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MEMORANDUM

Date: March 26, 2024

To: Council

From: Brandon Muffley, Council staff

Subject: Ecosystem Approach to Fisheries Management (EAFM) Risk Assessment

On Tuesday, April 9, 2024, the Mid-Atlantic Fishery Management Council (Council) will review the draft 2024 EAFM risk assessment report. The risk assessment is provided to the Council annually and is intended to track ecosystem elements that may threaten the Council's ability to achieve the ecological, socio-economic, and management objectives desired for Council-managed fisheries. The Council will provide any guidance and feedback on the draft document that should be considered for completion of the risk assessment later in the year.

Background

In October 2023, the Council reviewed and approved a number of changes and updates to be included in a revised EAFM risk assessment. These changes included the addition of four new risk elements and revisions to the definitions, indicators, and/or risk criteria for 16 of the 24 existing risk elements. These updates were developed as part of a comprehensive review of the risk assessment by the Council's Ecosystem and Ocean Planning (EOP) Committee and Advisory Panel (AP)[1]. The goal of the review was to produce an updated risk assessment that reflects the Council's current priorities and can be adaptive and responsive to new and changing conditions that can support a variety of Council management needs.

The draft report has been updated to reflect the approved changes to the risk assessment and incorporates the latest data and scientific information, indicators from the 2024 Mid-Atlantic State of the Ecosystem report[2], and new analyses developed by Council and NEFSC staff. For some elements, there are indicators and risk criteria that are still draft (identified as "potential" in the relevant headings of the report) and require additional feedback from the Council, EOP Committee and AP. In addition, there are several risk elements, including all four new elements, that are still under development and will take additional time to complete and, therefore, there is no risk ranking associated with those elements.

[1] See the September 13-14, 2023 EOP Committee and AP meeting summary for additional information: https://www.mafmc.org/s/Tab07_EAFM-Risk-Assessment-Review.pdf

[2] The 2024 Mid-Atlantic State of the Ecosystem report will be presented to the Council at the April 2024 Council meeting and can be found at: https://www.mafmc.org/council-events/2024/april-council-meeting.

Over the next several months, staff will continue to work on tasks needed to complete the remaining risk elements and incorporate any input from the Council identified at the April meeting. Once ready, a completed draft risk assessment will be presented to the EOP Committee and AP for feedback and recommendations. A final risk assessment that addresses the EOP input will be presented to the Council later this year for review and approval.

Meeting Materials

Materials listed below are provided for Council discussion of this agenda item.

- Draft 2024 EAFM risk assessment report

Introduction

Risk Element Information and Recommendations for Council Consideration

The Council approved an Ecosystem Approach to Fisheries Management (EAFM) Guidance Document in 2016 which outlined a path forward to more fully incorporate ecosystem considerations into marine fisheries management[1], and revised the document in February 2019[2]. The Council's stated goal for EAFM is "to manage for ecologically sustainable utilization of living marine resources while maintaining ecosystem productivity, structure, and function." Ecologically sustainable utilization is further defined as "utilization that accommodates the needs of present and future generations, while maintaining the integrity, health, and diversity of the marine ecosystem." Of particular interest to the Council was the development of tools to incorporate the effects of species, fleet, habitat and climate interactions into its management and science programs. To accomplish this, the Council agreed to adopt a structured framework to first prioritize ecosystem interactions, second to specify key questions regarding high priority interactions and third tailor appropriate analyses to address them [1]. Because there are so many possible ecosystem interactions to consider, a risk assessment was adopted as the first step to identify a subset of high priority interactions [2]. The Council completed its first risk assessment in 2017 and the risk elements included in the assessment spanned biological, ecological, social and economic issues and risk criteria for the assessment were based on a range of indicators and expert knowledge [2].

The risk assessment is updated annually and was designed to help the Council decide where to focus limited resources to address ecosystem considerations by first clarifying priorities. Overall, the purpose of the EAFM risk assessment is to provide the Council with a proactive strategic planning tool for the sustainable management of marine resources under its jurisdiction, while taking interactions within the ecosystem into account.

Given the length of time since its initial development, the availability of new information and analyses, and ever-changing risks facing Council-managed fisheries, the Council conducted a comprehensive review of the EAFM risk assessment in 2023. The goal of the review was to produce an updated risk assessment that incorporates the latest scientific information, reflects the Council's current priorities, and can be adaptive and responsive to new and changing conditions that can support a variety of Council management needs. At the conclusion of the review, the Council identified 28 risk elements to be included in the updated assessment – 24 existing elements and 4 new elements. In addition, the Council supported new and/or revised indicators for 16 of the existing risk elements.

This draft document revises the Mid-Atlantic Council's EAFM risk assessment and includes the changes approved by the Council as part of its comprehensive review and updates the assessment with the most recent data available, indicators from the 2024 State of the Ecosystem report, and with new analyses conducted by Council and Center staff for relevant risk elements. This report does not include rankings for 3 existing elements and the 4 new elements approved by the Council. Additional time is needed to develop the indicators and risk ranking criteria for these elements. Once developed, this information will be shared with the Council's Ecosystem and Ocean Planning Committee and Advisory Panel for review and feedback. A final EAFM risk assessment report with information on all 28 risk elements will then be presented to the Council later this year for approval.

Components of the EAFM risk assessment

Risk Elements - identify what we are measuring. They can be any aspect that may threaten achieving the biological, economic, or social objectives that the Council desires from a fishery.

Definitions - describe why we are measuring it and clearly state what is at risk. In general, because the Council is charged with managing fisheries for Optimum Yield (OY), many risk definitions are centered on a particular element's potential impact on achieving OY. However, some Risk Elements addressed additional Council objectives (e.g. maximizing fishery value, optimizing employment).

Indicators - are how we measure risk and are observations that gives information about the risk element. Indicators may be a time series of data, may come from an individual study, or from qualitative information.

Risk Criteria - help specify what is the risk and include the following risk levels: low, low-moderate, moderate-high, and high.

[1] http://www.mafmc.org/s/EAFM_Guidance-Doc_2017-02-07.pdf
[2] http://www.mafmc.org/s/EAFM-Doc-Revised-2019-02-08.pdf

Risk Assessment - applies the risk criteria to the indicators and summarizes the rationale for the risk ranking.

The risk elements included in the Council's 2024 updated assessment span biological, ecological, social and economic issues (Table 1) and risk criteria for the assessment were based on a range of indicators and expert knowledge (Table 2).

Table 1: Risk Elements, Brief Definitions, and Indicators Used. Additional detail and information on each risk elements definition and indicator(s) can be found in the full risk assessment text.

Element	Definition	Indicator
Ecological		
Assessment performance	Risk of not achieving OY due to analytical limitations	Current assessment method/data quality/retrospective pattern
F status	Risk of not achieving OY due to overfishing	Current F relative to reference F from assessment
B status	Risk of not achieving OY due to depleted stock	Current B relative to reference B from assessment
Food web (Prey availability)	Risk of not achieving OY due to availability of prey	Prey biomass, fish condition
Food web (Predation pressure)	Risk of not achieving OY due predation pressure	Predator consumption, predation mortality
Food web (Protected species prey)	Risk of not achieving protected species objectives due to interactions with Council-managed species	Diet composition
Ecosystem productivity	Risk of not achieving OY due to changing system productivity	Five indicators, see text
Climate	Risk of not achieving OY due to climate change on productivity	Northeast Climate Vulnerability Assessment
Distribution shifts	Risk of not achieving OY due to climate-driven distribution shifts	Northeast Climate Vulnerability Assessment + 2 indicators
Estuarine habitat	Risk of not achieving OY due to threats to estuarine/nursery habitat	Enumerated threats + estuarine dependence
Offshore habitat	Risk of not achieving OY due to changing offshore habitat	Integrated habitat model index
Economic		
Commercial value	Risk of not maximizing commercial fishery value	Gross revenue in aggregate
Recreational angler days/trips	Risk of not maximizing fishery value and opportunities	Total numbers of anglers and trips in aggregate
Commercial fishery resilience (Revenue diversity)	Risk of reduced fishery business resilience (at permit level)	Species diversity of revenue
Commercial fishery resilience (Shoreside support)	Risk of reduced fishery business resilience due to shoreside support infrastructure	Number of shoreside support businesses
Social		
Commercial fishery resilience (Fleet diversity)	Risk of reduced fishery resilience	Number of fleets, fleet diversity
Recreational fleet diversity	Risk of reduced recreational fishery resilience	Recreational fleet effort diversity
Fishing community vulnerability	Risk of reduced community resilience	Community vulnerability, fishery engagement and reliance
Food Production		
Commercial fishing production	Risk of not optimizing commercial fishing production	Seafood and total landings in aggregate
Recreational fishing production	Risk of not maintaining personal food production	Recreational landings in aggregate
Management		
F Control	Risk of not achieving OY due to inadequate control	Total catch compared to catch targets
Technical Interactions	Risk of not achieving OY due to interactions with non-Council managed species	Number and type of interactions with protected or non-MAFMC managed species, co-management

Table 1: Risk Elements, Brief Definitions, and Indicators Used. Additional detail and information on each risk elements definition and indicator(s) can be found in the full risk assessment text. *(continued)*

Element	Definition	Indicator
Offshore wind (Bio/Ecosystem)	Risk of not achieving OY due stock and ecosystem impacts	Fished, protected, and forage species overlap with wind areas
Offshore wind (Science/Access)	Risk of not achieving OY due to access and uncertainty	Fishery revenue in and federal survey overlap with wind areas
Other ocean activities	Risk of not achieving OY due to other non-fishing activities	Fishery overlap, spatial coverage of shipping/energy/mining areas
Regulatory complexity & stability	Risk of not achieving compliance due to complexity	Number and frequency of changing regulations by species and state
Discards	Risk of not minimizing regulatory discards, bycatch to extent practicable	Discards relative to catch, discard mortality
Allocation	Risk of not achieving OY due to spatial mismatch of stocks and management	Allocation considerations by management

Table 2: Risk Ranking Criteria used for each Risk Element. Additional information on the risk ranking criteria can be found in the full risk assessment text.

Element	Low	Low-Moderate	Moderate-High	High
Assessment performance	Assessment model(s) passed peer review, high data quality	Assessment passed peer review but some key data and/or reference points may be lacking	*This category not used*	Assessment failed peer review or no assessment, data-limited tools applied
F status	F < Fmsy	Unknown, but weight of evidence indicates low overfishing risk	Unknown status	F > Fmsy
B status	B > Bmsy	Bmsy > B > 0.5 Bmsy, or unknown, but weight of evidence indicates low risk	Unknown status	B < 0.5 Bmsy
Food web (Prey availability)	TBD	TBD	TBD	TBD
Food web (Predation pressure)	TBD	TBD	TBD	TBD
Food web (Protected species prey)	Few interactions with any protected species	Important prey of 1-2 protected species, or important prey of 3 or more protected species with management consideration of interaction	Important prey of 3 or more protected species	Managed species is sole prey for a protected species
Ecosystem productivity	No trends in ecosystem productivity	Trend in ecosystem productivity (1-2 measures, increase or decrease)	Trend in ecosystem productivity (3+ measures, increase or decrease)	Decreasing trend in ecosystem productivity, 4+ measures
Climate	Low climate vulnerability ranking	Moderate climate vulnerability ranking	High climate vulnerability ranking	Very high climate vulnerability ranking
Distribution shifts	Low potential for distribution shifts	Moderate potential for distribution shifts	High potential and observed distribution shifts	Very high potential and observed distribution shifts
Estuarine habitat	Not dependent on nearshore coastal or estuarine habitat	Estuarine dependent, estuarine condition stable	Estuarine dependent, estuarine condition fair	Estuarine dependent, estuarine condition poor
Offshore habitat	TBD	TBD	TBD	TBD
Commercial value	No trend and low variability in revenue	Increasing or high variability in revenue	Significant long term revenue decrease	Significant recent decrease in revenue
Recreational angler days/trips	No trends in angler trips	Increasing or high variability in angler trips	Significant long term decreases in angler trips	Significant recent decreases in angler trips
Commercial fishery resilience (Revenue diversity)	No trend in diversity measure	Increasing or high variability in diversity measure	Significant long term downward trend in diversity measure	Significant recent downward trend in diversity measure
Commercial fishery resilience (Shoreside support)	No trend in shoreside support businesses	Increasing or high variability in shoreside support businesses	Significant recent decrease in one measure of shoreside support businesses	Significant recent decrease in multiple measures of shoreside support businesses

Table 2: Risk Ranking Criteria used for each Risk Element. Additional information on the risk ranking criteria can be found in the full risk assessment text. *(continued)*

Element	Low	Low-Moderate	Moderate-High	High
Commercial fishery resilience (Fleet diversity)	No trend in diversity measure	Increasing or high variability in diversity measure	Significant long term downward trend in diversity measure	Significant recent downward trend in diversity measure
Recreational fleet diversity	TBD	TBD	TBD	TBD
Fishing community vulnerability	Few (<10%) vulnerable fishery dependent communities	10-25% of fishery dependent communities with >3 high vulnerability ratings	25-50% of fishery dependent communities with >3 high vulnerability ratings	Majority (>50%) of fishery dependent communities with >3 high vulnerability ratings
Commercial fishing production	No trend or increase in seafood landings	Increasing or high variability in seafood landings	Significant long term decrease in seafood landings	Significant recent decrease in seafood landings
Recreational fishing production	No trend or increase in recreational landings	Increasing or high variability in recreational landings	Significant long term decrease in recreational landings	Significant recent decrease in recreational landings
F Control	No recent history (last 5 years) of overages	Small recent overages, but infrequent	Routine recent overages, but small to moderate	Routine recent significant overages
Tech Interactions	No interactions with non-MAFMC managed species	Interactions with non-MAFMC managed species but infrequent, Category II fishery under MMPA; or AMs not likely triggered	AMs in non-MAFMC managed species may be triggered; or Category I fishery under MMPA (but takes less than PBR)	AMs in non-MAFMC managed species triggered; or Category I fishery under MMPA and takes above PBR
Offshore wind (Bio/Ecosystem)	TBD	TBD	TBD	TBD
Offshore wind (Science/Access)	TBD	TBD	TBD	TBD
Other ocean activities	TBD	TBD	TBD	TBD
Regulatory complexity	Simple/few regulations; rarely if ever change; same recreational regs across all states	Low-moderate complexity; occasional recent changes; few (1-2) recreational regulation differences across states	Moderate-high complexity; occasional recent changes; moderate (3-4) recreational regulation differences across states	High complexity; frequent recent changes; many (5+) recreational regulation differences across states
Discards	No significant discards or incidental catch; no significant discard mortality	Low or episodic discards and incidental catch; low discard mortality	Regular discards and incidental catch but managed; moderate discard mortality	High discards and incidental catch, difficult to manage; high discard mortality
Allocation	No recent or ongoing Council discussion about allocation	*This category not used*	*This category not used*	Recent or ongoing Council discussion about allocation

Risk Assessment

Ecological Elements

Stock Assessment Performance

Description:

Stock assessments provide the scientific basis for sustainable fishery management in this region. This risk element is applied at the species level, and addresses risk to achieving OY due to scientific uncertainty based on analytical and data limitations. The Council risk policy accounts for scientific uncertainty in assessments, with methods for determining scientific uncertainty currently being refined by the Council's Scientific and Statistical Committee (SSC).

Other assessment-related risk elements (F status and B status) describe risks according to our best understanding of stock status, but assessment methods and data quality shape that understanding.

Definition:

Risk of not achieving OY due to analytical limitations

Indicators:

Stock assessment review and general assessment data quality contribute to assessment of assessment performance risk. The EOP and Council can continue to use pass/fail criteria from independent stock assessment reviews while more formally incorporating data quality indicators (including data quality impacts from any source of scientific survey constraint), assessment retrospective performance indicators, or other indicators of analytical limitations. The SSC OFL CV process already reviews many aspects of analytical assessment uncertainty, including data quality and retrospective performance, which may further refine criteria used in this EAFM risk assessment.

Risk criteria:

Risk Level	*Definition*
Low	Assessment model(s) passed peer review, high data quality, small retrospective pattern
Low-Moderate	Assessment passed peer review but some data and/or reference points may be lacking
Moderate-High	Assessment passed peer review but with major data quality issue or large retrospective pattern
High	Assessment failed peer review or no assessment, data-limited tools applied

An alternative set of criteria could apply OFL CVs used by the SSC for establishing ABC, which represent overall assessment uncertainty. An OFL CV of 60% could represent the low risk category, 100% the low-moderate risk category, 150% the moderate-high risk category, and stocks without an assessment (where OFL CV is usually not applied) remaining in the high risk category. If applying these criteria, we could change the name of this to "Assessment uncertainty" to match what the SSC is evaluating.

