Introduction

The Council approved an 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 risk elements included in the Council's initial assessment spanned 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).

This document updates the Mid-Atlantic Council's initial EAFM risk assessment [3] with indicators from the 2023 State of the Ecosystem report. The Management elements were not updated in 2023. The risk assessment 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.

Many risk rankings are unchanged based on the updated indicators for 2023 and the Council's risk criteria. Below, we highlight only the elements where updated information has changed the perception of risk. In addition, we present new indicators based on Council feedback on the original risk analysis that the Council may wish to include in future updates to the EAFM risk assessment. As part of the Council's 2023 Implementation Plan, the Council will complete a comprehensive review of the risk assessment where new/different risk elements and analyses that could inform the risk criteria can be considered. The review was initiated in late 2022 and will occur throughout 2023 and includes working with the Council's Ecosystem and Ocean Planning Committee and Advisory Panel. It is anticipated any recommended changes and improvements identified during the review will be presented to the Council for their consideration at their October 2023 meeting.

[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

Table 1: Risk Elements, Definitions, and Indicators Used

Element	Definition	Indicator
Ecological		
Assessment performance	Risk of not achieving OY due to analytical limitations	Current assessment method/data quality
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 (MAFMC Predator)	Risk of not achieving OY due to MAFMC managed species interactions	Diet composition, management measures
Food web (MAFMC Prey)	Risk of not achieving OY due to MAFMC managed species interactions	Diet composition, management measures
Food web (Protected Species Prey)	Risk of not achieving protected species objectives due to species interactions	Diet composition, management measures
Ecosystem productivity	Risk of not achieving OY due to changing system productivity	Four indicators, see text
Climate	Risk of not achieving OY due to climate vulnerability	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 Revenue	Risk of not maximizing fishery value	Revenue in aggregate
Recreational Angler Days/Trips	Risk of not maximizing fishery value	Numbers of anglers and trips in aggregate
Commercial Fishery Resilience (Revenue Diversity)	Risk of reduced fishery business resilience	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		
Fleet Resilience	Risk of reduced fishery resilience	Number of fleets, fleet diversity
Social-Cultural	Risk of reduced community resilience	Community vulnerability, fishery engagement and reliance
Food Production		
Commercial	Risk of not optimizing seafood production	Seafood landings in aggregate
Recreational	Risk of not maintaining personal food production	Recreational landings in aggregate
Management		
Control	Risk of not achieving OY due to inadequate control	Catch compared to allocation
Interactions	Risk of not achieving OY due to interactions with species managed by other entities	Number and type of interactions with protected or non-MAFMC managed species, co-management
Other ocean uses	Risk of not achieving OY due to other human uses	Fishery overlap with energy/mining areas
Regulatory complexity	Risk of not achieving compliance due to complexity	Number of regulations by species
Discards	Risk of not minimizing bycatch to extent practicable	Standardized Bycatch Reporting
Allocation	Risk of not achieving OY due to spatial mismatch of stocks and management	Distribution shifts + number of interests

Table 2: Risk Ranking Criteria used for each Risk Element

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 (MAFMC Predator)	Few interactions as predators of other MAFMC managed species, or predator of other managed species in aggregate but below 50% of diet	*This category not used*	*This category not used*	Managed species highly dependent on other MAFMC managed species as prey
Food web (MAFMC Prey)	Few interactions as prey of other MAFMC managed species, or prey of other managed species but below 50% of diet	Important prey with management consideration of interaction	*This category not used*	Managed species is sole prey and/or subject to high mortality due to other MAFMC managed species
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, all 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 for distribution shifts	Very high potential for 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	No change in offshore habitat quality or quantity	Increasing variability in habitat quality or quantity	Significant long term decrease in habitat quality or quantity	Significant recent decrease in habitat quality or quantity
Commercial Revenue	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 days/trips	Increasing or high variability in angler days/trips	Significant long term decreases in angler days/trips	Significant recent decreases in angler days/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

Table 2: Risk Ranking Criteria used for each Risk Element *(continued)*

Element	Low	Low-Moderate	Moderate-High	High
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
Fleet Resilience	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
Social-Cultural	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	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	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
Control	No history of overages	Small overages, but infrequent	Routine overages, but small to moderate	Routine significant overages
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
Other ocean uses	No overlap; no impact on habitat	Low-moderate overlap; minor habitat impacts but transient	Moderate-high overlap; minor habitat impacts but persistent	High overlap; other uses could seriously disrupt fishery prosecution; major permanent habitat impacts
Regulatory complexity	Simple/few regulations; rarely if ever change	Low-moderate complexity; occasional changes	Moderate-high complexity; occasional changes	High complexity; frequently changed
Discards	No significant discards	Low or episodic discard	Regular discard but managed	High discard, difficult to manage
Allocation	No recent or ongoing Council discussion about allocation	*This category not used*	*This category not used*	Recent or ongoing Council discussion about allocation

Changes from 2022: Ecological risk elements

Decreased Risk: 2

The 2022 spiny dogfish Research Track assessment put forward an analytical stock assessment model which passed peer review. This model is considered an improvement over the empirical method applied in the past, which was ranked low-moderate risk. Therefore, the risk ranking for assessment performance (**Assess**, risk of not achieving OY due to analytical limitations) was decreased to low.

Based on the December 2022 Research Track assessment, bluefish stock biomass (**Bstatus**) improved from below $0.5B_{msy}$ (high risk) to above $0.5B_{msy}$ but below B_{msy} (low-moderate risk).

Increased Risk: 2

The 2022 *Illex* Research Track assessment was unable to put any analytical method forward to evaluate stock status or trends. Therefore, the risk ranking for assessment performance (**Assess**) was increased fron low-moderate to high.

Based on the December 2022 Research Track assessment, spiny dogfish fishing mortality (**Fstatus**) was above F_{msy} (high risk).

Update on Estuarine Habitat Quality (Chesapeake Bay)

Many important MAFMC managed species (e.g., summer flounder, scup, black sea bass, and bluefish) use estuarine habitats as nurseries or are considered estuarine and nearshore coastal-dependent, and interact with other important estuarine-dependent species (e.g., striped bass and menhaden).

Relative habitat use of Chesapeake Bay by several finfish species, including Atlantic croaker, spot, summer flounder, weakfish, clearnose skate, and horseshoe crab is declining [**schonfeld_spatial_2022?**]. There is evidence suitable habitat for juvenile summer flounder growth has declined by 50% or more [**fabrizio_characterization_2022?**]. Climate change is expected to continue impacting habitat function and use for multiple species. Restoration of oyster reefs (see below) and marshes could help address these challenges.

