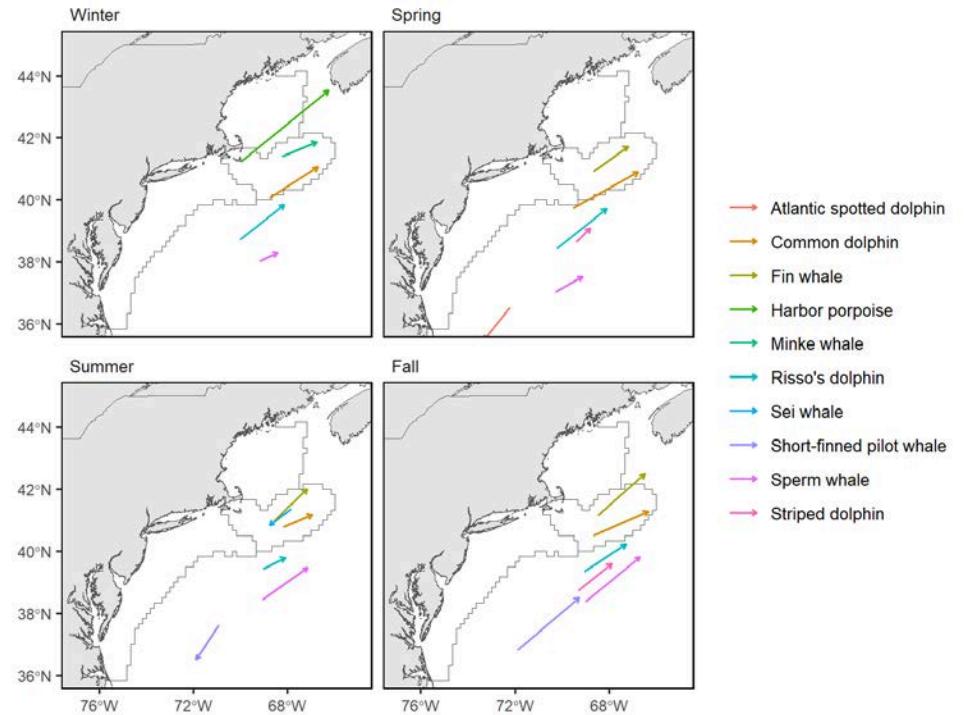
Potential Impacts: Changes in environmental conditions can affect stock reference points and short-term stock projections. When productivity changes are not accounted for, they can lead to misspecified quotas and rebuilding plans.

Risks to Managing Spatially: Coastwide

Indicators: Fish distribution shifts

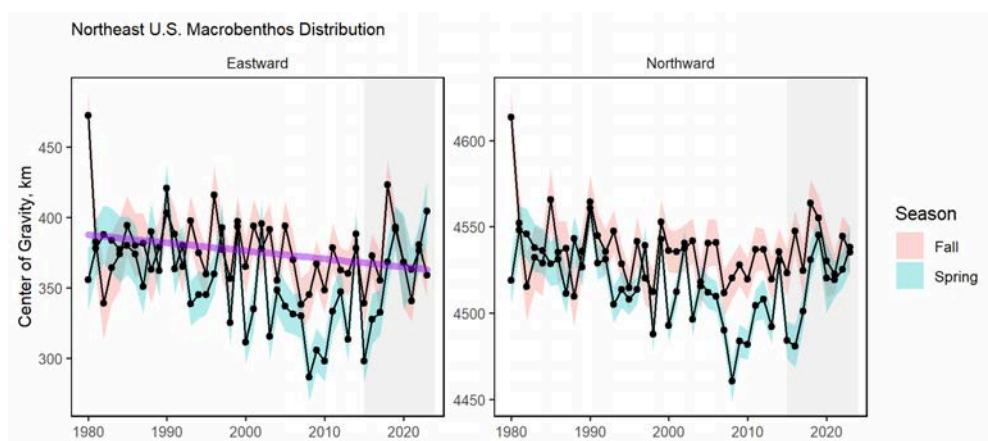
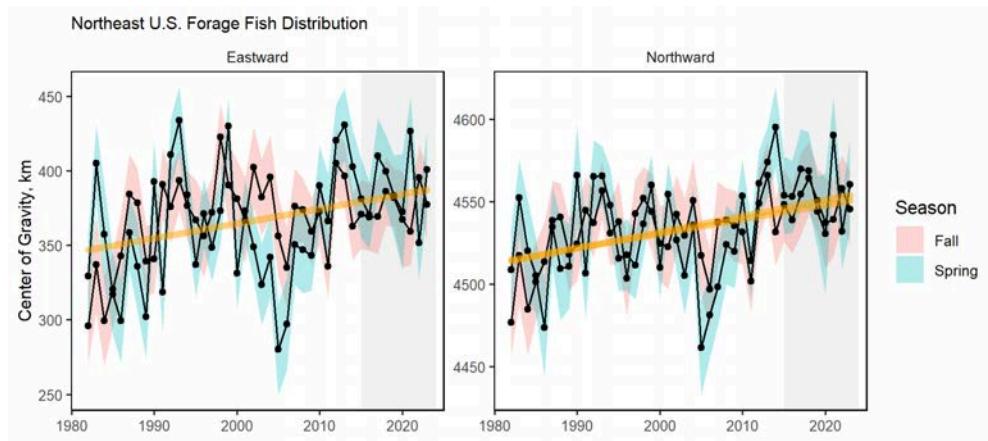


Cetacean distribution shifts

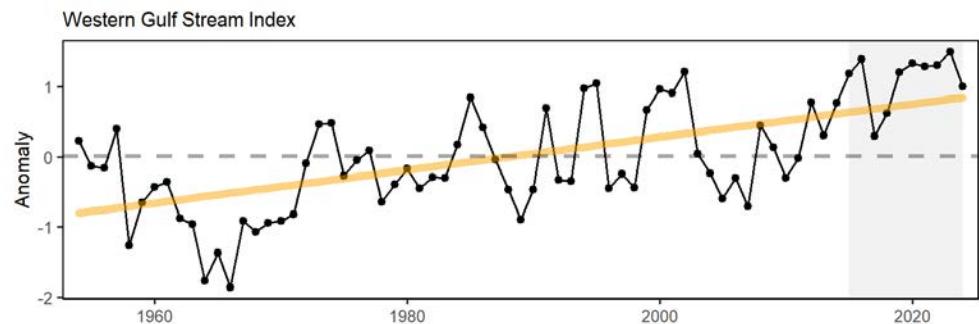
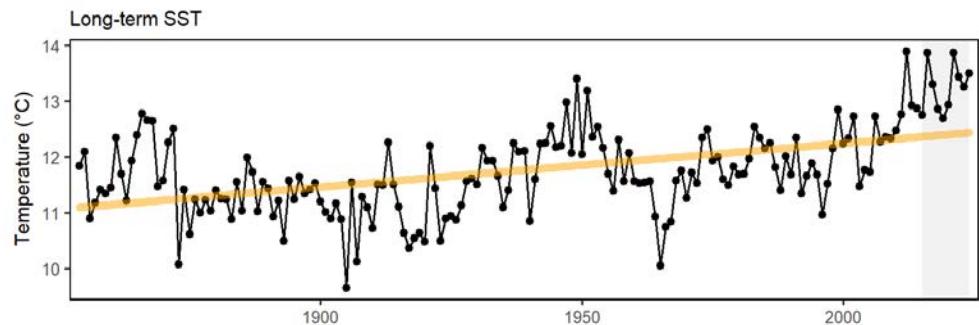


Risks to Managing Spatially: Coastwide

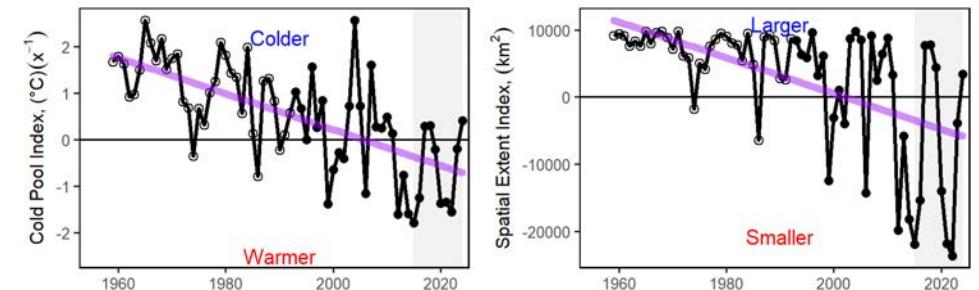
Drivers: Forage shifts, pelagic and benthic



Drivers: changing ocean habitat

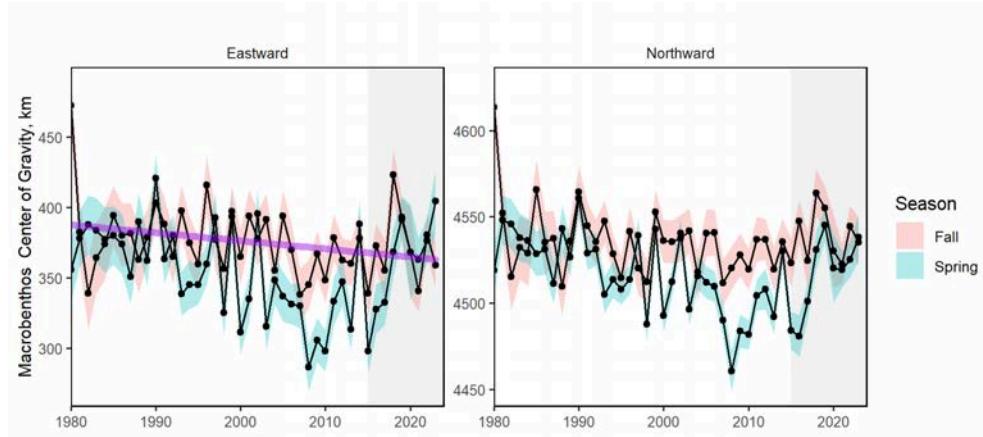


Cold pool temperature and spatial extent

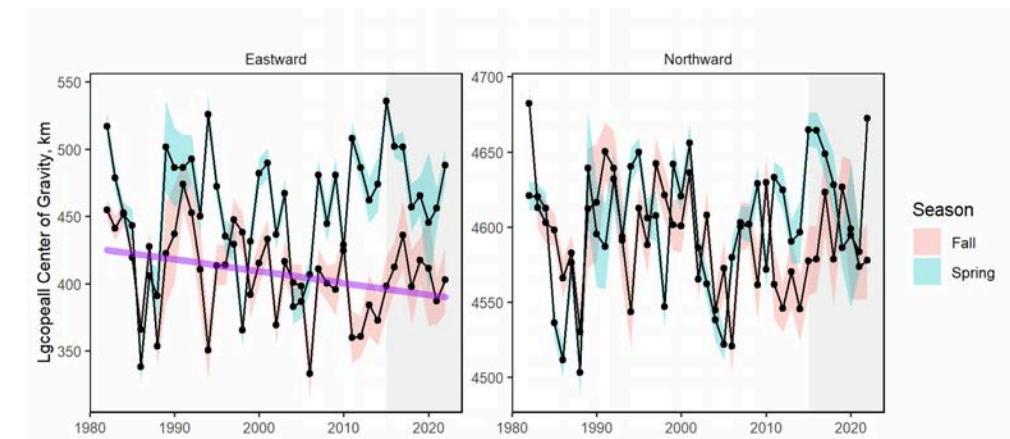
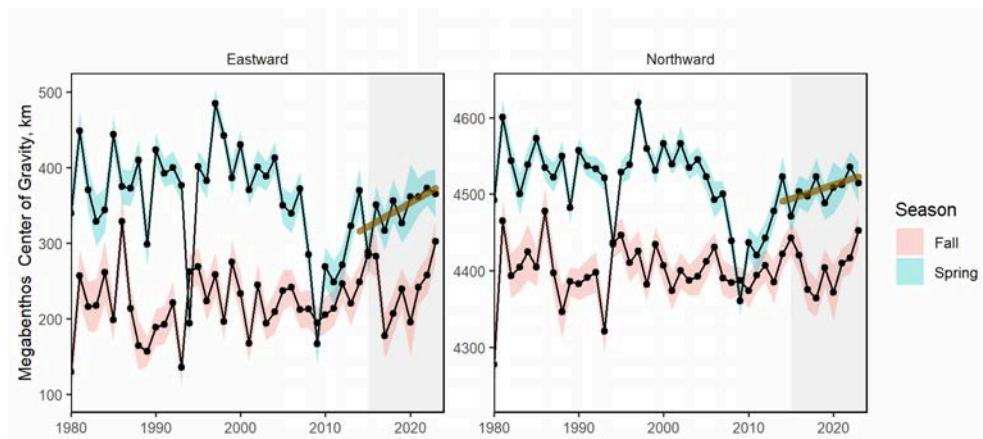
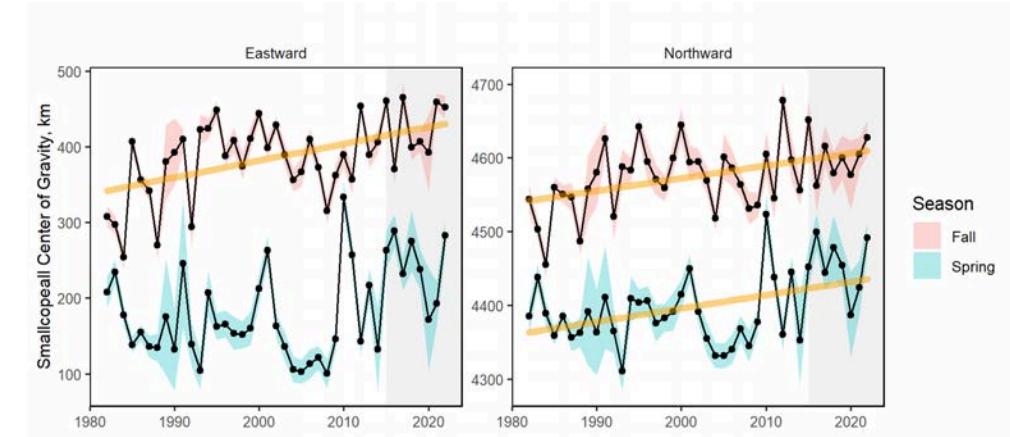