Risk Assessment

Stocks with low risk due to assessment performance include ocean quahog, surf clam, summer flounder, scup, black sea bass, Atlantic mackerel, butterfish, golden tilefish, bluefish, and spiny dogfish. Longfin squid are assessed with index-based assessment methods which rank low-moderate risk due to incomplete survey coverage in some years, and reference points for longfin squid are lacking. Shortfin squid also lack reference points, and the 2022 Research Track assessment was unable to put any analytical method forward to evaluate stock status or trends, so assessment performance risk increased to high. The monkfish 2016 operational assessment was unable to model growth or population status due to innaccurate ageing methods, so both northern and southern stocks rank high risk for this element. Blueline tilefish ranks as high risk for assessment type because it is assessed with the data limited methods (DLM) toolbox, and chub mackerel rank high risk due to no assessment.

Fishing Mortality Status and Stock Biomass Status

Description:

Managed fisheries are required to be prosecuted within fishing mortality limits and managed stocks are required to be maintained above minimum threshold biomass levels to preserve sustainable yield. These elements are applied at the species level. Because OY is the objective, and OY is at most MSY under U.S. law, fishing mortality (F) limit reference points are based on F_{MSY}, while the stock biomass (B) target is biomass at MSY (B_{MSY}). F and B status relative to established MSY-based target and limit reference points or proxies [3] from stock assessments therefore indicate the level of risk to achieving OY from either overfishing or stock depletion, respectively.

Definitions:

Fishing Mortality – F Status: Risk of not achieving OY due to overfishing

Stock Biomass – B Status: Risk of not achieving OY due to depleted stock

Indicators:

Stock assessments estimate both current F relative to the F reference point and current B relative to the B reference point and these indicators are used directly. When these quantities are not estimated due to analytical limitations, the SSC can evaluate the weight of evidence for risk of overfishing and overfished status based on evidence outside the stock assessment, and this evaluation is used in the EAFM risk assessment.

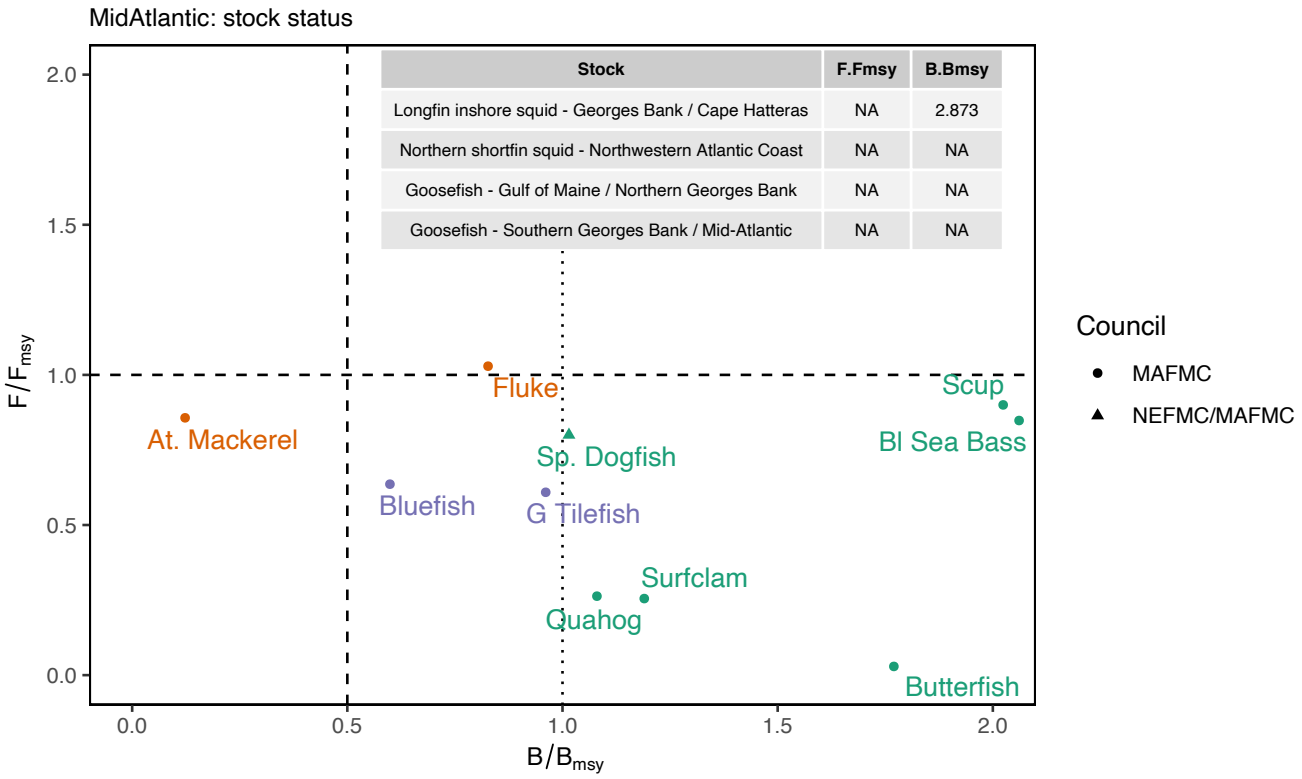

Figure 1: Summary of single species status for MAFMC and jointly federally managed stocks (Spiny dogfish and both Goosefish). The dotted vertical line is the target biomass reference point of B_{MSY}. The dashed lines are the management thresholds of one half B_{MSY} (vertical) or F_{MSY}. (horizontal). Stocks in orange are below the biomass threshold (overfished) or have fishing mortality above the limit (subject to overfishing), so are not meeting objectives. Stocks in purple are above the biomass threshold but below the biomass target with fishing mortality within the limit. Stocks in green are above the biomass target, with fishing mortality within the limit.

Risk criteria:

We applied low and high risk criteria for these elements as defined in U.S. law. Low risk criteria are $F < F_{MSY}$ and $B > B_{MSY}$ for an individual stock. High risk criteria are $F > F_{MSY}$ and $B < 0.5\ B_{MSY}$ for an individual stock. The Council established the intermediate risk categories to address stocks with unknown status. Moderate-high risk was defined as unknown status in the absence of other information for both F and B. Low-moderate risk was defined as unknown status, but with a weight of evidence indicating low overfishing risk for F. Similarly, low-moderate risk for B was either $0.5\ B_{MSY} < B < B_{MSY}$ or unknown status, but with a weight of evidence indicating low risk that the population is depleted.

Risk Level	*Definition*
Low	F < Fmsy
Low-Moderate	Unknown, but weight of evidence indicates low overfishing risk
Moderate-High	Unknown status
High	F > Fmsy

Risk Level	*Definition*
Low	B > Bmsy
Low-Moderate	Bmsy > B > 0.5 Bmsy, or unknown, but weight of evidence indicates low risk
Moderate-High	Unknown status
High	B < 0.5 Bmsy

Risk Assessment

Single species management objectives (1. maintaining biomass above minimum thresholds and 2. maintaining fishing mortality below overfishing limits) are being met for all but two MAFMC-managed species (Fig. 1), though the status of six stocks is unknown (Table **??**). Based on current assessment results, F and B status are both in the low risk category for surfclams, ocean quahogs, scup, and black sea bass. Butterfish, bluefish, and golden tilefish F status is in the low risk category, and B risk is in the low-moderate risk category. Spiny dogfish F status is in the high risk category, and B status is in the low risk category. Summer flounder F status is in the high risk category and B status is in the low-moderate risk category. Atlantic mackerel F status is in the low risk category and B status is in the high risk category.

Stocks with unknown status have a range of rankings. F and B status for chub mackerel and northern and southern monkfish stocks are ranked low-moderate risk (unknown but weight of evidence supports lower risk). Longfin squid B is above the established B threshold, and both squid stocks have unknown F status, but F is difficult to estimate because it is very low relative to natural mortality, so they were also ranked low-moderate risk. Blueline tilefish are high risk for F status and have unknown B status and little auxiliary information in the Mid-Atlantic region, and so rank moderate-high risk for B status.

Food Web (1) - Prey Availability

Description:

This element is applied at the species level.

Fish stocks and protected species stocks are managed using single species approaches, but fish and protected species stocks exist within a food web of predator and prey interactions. This element is one of two separating food web risks to achieving OY for Council managed species from two sources. This first element assesses prey availability for each species, and the second food web risk element assesses predation pressure on each species (see next element).

Definition:

Risk of not achieving OY for Council managed species due to availability of prey.

Indicators:

Indicators of prey availability for each Council managed species would be based on food habits information for the Council managed species combined with population trends for key prey species (if available). Prey could include all species (Council managed, other-managed, and non-managed) or a subset as determined by the EOP and Council.

Another indicator of prey could be based on stomach contents of predators, as was used for the 2022 bluefish research track assessment and presented in the 2023 State of the Ecosystem report. This index includes 22 forage species and was designed for bluefish, but also includes important forage for summer flounder and other Council managed species (Fig. 2).

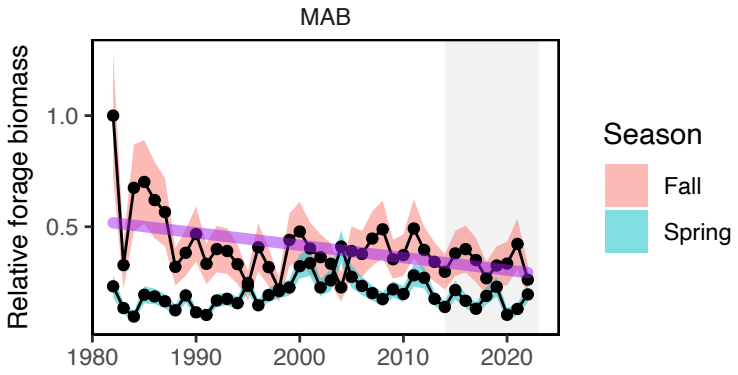

Figure 2: Forage fish index in the MAB for spring (blue) and fall (red) surveys, with a decline (purple) in fall. Index values are relative to the maximum observation within a region across surveys.

A secondary indicator of prey availability would include the fish condition indicators from the State of the Ecosystem report (shown below under Ecosystem Productivity). These would not rely on detailed diet information, instead reflecting the impact of environmental drivers including prey availability on fish growth.

Potential risk criteria:

Risk Level	*Definition*
Low	Prey availability high (not limiting) and/or good fish condition past 5 years
Low-Moderate	Aggregate prey available for this species has stable or increasing trend, moderate condition
Moderate-High	Aggregate prey available for this species has significant decreasing trend, poor condition
High	Managed species highly dependent on prey with limited and declining availability, poor condition

Risk Assessment

To be developed later in year in collaboration with the EOP Committee and AP once indicators and risk criteria are developed.

Food Web (2) - Predation Pressure

Description:

This element is applied at the species level.

Fish stocks and protected species stocks are managed using single species approaches, but fish and protected species stocks exist within a food web of predator and prey interactions. This element is one of two separating food web

risks to achieving OY for Council managed species from two sources. This second food web risk element assesses predation pressure on each species, and the first element assesses prey availability for each species (see element above).

Definition:

Risk of not achieving OY for Council managed species due to predation pressure.

Indicators:

Indicators of predation pressure on a Council managed species would be based on food habits information for predators of the species combined with key predator trends. This could be derived from empirical information or food web/multispecies models. Predators could include all species (protected, HMS, Council managed, other-managed, and unmanaged) or a subset as determined by the EOP and Council. Predation mortality (M2) compared to fishing mortality (F) to evaluate the relative importance of predation mortality is another indicator that could help inform the risk criteria levels.

Potential risk criteria:

Risk Level	*Definition*
Low	Predation pressure represents low proportion of overall mortality
Low-Moderate	Predation pressure moderate proportion of overall mortality, decreasing mortality trend
Moderate-High	Predation pressure moderate proportion of overall mortality, increasing mortality trend
High	Predation pressure represents high proportion of overall mortality, increasing mortality trend

Risk Assessment

To be developed later in year in collaboration with the EOP Committee and AP once indicators and risk criteria are developed.

Food Web (3) - Protected Species Prey

Description:

This element is applied at the species level.

Fish stocks and protected species stocks are managed using single species approaches, but fish and protected species stocks exist within a food web of predator and prey interactions. The previous two elements focus on Council managed species OY, while this element focuses on protected species objectives (maintain or recover populations and minimize bycatch).

This element ranks the risks of not achieving protected species objectives due to species interactions with Council managed species. In the US, protected species include marine mammals (under the Marine Mammal Protection Act), Endangered and Threatened species (under the Endangered Species Act), and migratory birds (under the Migratory Bird Treaty Act). In the Northeast US, endangered/threatened species include Atlantic salmon, Atlantic and shortnose sturgeon, all sea turtle species, and five whales.

Definition:

Risk of not achieving protected species objectives due to interactions with Council-managed species

Indicators:

Food web models and diet information can be used to establish thresholds of "importance" for predators and prey. Although monkfish occasionally ingest seabirds [4], there are no Council-managed species that are important predators of protected species [5], so here we rank only risks where Council managed species represent prey of protected species. An important prey of protected species is defined here as individually comprising >30% of the

predator's diet by weight. Critical prey warranting a high risk ranking would be a majority (>50%) of diet for an individual protected species.

Potential risk criteria:

Risk Level	*Definition*
Low	Few interactions with any protected species
Low-Moderate	Important prey of 1-2 protected species, or important prey of 3 or more protected species with management consideration of interaction
Moderate-High	Important prey of 3 or more protected species
High	Managed species is sole prey for a protected species

Risk Assessment

Protected species include marine mammals (under the Marine Mammal Protection Act), Endangered and Threatened species (under the Endangered Species Act), and migratory birds (under the Migratory Bird Treaty Act). In the Northeast US, endangered/threatened species include Atlantic salmon, Atlantic and shortnose sturgeon, all sea turtle species, and 5 baleen whales. MAFMC managed species are not important predators of protected species [5], even though monkfish occasionally ingest seabirds [4]. Atlantic salmon, both species of sturgeon, and sea turtles are not major predators of MAFMC managed species, as reviewed in the MAFMC Forage Fish white paper [6–12]. Information sources for marine mammal diets in the Northeast US [13], and seabird diets [14–19] were reviewed.

Diet information for protected species tends to be more uncertain than for fished species, so we consider diet at the family level for these rankings because diet compositions are not reported to the species level. Longfin squids are estimated to comprise >30% of diet for one protectes species, pilot whale, in the Northeast US [13,20], therefore we rank this species low-moderate risk for this element. Shortfin squid were identified as important prey for two pelagic seabirds in the Northeast US [15], and therefore ranked low-moderate risk. Unmanaged forage fish such as sand lance and saury were identified as important prey for >3 seabird species in the Northeast US [15], as well as grey seals [13]. MAFMC has enacted measures to restrict fishing on these species, such that they rank low-moderate risk for this element. Other MAFMC managed species do not meet the threshold of important prey of protected species based on available information, so they rank low risk for this element.

Ecosystem Productivity

Description:

This element is applied at the ecosystem level (the Mid-Atlantic Ecosystem Production Unit).

Productivity at the base of the food web supports and ultimately limits the amount of managed species production in an ecosystem.

Definition:

Risk of not achieving OY due to changing system productivity at the base of the food web.

Indicators:

A combination of five indicators will be used to assess the risk of changing ecosystem productivity. We examine trends in total primary production, zooplankton abundance for a key Mid-Atlantic species, aggregate forage fish (new), and two aggregate fish productivity measures: condition factor (weight divided by length of individual fish) and a survey based "recruitment" (small fish to large fish) index. An assessment-based recruitment index was recently added to the State of the Ecosystem report as well. Because benthic crustaceans are important prey for many Council-managed species, we note a benthic production indicator is desirable but not yet available.

These indicators evaluate ecosystem productivity in aggregate, which may change due to drivers such as decreasing primary productivity, changes in spatial/temporal overlap at the base of the food web, or other factors.

For primary production and fish productivity, the spatial scale of analysis is the Mid-Atlantic Ecosystem Production Unit.

Primary production Primary production has fluctuated recently with current conditions near average. The observed stability in system productivity is in contrast to an apparent shift in the timing of the bloom cycle in the Mid-Atlantic. Comparing remote sensing information from the 1970-80s to 1997-2015 information suggests that winter productivity was historically higher in the MAB and that the spring bloom we see today was less prominent. Shifts in timing of low trophic level production (Fig. 3) can affect Council managed fish species through early life history stages that feed on zooplankton.