Forage and structure-forming species were likely favored by 2022 conditions in Chesapeake Bay. Average water temperatures in 2022 and above-average salinity conditions mean a suitable habitat year for bay anchovy, a key forage species. Bay anchovy abundances are directly correlated with the area of suitable habitat. Above-average salinities beginning in June 2022 were associated with strong oyster recruitment [**kimmel_relationship_2014?**]. However, oyster populations are severely depleted from historical levels. Large-scale restoration in 10 tributaries across the Chesapeake Bay is helping recover oyster reef habitat and populations in select areas.

Updated information on estuarine conditions suggests that high risk for estuarine-dependent species is still warranted. However, direct links between estuarine habitat conditions and population attributes for managed species (as reported in the SOE for Chesapeake Bay striped bass and blue crabs, as well as summer flounder and black sea bass) could be incorporated into future risk assessments as the science continues to develop.

Update on Climate risks

Current risks to species productivity (and therefore to achieving OY) due to projected climate change in the Northeast US were derived from a comprehensive assessment [4]. This assessment 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. Mid-Atlantic species were all either highly (77%) or very highly (23%) exposed to climate risk in this region, with a range of sensitivity (low-62%, moderate-15%, high-15%, and very high-8%) to expected climate change in the Northeast US. The combination of exposure and sensitivity results in the overall vulnerability ranking for each species (see the **Climate** column of Table 4).

In 2021, the SOE was restructured with an entire section focused on Climate risks to meeting fishery management objectives. New information has been added to the SOE that could be used to update species-specific Climate risk rankings in the future. The 2023 SOE includes multiple climate indicators including surface and bottom water temperature, marine heat waves, Gulf Stream position and warm core rings, cold pool area and persistence, and ocean acidification measurements.

Ocean acidification has different implications depending on the species and life stage. Summer aragonite saturation was at or below the sensitivity levels for both Atlantic sea scallop and longfin squid in Long Island Sound and the nearshore and mid-shelf regions of the New Jersey shelf several times over the past decade (Fig. 1). Recent lab studies have found that surf clams exhibited metabolic depression in a pH range of 7.46-7.28 [**pousse_energetic_2020?**]. Aggregated data from 2007-2021 show that summer bottom ocean pH (7.69-8.07) has not yet reached the metabolic depression threshold observed for surfclams in lab studies so far. The projected effects of changing temperature and ocean chemistry over the coming century may alter surfclam growth and reproduction [**pousse_dynamic_2022?**].

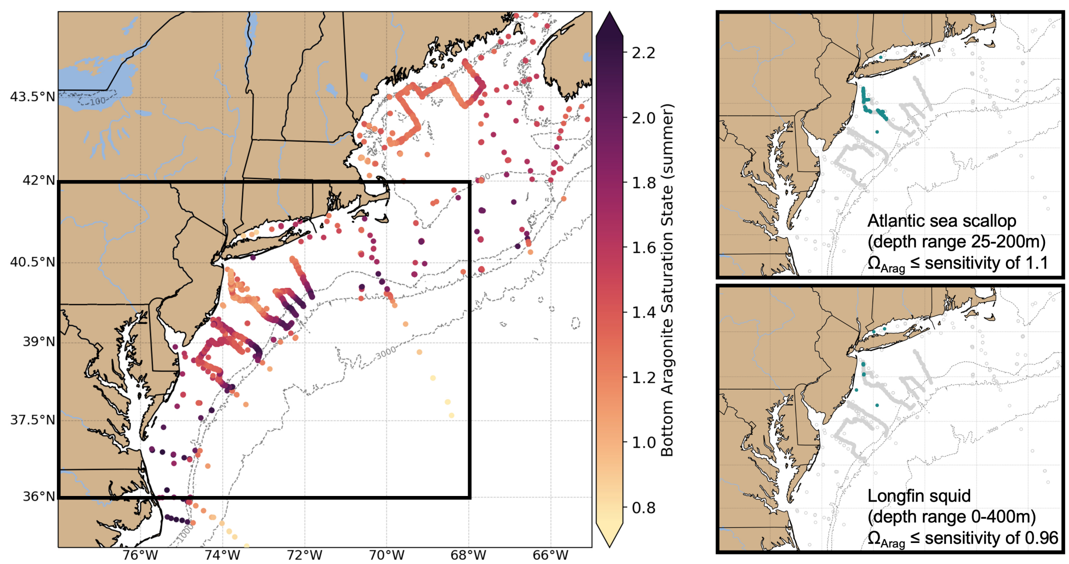


Figure 1: Left panel: Bottom aragonite saturation state (Ω_{Arag}; summer only: June-August) on the U.S. Northeast Shelf based on quality-controlled vessel- and glider-based datasets from 2007-present. Right panel: Locations where summer bottom Ω_{Arag} were at or below the laboratory-derived sensitivity level for Atlantic sea scallop (top panel) and longfin squid (bottom). Gray circles indicate locations where carbonate chemistry samples were collected, but bottom Ω_{Arag} values were higher than sensitivity values determined for that species.

While offshore habitat conditions have degraded for some species, they have improved for others. Between 2017 and 2021, extraordinarily high availability of northern shortfin squid (*Illex*) were observed in the Mid-Atlantic, resulting in high fishery catch per unit effort (CPUE) and early fishery closures. High instances of squid catch near the shelf break are significantly related to low bottom temperatures ($<$ 10 degrees C), high salinity ($>$35.6 psu), increased chlorophyll frontal activity, as well as the presence and orientation of warm core rings. Warm core rings are an important contributor to squid availability, likely influencing habitat conditions across different life stages and as a transport mechanism of higher salinity water to the shelf. In addition, fishing effort is often concentrated on the eastern edge of warm core rings, which are associated with upwelling and enhanced productivity. There were fewer warm core rings near the continental shelf in 2022, which combined with economic fishery drivers may have contributed to total catch of *Illex* squid being 20% less than the total catch reported in 2021.

This updated information could be used by the Council to consider offshore habitat risk indicators and critiera for several species.

Potential new indicators

A forage fish index was introduced in the 2023 SOE to evaluate changes in the aggregate forage base available to predators (Fig. 2). This index could be used in combination with new information on energy density of key forage species (Fig. 3) and current food web risk indicators to evaluate overall food web risks to MAFMC managed species and protected species (elements **FW1Pred**, **FW1Prey**, **FW2Prey**).