New Spatial Shift Indicators: Benthos, Zooplankton

Benthos center of gravity from fish stomachs



Copepods center of gravity from ECOMON



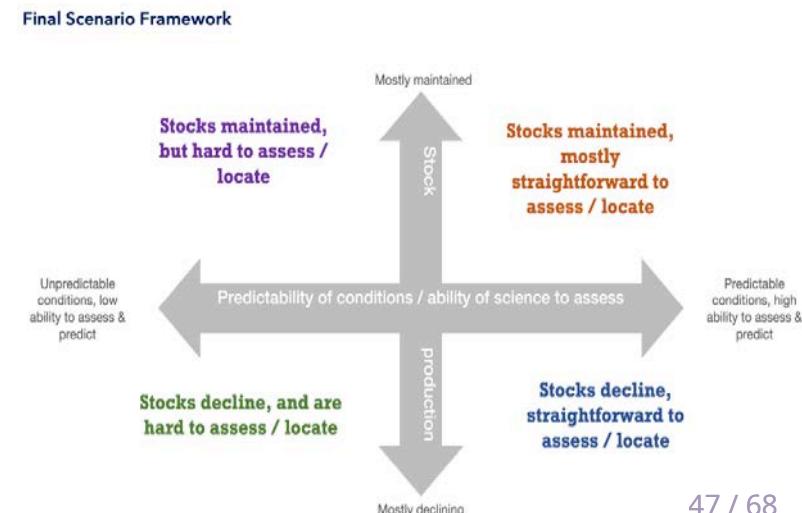
Risks to Managing Spatially: Coastwide

Future considerations

Distribution shifts caused by changes in thermal habitat and ocean circulation are likely to continue as long as long-term trends persist. Episodic and short-term events (see [2024 Highlights](#)) may increase variability in the trends, however species distributions are unlikely to reverse to historical ranges in the short term. Increased mechanistic understanding of distribution drivers is needed to better understand future distribution shifts: species with high mobility or short lifespans react differently from immobile or long lived species.

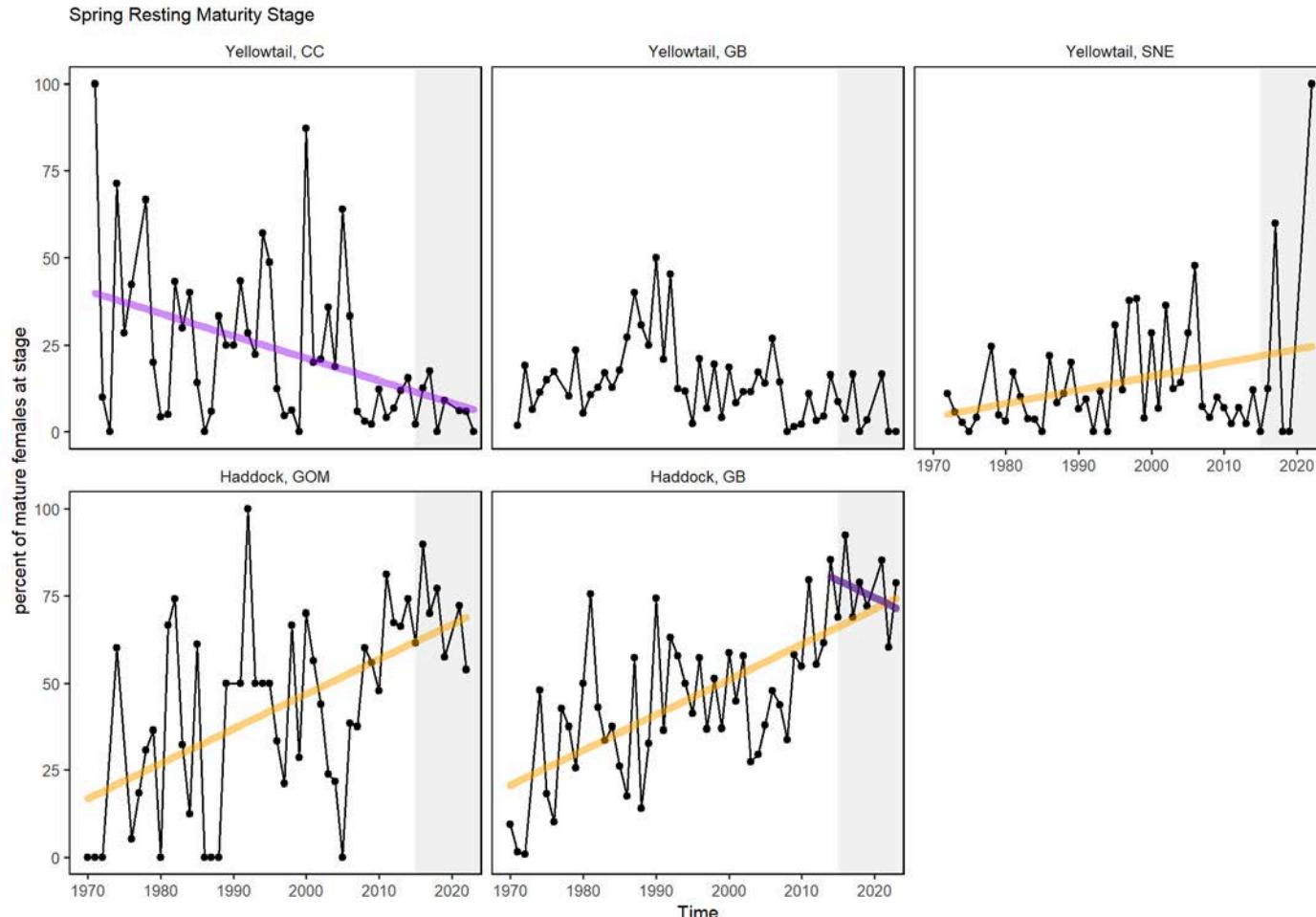
Long-term oceanographic projections forecast a [temporary pause in warming](#) over the next decade due to internal variability in circulation and a southward shift of the Gulf Stream. Near-term forecasts are being evaluated to determine how well they are able to predict episodic and anomalous events that are outside of the long-term patterns.

Adapting management to changing stock distributions and dynamic ocean processes will require continued monitoring of populations in space and evaluating management measures against a range of possible future spatial distributions. Processes like the [East Coast Climate Scenario Planning](#), and subsequent formation of the [East Coast Climate Coordination Group](#), can help coordinate management.



Risks to Managing Seasonally: Coastwide

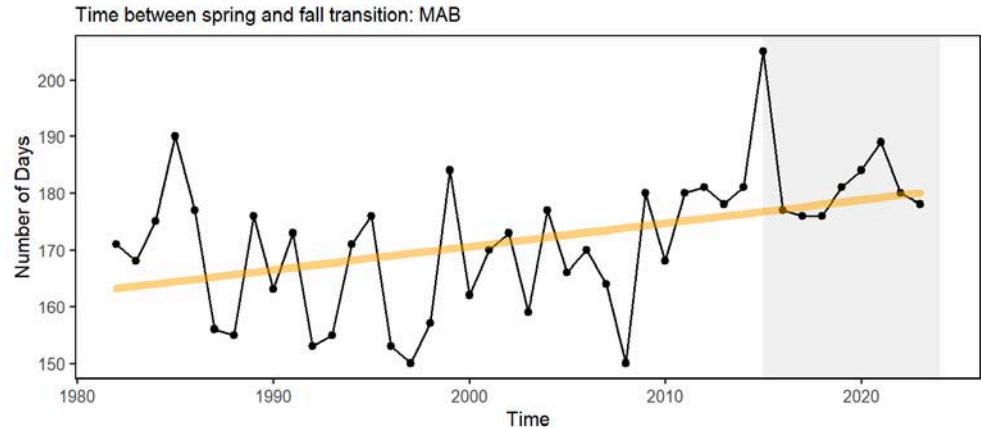
Indicators: spawning timing, migration change



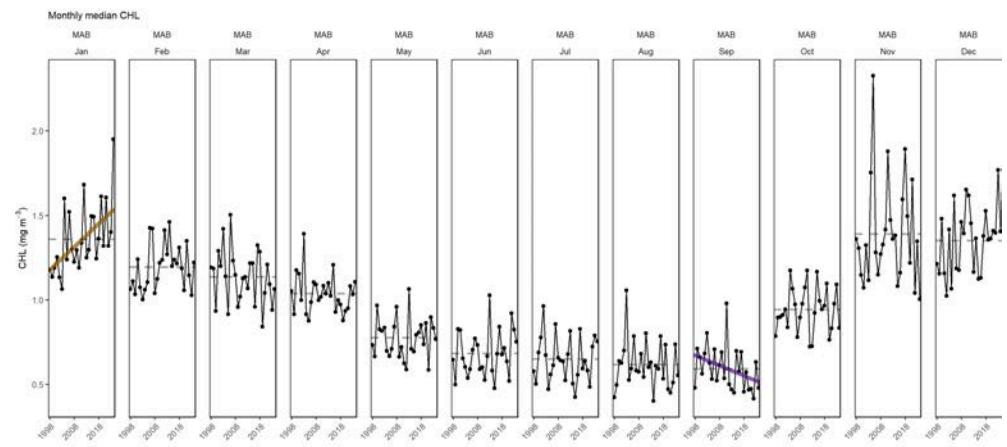
- Recreational tuna fisheries 50 days earlier in the year in 2019 compared to 2002.
- In Cape Cod Bay, peak spring habitat use by right and humpback whales has shifted 18-19 days later over time.
- Baseline information on large whale seasonal presence has been collected.

Risks to Managing Seasonally: Mid-Atlantic

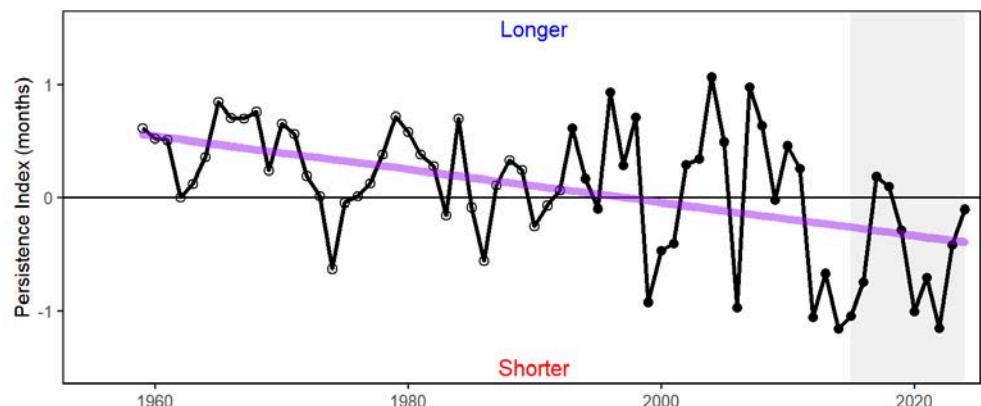
Drivers: thermal transition, habitat persistence, bloom timing



