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Northeast Habitat Climate Vulnerability Assessment

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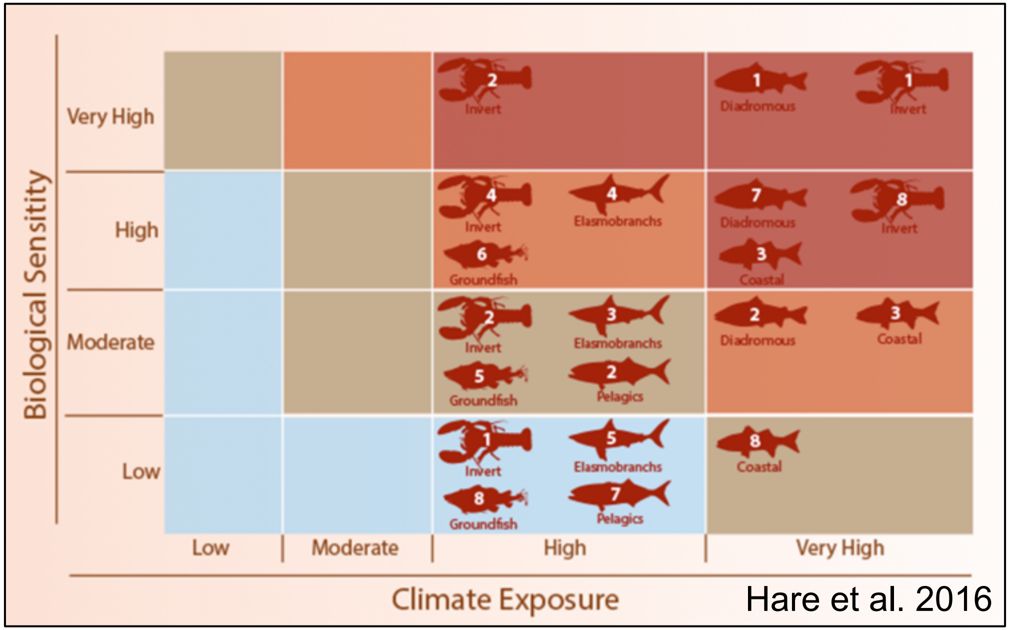
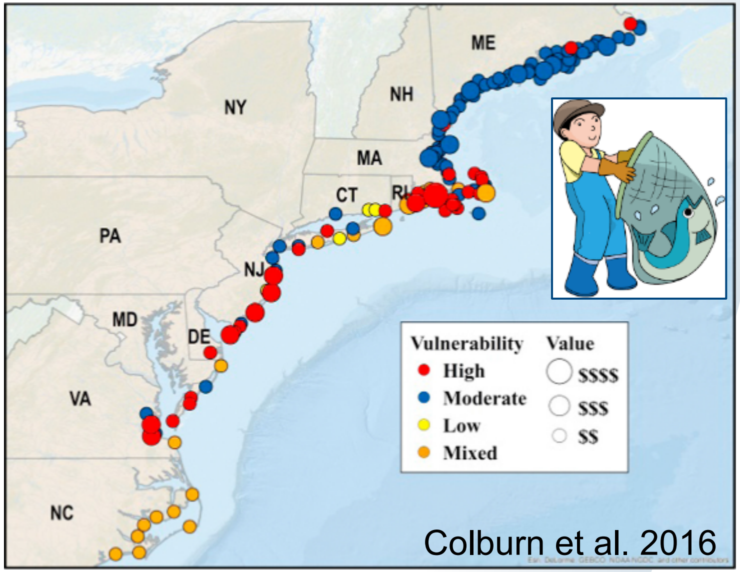
Objective: To provide regional fisheries, habitat, and protected species managers and scientists with a practical tool to efficiently assess the relative vulnerability of habitats to climate change.

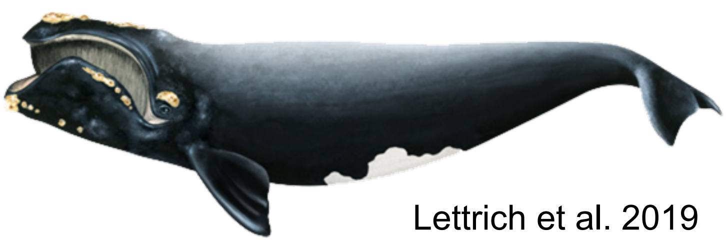
Growing toolbox of vulnerability assessments