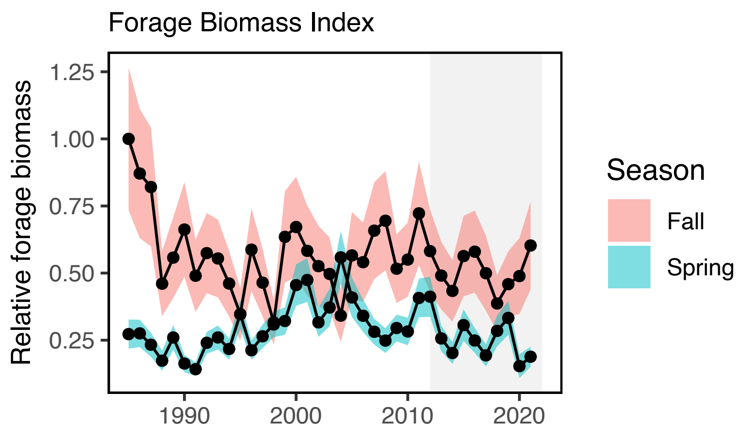


Figure 2: Forage fish index based on spring and fall survey predator diets.

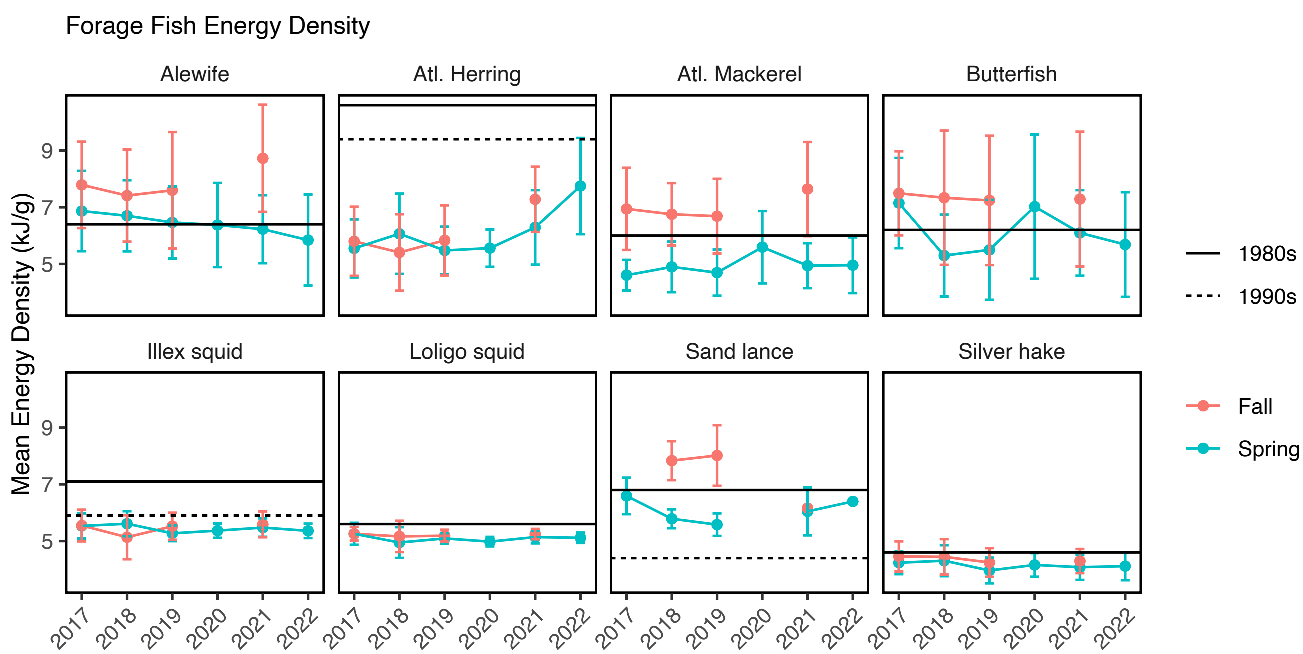


Figure 3: Forage fish energy density mean and standard deviation by season and year, compared with 1980s (solid line; Steimle and Terranove 1985) and 1990s (dashed line; Lawson et al. 1998) values.

A Habitat Climate Vulnerability Assessment (HCVA) for habitat types in the Northeast US Large Marine Ecosystem was published in January 2021 [5]. To better understand which species depend on vulnerable habitats, the Atlantic Coastal Fish Habitat Partnership (ACFHP) habitat-species matrix [6] was used in conjunction with the results of the HCVA and the Northeast Fish and Shellfish Climate Vulnerability Assessment (FCVA) completed in 2016 [4].

The ACFHP matrix identified the importance of coastal benthic habitats to each life stage of select fish species, which helps elucidate species that may be highly dependent on highly vulnerable habitats that were identified in the HCVA.

Several MAFMC managed species, including black sea bass, scup, and summer flounder, are dependent on several highly vulnerable nearshore habitats from salt marsh through shallow estuarine and marine reefs. Details on highly vulnerable habitats with linkages to a variety of species, including which life stages have different levels of dependence on a particular habitat, are available in a detailed table.[3]

Please see the 2022 Risk Assessment update for examples of species narratives linking habitat risk to individual managed species.

We seek Council feedback on how best to include information on habitat climate vulnerability for managed species in future EAFM risk assessments.

Changes from 2022: Economic, Social, and Food production risk elements

Decreased Risk: 1

Recreational value has changed from low-moderate risk to low risk based on 2023 indicator updates. Recreational value was ranked high risk in the 2018 risk assessment due to a significant decrease in angler trips over the most recent 10 years of the time series. In 2019, the risk assessment noted that in the updated MRIP angler trip time series, "declines are less pronounced than measured previously. A reduction from the highest risk ranking to a lower risk category may be warranted."

Updated information from 2021 eliminated the recent trend, and contributed to a long term increase in recreational effort (angler trips), with 2020 effort above the long-term average; however the addition of the 2022 data results in no long term trend (Fig. 4).

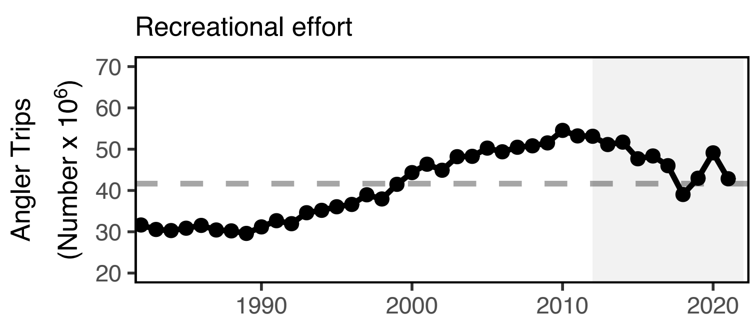


Figure 4: Recreational effort in the Mid-Atlantic.

No long term change in recreational angler trips results in an updated low risk ranking according to Council criteria.