Bloom timing

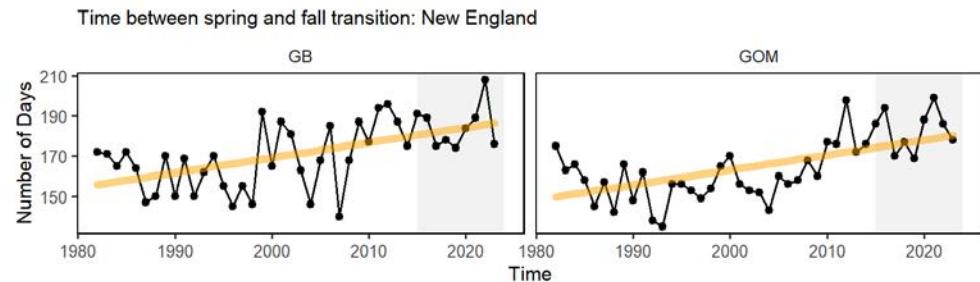


Cold pool seasonal persistence



Risks to Managing Seasonally: New England

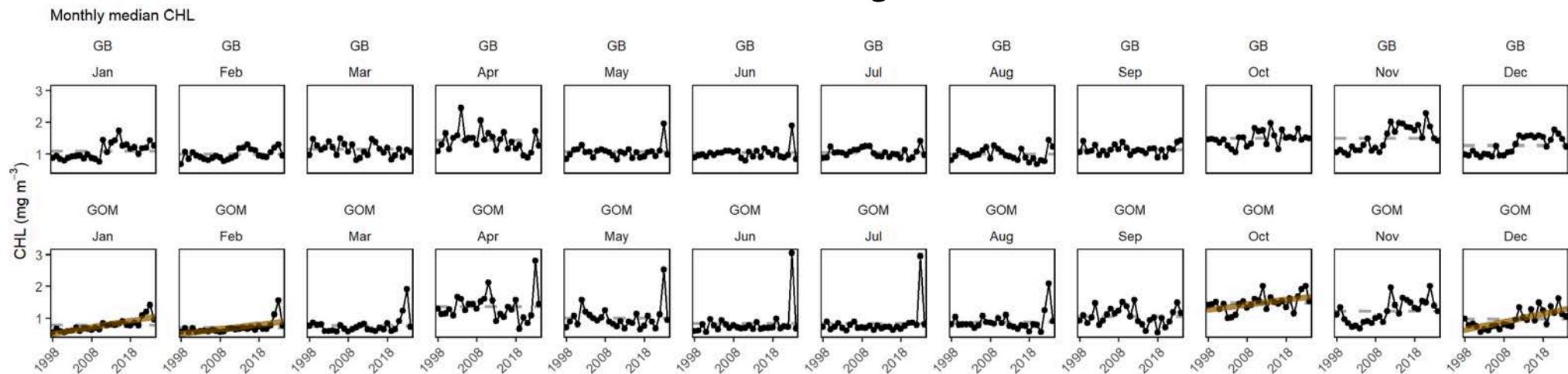
Drivers: thermal transition, habitat persistence, bloom timing



Future considerations

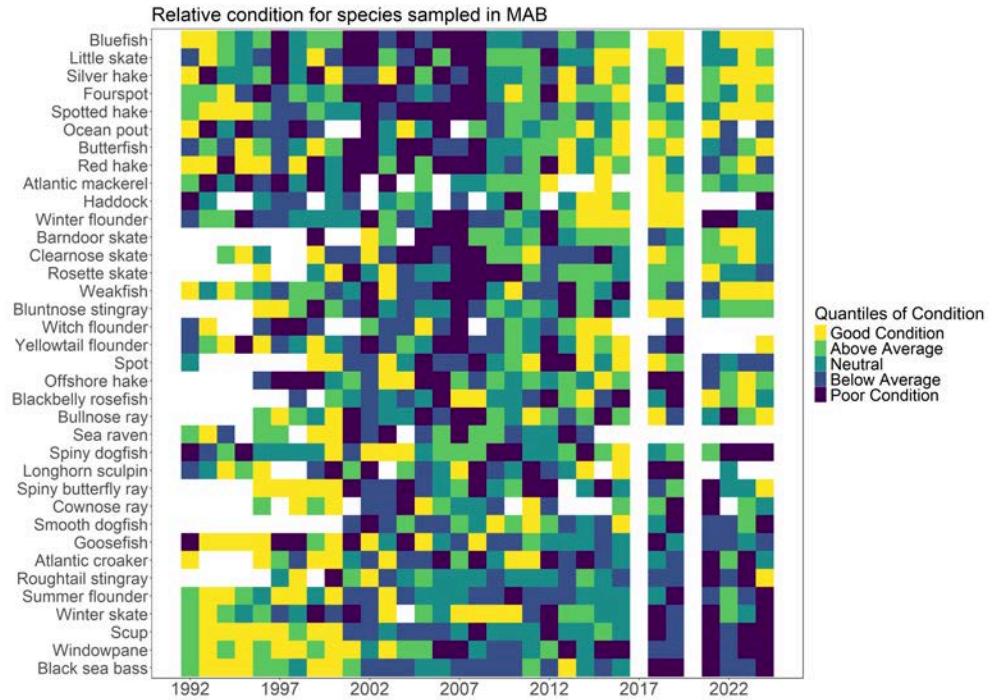
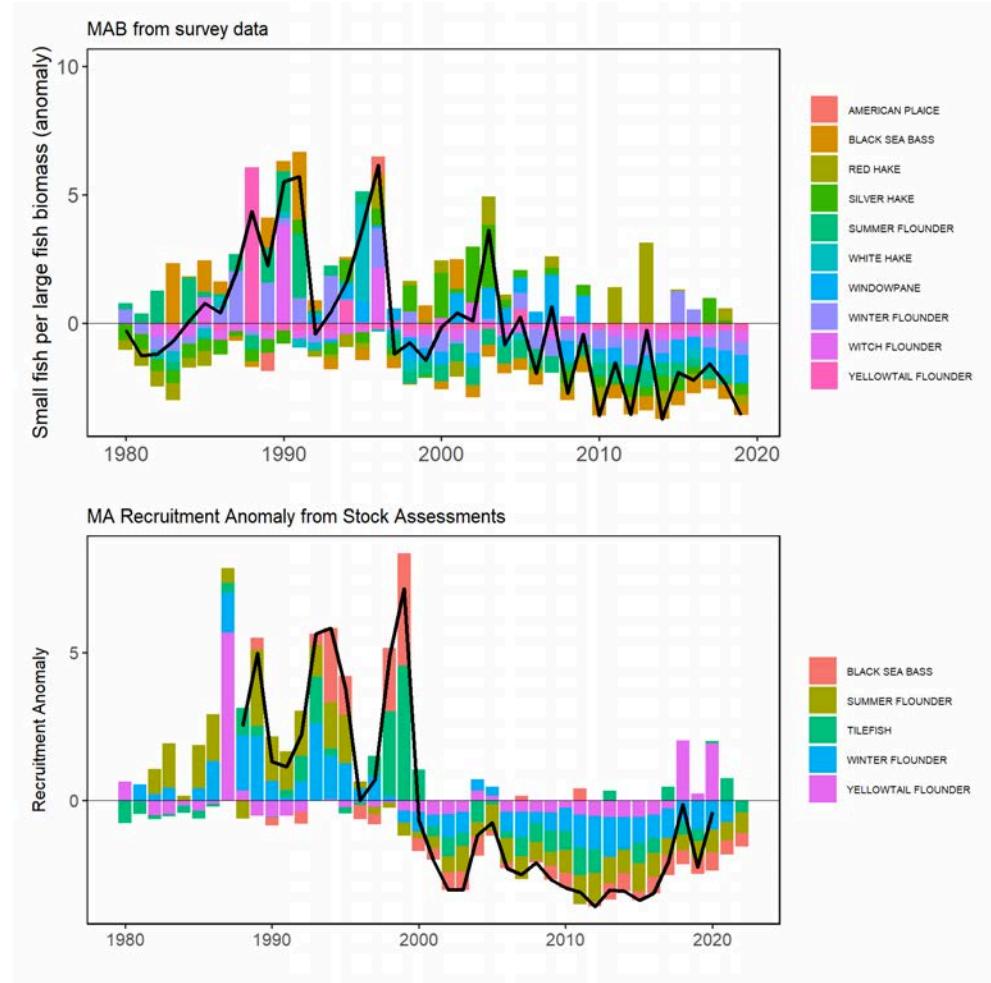
- Management actions that rely on effective alignment of fisheries availability and biological processes should continue to evaluate whether prior assumptions on seasonal timings still hold.
- New indicators should be developed to monitor timing shifts for stocks.

Bloom Timing



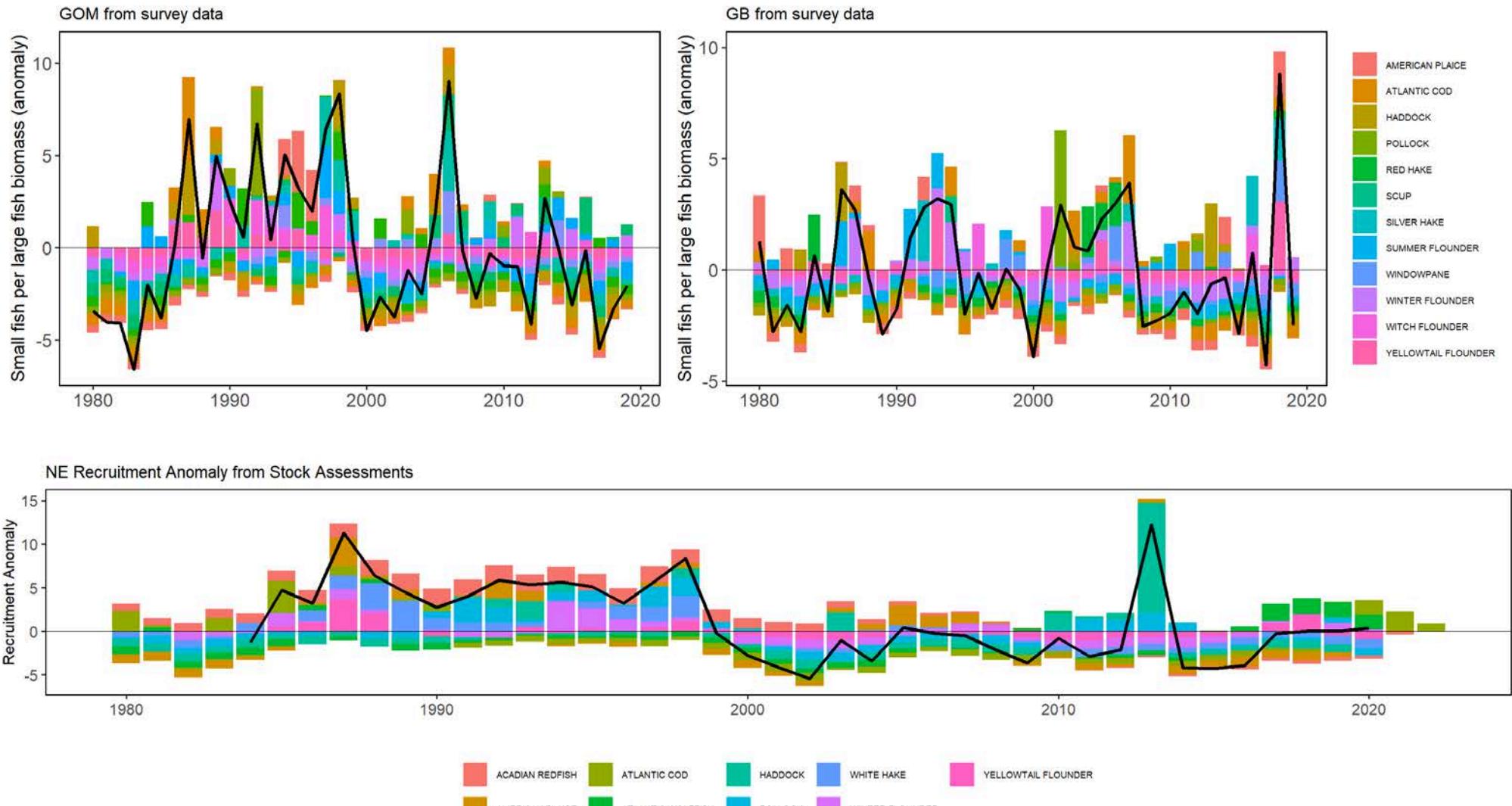
Risks to Setting Catch Limits: Mid-Atlantic