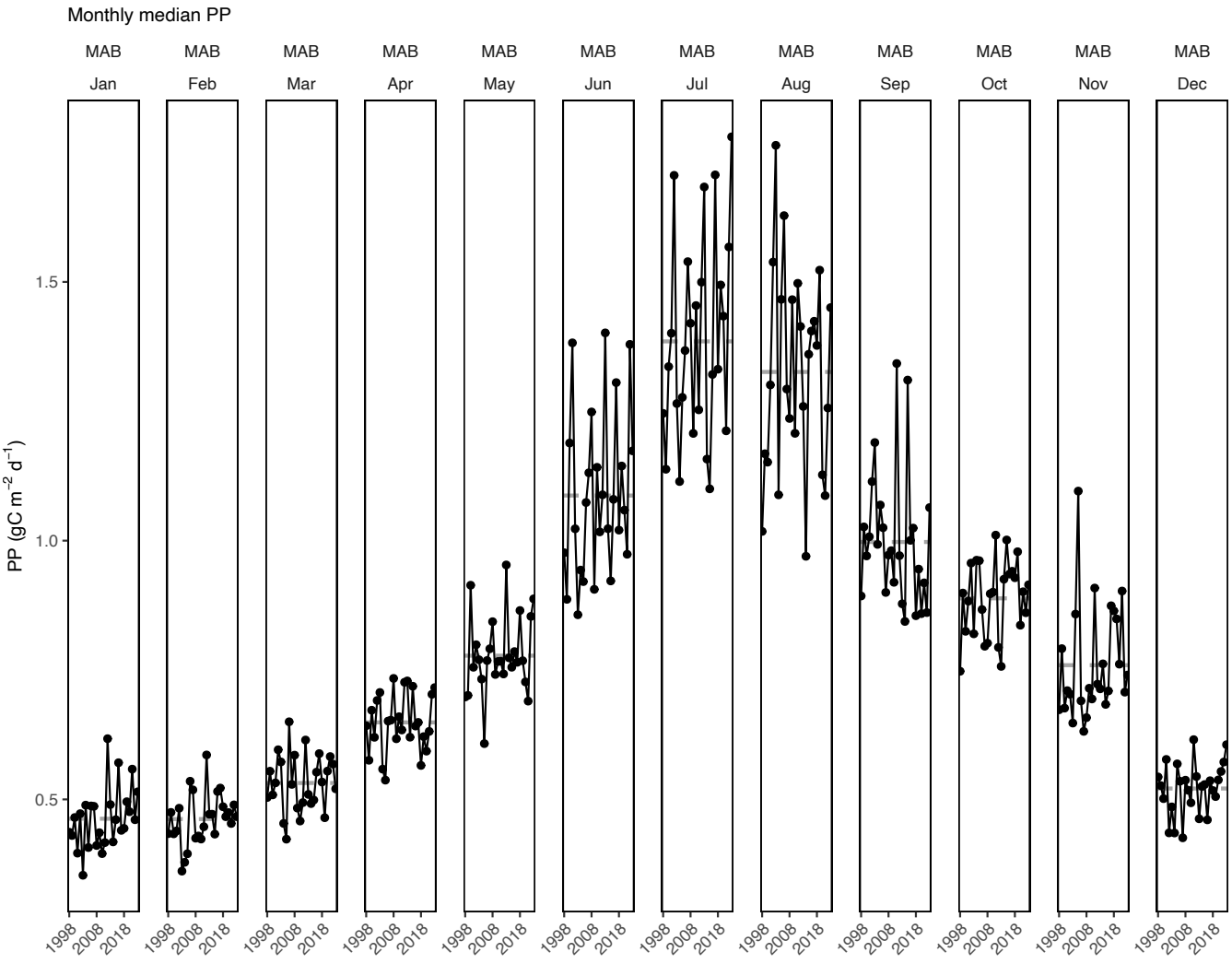

Figure 3: Monthly primary production trends show the annual cycle (i.e. the peak during the summer months) and the changes over time for each month.

Zooplankton abundance Zooplankton provide a critical link between phytoplankton at the base of the food web, and higher trophic organisms such as fish, mammals, and birds. Changes in the species composition and biomass of the zooplankton community have a great potential to affect recruitment success and fisheries productivity, and climate change may be the most important pathway for these changes to manifest. Therefore these indices are relevant to both productivity and trophic structure objectives.

The time series of zooplankton biovolume suggest that overall zooplankton production has not changed over time. However, increasing zooplankton diversity and increasing small copepods and cnidarians in the Mid-Atlantic (Fig. 4) suggest a change in zooplankton community composition which may affect fish species such as mackerel.

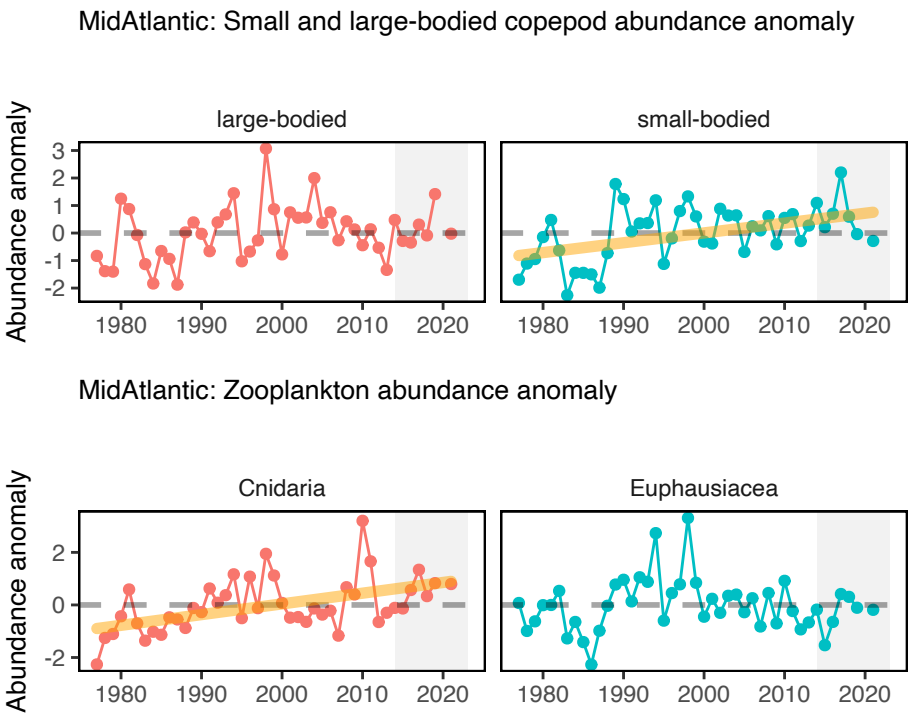

Figure 4: Changes in zooplankton abundance in the MAB for large (top left) and small (top right) copepods, Cnidarians (bottom left), and Euphausiids (bottom right), with significant increases (orange) in small copeods and Cnidarians.

Forage Base - new indicator The amount of forage available is one important driver of fish productivity. Indicators of aggregate pelagic forage fish biomass and forage fish energy content are presented in the State of the Ecosystem report (Fig. 2). Indicators of benthic forage are under development but not yet available. Food habits data from surveys and literature could be used to define the forage base common to all Council managed and protected species.

Fish condition Fish condition is measured as the weight per length–a measure of "fatness". This information is from NEFSC bottom trawl surveys and shows a change in condition across all species at around 2000 (Fig. 5). Around 2010-2013 some species started to have better condition. In 2023, condition was mixed, with general improvement since a relatively low condition year in 2021. Preliminary analyses show that changes in temperature, zooplankton, fishing pressure, and population size influence the condition of different fish species.

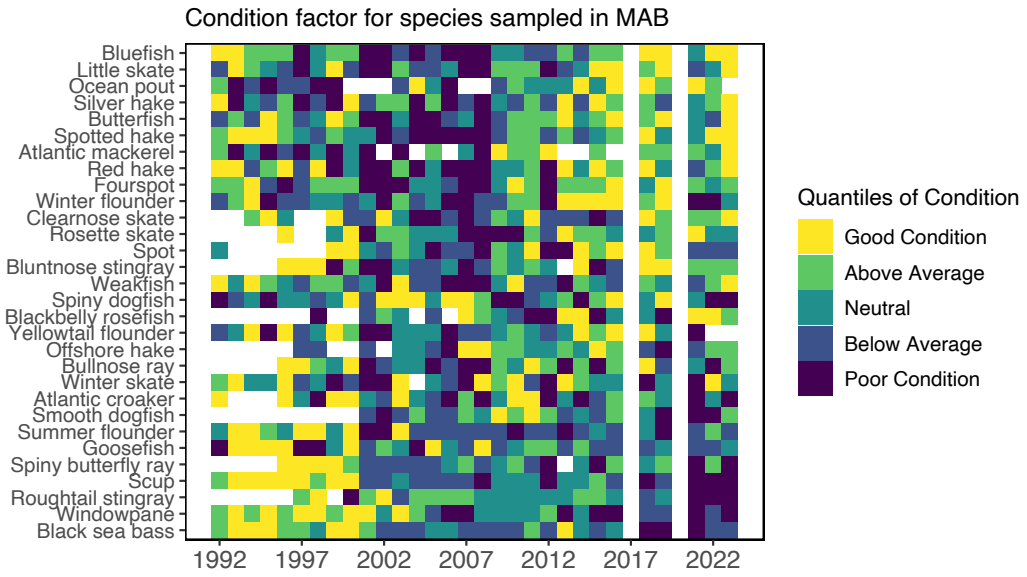

Figure 5: Condition factor for fish species in the MAB based on fall NEFSC bottom trawl survey data. MAB data are missing for 2017 due to survey delays, and no survey was conducted in 2020.

Fish productivity The number of small fish relative to the biomass of larger fish of the same species, as derived from the NEFSC survey, is a simple measure of productivity intended to complement model-based stock assessment estimates of recruitment. Fish productivity has been declining in the Mid-Atlantic since the early 2000s, as described by the small-fish-per-large-fish anomaly indicator (Fig. 6). This decline in fish productivity is also shown by a similar analysis based on stock assessment model outputs (recruitment per spawning stock biomass anomaly).

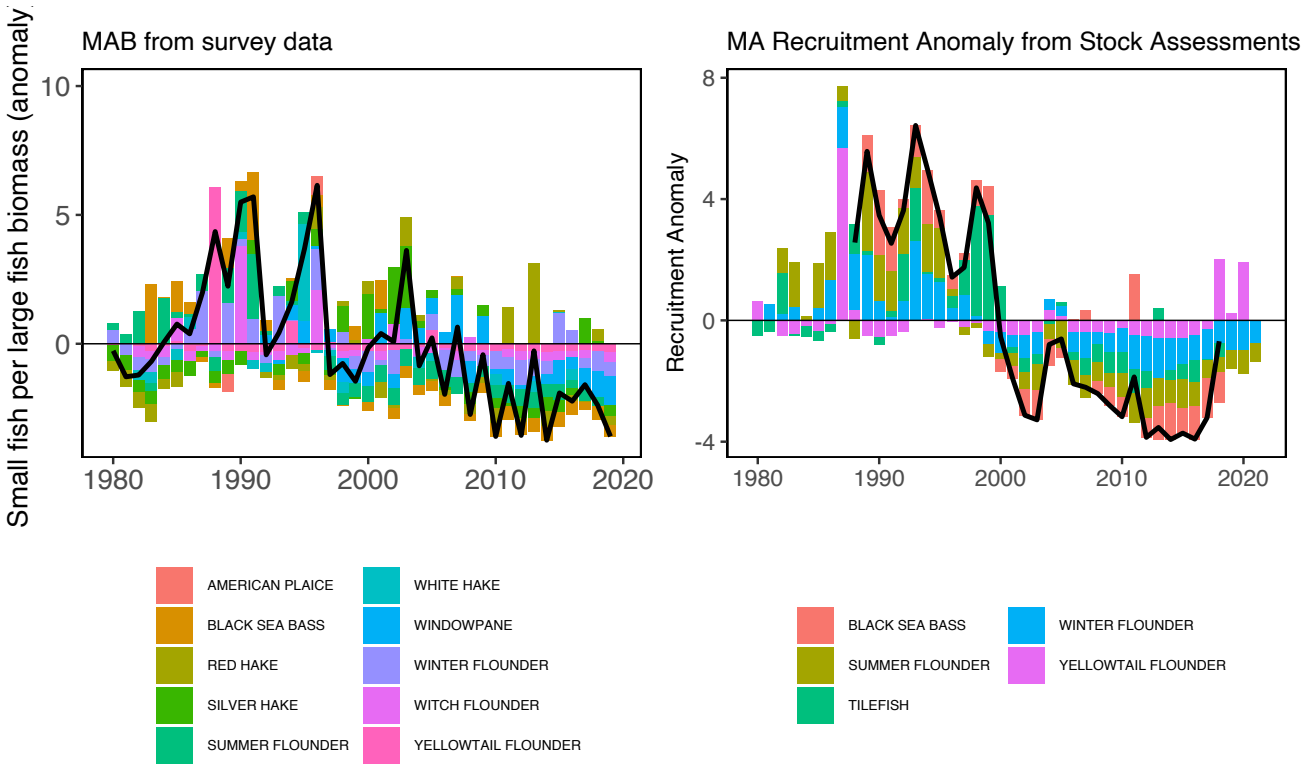

Figure 6: Fish productivity measures. Left: Small fish per large fish survey biomass anomaly in the Mid-Atlantic Bight. Right: assessment recruitment per spawning stock biomass anomaly for stocks mainly in the Mid-Atlantic. The summed anomaly across species is shown by the black line, drawn across all years with the same number of stocks analyzed.

Potential risk criteria:

Low risk for this element was defined as no trends in ecosystem productivity across all five indicators. The Low-Moderate risk criterion was trend(s) in ecosystem productivity for 1-2 indicators, whether increasing or decreasing. The Moderate-High risk criterion was trends in ecosystem productivity (3+ measures, increase or decrease). The High risk criterion was decreasing trends across 4 or more indicators.

Risk Level	*Definition*
Low	No trends in ecosystem productivity
Low-Moderate	Trend in ecosystem productivity (1-2 measures, increase or decrease)
Moderate-High	Trend in ecosystem productivity (3+ measures, increase or decrease)
High	Decreasing trend in ecosystem productivity, 4+ measures

Risk Assessment

Two measures of ecosystem productivity have significant trends, so the ranking for this element is low-moderate risk. The forage index shows a significant decrease in fall, and several zooplankton indicators show significant increasing trends. However, the potential for changing seasonality of primary production warrants further attention, as do patterns in condition and productivity across multiple stocks.

Climate

Description:

Climate change is expected to alter environmental conditions for managed fish in the Northeast US. This element is applied at the species level, and evaluates risks to species productivity (and therefore to achieving OY) due to projected climate change factors in the region using a comprehensive assessment [21] and other climate indicators (e.g., Mid-Atlantic ocean acidification).

Definition:

Risk of not achieving OY due to projected climate change or ocean acidification impacts on species productivity.

Indicators:

Indicators for climate productivity risk were taken from a climate vulnerability assessment [21] that evaluated exposure of each species to multiple climate threats, including ocean and air temperature, ocean acidification, ocean salinity, ocean currents, precipitation, and sea level rise. The assessment also evaluated the sensitivity (*not extinction risk*) of each species based on habitat and prey specificity, sensitivity to temperature and ocean acidification, multiple life history factors, and number of non-climate stressors (Fig. 7).

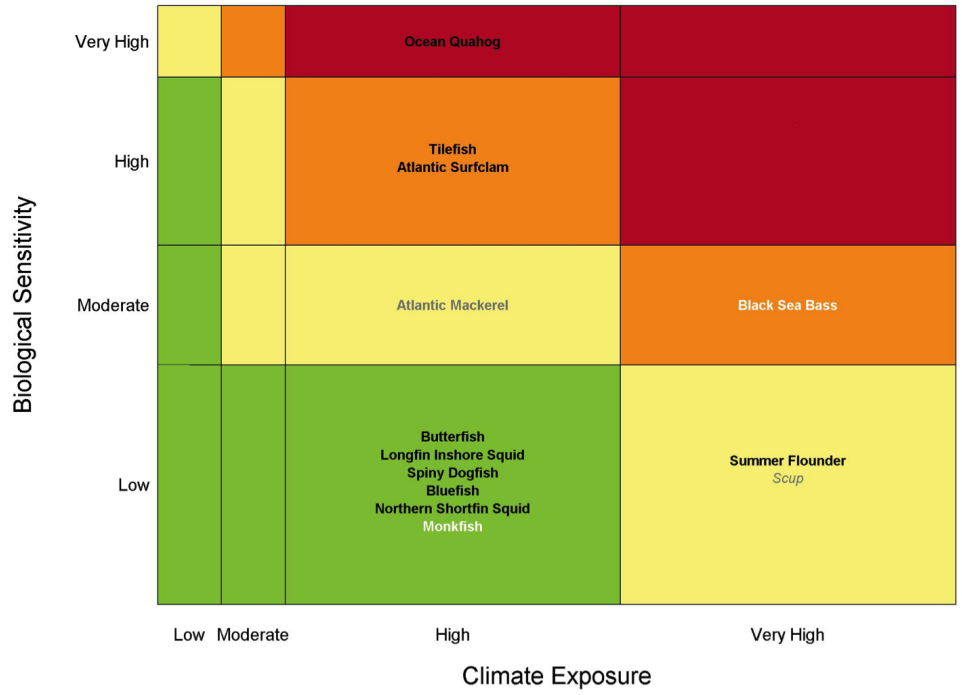

Figure 7: Hare et al., 2016 Climate vulnerability by species, Northeast US

Additional indicators linking temperature and ocean acidification (Fig. 8) to individual stocks are presented in the State of the Ecosystem reports, and will be expanded in the future as more temperature sensitivity information for each managed species becomes available.