Increased Risk: 0

No indicators for existing economic, social, and food production elements have changed enough to warrant increased risk rankings according to the Council risk criteria.

[3] https://noaa-edab.github.io/ecodata/Hab_table

Potential new indicators

Recreational Fleet Diversity

Recreational diversity indices could be considered as additional risk element(s) to complement the existing Commercial fishery resilience (revenue diversity) element. While recreational value measured as angler trips has gone from high risk to low-moderate risk based on updated data, recreational fleet diversity (i.e., effort by shoreside, private boat, and for-hire anglers) has declined over the long term (Fig. 5).

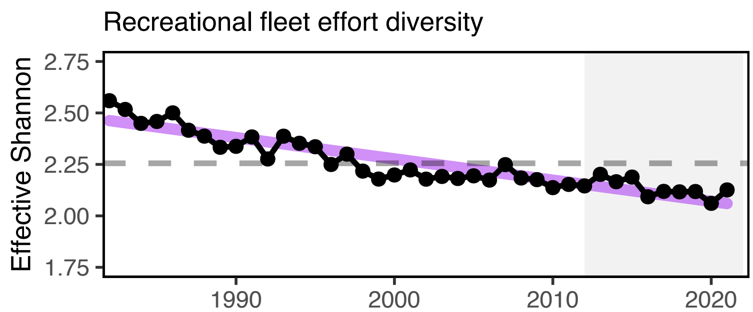


Figure 5: Recreational fleet effort diversity in the Mid-Atlantic.

Increased angler trips in 2020 relative to previous years strongly influence the long term increase in recreational effort. While the overall number of recreational opportunities in the MAB is above the long term average, the continuing decline in recreational fleet effort diversity suggests a potentially reduced range of recreational fishing options.

The downward effort diversity trend is driven by party/charter contraction (from a high of 24% of angler trips to 7% currently), and a shift toward shorebased angling. Effort in private boats remained stable between 36-37% of angler trips across the entire series.

Changes in recreational fleet diversity can be considered when managers seek options to maintain recreational opportunities. Shore anglers will have access to different species than vessel-based anglers, and when the same species is accessible both from shore and from a vessel, shore anglers typically have access to smaller individuals. Many states have developed shore-based regulations where the minimum size is lower than in other areas and sectors to maintain opportunities in the shore angling sector.

Environmental justice vulnerability in commercial and recreational fishing communities

These indicators highlighted in the 2022 Risk Assessment update showed signals of increased recreational fishing engagement and reliance in the Mid-Atlantic during 2020 (likely in response to COVID-19) as reported in the 2023 SOE. Combinations of these updated indicators can be used to update and expand on the **Social-Cultural** risk element.

We seek Council feedback on whether to include fishing community environmental justice vulnerability and recreational diversity indicators within the EAFM risk assessment, and if so, what risk criteria should be applied to these indicators.

Changes from 2022: Management risk elements

No changes were made to these rankings for 2023.

Management risk elements contain a mixture of quantitatively (Fishing Mortality Control, Technical Interactions, Discards, and Allocation) and qualitatively (Other Ocean Uses and Regulatory Complexity) calculated rankings. In general, the management indicators evaluate a particular risk over several years; therefore, the rankings should remain fairly consistent on an annual basis unless something changed in the fishery or if a management action occurred. A comprehensive evaluation and update of all management risk elements was conducted by Council staff in 2020 and were updated in 2021. In 2022, a similar update was conducted with Council staff reviewing the 2021 rankings and associated justifications to determine if any significant fishery or management changes would result in a change in a risk element ranking. The management risk element rankings can be found in Table 6.

Potential new indicators

Other ocean uses: offshore wind energy development timeline, revenue in lease areas, coastal community vulnerability

As of January 2023, 24 offshore wind development projects are proposed for construction over the next decade in the Northeast (timelines and project data are based on Tables E-2, E-4, and E-4-2 of South Fork Wind Farm Final Environmental Impact Statement). Offshore wind areas are anticipated to cover more than 2.3 million acres by 2030 in the Greater Atlantic region (Fig. 6). Beyond 2030 values include acreage for future areas in the Central Atlantic and Gulf of Maine Area planning area for floating research array.

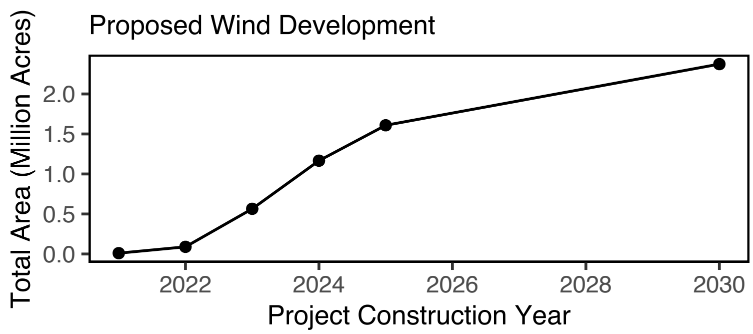
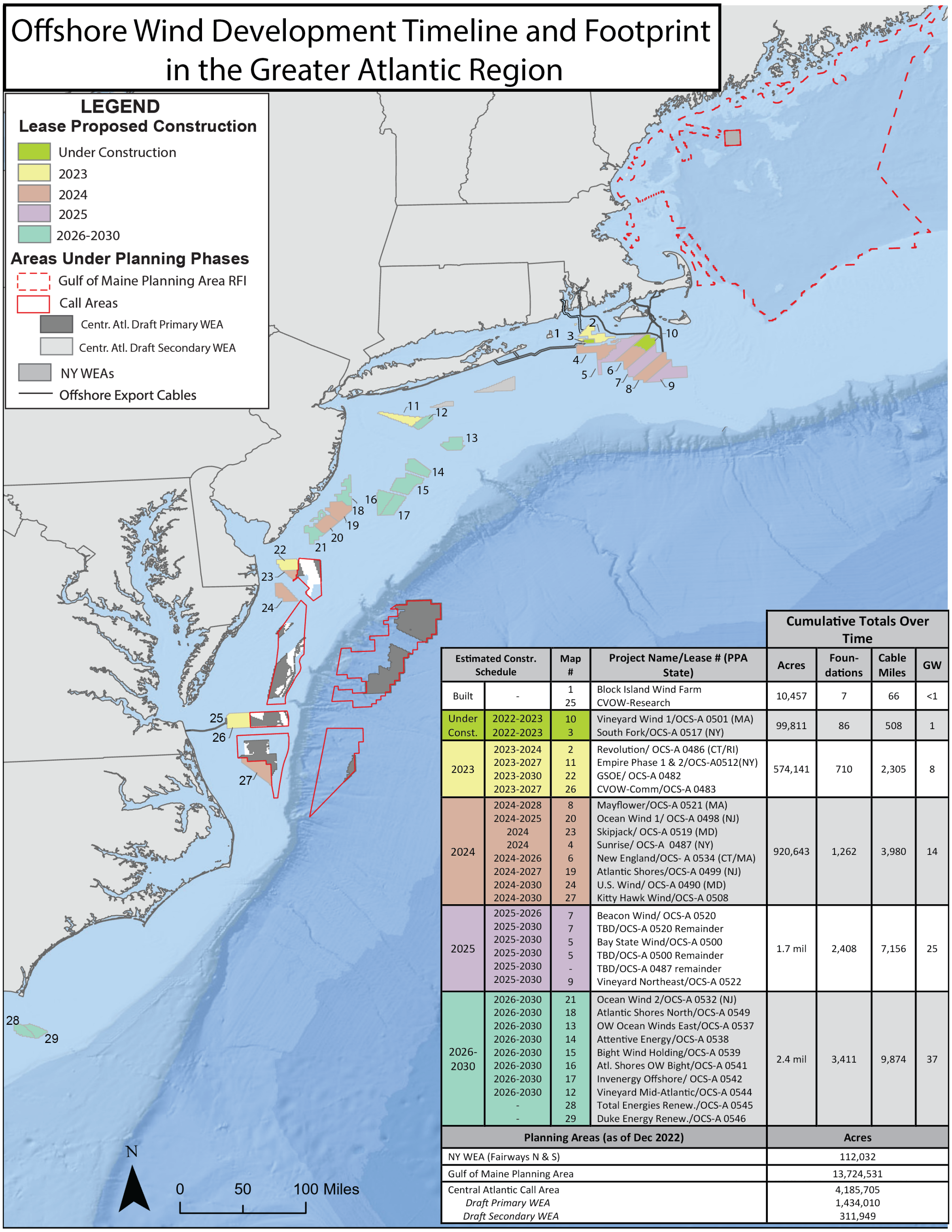