Indicators: fish productivity and condition



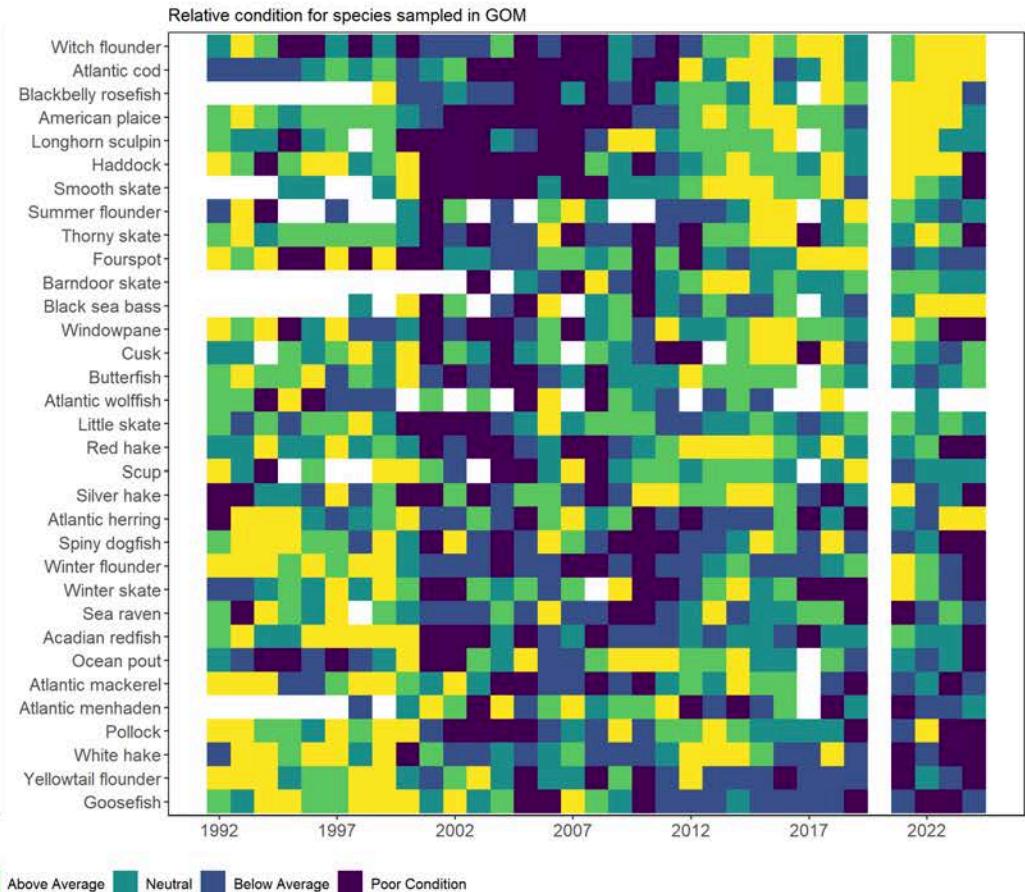
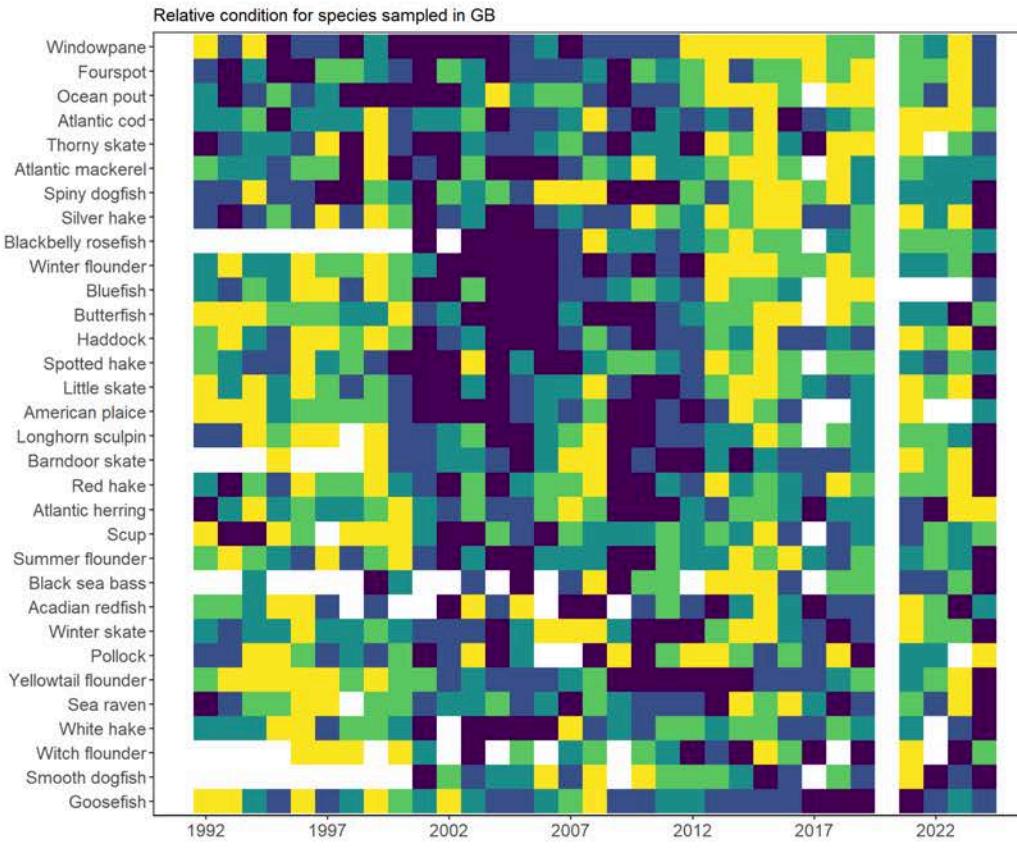
Risks to Setting Catch Limits: New England

Indicator: Fish productivity



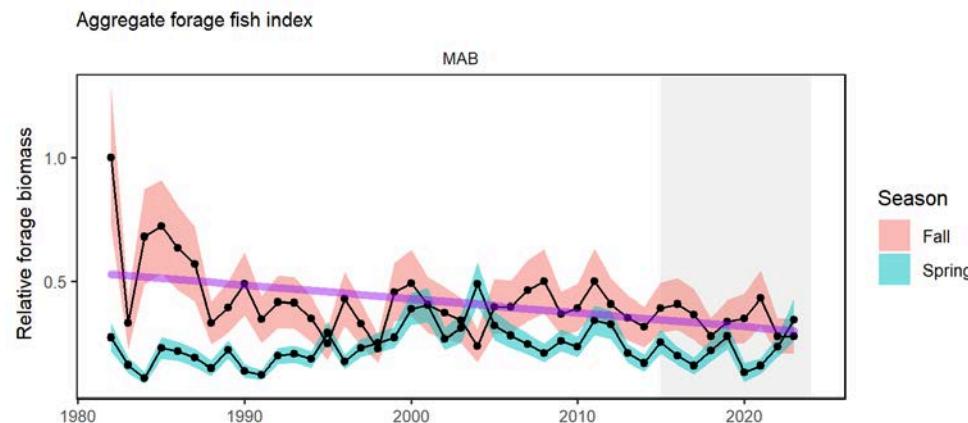
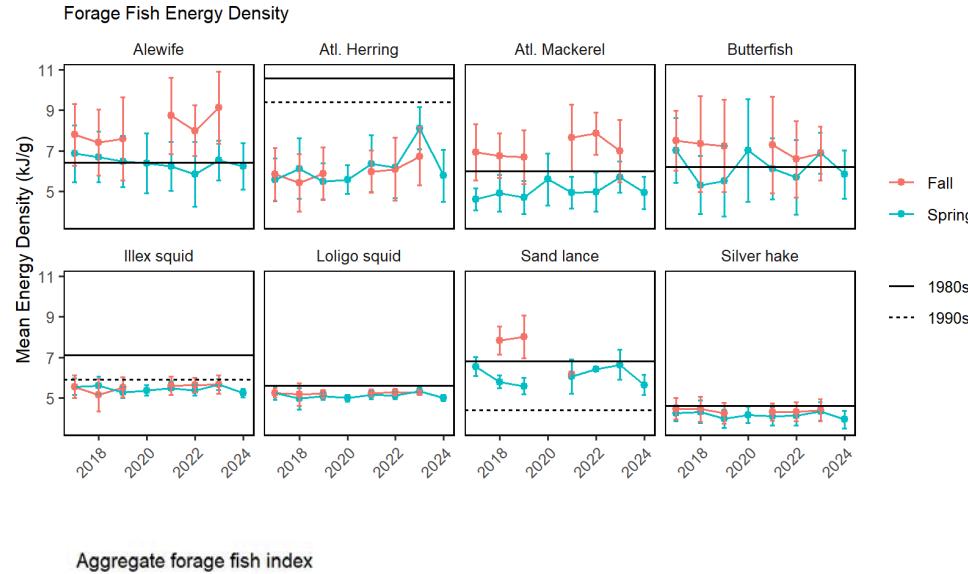
Risks to Setting Catch Limits: New England