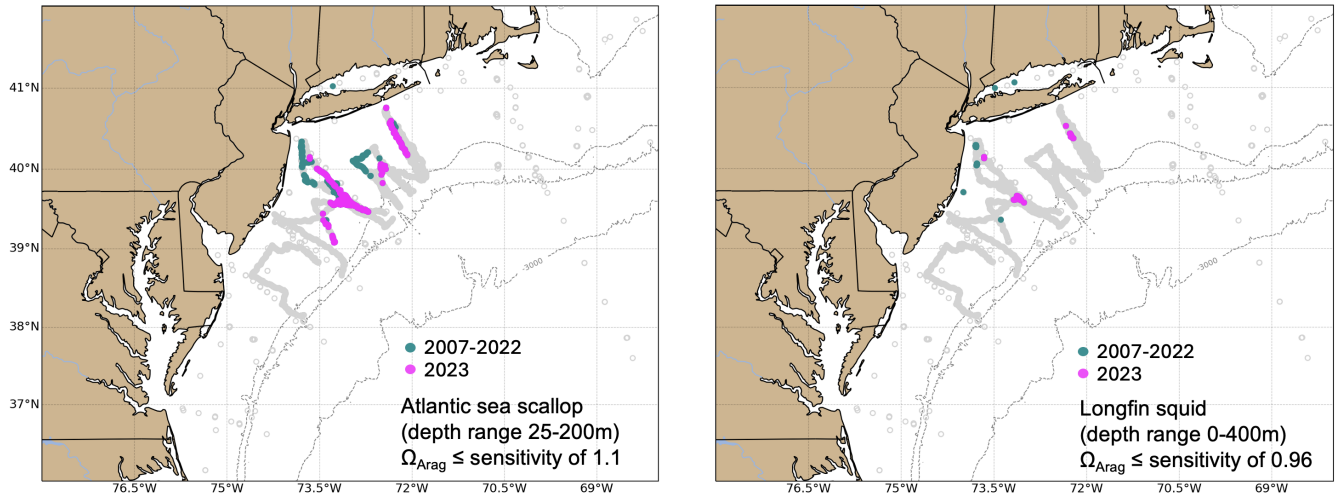

Figure 8: Locations where bottom aragonite saturation state (Ω_{Arag}; summer only: June-August) were at or below the laboratory-derived sensitivity level for Atlantic sea scallop (left panel) and longfin squid (right panel) for the time periods 2007-2022 (dark cyan) and 2023 only (magenta). Gray circles indicate locations where bottom Ω_{Arag} values were above the species specific sensitivity values.

Risk criteria:

Risk Level	*Definition*
Low	Low climate vulnerability ranking
Low-Moderate	Moderate climate vulnerability ranking
Moderate-High	High climate vulnerability ranking, climate indicators impacting the stock increasing (worsening)
High	Very high climate vulnerability ranking, climate indicators impacting the stock increasing (worsening)

Low risk ranking was defined as a low climate vulnerability ranking. Low-Moderate risk was a moderate climate vulnerability ranking. Moderate-High risk was a high climate vulnerability ranking. High risk was a very high climate vulnerability ranking.

Risk Assessment

Mid-Atlantic species were all either highly or very highly exposed to climate risk in this region, and ranged from low to very high sensitivity to expected climate change in the Northeast US. The combination of exposure and sensitivity results in the overall vulnerability ranking. We applied those climate vulnerability rankings directly here (Fig. 7).

As noted in the SOE, ocean quahog have highest climate vulnerability among Mid-Atlantic managed species. Surfclams, black sea bass, and both species of tilefish ranked moderate-high risk. Summer flounder, scup, and Atlantic mackerel ranked moderate-high risk. The remaining species ranked low risk. Chub mackerel, unmanaged forage, and deepsea corals were not ranked in the CVA.

Distribution Shifts

Description:

Climate change is expected to drive changes in spatial distribution for managed fish in the Northeast US as environmental conditions become more or less favorable for each stock throughout its range. Species distribution shifts in turn can increase risks of ineffective spatial catch allocation; if catch allocation is greatly mismatched with species distribution OY may not be achieved. This element is applied at the species level, and evaluates risks of species distribution shifts due to projected climate change in the Northeast US.

Definition:

Risk of not achieving OY due to spatial mismatch of stocks and management as a result of climate-driven distribution shifts.

Indicators:

Risks of species distribution shifts due to projected climate change in the Northeast US were assessed in a comprehensive assessment [21]. We applied those distribution shift risk rankings directly in the risk assessment (Fig. 9).

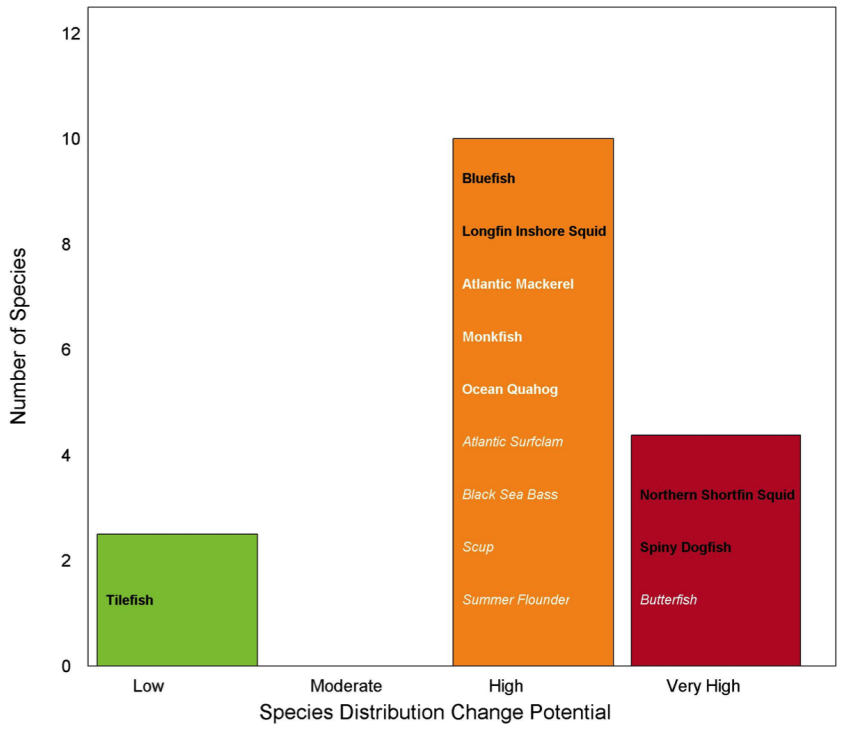

Figure 9: Hare et al., 2016 Distribution shift risk by species, Northeast US

In addition, changes in species distribution are monitored using fisheries independent bottom trawl surveys. Two distribution shift indicators are derived from these surveys: species distribution models, and time series of the along shelf position of the center of distribution.

Historical vs.current distribution

Species distribution models incorporating habitat variables show where distributions have increased or decreased over time: https://www.fisheries.noaa.gov/new-england-mid-atlantic/ecosystems/fisheries-habitat-northeast-us-shelf-ecosystem

Changes in along shelf position

The annual centroid of a species' distribution can be characterized by the position in the ecosystem along an axis oriented from the southwest to the northeast, referred to as the along shelf distance, and by depth. Along shelf distances range from 0 to 1360 km, which relates to positions along the axis from the origin in the southwest to the northeast. All species combined show a shift to the northeast and into deeper water (Fig. 10). Individual Council managed species distribution centeroids, aside from squids, also showed this trend to the northeast along the shelf in previous analysis.

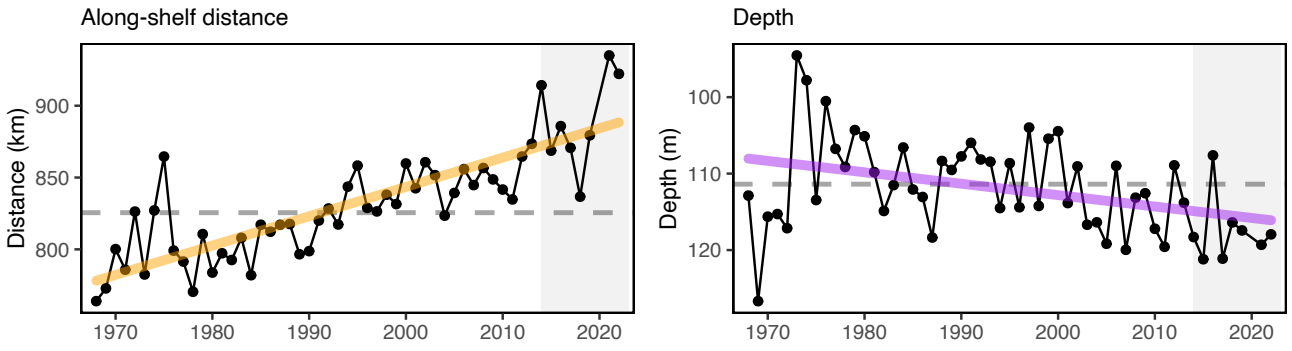

Figure 10: Aggregate species distribution metrics for species in the Northeast Large Marine Ecosystem: along shelf distance with increasing trend (orange), and depth with decreasing trend indicating deeper water (purple).

Risk criteria:

Risk Level	*Definition*
Low	Low potential for distribution shifts
Low-Moderate	Moderate potential for distribution shifts
Moderate-High	High potential for distribution shifts, observed distribution shifts
High	Very high potential for distribution shifts, observed distribution shifts

Risk Assessment

All Mid-Atlantic species with the exception of golden and blueline tilefish had either high or very high risk of distribution shifts in the Northeast US. Chub mackerel, unmanaged forage, and deepsea corals distribution shift risks were not ranked in the CVA.

Estuarine and Coastal Habitat

Description:

Estuarine and coastal habitat provides important nursery grounds for Council managed species, and is changing in quality and quantity due to multiple stressors from climate, land use, and coastal development. This element is applied at the species level, and evaluates risk of not achieving OY due to threats to estuarine and nearshore coastal habitat/nursery grounds.

Definition:

Risk of not achieving OY due to threats to estuarine/nursery habitat.

Indicators:

Risk was determined by first evaluating the estuarine dependence of species, and then by enumerating threats to the estuarine habitat required by these species. An assessment of national coastal and estuarine condition was used in this assessment. Water and habitat quality assessments produced for Chesapeake Bay, Delaware Bay, Long Island Sound, and other coastal estuaries have been developed and can be considered in the future. The National Coastal Condition Assessment for the Northeast US [22] was used to evaluate estuarine and coastal condition. This report lists water, sediment, benthic, and coastal habitat quality as well as fish contamination. State of the Ecosystem reports now include up to date indicators of Chesapeake Bay habitat conditions which could be included as indicators (Fig. 11).

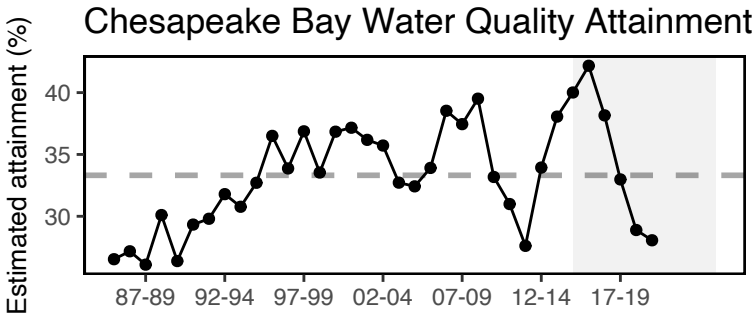

Figure 11: Chesapeake Bay water quality trend, 3 year running mean proportion of areas meeting or exceeding quality thresholds based on dissolved oxygen, chlorophyll, water clarity, and submerged aquatic vegetation.

Species specific habitat use indicators for Chesapeake Bay are in development. As reported in the 2023 SOE, Chesapeake Bay suitable habitat for juvenile summer flounder growth has declined by 50% or more. Climate change is expected to continue impacting habitat function and use for multiple species. Habitat is improving in some areas (tidal fresh SAV, oyster reefs), but eelgrass is declining. Similar information from multiple East Coast estuaries could be integrated into the risk assessment as it becomes available.

Risk criteria:

Risk Level	*Definition*
Low	Not dependent on nearshore coastal or estuarine habitat
Low-Moderate	Estuarine dependent, estuarine condition stable
Moderate-High	Estuarine dependent, estuarine condition fair
High	Estuarine dependent, estuarine condition poor

Species were defined as low risk if not dependent on nearshore coastal or estuarine habitat. Low-Moderate risk were estuarine dependent species with a stable estuarine condition. Moderate-High risk were estuarine dependent species with a fair estuarine condition. High risk were estuarine dependent species with a poor estuarine condition.

Risk Assessment

Northeast US coastal waters in the Mid-Atlantic region rated fair to poor for water quality, fair for sediment quality, poor for benthic quality, good to fair for coastal habitat, and fair to poor for fish contamination. These ratings were based on nearshore and estuarine summer sampling 2003-2006 [22]. The overall coastal condition was rated fair for the entire region, but this includes offshore conditions which we address in the next element. Therefore, estuarine and nearshore coastal habitat dependent species (summer flounder, scup, black sea bass, and bluefish, [23]) were ranked high risk based on overall poor estuarine condition for this element, and all others were ranked low risk due to lower dependence on this habitat type.

Offshore Habitat (new)

Description:

This element is applied at the species level.

Offshore habitat, defined here as all habitat outside of the estuary and beyond the immediate coastal/nearshore areas, supports all life stages of many Council managed species, and is changing in quality and quantity due to multiple stressors from climate to other ocean uses such as offshore wind development. This element evaluates risk of achieving OY due to changes in offshore habitat quality and quantity.

Definition:

Risk of not achieving OY due to changing offshore habitat. The rationale is that multiple drivers of offshore habitat change, including ocean industrialization, are included in this definition.

Indicators:

Indicators of offshore habitat trends are available from species-specific habitat modeling through the Northeast Regional Habitat Assessment, NEFSC, and multiple other efforts throughout the region.

Indicators include the amount of habitat, quality of habitat, or other aspects of habitat important to support fish productivity. For example, the cold pool is a seasonal habitat feature linked to several species in the Mid-Atlantic with indicators for spatial extent, duration, and temperature within the feature.

Potential risk criteria:

Risk Level	*Definition*
Low	No trends in offshore habitat
Low-Moderate	Trend in offshore habitat (1-2 measures, increase or decrease)
Moderate-High	Trend in offshore habitat (3+ measures, increase or decrease)
High	Decreasing trend in offshore habitat, 4+ measures

Risk Assessment

To be developed later in year in collaboration with the EOP Committee and AP once indicators and risk criteria are developed.

Economic Elements

Commercial Value

Description:

This element is applied at the ecosystem level, and addresses the risk of not maximizing fishery value. Revenue serves as a proxy for commercial profits, which is the component of a fishery's value that this element is ultimately attempting to assess risk towards. Lack of cost information across all fleet segments precludes the assessment of risk to profitability itself at the ecosystem level.

Definition:

Risk of not maximizing commercial fishery value.

Indicators:

Gross revenue is the current indicator for this element, and can be developed for all fishing activity within the Mid-Atlantic and for all Council managed species. Revenue serves as a proxy for commercial profits, which is the component of a fishery's value that this element is ultimately attempting to assess risk towards. Currently this indicator is aggregated and presented at the ecosystem-level.

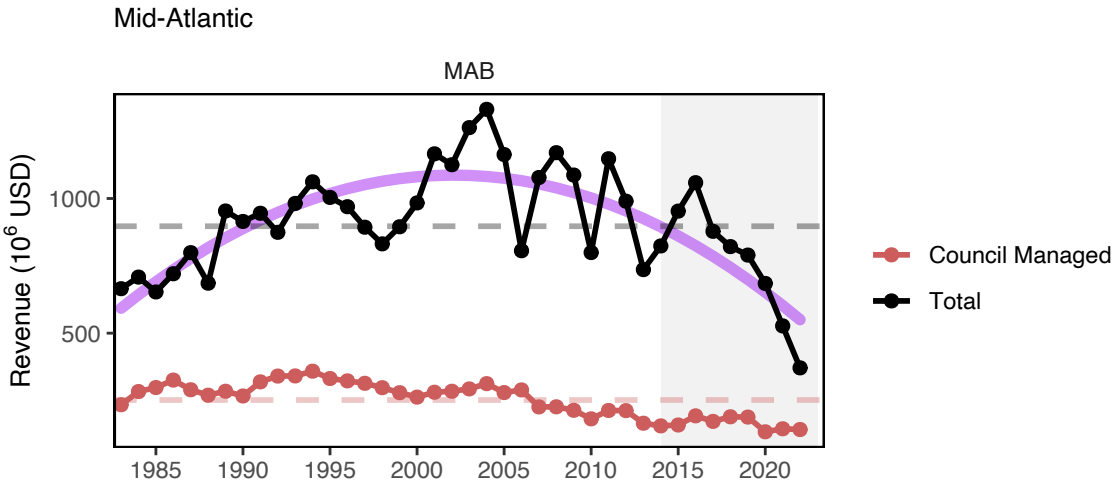

Figure 12: Revenue for the for the Mid-Atlantic region: total (black) and from MAFMC managed species (red), with a significant decrease (purple) for total revenue.