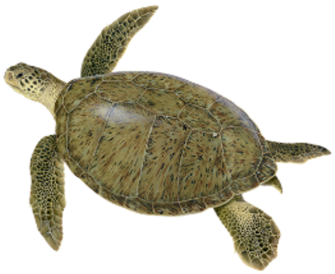


Hare et al. 2016



Colburn et al. 2016





Lettrich et al. 2019

Habitats Assessed (52)

Marine & Estuarine	• Rocky Bottom • Sand Bottom • Mud Bottom • Shellfish Reef • Kelp • Turf Algae • SAV • Water Column	Riverine	• Rocky Streambed and Bank • Sand Streambed and Bank • Mud Streambed and Bank • Algal Bed • SAV • Emergent Wetland • Water Column
Marine	• Deep Sea Coral		
Estuarine	• Emergent Wetland		

- Nearshore, Offshore, and Intertidal assessed separately
- Riverine tidal and non-tidal assessed separately

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Approach

Sensitivity

- Habitat condition
- Habitat fragmentation
- Ability to spread or disperse
- Resilience
- Resistance
- Changes in abiotic factors
- Non-climate stressors
- Critical ecological linkages

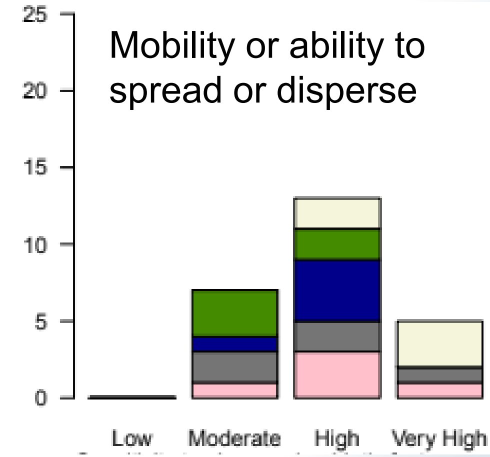
Exposure

- Sea surface temperature
- Bottom temperature
- Air temperature
- Salinity (surface & bottom)
- pH
- Precipitation
- Streamflow
- Stream temperature
- Sea level rise

Habitat Vulnerability

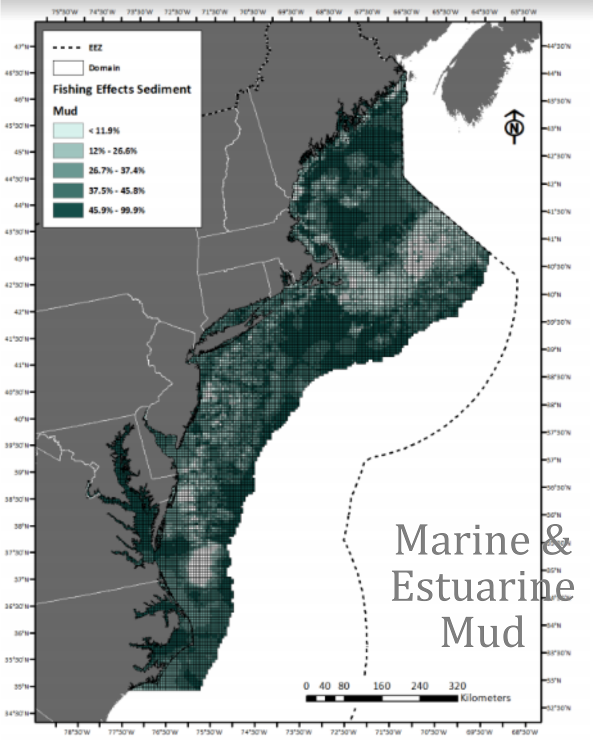
Sensitivity Scoring

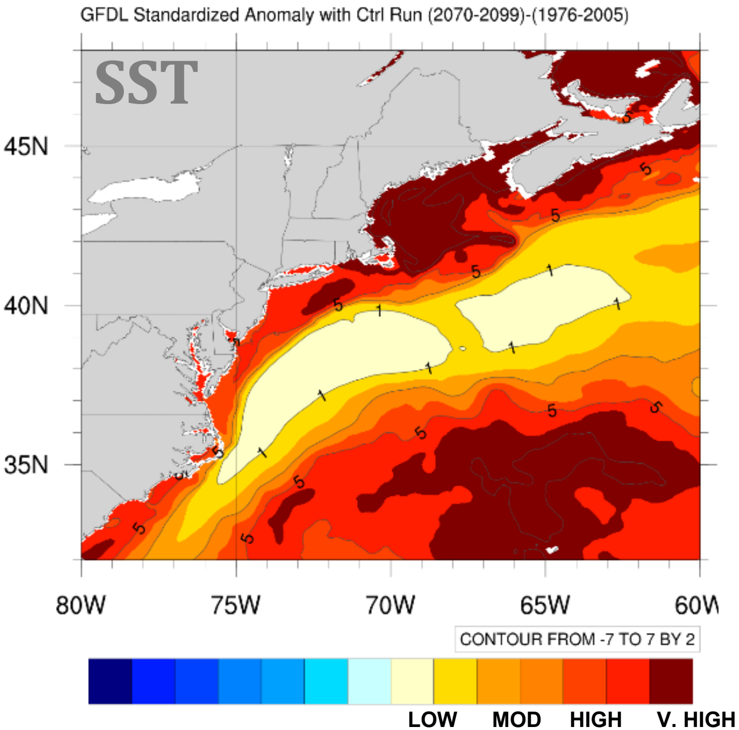
Scoring Bins
Low
Moderate
High
Very High