Figure 6: Proposed wind development on the northeast shelf.



Estimated Constr. Schedule		Map #	Project Name/Lease # (PPA State)	Cumulative Totals Over Time: Acres	Foun-dations	Cable Miles	GW
Built	-	1 25	Block Island Wind Farm CVOW-Research	10,457	7	66	<1
Under Const.	2022-2023 2022-2023	10 3	Vineyard Wind 1/OCS-A 0501 (MA) South Fork/OCS-A 0517 (NY)	99,811	86	508	1
2023	2023-2024 2023-2027 2023-2030 2023-2027	2 11 22 26	Revolution/ OCS-A 0486 (CT/RI) Empire Phase 1 & 2/OCS-A0512(NY) GSOE/ OCS-A 0482 CVOW-Comm/OCS-A 0483	574,141	710	2,305	8
2024	2024-2028 2024-2025 2024 2024 2024-2026 2024-2027 2024-2030 2024-2030	8 20 23 4 6 19 24 27	Mayflower/OCS-A 0521 (MA) Ocean Wind 1/ OCS-A 0498 (NJ) Skipjack/ OCS-A 0519 (MD) Sunrise/ OCS-A 0487 (NY) New England/OCS- A 0534 (CT/MA) Atlantic Shores/OCS-A 0499 (NJ) U.S. Wind/ OCS-A 0490 (MD) Kitty Hawk Wind/OCS-A 0508	920,643	1,262	3,980	14
2025	2025-2026 2025-2030 2025-2030 2025-2030 2025-2030 2025-2030	7 7 5 5 - 9	Beacon Wind/ OCS-A 0520 TBD/OCS-A 0520 Remainder Bay State Wind/OCS-A 0500 TBD/OCS-A 0500 Remainder TBD/OCS-A 0487 remainder Vineyard Northeast/OCS-A 0522	1.7 mil	2,408	7,156	25
2026-2030	2026-2030 2026-2030 2026-2030 2026-2030 2026-2030 2026-2030 2026-2030 2026-2030 - -	21 18 13 14 15 16 17 12 28 29	Ocean Wind 2/OCS-A 0532 (NJ) Atlantic Shores North/OCS-A 0549 OW Ocean Winds East/OCS-A 0537 Attentive Energy/OCS-A 0538 Bight Wind Holding/OCS-A 0539 Atl. Shores OW Bight/OCS-A 0541 Invenergy Offshore/ OCS-A 0542 Vineyard Mid-Atlantic/OCS-A 0544 Total Energies Renew./OCS-A 0545 Duke Energy Renew./OCS-A 0546	2.4 mil	3,411	9,874	37

Planning Areas (as of Dec 2022)	Acres
NY WEA (Fairways N & S)	112,032
Gulf of Maine Planning Area	13,724,531
Central Atlantic Call Area *Draft Primary WEA* *Draft Secondary WEA*	4,185,705 1,434,010 311,949

Figure 7: All Northeast Project areas by year construction ends (each project has 2 year construction period).

Just over 2,500 foundations and more than 7,000 miles of inter-array and offshore export cables are proposed to date.

The colored chart in Fig. 7 also presents the offshore wind development timeline in the Greater Atlantic region with the estimated year that foundations would be constructed (matches the color of the wind areas). These timelines and data estimates are expected to shift but represent the most recent information available as of January2023. Based on current timelines, the areas affected would be spread out such that it is unlikely that any one particular area would experience full development at one time. Future wind development areas are also presented. Additional call areas, which may eventually become lease areas, totalling over 488,000 acres in the Central Atlantic[4] may be identified for BOEM's anticipated 2023 lease sale. It's anticipated that the Central Atlantic leases will fulfill outstanding offshore wind energy production goals for VA and NC.

Based on federal vessel logbook data, commercial fishery revenue from trips in the current offshore wind lease areas and the draft Central Atlantic Bight Primary and Secondary Call Areas have varied annually from 2008-2021, with less than $1 million in revenue overlapping with these areas for most fisheries. However, some fisheries see periodic spikes in revenue overlap with wind energy lease areas, including up to $4.7 million affected in the surfclam fishery and nearly $4.3 million affected in the longfin squid fishery in 2008 and 2016, respectively.(Fig. 8).