Indicator: Condition

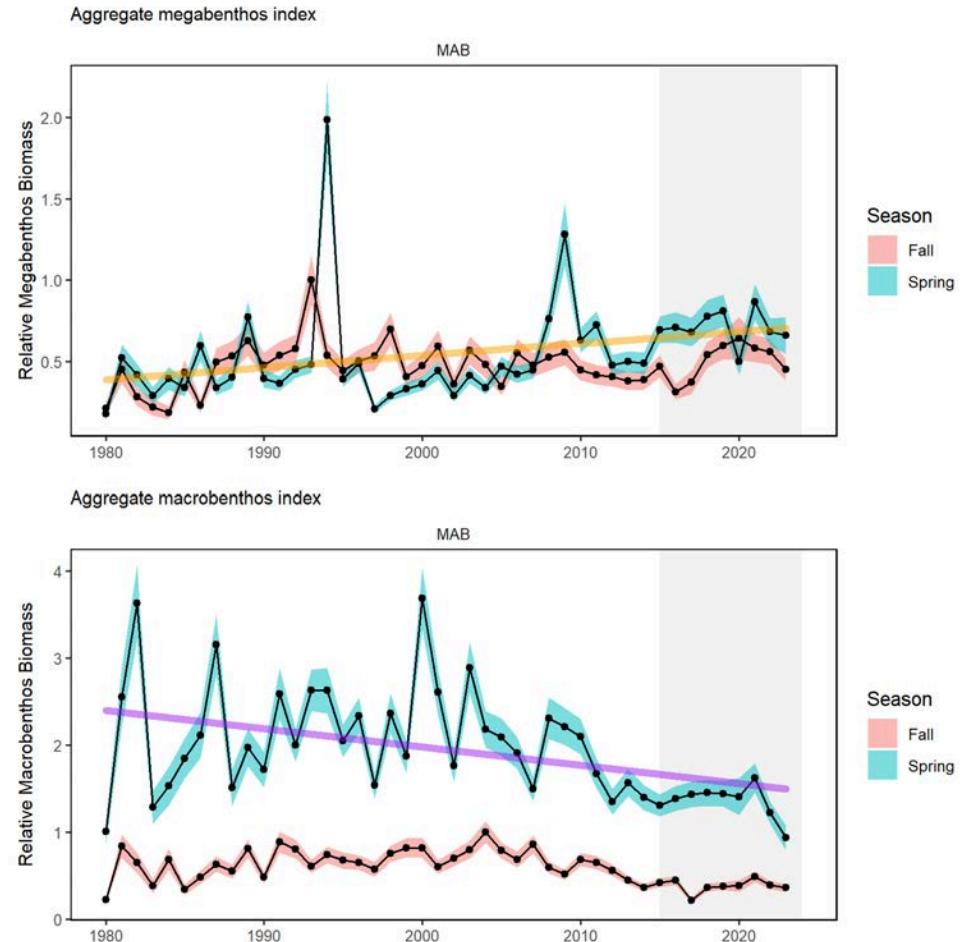


Risks to Setting Catch Limits: Mid Atlantic Drivers

Drivers: Forage Quality and Abundance

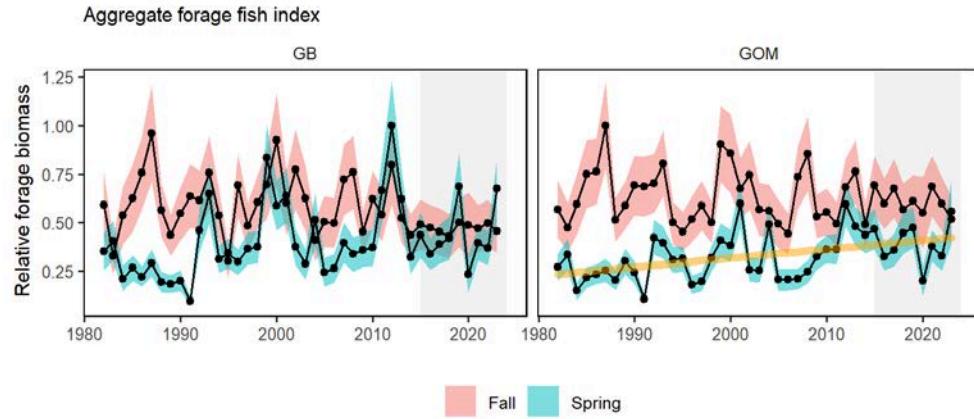


New indicators: benthos abundance

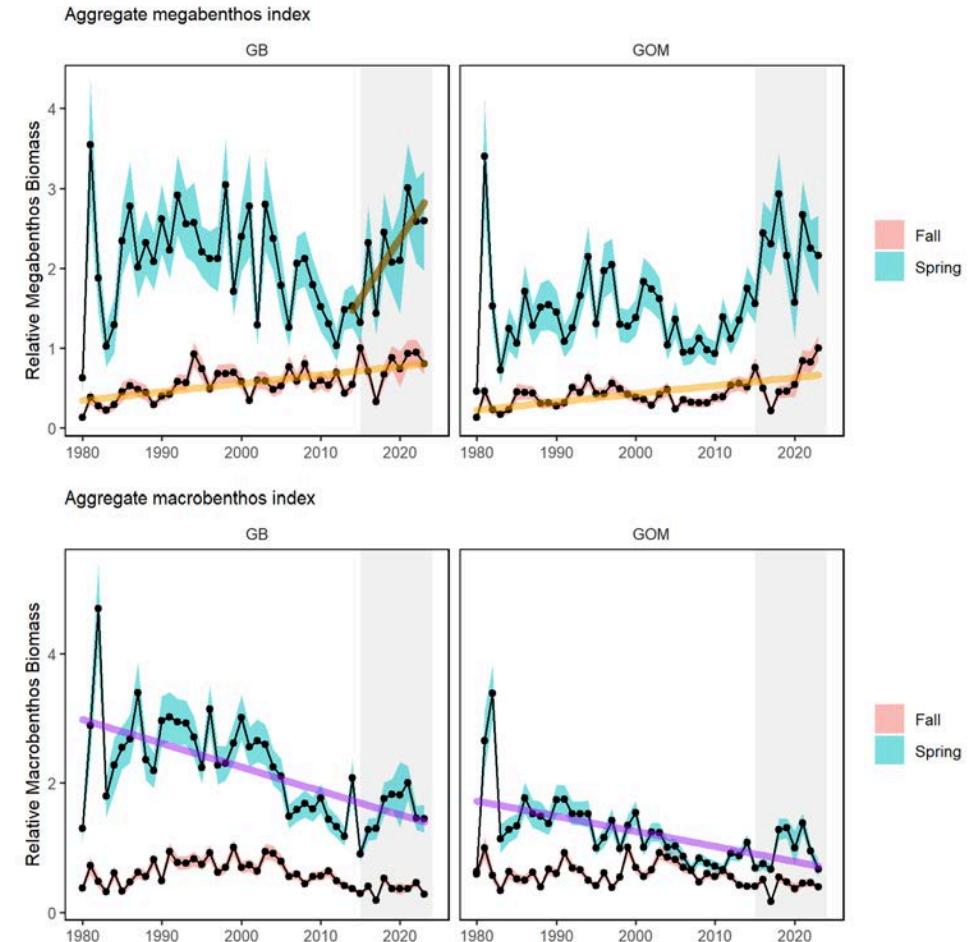


Risks to Setting Catch Limits: New England Drivers

Drivers: Forage Quality and Abundance

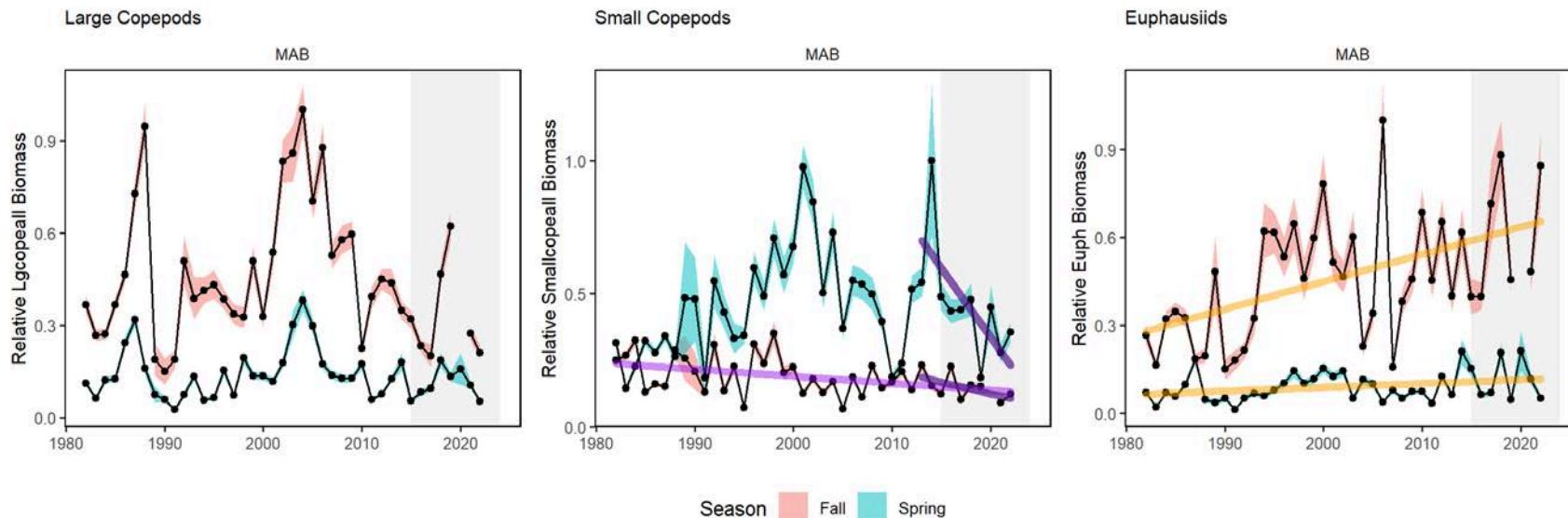
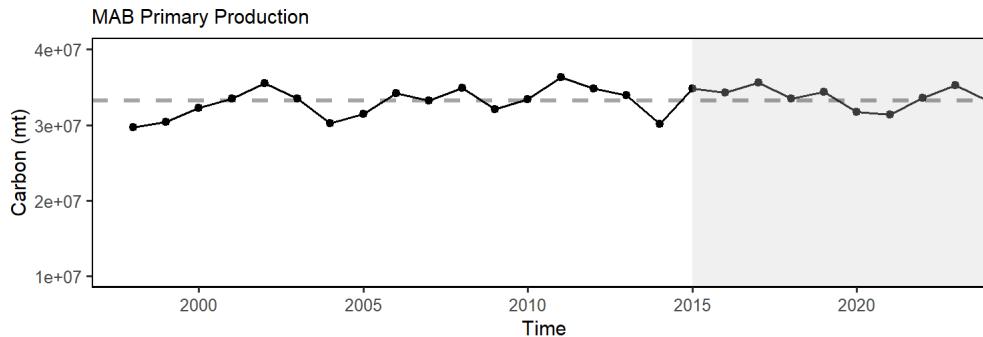


New indicators: benthos abundance



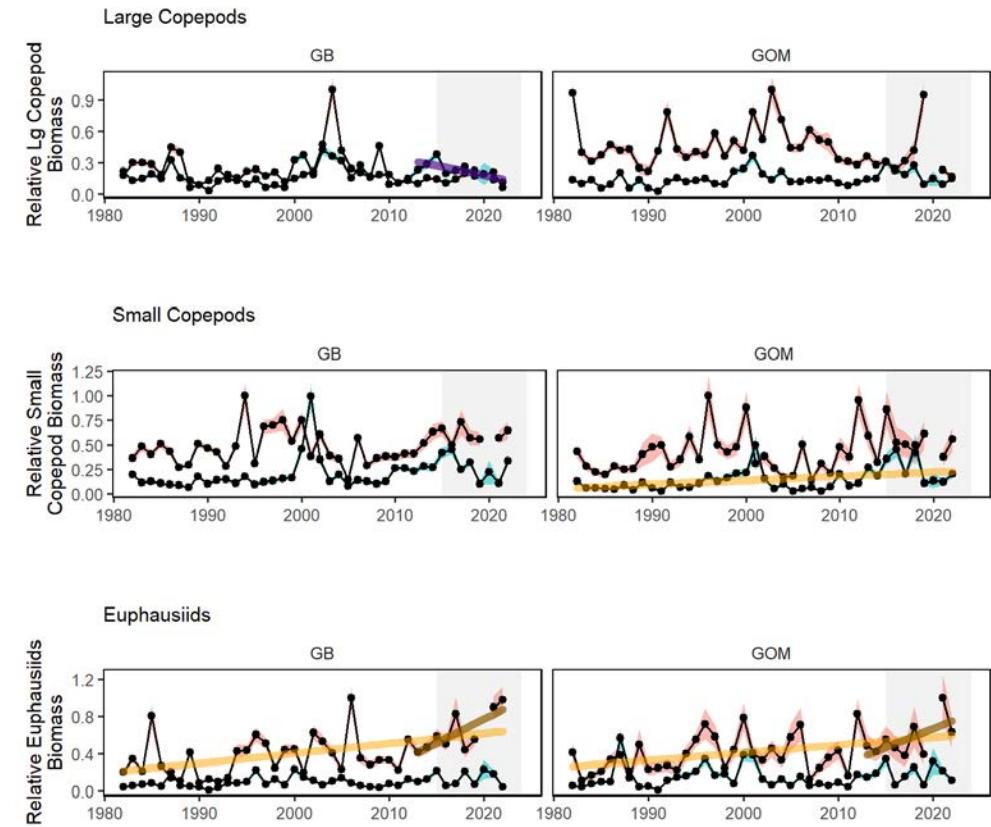
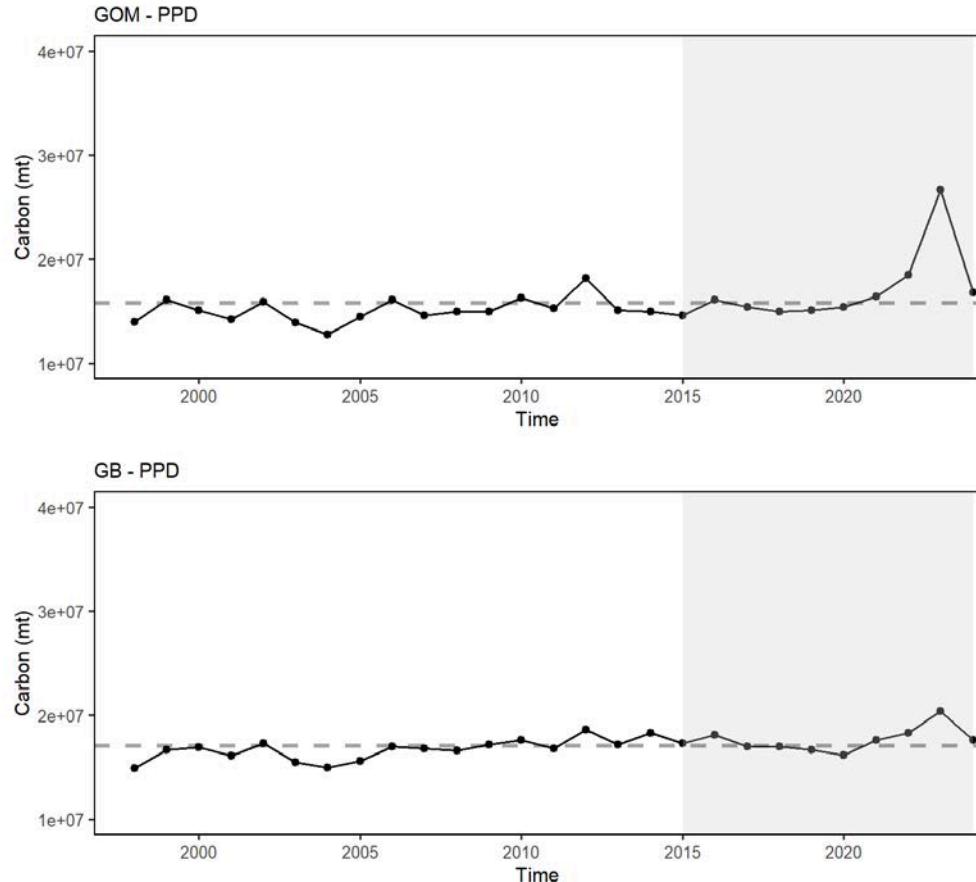
Risks to Setting Catch Limits: Mid Atlantic Drivers