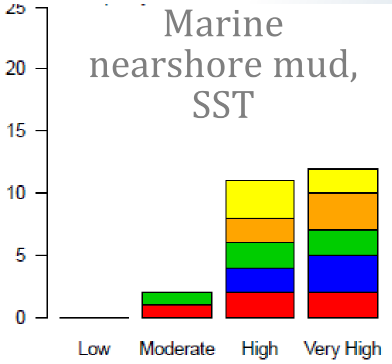


- Expert elicitation: 15 habitat experts, 5 per system
- In-person workshop to leverage collective knowledge of the group

Exposure Scoring







- Compare habitat distribution and climate projections (RCP 8.5, end of century)

Preliminary Results

Sensitivity \ Exposure	Low	Moderate	High	Very High
Very High		**Deep sea coral and sponge: Gulf of Maine**	*Deep sea coral and sponge: seamounts and canyons**	
High			Riverine tidal native wetland Marine submerged aquatic vegetation Estuarine submerged aquatic vegetation Estuarine kelp Estuarine subtidal shellfish reef Marine subtidal shellfish reef Estuarine water column Marine kelp Riverine non-tidal native wetland Riverine submerged aquatic vegetation *Riverine water column*	Mid-Atlantic native salt marsh New England native salt marsh Marine intertidal shellfish reef Estuarine intertidal shellfish reef
Moderate		Marine rocky bottom >200m	Marine shellfish aquaculture Estuarine subtidal mud Estuarine shellfish aquaculture Riverine mud Riverine sand	Marine intertidal mud Marine intertidal rocky bottom *Marine intertidal sand*
Low	Marine water column,	Marine mud >200m Marine sand >200m Marine water column, shelf bottom Marine water column, slope bottom	**Riverine rocky bottom** **Estuarine subtidal rocky bottom** **Marine rocky bottom <200m** Marine mud <200m Marine water column, shallow/inner shelf Estuarine red, green, and small brown algae Estuarine manmade subtidal hard bottom Estuarine subtidal sand Marine red, green, and small brown algae Marine manmade hard bottom Marine sand <200m Marine water colum, shelf surface Riverine algae Riverine non-tidal invasive wetland Riverine tidal invasive wetland	**Estuarine intertidal rocky bottom**** **Estuarine intertidal mud** Estuarine intertidal sand Mid-Atlantic invasive salt marsh New England invasive salt marsh Estuarine manmade intertidal hard bottom

PLEASE NOTE: These results are draft and will likely change.

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Deep sea coral and sponge: Gulf of Maine	*Deep sea coral and sponge: seamounts and canyons**	
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Marine rocky bottom >200m	Marine shellfish aquaculture Estuarine subtidal mud Estuarine shellfish aquaculture Riverine mud Riverine sand	Marine intertidal mud Marine intertidal rocky bottom *Marine intertidal sand*

Moderate, High, Very High

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Habitat Narratives

Estuarine kelp
System: Estuarine
Class: Aquatic Bed
Sub Class: Kelp
Geographic area: Entire Area

Overall Vulnerability Rank = High
Habitat Sensitivity = High
Climate Exposure = High

	Estuarine kelp	Attribute Mean	Data Quality	Distribution of Expert Scores
Sensitivity attributes	Habitat condition	3.2	2.2	
	Habitat fragmentation	3.2	2.2	
	Distribution/Range	3.2	2.2	
	Mobility/Ability to spread or disperse	2.8	2.2	
	Resistance	3.2	2.2	
	Resilience	3.2	2.2	
	Sensitivity to changes in abiotic factors	3.4	2.2	
	Sensitivity and intensity of non−climate stressors	3.4	2.2	
	Dependency on critical ecological linkages	3.4	2	
	Sensitivity Component Score	High		
Exposure variables	Sea surface temp	4	2.5	
	Bottom temp	1	0	
	Air temp	1	0	
	River temp	1	0	
	Surface salinity	1.9	2.1	
	Bottom salinity	1	0	
	pH	4	2	
	Sea level rise	2.4	2.2	
	Precipitation	1	0	
	River flow	1	0	
	Exposure Component Score	High		
	Overall Vulnerability Rank	High		