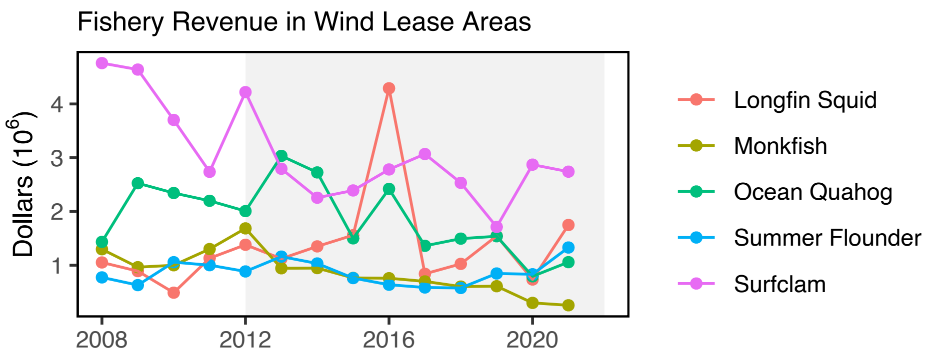


Figure 8: Fishery revenue in wind energy lease areas in the Mid-Atlantic.

Of MAFMC-managed fisheries, the chub mackerel fishery could be the fishery most affected by offshore wind development, with a maximum of 17% of annual regional fishery revenue occurring within potential wind lease areas and the Central Atlantic draft call areas during this period, followed by the surfclam (16%), black sea bass (15%), ocean quahog (13%), and blueline tilefish fisheries (10%). The spiny dogfish fishery was the least affected, at 3% maximum annual revenue affected, while 5% of annual revenues were affected for several others (bluefish, butterfish, and summer flounder). A maximum of 10% of the annual longfin squid revenues were affected by these areas, with similar effects for the scup (9%), Atlantic mackerel (8%), monkfish (7%) and golden tilefish (6%) fisheries (see Table **??**). While up to 14% of annual *Illex* squid revenue overlapped with offshore wind areas, this is likely overestimated due to the precision of logbook data when compared to vessel monitoring system data (see Table **??**).

Table 3: Top Species Landings and Revenue from Wind Energy Areas. * Landings and revenue for these species are likely underestimated due to limited coverage of these fisheries in historic reporting requirements for vessels issued federal permits by the NMFS Greater Atlantic Regional Fisheries Office. However, such limitations also suggest an inaccurately higher proportion of such landings and revenues in existing lease areas. ** Clearnose skates were reported separately from skates, which is presumed to include all skates managed under the Northeast skate complex. *** Based on comparison with other data sources, the high values for Illex squid are likely overestimates affected by the methods used to model logbook data to estimate spatial overlap of fishign operations with wind energy areas.

NEFMC, MAFMC, and ASMFC Managed Species	Maximum Percent Total Annual Regional Species Landings	Maximum Percent Total Annual Regional Species Revenue
Black drum*	36	34
American eel*	15	29

[4] https://www.boem.gov/sites/default/files/images/draft__wea__primary__secondary3.jpg

NEFMC, MAFMC, and ASMFC Managed Species	Maximum Percent Total Annual Regional Species Landings	Maximum Percent Total Annual Regional Species Revenue
Clearnose skate**	19	20
Atlantic menhaden*	25	19
Atlantic chub mackerel*	16	17
Atlantic surfclam	17	16
Black sea bass	15	15
Yellowtail flounder	15	15
Illex squid***	14	14
Offshore hake	14	14
Ocean quahog	13	13
Atlantic sea scallops	13	12
Blueline tilefish*	8	10
Skates**	10	10
Longfin squid	9	9
Scup	8	9
Atlantic mackerel	8	8
Monkfish	9	7
Red hake	11	7

Proposed wind development areas interact with the region's federal scientific surveys. Scientific surveys are impacted by offshore wind in four ways: 1. Exclusion of NOAA Fisheries' sampling platforms from the wind development area due to operational and safety limitations; 2.Impacts on the random-stratified statistical design that is the basis for scientific assessments, advice, and analyses; 3.Alteration of benthic and pelagic habitats, and airspace in and around the wind energy development, requiring new designs and methods to sample new habitats; and, 4.Reduced sampling productivity through navigation impacts of wind energy infrastructure on aerial and vessel survey operations. Increase vessel transit between stations may decrease data collections that are already limited by annual days-at-sea day allocations. The total survey area overlap ranges from 1-14% for all Greater Atlantic federal surveys. Individual survey strata have significant interaction with wind, including the sea scallop survey (up to 96% of individual strata) and the bottom trawl survey (BTS, up to 60% strata overlap). Additionally, up to 50% of the southern New England North Atlantic right whale survey's area overlaps with proposed project areas. A region-wide survey mitigation program is underway [**northeast_fisheries_science_center_us_noaa_2022?**].

Equity and environmental justice (EJ) are priority concerns with offshore wind development and fisheries impacts in the Northeast. Fig. 9 links historic port revenue (2008-2021) from within all wind lease areas as a proportion of the port's total revenue based on vessel trip reports as described in the revenue and landings of species in the wind indicator above. The range (minimum and maximum) of total percent revenue from within wind energy areas is presented in the graph and ports are sorted from greatest to least revenue from within wind areas.