Drivers: Low trophic levels



Risks to Setting Catch Limits: New England Drivers

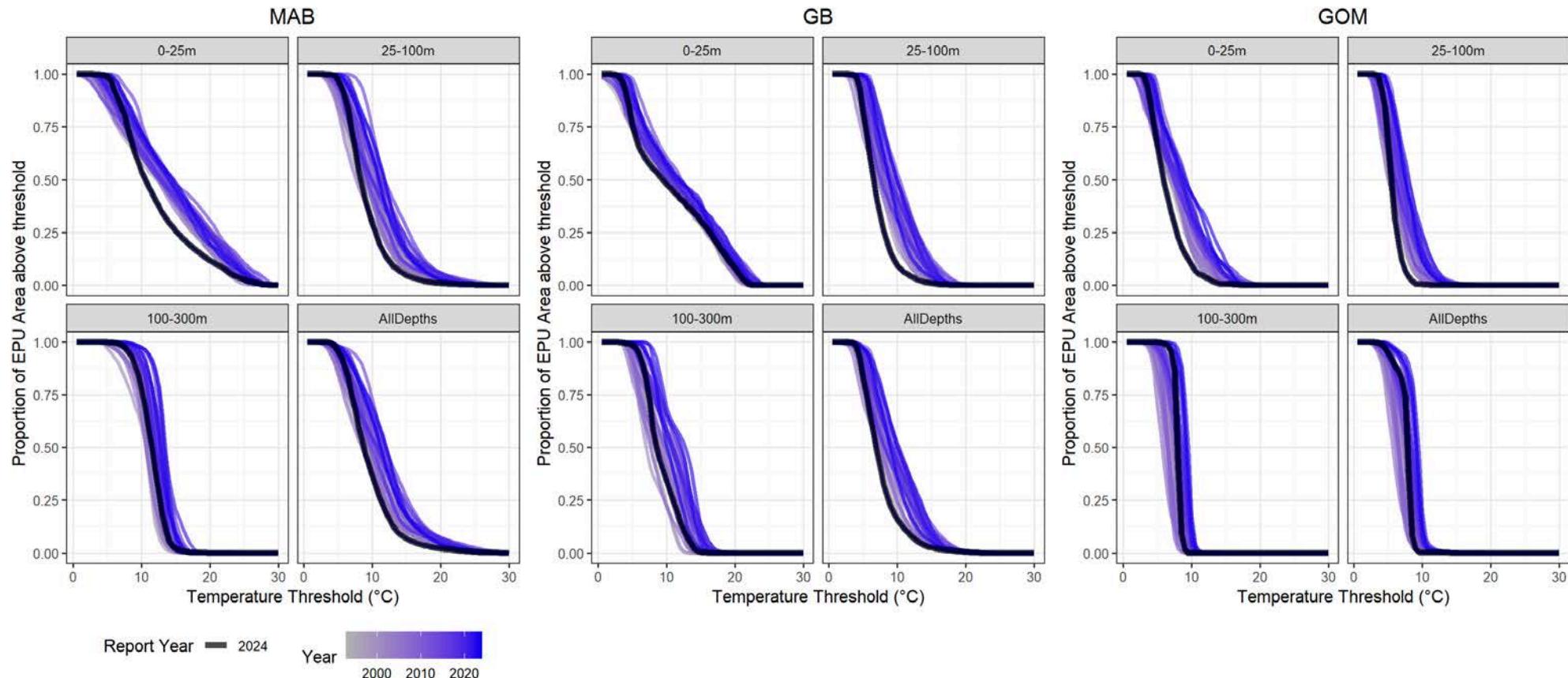
Drivers: Low trophic levels



Risks to Setting Catch Limits: Coastwide

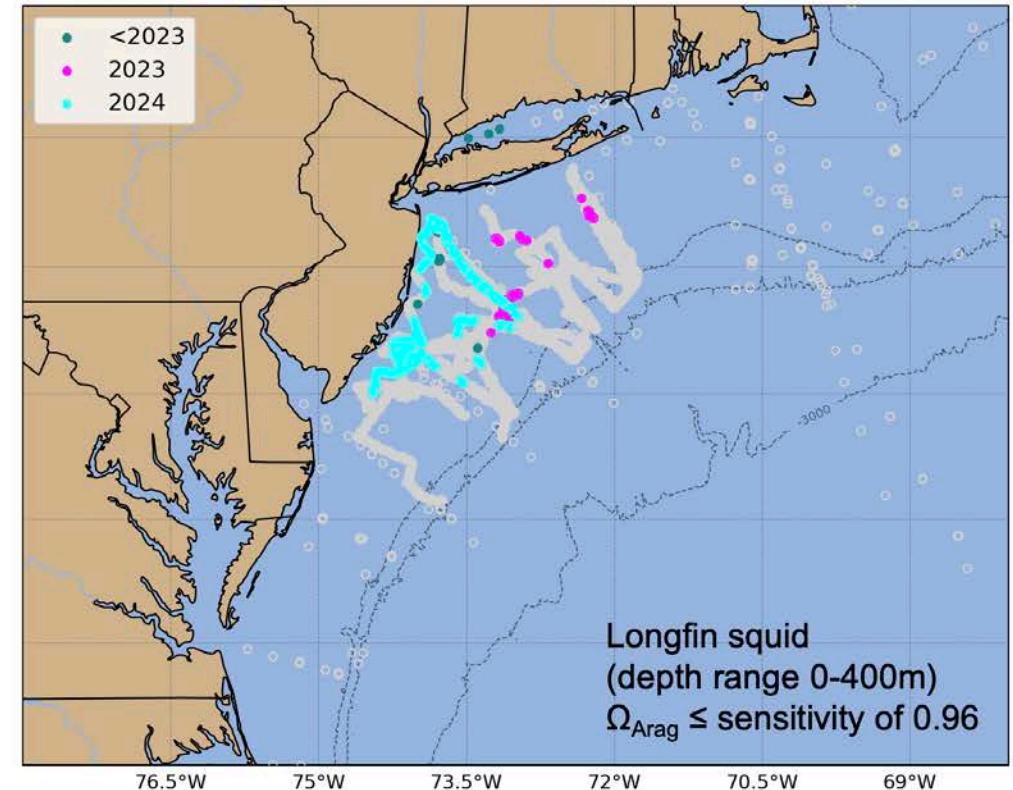
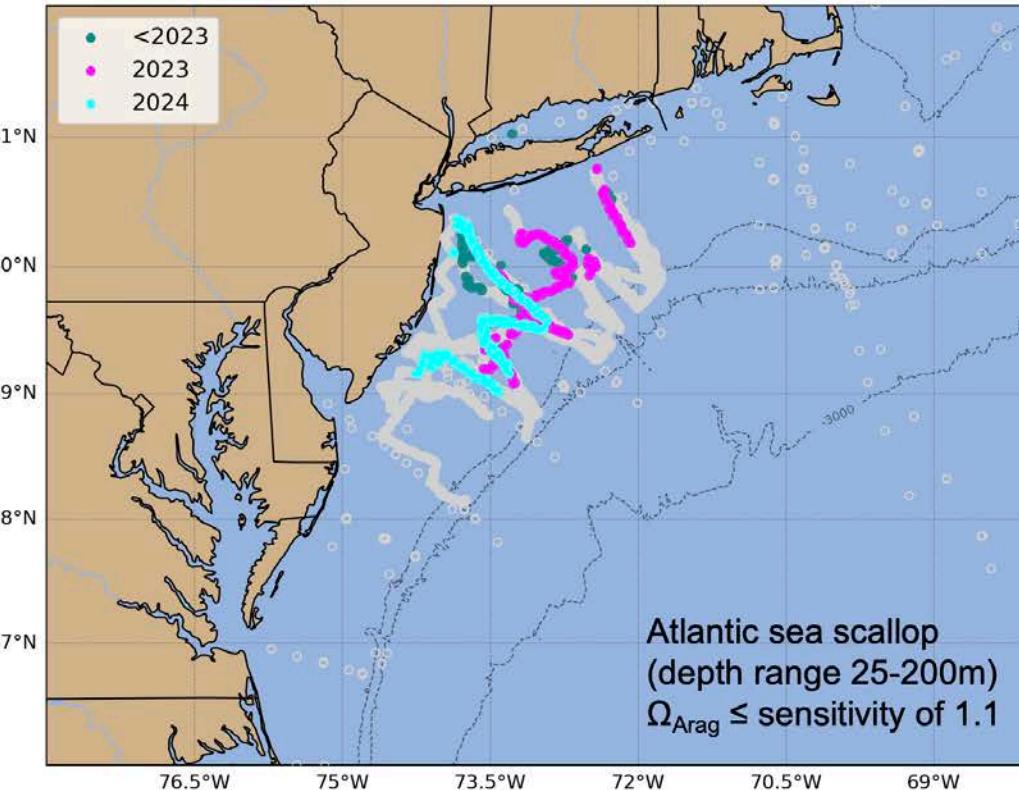
Drivers: Environmental

2024 Thermal habitat area by depth



Risks to Setting Catch Limits: Coastwide

Drivers: Environmental *Potential Ocean Acidification Impacts: Scallops and Longfin squid*



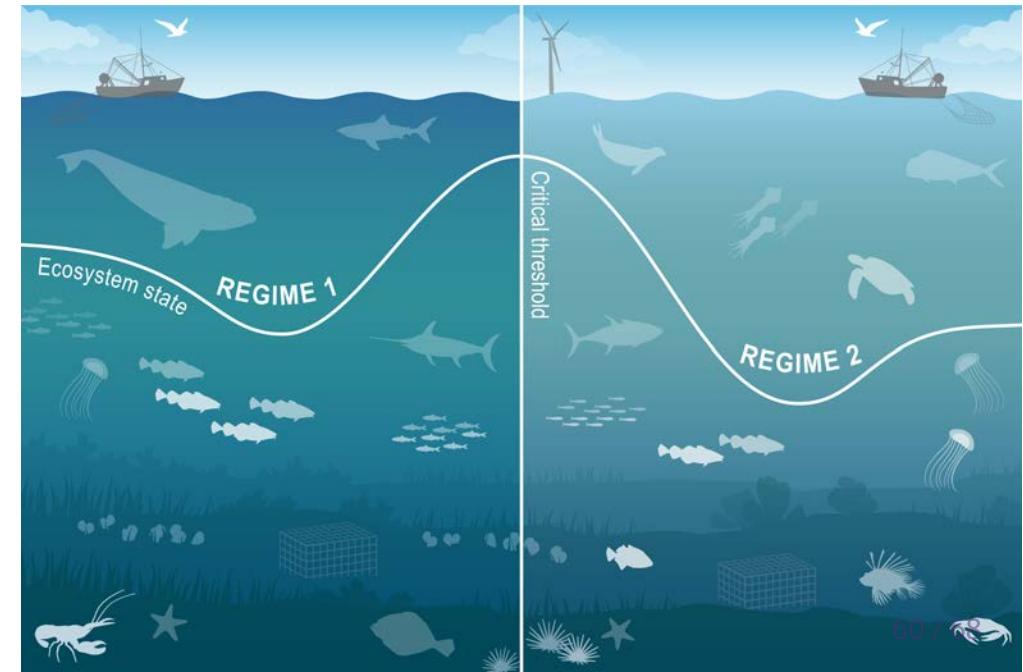
Drivers: Predation

Seals increasing, mix of population status for HMS

Risks to Setting Catch Limits

Future considerations

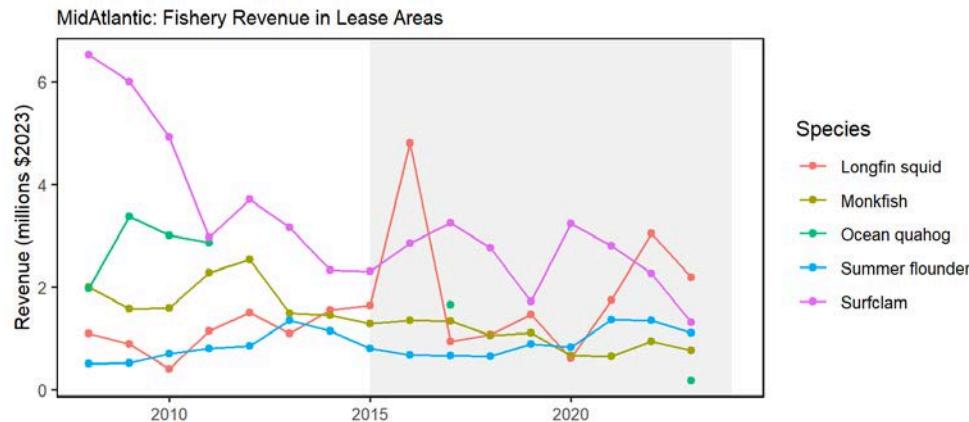
- Processes that control fish productivity and mortality are dynamic, complex, and are the result of the interactions between multiple changing system drivers.
- There is a real risk that short-term predictions in assessments and rebuilding plans that assume unchanging underlying conditions will not be as effective, given the observed change documented in the prior sections in both ecological and environmental processes.
- Assumptions for species' growth, reproduction, and natural mortality should continue to be evaluated for individual species.
- With observations of system-wide productivity shifts of multiple managed stocks, more research is needed to determine whether regime shifts or ecosystem reorganization are occurring, and how this should be incorporated into management.



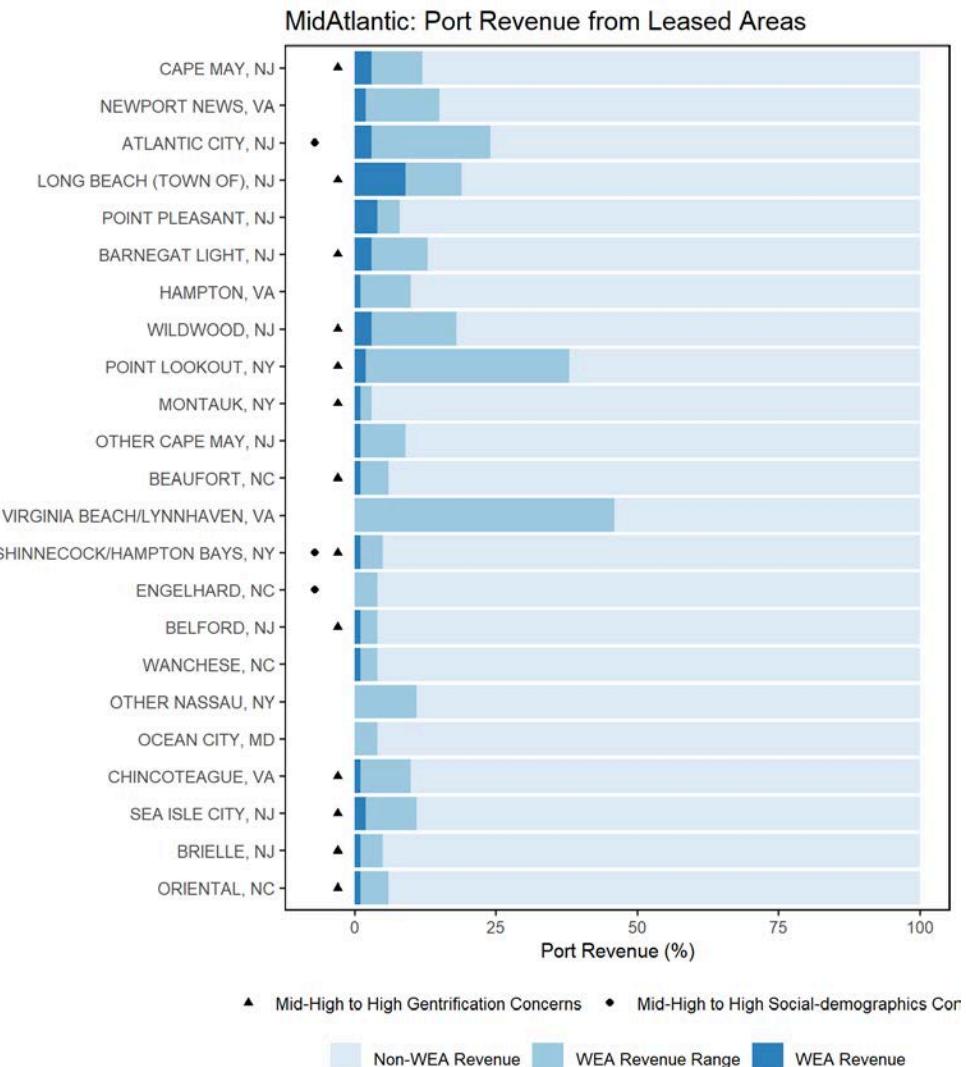
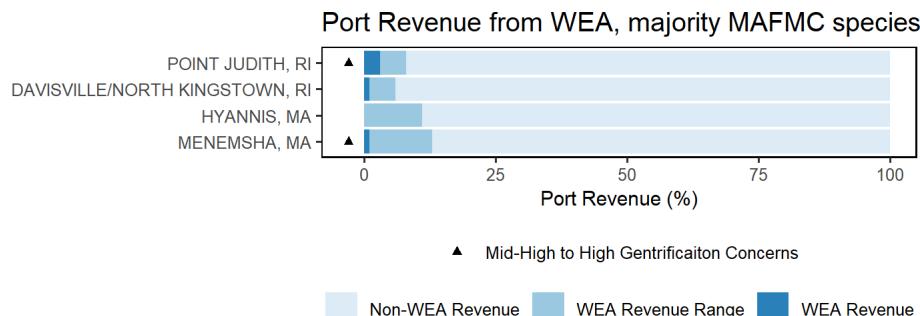
Risks: Offshore Wind Development Mid Atlantic