Low
Moderate
High
Very High

- Habitat definition
- Key drivers of vulnerability score
- Data quality and gaps
- Climate effects on habitat condition and distribution
- Summary of key habitat characteristics

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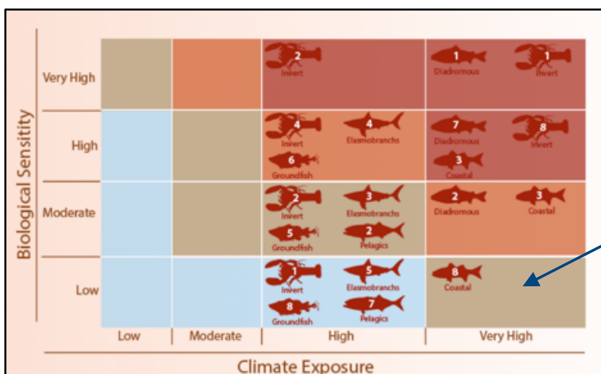
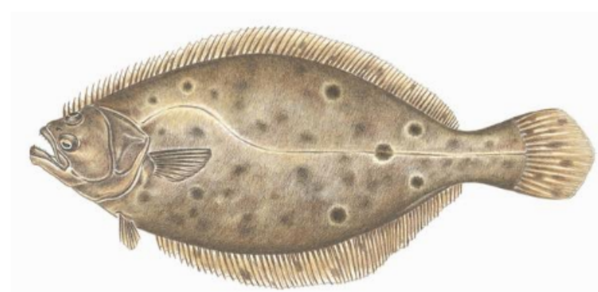
Linking with species vulnerability

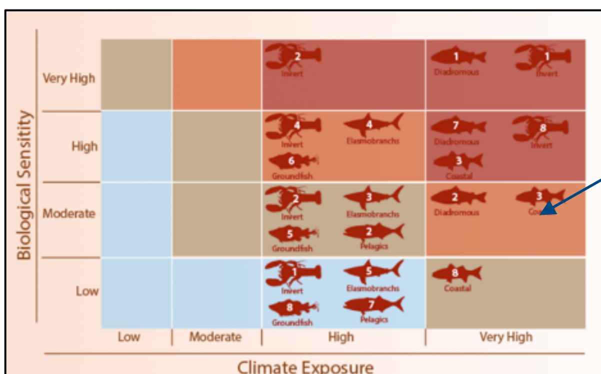
- For example: SAV is a HAPC for summer flounder, estuarine SAV scored high climate vulnerability
- Summer flounder scored moderate climate vulnerability

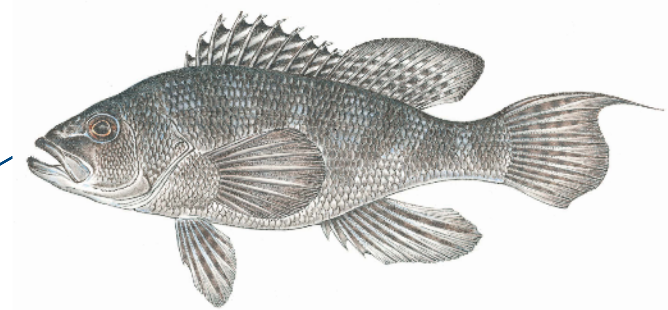




Linking with species vulnerability

- For example: Black Sea Bass juveniles often use estuarine shellfish and seagrass (high vulnerability) and cobble and manmade structures (low vulnerability) as nursery
- Looking for Council feedback on case study species





How can this assessment be used?

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2020 State of the Ecosystem
Mid-Atlantic

Total commercial fishery landings were scaled to ecosystem productivity. Primary production required to support Mid-Atlantic commercial landings has been declining since 2000.

Engagement in commercial fishing has declined since 2004 for medium to highly engaged Mid-Atlantic fishing communities. This may be related to the overall downward trend in commercial landings since 1986, and the decline in total revenue since 2004.

2018 retained recreational catch in the Mid-Atlantic was the lowest observed since 1982. There is also a similar, although less steep decline in recreational fishing effort. The party/charter sector is expected to continue to shrink. Recreational species catch diversity has been maintained by increased catch of South Atlantic and state managed species.