Net revenue (Gross revenue - trip costs) is a better proxy for trip value, in an economic context. However, this metric can be calculated only for trips by vessels holding federal licenses and submitting Vessel Trip Reports. This indicator would thus not capture all fishing within the region, and of potential interest to the Council. It underrepresents the total revenue generated regionally by about ½, and does not present the same trends as the subset for which net revenue can be generated. See Fig. 13 for the comparison of all revenue from Hatteras to the Canadian border versus what net revenue can be calculated for. The Ecosystem and Ocean Planning Committee and Advisory Panel recommended continued development of this indicator.

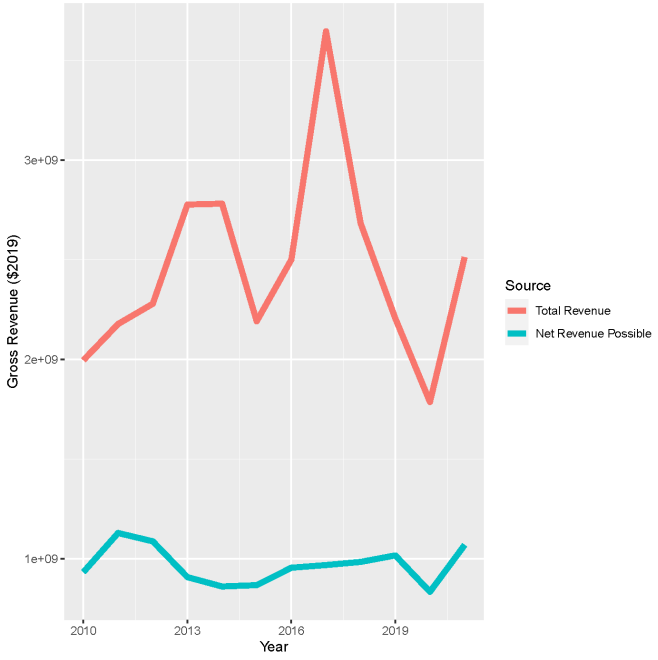

Figure 13: Cost coverage

Risk criteria:

Risk Level	*Definition*
Low	No trend and low variability in revenue
Low-Moderate	Increasing or high variability in revenue
Moderate-High	Significant long term revenue decrease
High	Significant recent decrease in revenue

Risk Assessment

There is a long term significant decrease in gross revenue, indicating moderate-high risk to commercial fishery value.

Marine Recreational Angler Days/Trips

Description:

Providing recreational opportunities is a stated goal of optimal fishery management under the legal definition of "benefits to the nation". Recreational fishing is important in the Mid-Atlantic region with the economic and social aspects of many coastal communities being highly dependent on recreational fishing.

This element is assessed at the ecosystem level where it applies equally to all recreationally fished species.

Definition:

Risk of not maximizing recreational fishery value and opportunities.

Indicators:

Currently, angler trips is the proxy indicator for the value generated from recreational fishing (Fig. 14). Although willingness to pay would better capture the economic concept of recreational value, this information is not gathered systematically in the region. Potentially, multiple indicators could be used to better proxy for recreational fishery value.

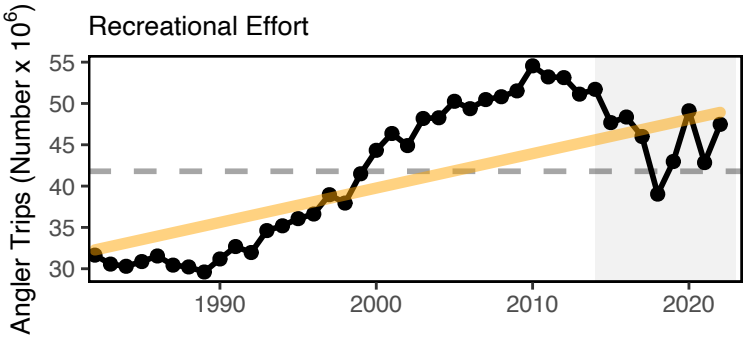

Figure 14: Recreational effort (number of trips, black) in the Mid-Atlantic, with significant increase (orange line).

Risk criteria:

Risk Level	*Definition*
Low	No trends in angler trips
Low-Moderate	Increasing or high variability in angler trips
Moderate-High	Significant long term decreases in angler trips
High	Significant recent decreases in angler trips

Risk Assessment

There is a long term significant increase in angler trips, indicating low-moderate risk to recreational fishery value. In addition, the indicator has shown high interannal variation since 2017.

Commercial Fishery Resilience (1) - Revenue Diversity

Description:

This element is applied at the ecosystem level, and addresses the potential risk of reduced commercial fishery business resilience by evaluating species diversity of revenue at the permit level.

Definition:

Commercial Fishery Resilience (Species Revenue Diversity) - Risk of reduced commercial fishery business resilience (at permit level).

Indicators:

Currently the average effective Shannon index for species revenue at the permit level (Fig. 15) is used to calculate diversity for all permits landing any amount of Council-managed species within a year (including both monkfish and spiny dogfish). Although the exact value of the effective Shannon index is relatively uninformative in this context, the relative value identifies changes in diversity.

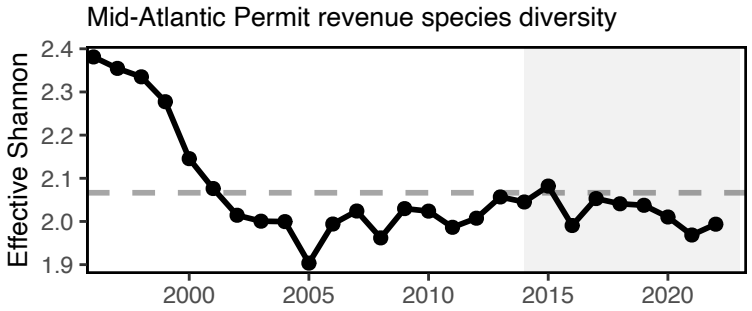

Figure 15: Species revenue diversity in the Mid Atlantic.

Risk criteria:

Risk Level	*Definition*
Low	No trend in diversity measure
Low-Moderate	Increasing trend or high variance in diversity measure
Moderate-High	Significant long term downward trend in diversity measure
High	Significant recent downward trend in diversity measure

Risk Assessment

Permit revenue species diversity has less than 30 years in the time series, therefore trend was not assessed. With no trend, this element ranks low risk. However, a decline prior to 2000 is visually apparent and could be assessed with updated methods for the 2025 risk assessment.

Commercial Fishery Resilience (2) - Shoreside Support

Description:

This element is applied at the ecosystem level, and ranks the risk of reduced commercial fishery business resilience due to shoreside support infrastructure by examining the number of shoreside support businesses.

Definition:

Risk of reduced commercial fishery business resilience due to loss of shoreside support infrastructure.

Indicators:

Indicators include the number of shoreside support businesses. The number of shoreside support businesses were tallied for all Mid-Atlantic states in two categories: number of companies (Quarterly Census of Employment and Wages. Obtained September 27, 2017. US Department of Labor, Bureau of Labor Statistics. https://www.bls.gov/cew/home.htm) and number of non-employer entities Non-employer Statistics." Obtained September 28, 2017. U.S. Census Bureau. https://www.census.gov/programs-surveys/nonemployer-statistics.html), which we consider separately. Non-employer entities are businesses that have no paid employees (i.e. entrepreneurs, or the owner is the workforce), while the shoreside support companies include all businesses with paid employees. Some state level data was not included due to confidentiality.

The number of shoreside support companies include seafood merchant wholesalers, seafood product preparation and packaging, and seafood markets across all Mid-Atlantic states.

Potential risk criteria:

Risk Level	*Definition*
Low	No trend in shoreside support businesses
Low-Moderate	Increasing or high variability in shoreside support businesses
Moderate-High	Significant recent decrease in one measure of shoreside support businesses
High	Significant recent decrease in multiple measures of shoreside support businesses

Risk Assessment

The indicator shows a significant long-term decrease, which represents moderate-high risk to fishery resilience. The number of non-employer entities, including seafood preparation and packaging and seafood markets, shows a long-term increase. Data from other shoreside fishery supporting businesses, such as gear manufacturers and welding companies, are not included here due to aggregation of the statistics across non-fishing industries (e.g. net manufacturers combined with all other businesses).

Social-Cultural Elements

Commercial Fishery Resilience (3) – Fleet Diversity

Description:

This element is applied at the ecosystem level, and ranks the risk to maintaining equity in access to fishery resources. Beyond equity concerns, maintaining diversity can provide the capacity to adapt to change at the ecosystem level for dependent fishing communities, and can address objectives related to stability.

Definition:

Risk of reduced fishery resilience (number and diversity of fleets).

Indicators:

Currently the diversity in revenue generated by different fleet segments, as well as a count of the number of active fleets, at the ecosystem level (Fig. 16). A fleet is defined here as the combination of gear (Scallop Dredge, Other Dredge, Gillnet, Hand Gear, Longline, Bottom Trawl, Midwater Trawl, Pot, Purse Seine, or Clam Dredge) and vessel length category (Less than 30 ft, 30 to 50 ft, 50 to 75 feet, 75 ft and above). The effective Shannon index is used to calculate the diversity of revenue across these fleets. Although the exact value of the effective Shannon index is relatively uninformative in this context, the relative value identifies changes in diversity.

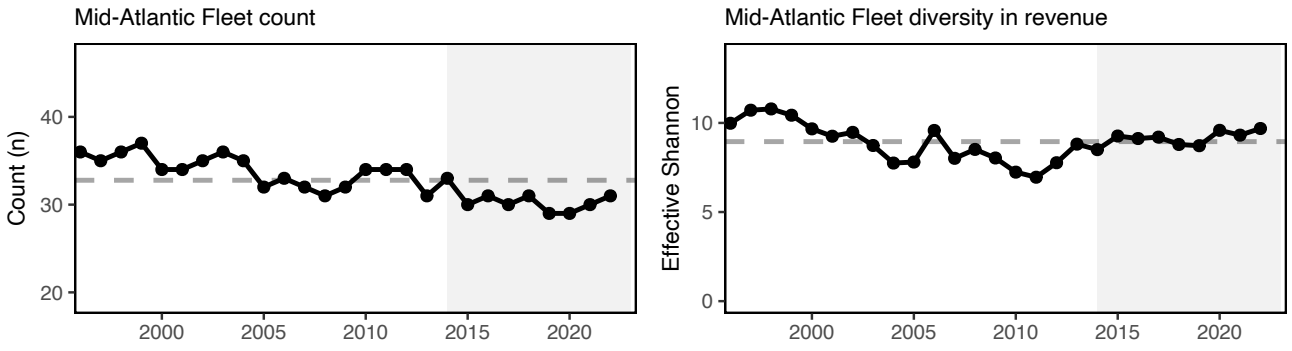

Figure 16: Commercial fleet count and revenue diversity in the Mid Atlantic.

Other metrics for diversity exist. The Simpson index is a common measure of biodiversity, but has the undesirable attribute of being asymmetric and weighing more common types more heavily than the less common types. Although the Shannon index provides a measure proportional to each type's relative frequency, the effective Shannon index has the added benefit of converting diversity measures onto a common scale. As such, the effective Shannon index was selected as the preferred index of fishing diversity, consistent with the literature and ensuring no differential treatment between large and small fleets [24].

Risk criteria:

Risk Level	*Definition*
Low	No trend in diversity measure
Low-Moderate	Increasing or high variability in diversity measure
Moderate-High	Significant long term downward trend in diversity measure
High	Significant recent downward trend in diversity measure

Risk Assessment

The commercial fleet count and revenue diversity have less than 30 years in the time series, therefore trend was not assessed. For fleet count a visual trend may be apparent, while for revenue diversity no apparent visual trend exists. With no trend, this element ranks low risk.

Recreational Fleet Diversity (new)

Description:

This element is applied at the ecosystem level, and ranks the risk to maintaining equity in recreational access to fishery resources. Beyond equity concerns, maintaining diversity can provide the capacity to adapt to change at the ecosystem level for dependent fishing communities, and can address objectives related to stability.

Definition:

Risk of reduced recreational fishery business resilience (diversity of modes).

Indicators:

Recreational fleet effort diversity has been presented in the Mid-Atlantic State of the Ecosystem Report for several years. This indicator is an effective Shannon estimate of diversity of effort across mode (i.e. effort by shoreside, private boat, and for-hire anglers; Fig. 17). The downward effort diversity trend is driven by party/charter contraction (down from 2% in 2021 to 1.4% in 2023), and a shift toward shorebased angling, which currently makes up 59% of angler trips. Effort in private boats has increased slightly to 40% of trips from 37% in 2021.

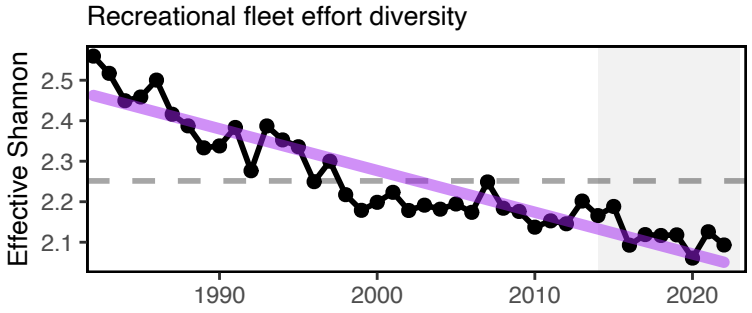

Figure 17: Recreational fleet effort diversity (black) in the Mid-Atlantic, with significant decrease (purple line).

The Ecosystem and Ocean Planning Committee and AP also recommended a harvest:catch ratio by mode indicator. The intent of this indicator would be to evaluate if recreational fishing behavior/preferences are changing (i.e., harvest versus catch and release) within the different recreational modes/sectors.

At present, proposed criteria are based only on the existing diversity indicator.

Proposed risk criteria:

Risk Level	*Definition*
Low	No trend in diversity measure
Low-Moderate	Increasing or high variability in diversity measure
Moderate-High	Significant long term downward trend in diversity measure
High	Significant recent downward trend in diversity measure

Risk Assessment

To be developed later in year in collaboration with the EOP Committee and AP once indicators and risk criteria are developed.

Fishing Community Vulnerability

Description:

This element ranks the vulnerability of communities to events such as regulatory changes to fisheries, wind farms, and other ocean-based businesses, as well as to natural hazards, disasters, and climate change. Vulnerability metrics can help assess the relative impact of system changes on human communities dependent on and engaged in fishing activities.

This element is applied at the ecosystem level.

Definition:

Risk of reduced community resilience (vulnerability, reliance, engagement).

Indicators:

The NOAA Fisheries Community Social Vulnerability Indicators (CSVIs; [25]) are statistical measures of the vulnerability of communities to events such as regulatory changes to fisheries, wind farms, and other ocean-based businesses, as well as to natural hazards, disasters, and climate change. The CSVIs currently serve as indicators of social vulnerability, gentrification pressure vulnerability, commercial and recreational fishing dependence (with dependence being a function of both reliance and engagement), sea level rise risk, species vulnerability to climate change, and catch composition diversity. We use a combination of these five indicators for the most fishery dependent communities to evaluate overall social risk levels.

Potential risk criteria:

Risk Level	*Definition*
Low	Few (<10%) vulnerable fishery dependent communities
Low-Moderate	10-25% of fishery dependent communities with >3 high vulnerability ratings
Moderate-High	25-50% of fishery dependent communities with >3 high vulnerability ratings
High	Majority (>50%) of fishery dependent communities with >3 high vulnerability ratings

Below is a brief description for each vulnerability category based on the NOAA social indicator study [25,26]:

- **Fishing dependence** indices portray the importance or level of dependence of commercial or recreational fishing to coastal communities.
- **Social vulnerability** indices represent social factors that can shape either an individual or community's ability to adapt to change. These factors exist within all communities regardless of the importance of fishing.
- **Gentrification pressure** indices characterize those factors that, over time may indicate a threat to commercial or recreational working waterfront, including infrastructure.