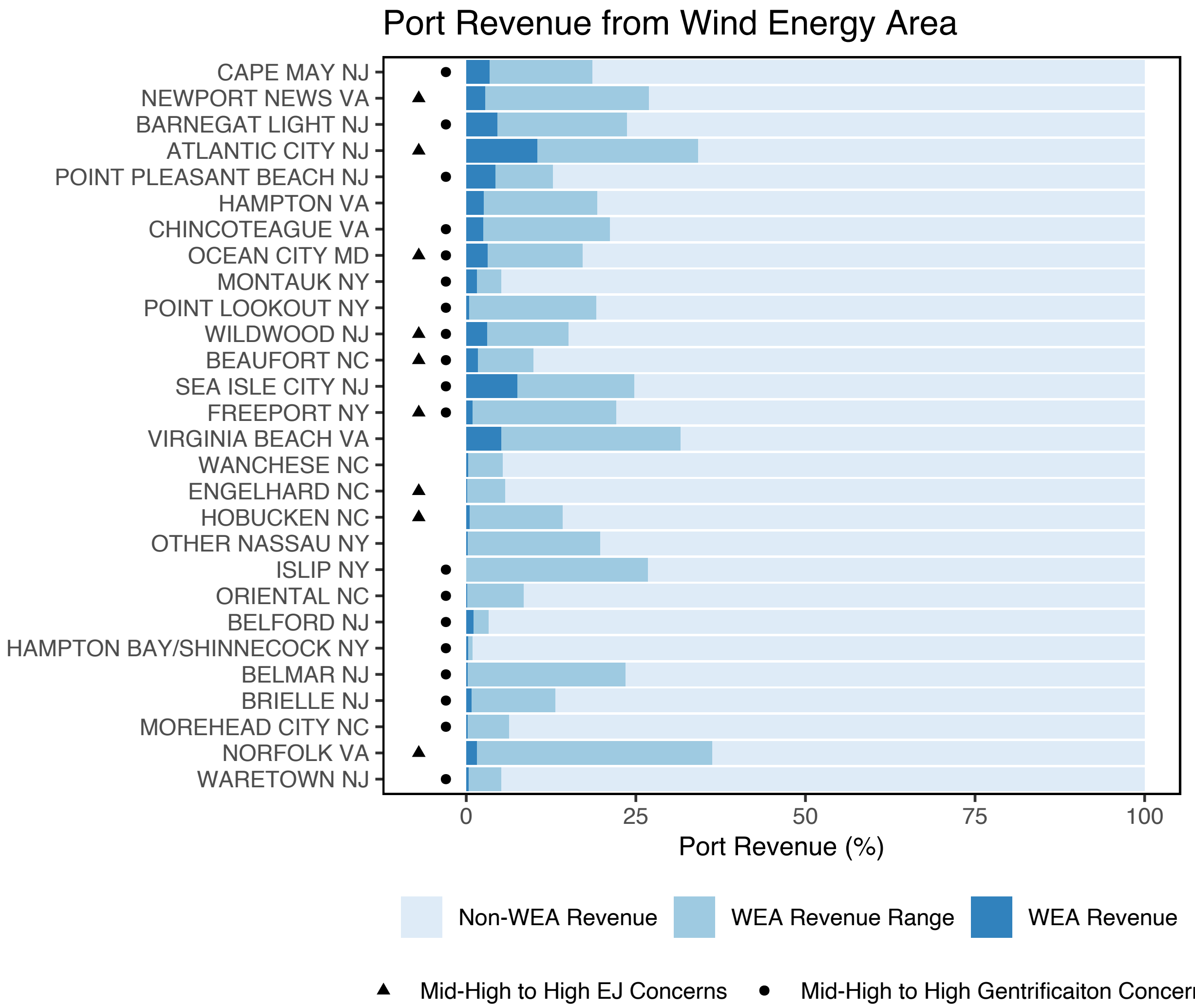


Figure 9: Percent of Mid-Atlantic port revenue from Wind Energy Areas (WEA) in descending order from most to least port revenue from WEA. EJ = Environmental Justice.

For example, Atlantic City, NJ had a minimum of 11% and maximum of 30% overlap of fisheries revenue in potential wind development areas to the total port fisheries revenue between 2008-2021. Those communities that score Med-High or higher in at least one of the vulnerability indicators that address environmental justice concerns (i.e., Poverty, Population Composition, Personal Disruption; see indicator definitions) are noted with a triangle. Gentrification pressure is also highlighted here, with those communities that score Med-High or higher in one or more gentrification pressure indicators (i.e., Housing Disruption, Retiree Migration, Urban Sprawl) represented with a circle (Fig. 9). BOEM reports that cumulative offshore wind development (if all proposed projects are developed) could have moderate impacts on low-income members of environmental justice communities who work in the commercial fishing and for-hire fishing industry due to disruptions to fish populations, restrictions on navigation and increased vessel traffic, as well as existing vulnerabilities of low-income workers to economic impacts [7].

Some ports in New England land Mid-Atlantic managed species from wind areas as well. For the maximum percent value reported in each New England port, the majority (at least 50% based on both value and pounds) of those landings were Mid-Atlantic managed species within wind areas for Barnstable, MA, Boston, MA, Hyannis, MA, North Kingstown/Davisville, RI, and Point Judith, RI. Woods Hole, MA would be added to this list based on pounds only, but did not exceed 50% of value from Mid-Atlantic managed species within wind areas.

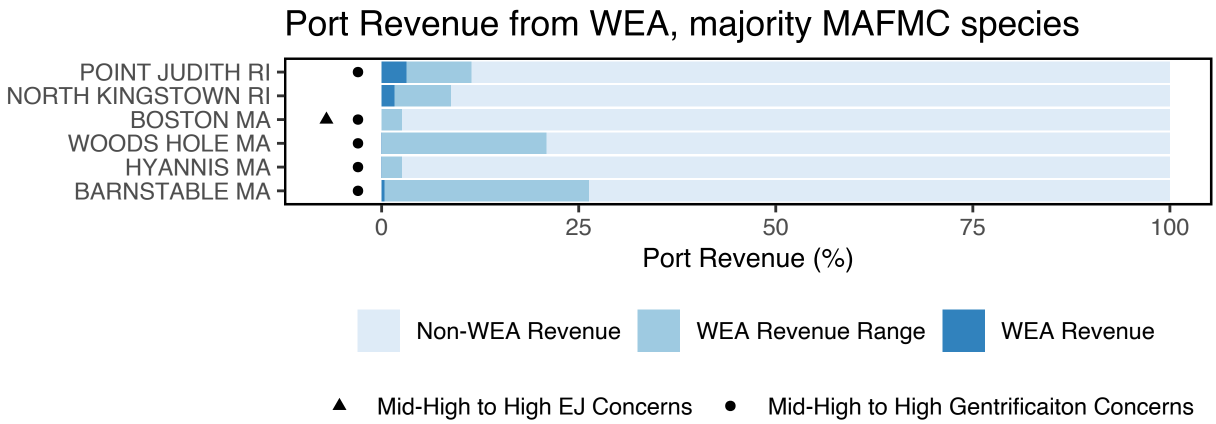


Figure 10: Percent of New England port revenue with majority MAFMC landings from Wind Energy Areas (WEA) in descending order from most to least port revenue from WEA. EJ = Environmental Justice.

Top fishing communities high in environmental justice concerns (i.e., Atlantic City, NJ, Newport News, VA, Hobucken and Beaufort, NC) should be considered in decision making to reduce the social and economic impacts and aid in the resilience and adaptive capacity of underserved communities. It also highlights communities where we need to provide further resources to reach underserved and underrepresented groups and create opportunities for and directly involve these groups in the decision-making process.

Implications

Current plans for rapid buildout of offshore wind in a patchwork of areas spreads the impacts differentially throughout the region (Fig. 7).

Up to 17% of maximum annual fisheries revenue for major Mid-Atlantic commercial species in lease areas and draft call areas could be forgone or reduced and associated effort displaced if all sites are developed. Displaced fishing effort can alter historic fishing area, timing, and method patterns, which can in turn change habitat, species (managed and protected), and fleet interactions. Several factors, including fishery regulations, fishery availability, and user conflicts affect where, when, and how fishing effort may be displaced, along with impacts to and responses of affected fish species.