Elements: OSW1 and OSW2

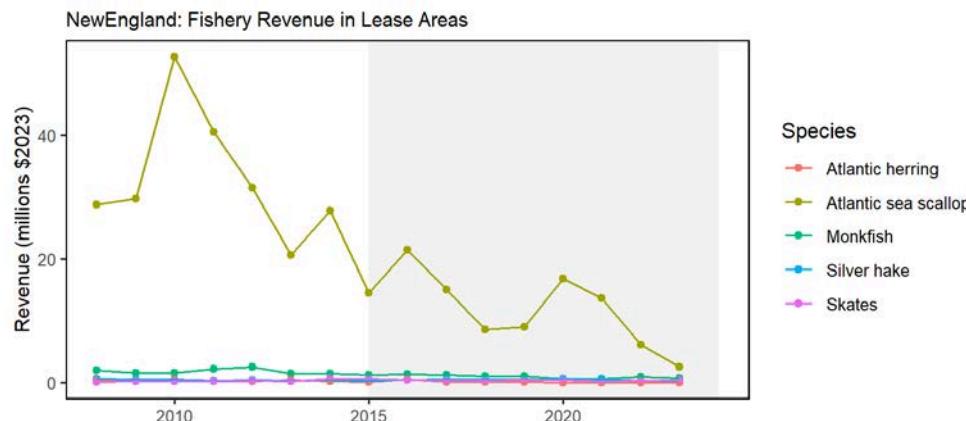
Indicators: fishery and community specific revenue in lease areas



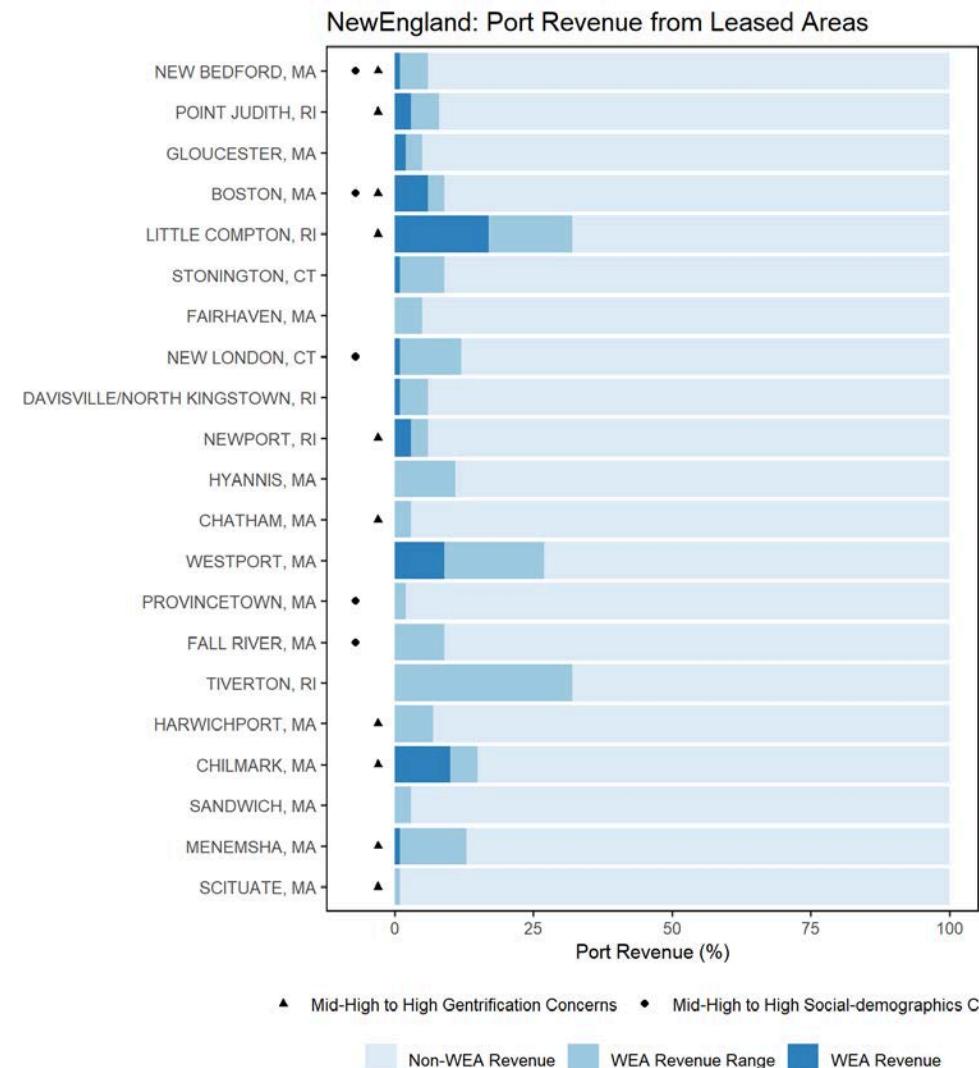
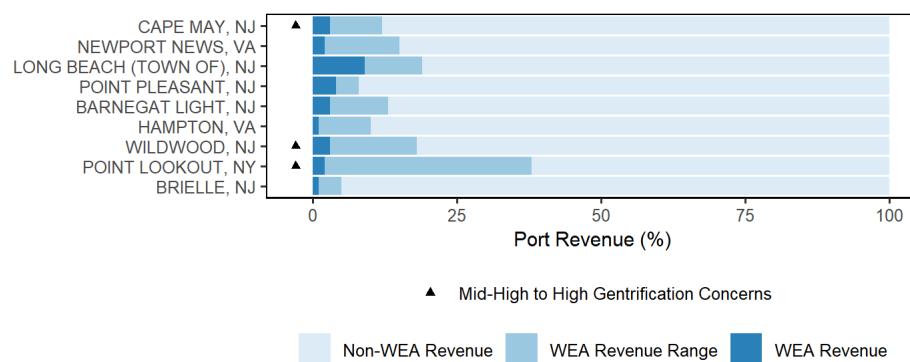
Council request: New England ports relying on Mid-Atlantic managed species



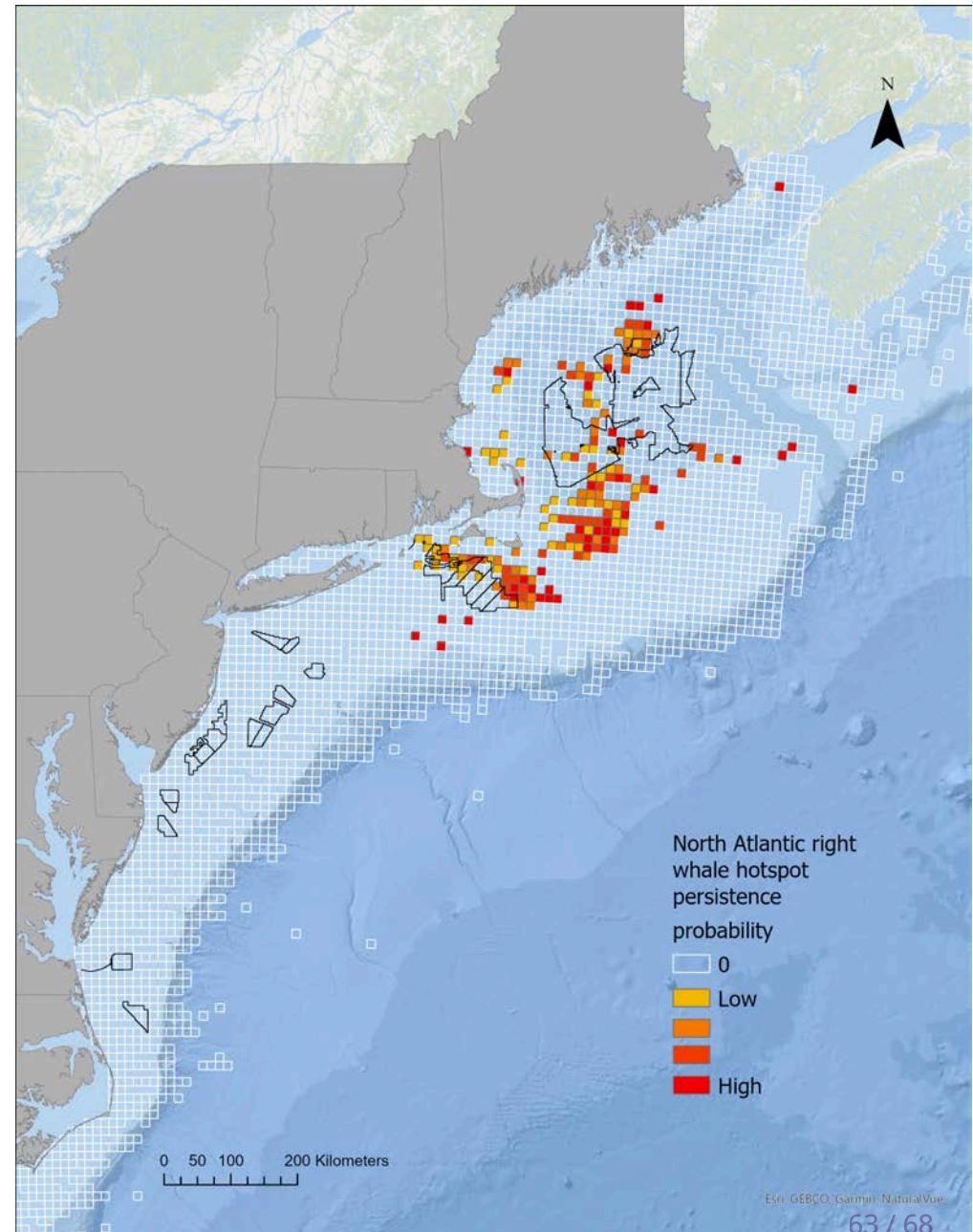
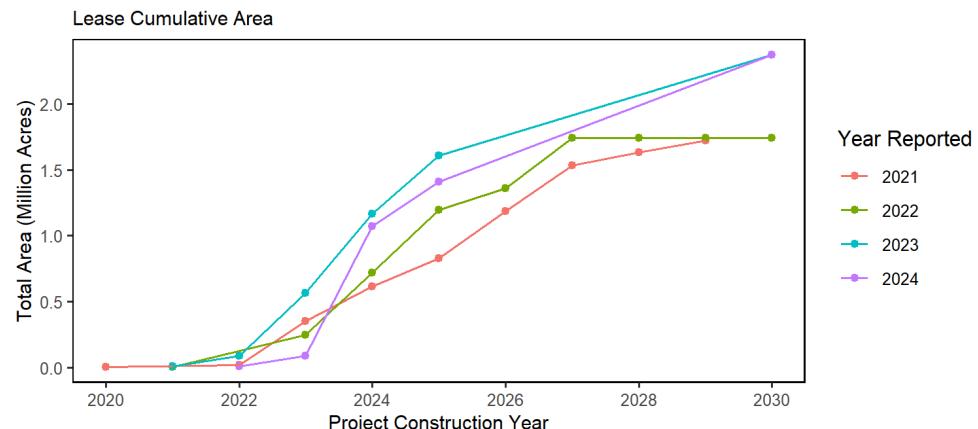
Indicators: fishery and community specific revenue in lease areas



Council request: New England ports relying on Mid-Atlantic managed species



Risks: Offshore Wind Development Summary



Implications:

- Current plans for buildout of offshore wind in a patchwork of areas spreads the impacts differentially throughout the region
- Planned wind areas overlap with one of the only known right whale foraging habitats, and altered local oceanography could affect right whale prey availability. Development also brings increased vessel strike risk and the potential impacts of pile driving noise.