Here, we define gentrification in fishing communities as described by [27], where coastal population growth combined with an influx of higher-income people seeking waterfront property can increase property values and displace working-class residents engaged in resource-dependent activities. "Three common elements of gentrification are reuse of waterfront structures, construction of new housing, and growth within the services sector [27]."

Communities are ranked as high, medium high, moderate, or low relative to the respective indicator. Community dependence on commercial and recreational fishing is mixed, with notably more communities in the Mid-Atlantic dependent on recreational fishing. While communities with high to medium high risk for social vulnerability are broadly distributed in suburban and rural areas of the Mid-Atlantic region, communities with high to medium high gentrification pressure are concentrated in beachfront communities near urban areas in New York and New Jersey.

The social and economic impacts of climate change have been modeled through application of social indicators of fishing dependent communities [25]. Assessment of a range of social indicators has been applied in the Mid-Atlantic Region to predict vulnerability of communities to regulatory changes and disasters. More recently this methodology has been extended to include specific indicators of vulnerability to climate change and linked to species vulnerability assessments [21,26]. The tools developed through this approach are vital to an evaluation of the risks of climate change facing coastal communities dependent on fishing. Below is a description of the CSVIs related to climate change.

- **Sea level rise index** is a measure of the overall risk of inundation from sea level rise based on community area lost from one to six foot level projections over the next ~90 years. A high rank indicates a community more vulnerable to sea level rise.
- **Species vulnerability** is measured by the proportion of community fish landings that attributed to species vulnerable to climate change.
- **Catch composition diversity** is the relative abundance of species landed in a community. It is measured by Simpson's Reciprocal Index, and a higher index value indicates greater diversity. Communities with a diverse array of species landed may be less vulnerable to climate change.

Sea level rise is predicted to have variable impacts on coastal communities. The Mid-Atlantic region has a 3-4 times higher than global average sea level rise rate [28]. Mid-Atlantic communities clustered around the Chesapeake Bay area and the New Jersey shore had especially high vulnerability to sea level rise. These vulnerabilities include infrastructure (docks, marinas, bait shops, gear storage) and access to shore-based facilities due realignment of coastal communities.

Mid-Atlantic fishing communities with total landings value of $100,000 or more were mapped for their dependence on species vulnerable to climate change and catch composition diversity (Simpson Reciprocal Index). A number of communities in southern New Jersey, Maryland and Virginia are highly dependent on species such as clams that

are highly vulnerable to climate change while displaying low catch composition diversity. Communities with this situation are considered more vulnerable to climate change in general [26].

A subset of social vulnerability factors, the poverty index, population composition index, and personal disruption index, can be used to assess potential environmental justice issues. The most highly engaged and reliant commercial and recreational fishing communities (Figs 18 and 19) in the Mid-Atlantic were evaluated for environmental justice (EJ) vulnerability based on 2021 data.

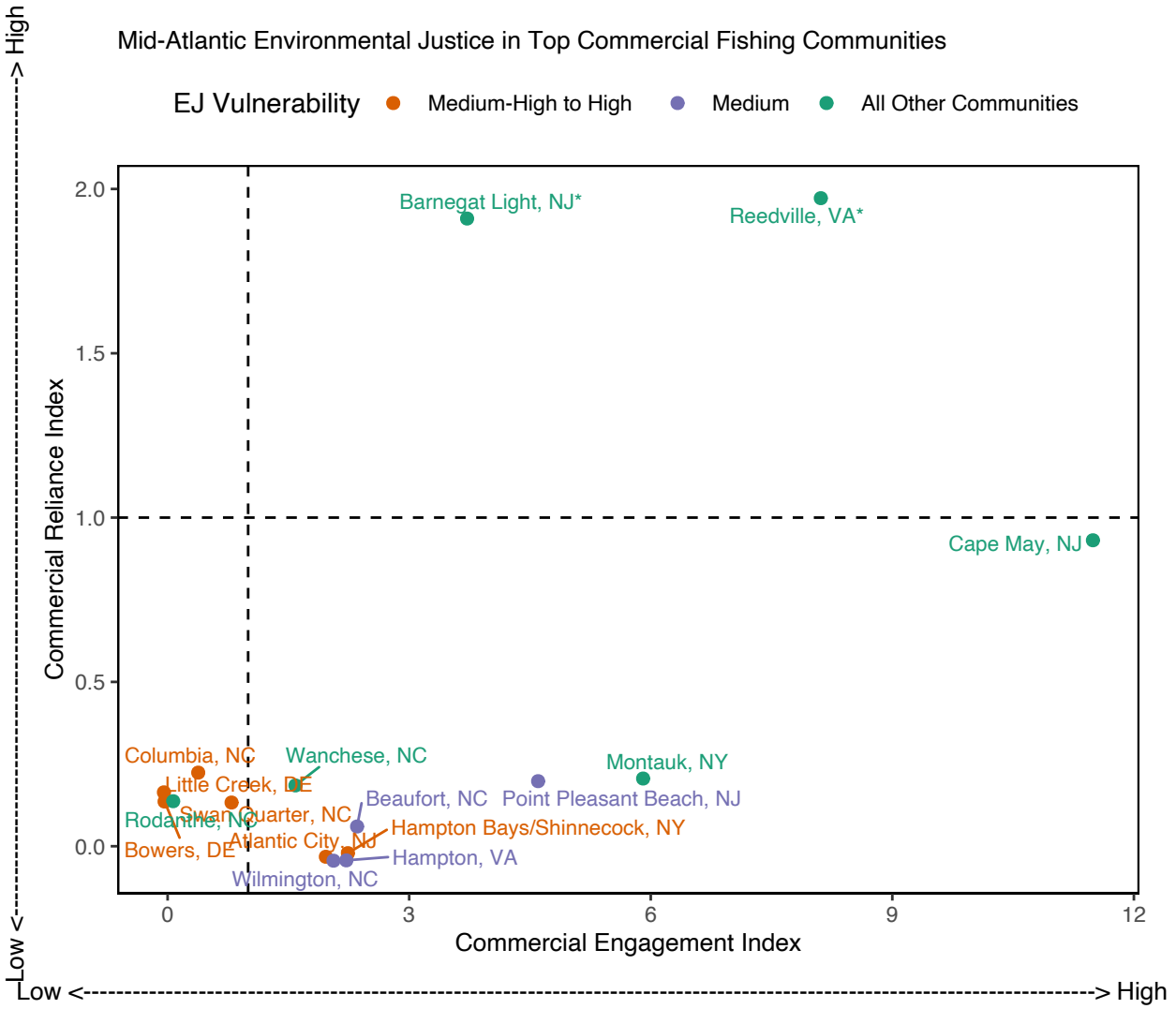

Figure 18: Commercial engagement, reliance, and environmental justice vulnerability for the top commercially engaged and reliant fishing communities in the Mid-Atlantic.

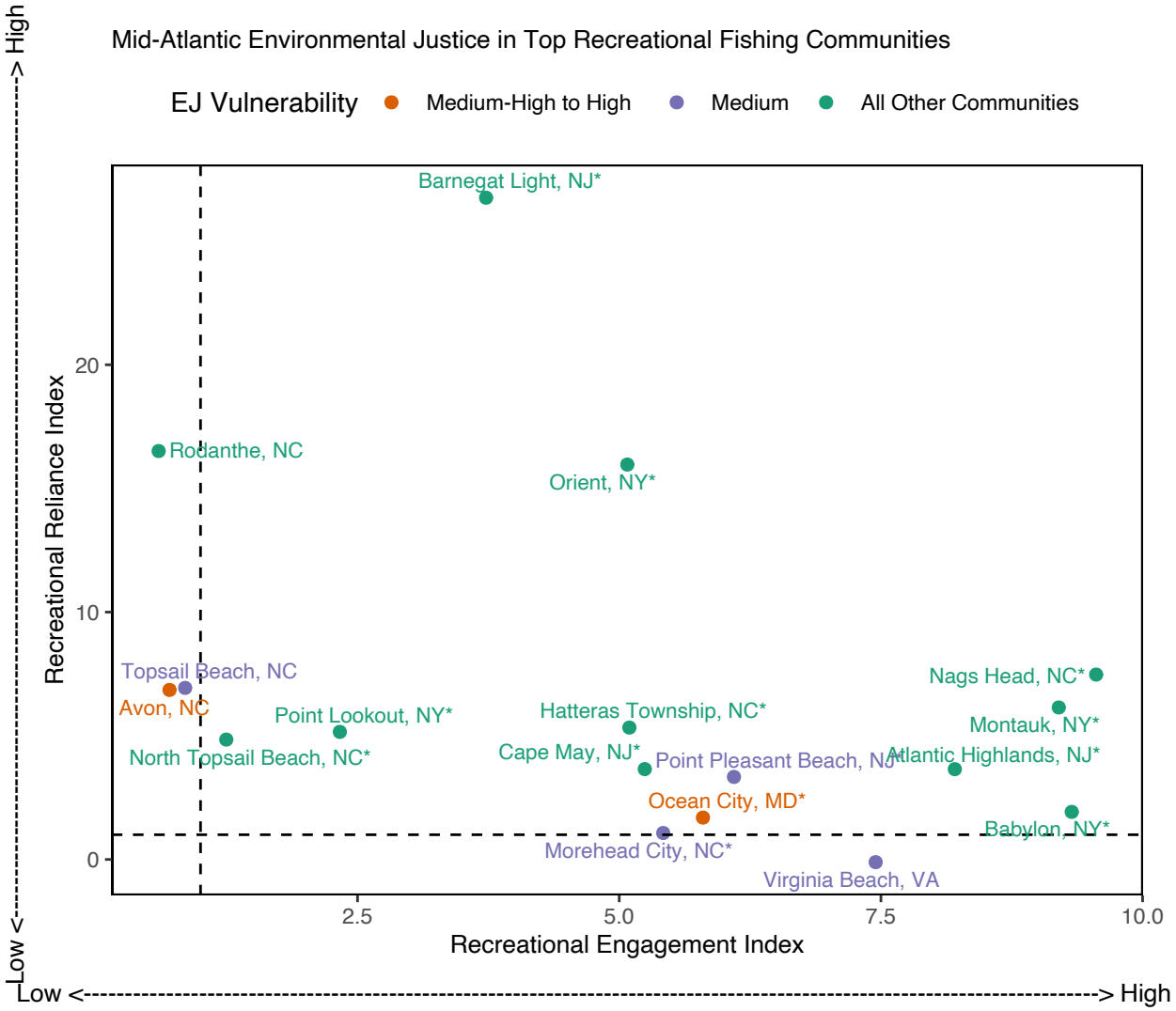

Figure 19: Recreational engagement and reliance, and environmental justice vulnerability, for the top recreationally engaged and reliant fishing communities in the Mid-Atlantic.

To estimate "high" vulnerability across all current indicators (which are ranked on different scales), we tallied rankings of MedHigh or High for social vulnerability and gentrification pressure, along with rankings of High risk from sea level rise, High/Very High species vulnerability, and rankings of Low catch composition diversity. We considered a majority (3 or more out 5) to represent high risk to a community overall because with only 5 indicators, this means that a majority (60-100%) of the individual indicators were high risk. Low risk ranking was defined as few (<10%) vulnerable fishery dependent communities with 3 or more high vulnerability rating. Low-Moderate risk was 10-25% of fishery dependent communities with 3 or more high vulnerability ratings. Moderate-High risk was 25-50% of fishery dependent communities with 3 or more high vulnerability ratings. High risk was a majority (>50%) of fishery dependent communities with 3 or more high vulnerability ratings.

Risk Assessment

In past risk assessments, four of the top communities (20%) had three or more of these high risk rankings, so we ranked overall social-cultural risk as low-moderate for these Mid-Atlantic communities. However, newer analyses evaluating EJ vulnerability could be incorporated into this analysis.

Food Production Elements

Commercial Fishing Production

Description:

This element is applied at the ecosystem level, and describes the risk of not optimizing domestic commercial fishing production from Council-managed species and total commercial fishing production in the Mid-Atlantic. Commercial seafood landings , as well as total landings which include bait, are used to assess fishing production.

Definition:

Risk of not optimizing total commercial fishing production.

Indicators:

Commercial seafood landings from Council managed species (in red, Fig. 20) and total landings (in black) which include bait and industrial uses managed by all entities were used to assess fishing production.

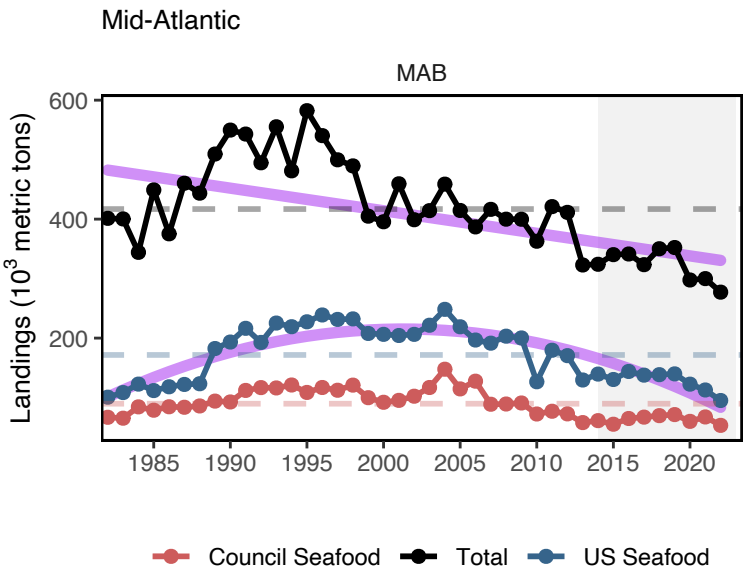

Figure 20: Total commercial landings (black), total U.S. seafood landings (blue), and Mid-Atlantic managed U.S. seafood landings (red), with significant declines (purple) in total and U.S. seafood landings.

Risk criteria:

New criteria still need to be developed to account for both seafood and total commercial landings. Criteria used previously are below.

Risk Level	Definition
Low	No trend or increase in seafood landings
Low-Moderate	Increasing or high variability in seafood landings
Moderate-High	Significant long term decrease in seafood landings
High	Significant recent decrease in seafood landings

Risk Assessment

There is a significant long term decrease in total commercial landings and U.S. seafood landings in the Mid-Atlantic, indicating moderate-high risk using previous criteria.

Recreational/Subsistence Food Production

Description:

This element is applied at the ecosystem level, and describes the risk of not maintaining personal food production.

Definition:

Risk of not maintaining personal food production

Indicators:

Total recreational harvest (all species) is currently used as indicators in the Mid-Atlantic region. Recreational seafood landings (as opposed to total catch which includes catch and release that are captured under other Risk Elements/indicators) were used to assess food use of recreationally caught fish.

The Ecosystem and Ocean Planning Committee and Advisory Panel also supported the potential development of new indicators that would evaluate the subsistence component of this risk element.

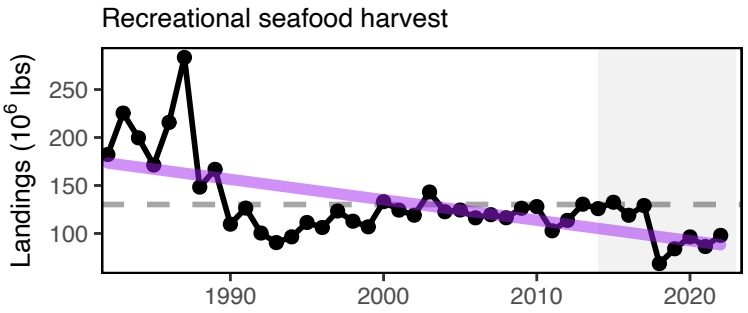

Figure 21: Total recreational seafood harvest (millions of pounds, black, significant decrease, purple) in the Mid-Atlantic region.

Risk criteria:

Risk Level	*Definition*
Low	No trend or increase in recreational landings
Low-Moderate	Increasing or high variability in recreational landings
Moderate-High	Significant long term decrease in recreational landings
High	Significant recent decrease in recreational landings

Risk Assessment

This significant long term decrease in both recreational landings represents a moderate-high risk to food production.

Management Elements

Fishing Mortality Control

Description:

This element is applied at the species and sector (commercial and recreational) level, and addresses the level of management control in terms of catch estimation and monitoring to prevent overfishing. Adequate management control indicates a low risk of overfishing, while poor management control indicates a higher risk of overfishing and hence not achieving OY.

The ability to control total catch within the specified Acceptable Biological Catch (ABC) is necessary to prevent overfishing, which is a fundamental requirement of US fisheries law. Chronic or persistent overfishing can lead

to stock depletion and ultimately to a stock being declared as overfished and requiring a stock rebuilding plan. The ability to constrain catch is a function of the efficacy of the catch monitoring program for each species and sector which relies on both proactive (in -season closure) and reactive (pay backs for overages in subsequent years) accountability measures (AMs). Under certain circumstances, specification of management measures which are too strict could lead to "underfishing" (not achieving the desired quota) and hence not achieving OY.