Habitat modeling indicates that summer flounder, butterfish, longfin squid, and spiny dogfish are among fish species highly likely to occupy wind energy lease areas. Habitat conditions for many of these species have become more favorable over time within wind lease areas.

There are no apparent trends in aggregate biomass of predators, forage fish, bottom feeders, and shellfish sampled by trawl surveys, implying a stable food web. However, we continue to see a northward shift in aggregate fish distribution along the Northeast US shelf, and a tendency towards distribution in deeper waters.

Forage fish energy content is now being measured regularly, revealing both seasonal and annual variation in energy of these important prey species due to changing ecosystem conditions. Notably, Atlantic herring energy content is half what it was in the 1980-90s.

Nearshore habitats are under stress. Heavy rains in 2018-2019 resulted in unprecedented fresh water and high nutrient flow into the Chesapeake Bay, driving low oxygen, increased oyster mortality, and spread of invasive catfish in this critical Mid-Atlantic nursery habitat. Sea level rise is altering coastal habitats in the Mid-Atlantic, driving declines in nesting seabirds on Virginia islands.

The Northeast US shelf ecosystem continued to experience warm conditions in 2019, with changes in ocean circulation affecting the shelf. The Gulf Stream is increasingly unstable, with more warm core rings resulting in higher likelihood of warm salty water and associated oceanic species such as shortfin squid coming onto the shelf.

The intensity and duration of marine surface heatwaves are increasing, and bottom temperatures both in the seasonal Mid-Atlantic cold pool and shelfwide are increasing. Warmer temperatures increase nutrient remineralization and summer phytoplankton productivity.

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National Oceanic and Atmospheric Administration | National Marine Fisheries Service

Risk Assessment Update 2020

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
Butterfish	l	l	l	l	l	l	l	h	l
Longfin squid	lm	lm	lm	l	l	lm	l	mh	l
Shortfin squid	lm	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	h	l	l	l	l	mh	h
Spiny dogfish	lm	l	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	h	l	mh	l	lm	h	mh

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Evaluating scientific uncertainty for OFL / ABC buffer

Ecosystem factors accounted	Assessment considered habitat and ecosystem effects on stock productivity, distribution, mortality and quantitatively included appropriate factors, reducing uncertainty in short term predictions. Evidence outside the assessment suggests that ecosystem productivity and habitat quality are stable. Comparable species in the region have synchronous production characteristics and stable short-term predictions. Climate vulnerability analysis suggests positive impacts on productivity from changing climate	Assessment considered habitat/ecosystem factors but did not demonstrate either reduced or inflated short-term prediction uncertainty based on these factors. Evidence outside the assessment suggests that ecosystem productivity and habitat quality are variable, with mixed productivity and uncertainty signals among comparable species in the region. Climate vulnerability analysis suggests neutral impacts on productivity from changing climate.	Assessment either demonstrated that including appropriate ecosystem/habitat factors increases short-term prediction uncertainty, or did not consider habitat and ecosystem factors. Evidence outside the assessment suggests that ecosystem productivity and habitat quality variable and degrading. Comparable species in the region have high uncertainty in short term predictions. Climate vulnerability analysis suggests negative impacts on productivity from changing climate.

Mid-Atlantic Fishery Management Council
Scientific and Statistical Committee
OFL CV Guidance Document

May 2019

Applications, continued

- Informing EFH and HAPC designations
- Informing research track stock assessments (ecosystem context for stock advice, Terms of Reference)
- Connect with Northeast Regional Habitat Assessment spatial products
- Provide context for project siting (e.g., aquaculture, wind, etc.)

Feedback from the Council

- If we were to link the habitat climate vulnerability results to **priority species**, what species would the Council be most interested in?

- How can we **best present the results** of this assessment for easy integration into Council decision-making processes?

Project Leads: Mark Nelson, Mike Johnson, Emily Farr, Jon Hare

NOAA Team: Vince Guida, Douglas Christel, Matthew Lettrich, Rory Saunders, Brian Grieve, Wendy Morrison, Thomas Noji, Vince Saba, Roger Griffis, Peg Brady, Tony Marshak, Lou Chiarella, Kenric Osgood, Mark Monaco, Donna Johnson, Michael Alexander, Diane Borgaard

Expert Scorers: Ursula Howson, David Stevenson, Bruce Vogt, Peter Auster, Jon Grabowski, Dave Packer, Damian Brady, Renee Mercaldo-Allen, Phil Colarusso, Mathias Collins, Christopher Meaney, Frank Borsuk, Matthew Cashman, James Hawkes

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