Planned development overlaps right whale mother and calf migration corridors and a significant foraging habitat that is used throughout the year [**quintana-rizzo_residency_2021?**] (Fig 11). Turbine presence and extraction of energy from the system could alter local oceanography [**christiansen_emergence_2022?**] and may affect right whale prey availability. For example, persistent foraging hotspots of right whales and seabirds overlap on Nantucket Shoals, where unique hydrography aggregates enhanced prey densities (citation). Wind leases (OCS-A 0521 and OCS-A 0522) currently intersect these hotspots on the southwestern corner of Nantucket Shoals and a prominent tidal front associated with invertebrate prey swarms important to seabirds and possibly right whales (citation). Proposed wind development areas also bring increased vessel strike risk from construction and operation vessels. In addition, there are a number of potential impacts to whales from pile driving and operational noise such as displacement, increased levels of communication masking, and elevated stress hormones.

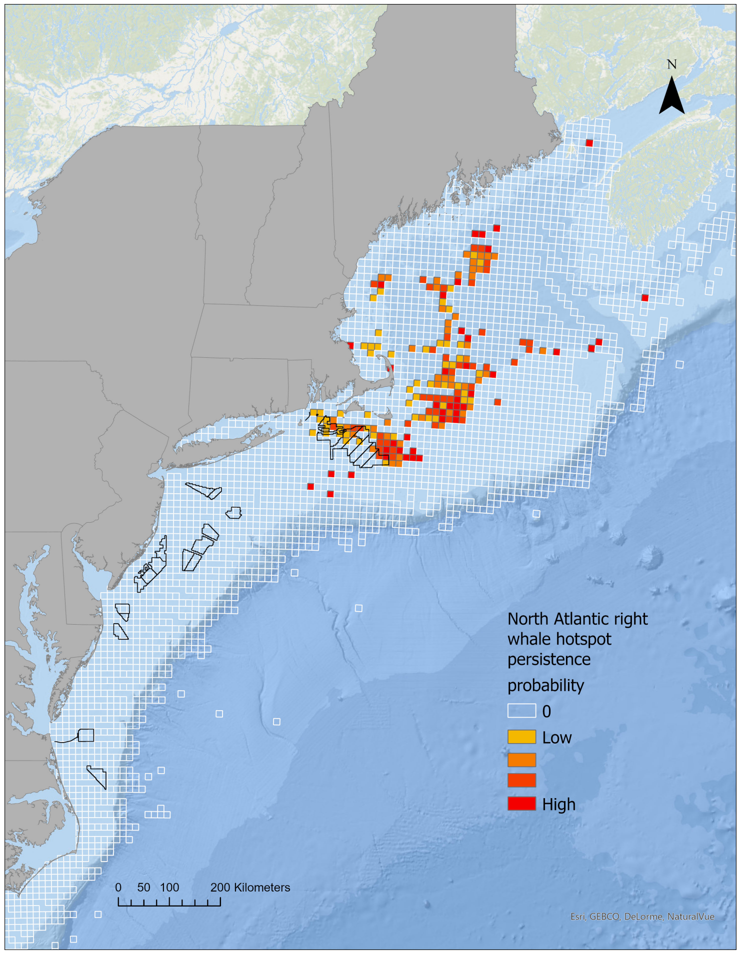


Figure 11: Northern Right Whale persistent hotspots and Wind Energy Areas.

Scientific data collection surveys for ocean and ecosystem conditions, fish, and protected species will be altered, potentially increasing uncertainty for stock assessments and associated management decision making.

The increase of offshore wind development can have both positive (e.g., employment opportunities) and negative (e.g., space-use conflicts) effects. Continued increase in coastal development and gentrification pressure has resulted in loss of fishing infrastructure space within ports. Understanding these existing pressures can allow for avoiding and mitigating negative impacts to our shore support industry and communities dependent on fishing. Some of the communities with the highest fisheries revenue overlap with offshore wind development areas that are also vulnerable to gentrification pressure are Point Pleasant and Atlantic City, NJ, Ocean City, MD, and Beaufort, NC.

We seek Council feedback on whether to include offshore wind development and related indicators within the EAFM risk assessment, and if so, what risk criteria should be applied to these indicators.

2023 EAFM Risk Tables

Table 4: Species level risk analysis results; l=low risk (green), lm= low-moderate risk (yellow), mh=moderate to high risk (orange), h=high risk (red)

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

Table 5: Ecosystem level risk analysis results; l=low risk (green), lm= low-moderate risk (yellow), mh=moderate to high risk (orange), h=high risk (red)

System	EcoProd	CommRev	RecVal	FishRes1	FishRes4	FleetDiv	Social	ComFood	RecFood
Mid-Atlantic	lm	mh	l	l	mh	l	lm	h	mh

Table 6: 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)

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

References

1. Gaichas SK, Seagraves RJ, Coakley JM, DePiper GS, Guida VG, Hare JA, et al. A Framework for Incorporating Species, Fleet, Habitat, and Climate Interactions into Fishery Management. Frontiers in Marine Science. 2016;3. doi:10.3389/fmars.2016.00105

2. Holsman K, Samhouri J, Cook G, Hazen E, Olsen E, Dillard M, et al. An ecosystem-based approach to marine risk assessment. Ecosystem Health and Sustainability. 2017;3: e01256. doi:10.1002/ehs2.1256

3. Gaichas SK, DePiper GS, Seagraves RJ, Muffley BW, Sabo M, Colburn LL, et al. Implementing Ecosystem Approaches to Fishery Management: Risk Assessment in the US Mid-Atlantic. Frontiers in Marine Science. 2018;5. doi:10.3389/fmars.2018.00442

4. Hare JA, Morrison WE, Nelson MW, Stachura MM, Teeters EJ, Griffis RB, et al. A Vulnerability Assessment of Fish and Invertebrates to Climate Change on the Northeast U.S. Continental Shelf. PLOS ONE. 2016;11: e0146756. doi:10.1371/journal.pone.0146756

5. Farr ER, Johnson MR, Nelson MW, Hare JA, Morrison WE, Lettrich MD, et al. An assessment of marine, estuarine, and riverine habitat vulnerability to climate change in the Northeast U.S. PLOS ONE. 2021;16: e0260654. doi:10.1371/journal.pone.0260654

6. Kritzer JP, DeLucia M-B, Greene E, Shumway C, Topolski MF, Thomas-Blate J, et al. The Importance of Benthic Habitats for Coastal Fisheries. BioScience. 2016;66: 274–284. doi:10.1093/biosci/biw014

7. BOEM. Vineyard Wind 1 Offshore Wind Energy Project Supplement to the Draft Environmental Impact Statement. OCS EIS/EA, BOEM 2020-025 [Internet]. 2020. Available: https://www.boem.gov/sites/default/files/documents/renewable-energy/Vineyard-Wind-1-Supplement-to-EIS.pdf