Definition:

Risk of not achieving OY due to a mismatch of projected effects of management controls with harvest/catch targets.

Indicators:

This risk element is currently defined at "Fishing Mortality Control" which includes both landings and dead discards. Therefore, the total catch at the fishery sector level is compared to the appropriate catch limit (ABC or Annual Catch Limit, ACL). For the commercial fishery, NMFS dealer data in conjunction with estimates of dead discards from the most recent stock assessment are used to compare the annual ABC/ACL to estimated annual commercial catch. For the recreational sector, Marine Recreational Information Program (MRIP) estimates of recreational landings and dead discards in conjunction with stock assessment estimates of recreational discards in weight are used to compare the annual ACL to estimated annual recreational catch estimates.

The Mid-Atlantic State of the Ecosystem report now includes an indicator that looks at total catch divided by total ABC or ACL provides a visualization of this indicator across all Mid-Atlantic species (Fig. 22).

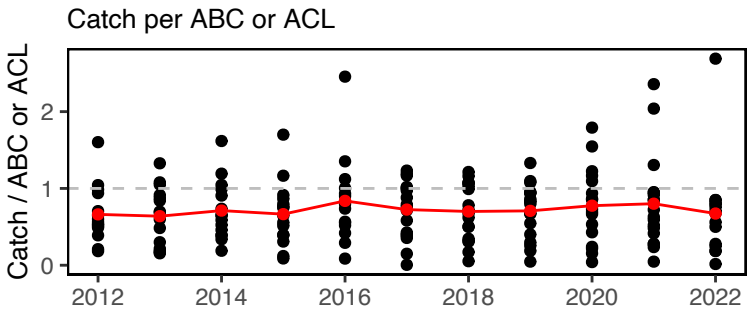

Figure 22: Catch divided by ABC/ACL for MAFMC managed fisheries. High points are recreational black sea bass (up to 2021) and scup (2022). Red line indicates the median ratio across all fisheries.

Risk criteria:

Risk Level	*Definition*
Low	No recent history (last 5 years) of overages
Low-Moderate	Small recent overages, but infrequent
Moderate-High	Routine recent overages, but small to moderate
High	Routine recent significant overages

Small overages are defined as <5%, moderate as 5-10%, and significant overages as >10%. For both sectors, low risk was defined as no history of overages during the last 5 years (2018-2022). Low-moderate risk was small but infrequent overages (1-2 overages). Moderate-high risk was routine (3 or more overages), but small-moderate overages, and high risk was routine, significant overages.

Risk Assessment

Both surfclam and ocean quahog remain as low risk because they are well within recent quotas and are managed as ITQ fisheries. Commercial fisheries for scup, Atlantic mackerel, butterfish, longfin squid, golden tilefish, bluefish, spiny dogfish, and chub mackerel as well as recreational blueline tilefish and spiny dogfish were also low risk with

no recent overages and a variety of management measures in place to avoid overages. While there are no stock assessments or ABCs in place for the Council's unmanaged forage species, there is no indication that the existing trip limits (1,700 pounds) for these species have been exceeded and therefore have a low risk criteria score. Commercial summer flounder, black sea bass, shortfin squid, and blueline tilefish as well as recreational summer flounder, Atlantic mackerel, and bluefish were ranked as low-moderate risk as each fishery had one, small overage during the last five years. Shortfin squid were also ranked low-moderate with two overages early in the time period hut have been below the higher catch limits put in place starting in 2020. Recreational scup and black sea bass are the only two sectors ranked as high risk each with three or more overages greater than 10% within the last five years. Recreational golden tilefish remains unranked because there are no catch and landing limits associated with the recreational fishery and appear to be a relatively minor component of total removals. However, recreational harvest is increasing and future stock assessments may include recreational removals and may warrant additional consideration at that time.

Technical Interactions

Description:

This element is applied at the species and sector (commercial and recreational) level and considers potential interactions with non-Council-managed species, including protected species, on Council-managed fisheries. Here the risk is caused by negative consequences from fishing activity regulated under Council FMPs which interacts with species managed by other agencies, including bycatch of protected species. For example, interactions with species protected under the U.S. Marine Mammal Protection Act (MMPA) could result in greater restrictions in Council managed fisheries, increasing the risk that OY would not be achieved in those fisheries.

Definition:

Risk of not achieving OY due to interactions with non-Council managed species, including protected species.

Indicators:

Indicators used for this element include the MMPA category fishery level (Category I - frequent incidental mortality or injury; Category II - occasional incidental mortality or injury; Category III, remote likelihood of incidental mortality or injury) assigned to the dominant gear type associated with the fishery sector. The occurrence of any accountability measures (AMs) from non-Council managed species, documented interactions with non-Council managed species, and new or anticipated regulatory changes to reduce interactions of protected species over the last 5 years (2018-2022) were also used as indicators.

Risk criteria:

Risk Level	*Definition*
Low	No interactions with non-Council managed species
Low-Moderate	Interactions with non-Council managed species but infrequent, Category II fishery under MMPA with limited takes; or AMs not likely triggered
Moderate-High	AMs in non-Council managed species may be triggered; or Category I fishery under MMPA (but takes less than PBR)
High	AMs in non-Council managed species triggered; or Category I fishery under MMPA and takes above PBR

Evaluation of this risk element requires quantification of the likelihood that non-Council AMs would be triggered and impact fishing activities for Council managed species. In addition, NMFS manages incidental mortality of mammals through take reductions plans which could negatively impact a fishery.

Risk Assessment

All recreational fisheries are ranked as low risk with hook and line gear having no/very limited known interactions with protected species and no AMs have been triggered from non-Council managed fisheries that have implications for the recreational sector. Similalrly, the commercial fisheries for ocean quahogs, surfclams, golden tilefish, blueline tilefish, bluefish, and unmanaged forage species were ranked low risk as there are no known interactions with

protected resources with the primary gear types or no AMs in other fisheries. Summer flounder, scup, black sea bass, Atlantic mackerel, butterfish, shortfin squid, and chub mackerel commercial fisheries were ranked as low-moderate risk due to Category II fisheries designation (primarily trawl and pot fisheries) with some infrequent interactions with marine mammals and shad and river herring catch cap implications from the Atlantic herring fishery. Moderate-high risk rankings were identified for the commercial longfin squid fishery (some marine mammal interactions, sea turtle and Atlantic sturgeon takes, and river herring/shad catch cap implications) and the spiny dogfish commercial fishery (some marine mammal interactions, sea turtle and Atlantic sturgeon takes, and new regulations anticipated to minimize takes of Atlantic sturgeon).

Offshore Wind – Biological/Ecosystem (new)

Description:

This element would be applied at the species level and considers the biological and ecosystem risks of offshore wind development on Council-managed fishery resources and/or the supporting habitat. Offshore wind development is expected to cover 2.4 million acres of ocean space by 2030 in the Greater Atlantic region (ME through NC). Within these lease areas, there are 3,400 foundations (i.e., wind turbines) with over 9,000 miles of interconnecting cable proposed for construction. Offshore wind siting, construction, and operation has the potential for a variety of biological impacts and associated risks for fisheries resources. Habitat alteration, local hydrodynamic changes, underwater noise, and electromagnetic fields (EMF) can affect stock productivity, food availability and migration patterns. However, these risks are likely different across species and habitat types and more research is needed to fully understand these impacts.

Definition:

Risk of not achieving OY due to biological impacts to stock productivity, distribution, and ecosystem structure and function.

Indicators:

Information and relevant data at the species level available in the NOAA Tech Memo titled "Fisheries and Offshore Wind Interactions: Synthesis of Science".

Species distribution overlap with offshore wind from a couple of potential data sources (e.g., https://apps-st.fisheries.noaa.gov/dismap/DisMAP.html). However, translating exposure into a risk of impacts, which is likely to be different by species, may be challenging.

From the State of the Ecosystem report - Right whale spatial overlap with offshore wind lease areas to help inform the ecosystem structure/function component of the definition.

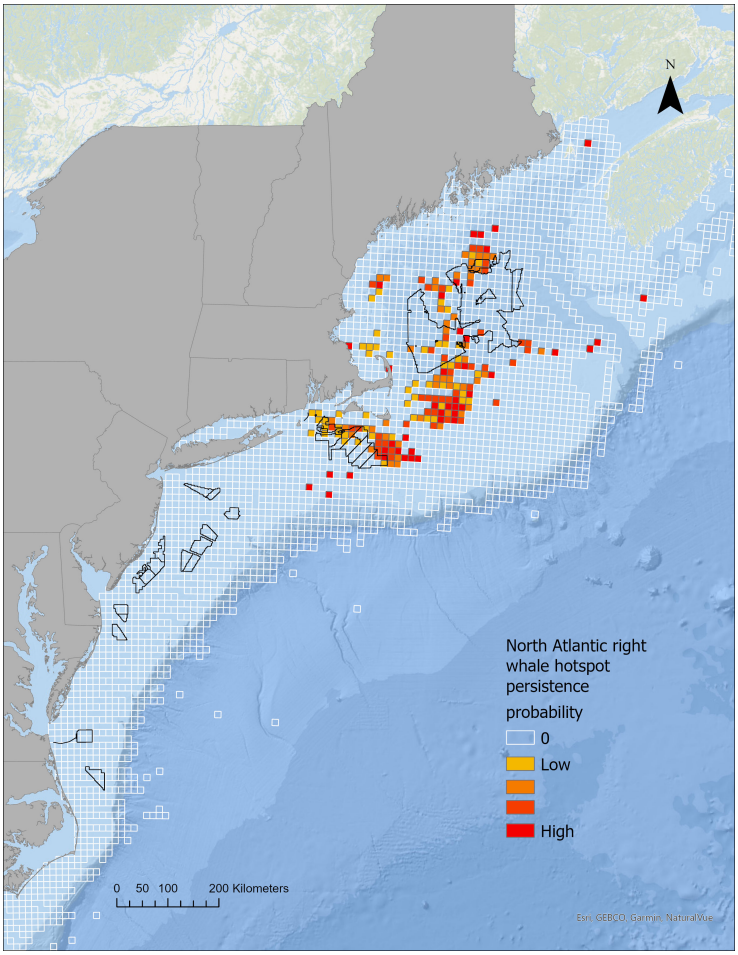

Figure 23: Northern Right Whale persistent hotspots (red shading) and Wind Energy Areas (black outlines).

Right whale hot spots overlap with offshore wind lease areas

In addition, recent work by [29] evaluated the habitat usage by forage species within and outside of offshore wind lease areas (Fig. 24). This information could also be used to help inform the ecosystem structure/function component of the definition.

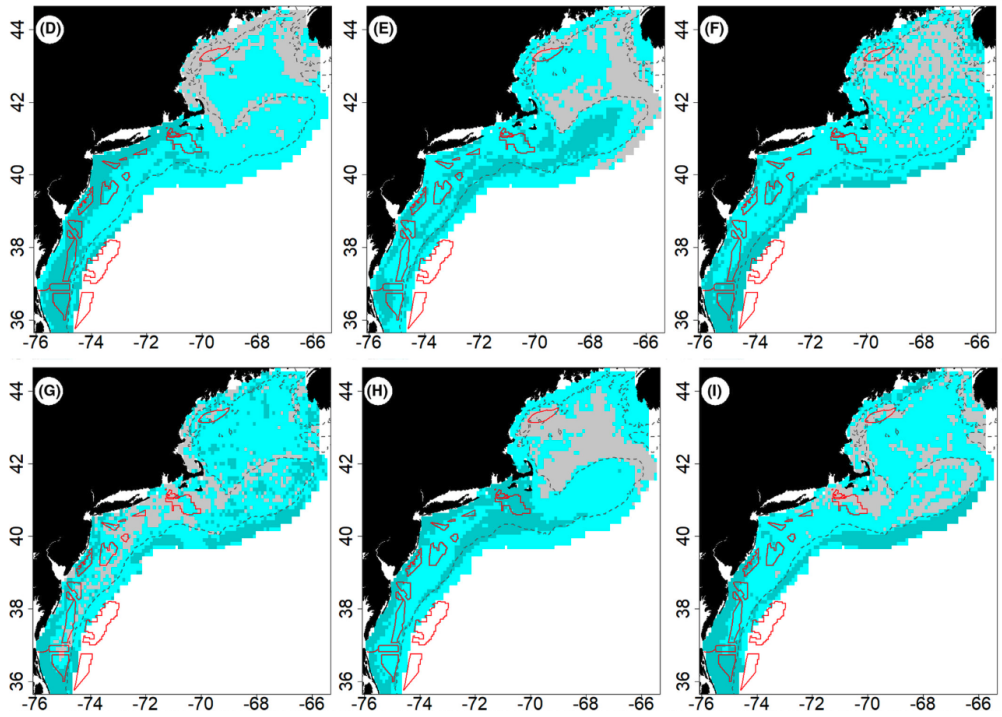

Figure 24: Mean occupancy habitats at the 20th (light blue) and 80th (dark blue) quantile thresholds across forage species; gray shows the model extent. Taxa with autumn models include (D) Round Herring, (E) longfin inshore squid, (F) Atlantic Chub Mackerel, (G) Spanish Sardine, (H) Butterfish, and (I) Atlantic Thread Herring.

Potential risk criteria:

To be developed.

Risk Assessment

To be developed later in the year in collaboration with the EOP Committee and AP once indicators and risk criteria are developed.

Offshore Wind – Fishery Science and Access (new)

Description:

This element would be applied at the species and sector (commercial and recreational) level and considers the risks of offshore wind development on data and science quality and to fishery/fleet access for Council-managed fishery resources. Given the anticipated overlap between offshore wind lease areas and spatial coverage of many fishery-dependent survey strata, there are anticipated survey impacts through "preclusion, habitat change, changes in statistical design, and reduced sampling productivity" [30]. These impacts to the quality and quantity of the data could have implications for stock assessments, scientific uncertainty, and catch levels. As wind turbine construction and operation continues and expands, fishing fleet access, fishing operations, and revenue are anticipated to change.

Definition:

Risk of not achieving OY due to fishery impacts due to access and scientific uncertainty.

Indicators:

Indicators for the Mid-Atlantic State of the Ecosystem and socioeconomic impacts web site. Fishery revenue (Fig. 25) and party charter activity from within lease areas by species, fleet, or community, community vulnerability/engagement/EEJ, spatial overlap of lease areas and federal fisheries surveys (Fig. 26).

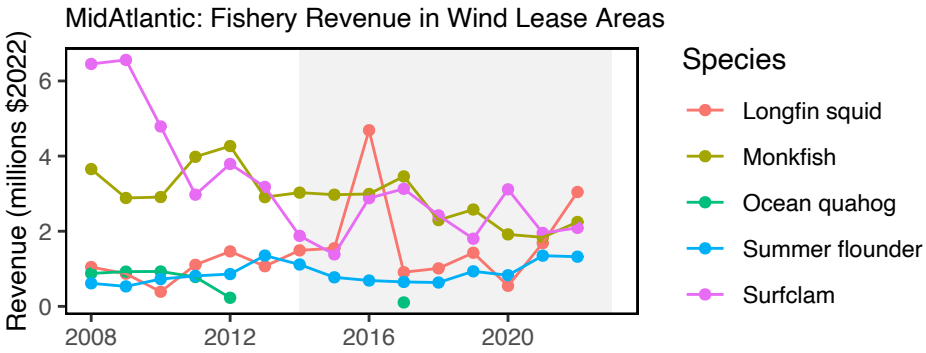

Figure 25: Fishery revenue in wind energy lease areas in the Mid-Atlantic.