2024 Highlights: Methods

Observations solicited from:

- SOE contributors
- NEFSC colleagues
- Academic colleagues
- Management partners
- Fishing industry

We welcome your observations!

northeast.ecosystem.highlights@noaa.gov

Observations included if:

- Record high or low observations
- Different from recent conditions
- Reported by multiple sources
- Affecting fishery operations
- Newsworthy

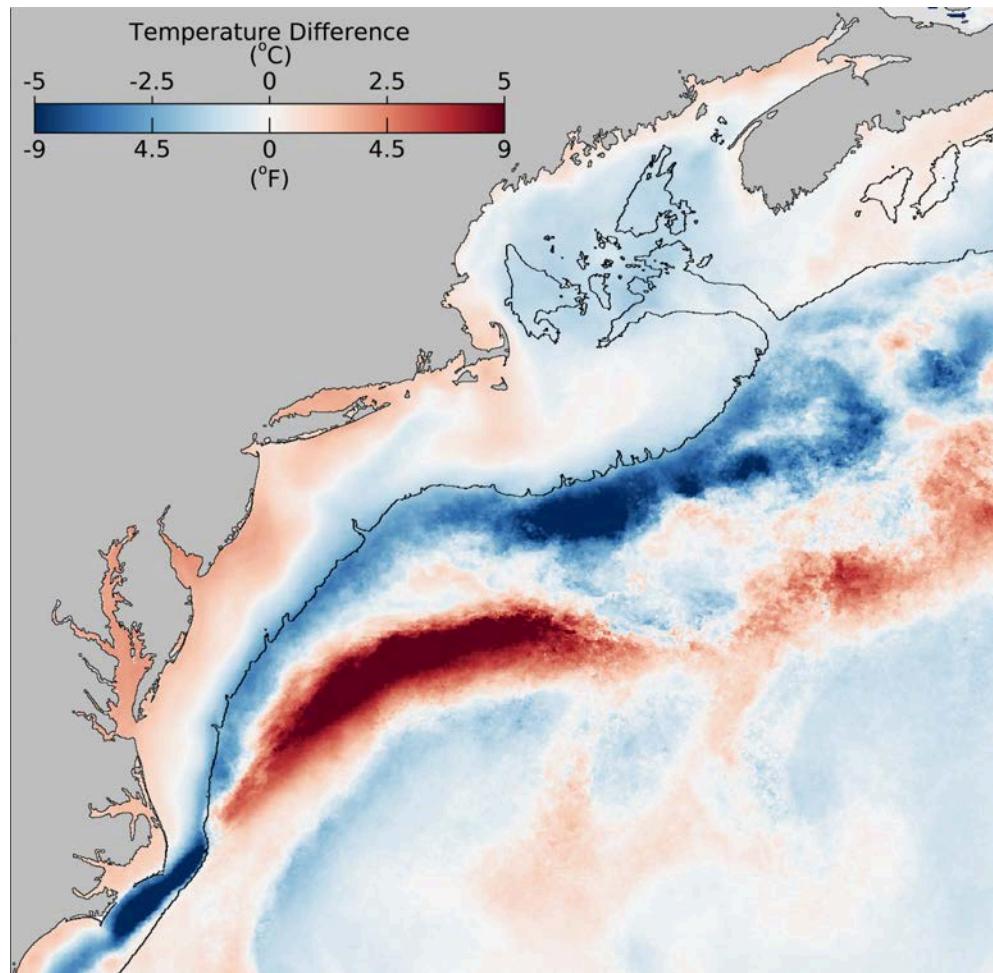
Not exhaustive list; Full impacts remain to be seen

Reprinted from Cape Cod Commercial Fisherman's Alliance February 2025 Newsletter →



A Chatham gillnetter has spent much of the last 20 years fishing about 70 miles south of Nantucket, February through April. In the last two years he has been bringing up strange, spiraled shells in his net. The appearance of what is likely Big or Giant Tun, a tropical or sub-tropical species, is one of many ocean anomalies in recent years, with more reports of "Gulf Stream orphans" than ever before. This would be a great anecdote to add to the Northeast Fisheries Science Center 2025 [State of the Ecosystem](#) reports. The center is looking for industry input for the 2024 Highlights section, particularly unusual or anomalous observations during the 2024 fishing season. Were water temperatures warmer/colder than normal or were there any other unusual conditions on the water that you observed? Was fishing unusually low/high or was the fishing season for specific species early/delayed? Did you see species in different places or at different times of the year than you normally see them? Email northeast.ecosystem.highlights@noaa.gov the details.

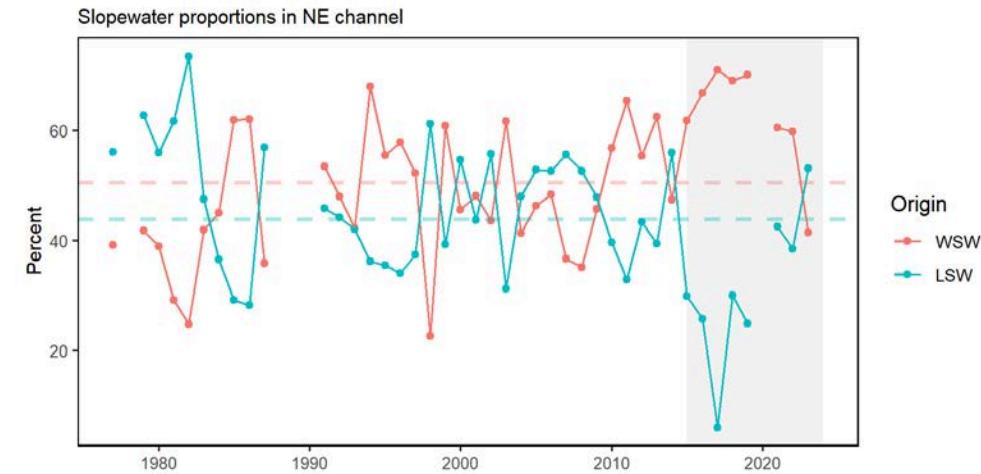
2024 Highlights: generally cooler, fresher Northeast Shelf



Globally, 2024 warmest year on record (above previous record 2023)

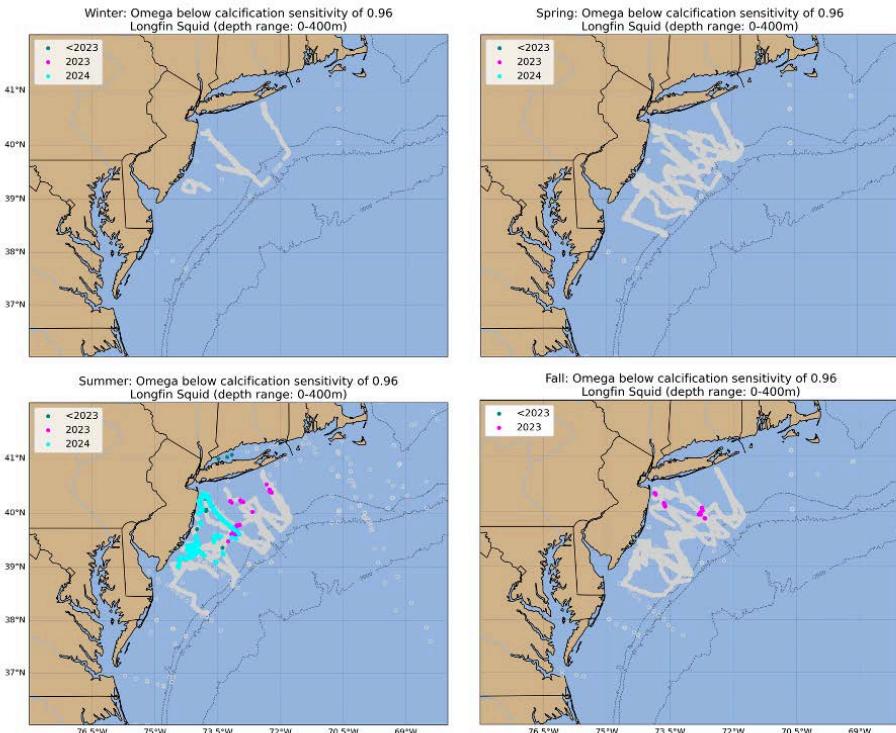
BUT, nearly all NE shelf seasonal surface and bottom temperatures back to longer term average

2023-2024 data suggest more Labrador slope water into the GOM



Linked to well-developed 2024 Mid Atlantic Cold Pool

2024 Highlights



Unusual timing, location, abundance:

- Fishery observations
 - Delayed migration of longfin squid, black sea bass, haddock
 - Unusual locations for pollock, bluefin tuna, Atlantic mackerel, longfin squid, bluefish, and bonito
 - Local abundance of Atlantic mackerel
 - Record catches of red drum in Chesapeake Bay
- Good scallop recruitment in Nantucket lightship
- Arctic copepods in GOM
- Cocolithophore bloom off NY
- Large whale aggregations



Extreme observation of ocean acidification risk off NJ

Multiple summer upwelling events off NJ

THANK YOU! SOEs made possible by (at least) 88 contributors from 20+ institutions

Andrew Applegate (NEFMC)	Marjy Friedrichs (VIMS)	Shannon Meseck	Tarsila Seara
Kimberly Bastille	Sarah Gaichas	Ryan Morse	Dave Secor (CBL)
Aaron Beaver (Anchor QEA)	Ben Galuardi (GAFRO)	Ray Mroch (SEFSC)	Emily Slesinger
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Brandon Beltz	James Gartland (VIMS)	Robert Murphy	Adrienne Silver (UMass/SMAST)
Ruth Boettcher (Virginia Department of Game and Inland Fisheries)	Lori Garzio (Rutgers University)	Kimberly Murray	Talya tenBrink (GARFO)
Mandy Bromilow (NOAA Chesapeake Bay Office)	Glen Gawarkiewicz (WHOI)	NEFSC staff	Abigail Tyrell
Joseph Caracappa	Laura Gruenburg	David Moe Nelson (NCCOS)	Rebecca Van Hoeck
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Doug Christel (GARFO)	Kimberly Hyde	Tom Parham (Maryland DNR)	John Walden
Patricia Clay	John Kocik	CJ Pellerin (NOAA Chesapeake Bay Office)	Harvey Walsh
Lisa Colburn	Steve Kress (National Audubon Society's Seabird Restoration Program)	Charles Perretti	Sarah Weisberg
Jennifer Cudney (NMFS Atlantic HMS Management Division)	Young-Oh Kwon (Woods Hole Oceanographic Institution)	Kristin Precoda	Changhua Weng
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Geret DePiper	Daniel Linden	Grace Saba (Rutgers University)	Sarah Wilkin (NMFS Office of Protected Resources)
Bart DiFiore (GMRI)	Andrew Lipsky	Vincent Saba	Mark Wuenschel
Emily Farr (NMFS Office of Habitat Conservation)	Sean Lucey (RWE)	Sarah Salois	Qian Zhang (U Maryland)
Michael Fogarty	Don Lyons (National Audubon Society's Seabird Restoration Program)	Chris Schillaci (GARFO)	
Paula Fratantoni	Chris Melrose	Amy Schueller (SEFSC)	
Kevin Friedland	Anna Mercer	Teresa Schwemmer (URI)	



References

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- DePiper, G. et al. (2021). "Learning by doing: collaborative conceptual modelling as a path forward in ecosystem-based management". In: *ICES Journal of Marine Science* 78.4, pp. 1217-1228. ISSN: 1054-3139. DOI: [10.1093/icesjms/fsab054](https://doi.org/10.1093/icesjms/fsab054). URL: <https://doi.org/10.1093/icesjms/fsab054> (visited on Aug. 08, 2022).
- Gaichas, S. K. et al. (2018). "Implementing Ecosystem Approaches to Fishery Management: Risk Assessment in the US Mid-Atlantic". In: *Frontiers in Marine Science* 5. ISSN: 2296-7745. DOI: [10.3389/fmars.2018.00442](https://doi.org/10.3389/fmars.2018.00442). URL: <https://www.frontiersin.org/articles/10.3389/fmars.2018.00442/abstract> (visited on Nov. 20, 2018).
- Muffley, B. et al. (2021). "There Is no I in EAFM Adapting Integrated Ecosystem Assessment for Mid-Atlantic Fisheries Management". In: *Coastal Management* 49.1. Publisher: Taylor & Francis _ eprint: <https://doi.org/10.1080/08920753.2021.1846156>, pp. 90-106. ISSN: 0892-0753. DOI: [10.1080/08920753.2021.1846156](https://doi.org/10.1080/08920753.2021.1846156). URL: <https://doi.org/10.1080/08920753.2021.1846156> (visited on Apr. 16, 2021).
- Perretti, C. et al. (2017). "Regime shifts in fish recruitment on the Northeast US Continental Shelf". En. In: *Marine Ecology Progress Series* 574, pp. 1-11. ISSN: 0171-8630, 1616-1599. DOI: [10.3354/meps12183](https://doi.org/10.3354/meps12183). URL: <http://www.int-res.com/abstracts/meps/v574/p1-11/> (visited on Feb. 10, 2022).

Additional resources

- [ecodata R package](#)
- [Indicator catalog](#)
- [SOE Technical Documentation](#)
- [SOE Reports on the web](#)
 - Slides available at <https://noaa-edab.github.io/presentations>
 - Contact: joseph.caracappa@noaa.gov