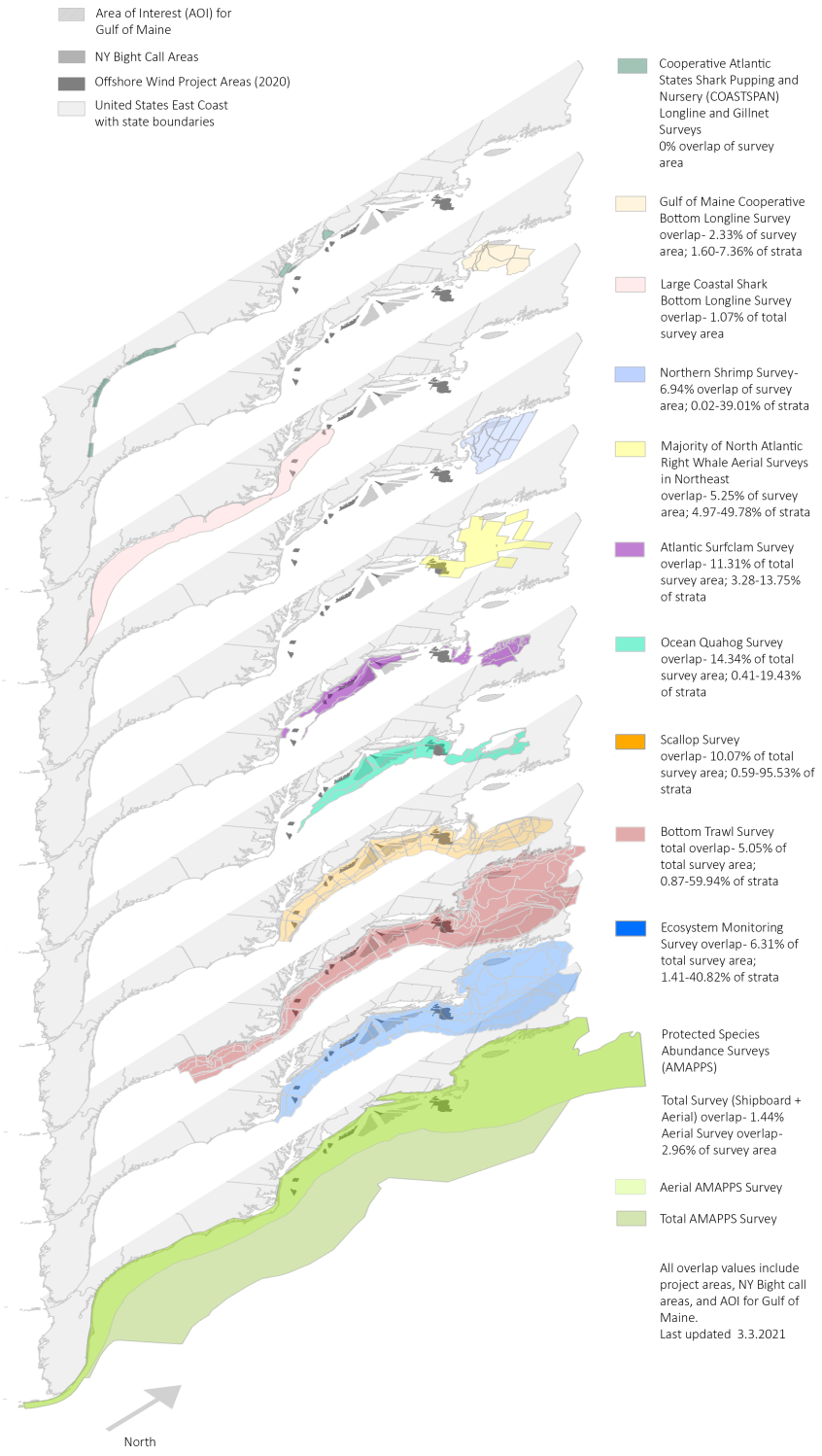

Figure 26: Spatial overlap map with NEFSC surveys (From 2021 SOE; wind areas are out of date)

FishRules and FishBrain apps for recreational fishing spatial overlap information (work is still under review).

Potential risk criteria:

Risk Level	*Definition*
Low	0-3% revenue in lease area; no/low EEJ concerns; 0-5% spatial overlap for relevant survey(s)
Low-Moderate	4-10% revenue in lease area; low-moderate EEJ concerns; 5-20% spatial overlap for relevant survey(s)
Moderate-High	11-20% revenue in lease area; moderate-high EEJ concerns; 21-40% spatial overlap for relevant survey(s)
High	>20% revenue in lease area; high EEJ concerns; >40% spatial overlap for relevant survey(s)

Risk Assessment

To be developed later in the year in collaboration with the EOP Committee and AP once indicators and risk criteria are developed.

Other Ocean Activities

Description:

This element is applied at the species and sector (commercial and recreational) level, and addresses the risk of fishery displacement or damage of a fishery resource and/or supporting habitat as a result of non-fishing activities in the ocean (e.g., energy development/aquaculture/shipping/other industrial uses, etc.). Many of these activities are in planning stages but not yet implemented in the region. It also includes evaluation of risk to Council fisheries from area-based measures outside of the control of the Council, including area closures implemented by other Councils to protect sensitive habitats, spawning areas, etc. and/or through marine monument/sanctuaries or other types of area-based management designations.

Definition:

Risk of not achieving OY due to fishery displacement from non-fishing ocean activities and/or area designations.

Indicators:

A more quantitative approach (similar to that done for offshore wind) could be applied with GIS mapping to determine the spatial footprint of current and future planned non-fishing activities (if available) could be calculated and qualify and spatial overlap with existing habitat and/or fishing ground locations. With a quantitative evaluation, potential to use a range/binned approach to specify risk level (e.g., 0-10% overlap, low risk, 11-20% overlap, low-moderate risk etc.), but those bins and risk level would likely be arbitrary. Depending on scope of element and how applied, could use the NMFS Habitat Climate Vulnerability Assessment, the Mid-Atlantic Council NRHA data explorer, and the America the CCC Area-Based Management tool for spatial mapping and overlap calculations.

Potential risk criteria:

Risk Level	*Definition*
Low	No spatial overlap with fisheries
Low-Moderate	Low-moderate overlap with fisheries
Moderate-High	Moderate-high overlap with fisheries
High	High overlap with fisheries; other uses could seriously disrupt fishery prosecution

Further refinement of the criteria will be needed to identify potential thresholds to indicate a specific risk level.

Risk Assessment

To be developed later in year in collaboration with the EOP Committee and AP once indicators and risk criteria are developed.

Regulatory Complexity and Stability

Description:

This element is applied at the species and sector (commercial and recreational) level. Constituents have frequently raised concerns about the complexity and continually changing fishery regulations and the need to simplify them to improve their efficacy. Complex and constantly changing regulations may lead to non-compliance and/or impact other fisheries. Non-compliance could have stock assessment, data quality, management, and fairness and equity implications.

Definition:

Risk of not achieving OY due to frequency of regulatory modifications and regulatory complexity, which may have an adverse effect on compliance.

Indicators:

For this element, a combination of qualitative and quantitative indicators were used. Council staff used a qualitative evaluation of the relative complexity of the regulations contained within an FMP and a quantitative approach that considered the frequency of any regulatory change over the last 5 years by fishery and sector. In addition, for the recreational sector, the number of states in management unit with different regulations was also used.

Potential risk criteria:

Risk Level	*Definition*
Low	Simple/few regulations; rarely/if ever change; same recreational regulations for all states in the management unit
Low-Moderate	Low-moderate complexity; occasional changes within last 5 years; few (1-2) recreational regulations across states in the management unit
Moderate-High	Moderate-high complexity; occasional changes within last 5 years; moderate (3-4) recreational regulations across states in management unit
High	High complexity; frequent changes within last 5 years; many (5+) recreational regulations across states in management unit

Risk Assessment

Surfclam, ocean quahog, commercial and recreational golden tilefish, commercial blueline tilefish, recreational spiny dogfish, chub mackerel and unmanaged forage all scored as low risk. These fisheries are generally smaller fisheries with fairly consistent catch specifications with few to little overages, if applicable; therefore, there have been minor/few regulation changes over the last five years, regulations have limited complexity and are fairly consistent across all states. Commercial summer flounder, scup, black sea bass, and bluefish ranked low-moderate risk with moderately complex regulations, particularly at the state level, but have changed very little recently. Recreational Atlantic mackerel and blueline tilefish also ranked as low-moderate due to their less complex regulations that are consistent across states, but have undergone some recent changes. The moderate-high risk ranking for butterfish, longfin squid, and shortfin squid were based on their high complexity and pending changes to the shortfin squid fishery. Recreational bluefish also scored as moderate-high risk based on recent regulation changes and a high degree of variability in regulations across the states. While the frequency of regulation changes in the recreational fisheries for summer flounder, scup, and black sea bass has declined recently, they still ranked as high risk as changes can still occur fairly regularly, regulations can be complex with a range of fishing mode and seasonal differences and there is a high degree of variability across states. The commercial fisheries for Atlantic mackerel and spiny dogfish also ranked as high risk due to their highly complex and frequently changing regulations, sometimes year to year or even within year.

Discards

Description:

This element is applied at the species and sector level. Stakeholders have identified the reduction of discards as a high priority in the Council management program, especially those caused by regulations since they represent biological and economic waste. Discards of either the target or non-target species in the fishery would be taken into consideration.

Definition:

Risk of not minimizing regulatory discards, bycatch mortality, and incidental catch to extent practicable.

Indicators:

NMFS provides estimates of discards by species based, in large part, on at-sea observations collected in the Northeast Fisheries Observer Program (NEFOP), for stock assessment purposes and quota monitoring. The observer program provides information on the reason for discarding during a commercial trip. In addition, the MRIP provides estimate of discards by species for the recreational fisheries. Discards and incidental catch were evaluated for each species and fishery with a focus on identifying discards caused by regulations for each fishery sector. All of this information was used to estimate total dead discards by fishing sector. The proportion of dead discards to overall catch (dead discards + harvest) of the target species by sector was calculated as one indicator. The discard mortality rate for the dominant gear type used in the stock assessment were used as another indicator. The relative proportion of non-target species to the total catch was also considered when evaluating the criteria.

Potential risk criteria:

Risk Level	*Definition*
Low	No significant discards or incidental catch; no significant discard mortality
Low-Moderate	Low or episodic discards and incidental catch; low discard mortality
Moderate-High	Regular discards and incidental catch but managed; moderate discard mortality
High	High discards and incidental catch, difficult to manage; high discard mortality.

Low risk was defined as no significant discards and incidental catch (<5%) and a discard mortality rate of <5% for the dominant gear type. Low-Moderate risk was low or episodic discarding and incidental catch (>5% but <20%) and a discard mortality rate of <25% for the dominant gear type. Moderate-High risk was regular discarding and incidental catch (>20% but <40%) but managed at an acceptable level and a discard mortality rate of <50% for the dominant gear type. High risk was high discarding and incidental catch (>40%) with difficulty in management and a discard mortality rate of >50% for the dominant gear type.

Risk Assessment

The commercial and recreational fisheries for both golden and blueline tilefish were ranked low risk. There is minimal data for the blueline tilefish fisheries, but discards are assumed to be small and there are few vessels targeting blueline tilefish. Recreational tilefish discards are also negligible and the ITQ commercial golden tilefish fishery is prohibited from discarding tilefish. Shortfin squid, chub mackerel, and unmanaged forage were also ranked as low risk due to the low discards and incidental catch associated with these fisheries. The commercial and recreational fisheries for Atlantic mackerel, bluefish, and spiny dogfish were all ranked at low-moderate risk. While discards occur frequently in these fisheries, dead discards comprise a relatively low proportion of total catch, are generally managed, and discard mortality for most gears is relatively low. Discards in the surfclam and ocean quahog fisheries is a low percent of the overall catch; however, the co-occurrence of surfclams and ocean quahogs has become a significant issue in the fishery and has led to discarding events and has been ranked as medium-high risk. The commercial fisheries for summer flounder, scup, butterfish, and longfin squid were also ranked as medium-high risk. For summer flounder and scup, commercial discards comprise a relatively small portion of the total commercial catch but can be highly variable and the discard mortality rate associated with trawl gear is high. A high proportion of butterfish are discarded and nearly 33% of the longfin squid catch is comprised of discarded non-target species. The recreational summer flounder, scup, and black sea bass fisheries all ranked as medium-high risk where discard

mortality is assumed to be 15% or less but discards make up a high proportion of the total catch, as high as 90%, and have led, in part, to recent ACL overages. The commercial black sea bass fishery ranked as high risk because dead discards account for 26% of the total commercial catch, discards have also been highly variable, and the dominant gear type (trawls) has a 100% discard mortality rate.

Allocation

Description:

Many Mid-Atlantic fisheries have some allocation component and any adjustments/changes in allocation can be driven by a number of factors which can present a variety of management, biological, and fishery risks. This element is applied at the species and sector level, and addresses the risk of not achieving OY due to spatial mismatch of stocks and management allocations or because of sub-optimal allocation by sector and/or area.

Definition:

Risk of not achieving OY due to spatial mismatch of stocks and management or sub-optimal allocation by sector and/or area.

Indicators:

The Allocation indicator consists of whether or not the Council is considering or an ongoing management action that might have any sort of allocation outcome/implication (by sector, region, permit holder etc.).

Risk criteria:

Risk Level	*Definition*
Low	No recent or ongoing Council discussion about allocation
Low-Moderate	*This category not used*
Moderate-High	*This category not used*
High	Recent or ongoing Council discussion about allocation

Currently, there are no definitions to specify intermediate levels of risk for this element, so only low and high risk criteria have been developed. A Low risk ranking was no recent or ongoing Council discussion about allocation. High risk was defined as recent or ongoing Council discussion about allocation.

Risk Assessment

The recreational fisheries for summer flounder, scup, black sea bass, and bluefish all ranked as high risk because the Council has initiated an amendment that, among other things, will consider sector separation within the recreational sector which may include designating allocations between the for-hire and private recreational sectors. All other fisheries were ranked as low risk because recent allocation decisions have been finalized and/or there are currently no allocation related issues under consideration. There have been some recent discussions regarding allocations in both the golden and blueline tilefish fisheries and may be considered in the future if recreational landings continue to increase for golden tilefish.

Summary

Species level risk elements

Table 30: Species level risk analysis results; l=low risk (green), lm= low-moderate risk (yellow), mh=moderate to high risk (orange), h=high risk (red). Greyed out risk elements to be completed later in 2024.

Species	Assess	Fstatus	Bstatus	PreyA	PredP	FW2Prey	Climate	DistShift	EstHabitat	OffHab
Ocean Quahog	low	low	low			low	high	modhigh	low	
Surfclam	low	low	low			low	modhigh	modhigh	low	
Summer flounder	low	high	lowmod			low	lowmod	modhigh	high	
Scup	low	low	low			low	lowmod	modhigh	high	
Black sea bass	low	low	low			low	modhigh	modhigh	high	
Atl. mackerel	low	low	high			low	lowmod	modhigh	low	
Chub mackerel	high	lowmod	lowmod			low	na	na	low	
Butterfish	low	low	lowmod			low	low	high	low	
Longfin squid	lowmod	lowmod	lowmod			lowmod	low	modhigh	low	
Shortfin squid	high	lowmod	lowmod			lowmod	low	high	low	
Golden tilefish	low	low	lowmod			low	modhigh	low	low	
Blueline tilefish	high	high	modhigh			low	modhigh	low	low	
Bluefish	low	low	lowmod			low	low	modhigh	high	
Spiny dogfish	low	high	low			low	low	high	low	
Monkfish	high	lowmod	lowmod			low	low	modhigh	low	
Unmanaged forage	na	na	na			lowmod	na	na	na	
Deepsea corals	na	na	na			low	na	na	na	

Ecosystem level risk elements

Table 31: Ecosystem level risk analysis results; l=low risk (green), lm= low-moderate risk (yellow), mh=moderate to high risk (orange), h=high risk (red). Greyed out risk elements to be completed later in 2024.

System	EcoProd	CommVal	RecVal	FishRes1	FishRes4	ComDiv	RecDiv	Social	ComFood	RecFood
Mid-Atlantic	lowmod	modhigh	lowmod	low	modhigh	low		lowmod	high	modhigh

Species and Sector level risk elements

Table 32: Species and sector level risk analysis results; l=low risk (green), lm= low-moderate risk (yellow), mh=moderate to high risk (orange), h=high risk (red). Greyed out risk elements to be completed later in 2024.

Species	FControl	Interact	OSW1	OSW2	OtherUse	RegComplex	Discards	Allocation
Ocean Quahog-C	low	low				low	modhigh	low
Surfclam-C	low	low				low	modhigh	low
Summer flounder-R	lowmod	low				high	modhigh	high
Summer flounder-C	lowmod	lowmod				lowmod	modhigh	low
Scup-R	high	low				high	modhigh	high
Scup-C	low	lowmod				lowmod	modhigh	low
Black sea bass-R	high	low				high	modhigh	high
Black sea bass-C	lowmod	lowmod				lowmod	high	low
Atl. mackerel-R	lowmod	low				lowmod	lowmod	low
Atl. mackerel-C	low	lowmod				high	lowmod	low
Butterfish-C	low	lowmod				modhigh	modhigh	low
Longfin squid-C	low	modhigh				modhigh	modhigh	low
Shortfin squid-C	lowmod	lowmod				modhigh	low	low
Golden tilefish-R	na	low				low	low	low
Golden tilefish-C	low	low				low	low	low
Blueline tilefish-R	low	low				lowmod	low	low
Blueline tilefish-C	lowmod	low				low	low	low
Bluefish-R	lowmod	low				modhigh	lowmod	high
Bluefish-C	low	low				lowmod	lowmod	low
Spiny dogfish-R	low	low				low	lowmod	low
Spiny dogfish-C	low	modhigh				high	lowmod	low
Chub mackerel-C	low	lowmod				low	low	low
Unmanaged forage	low	low				low	low	low
Deepsea corals	na	na				na	na	na

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