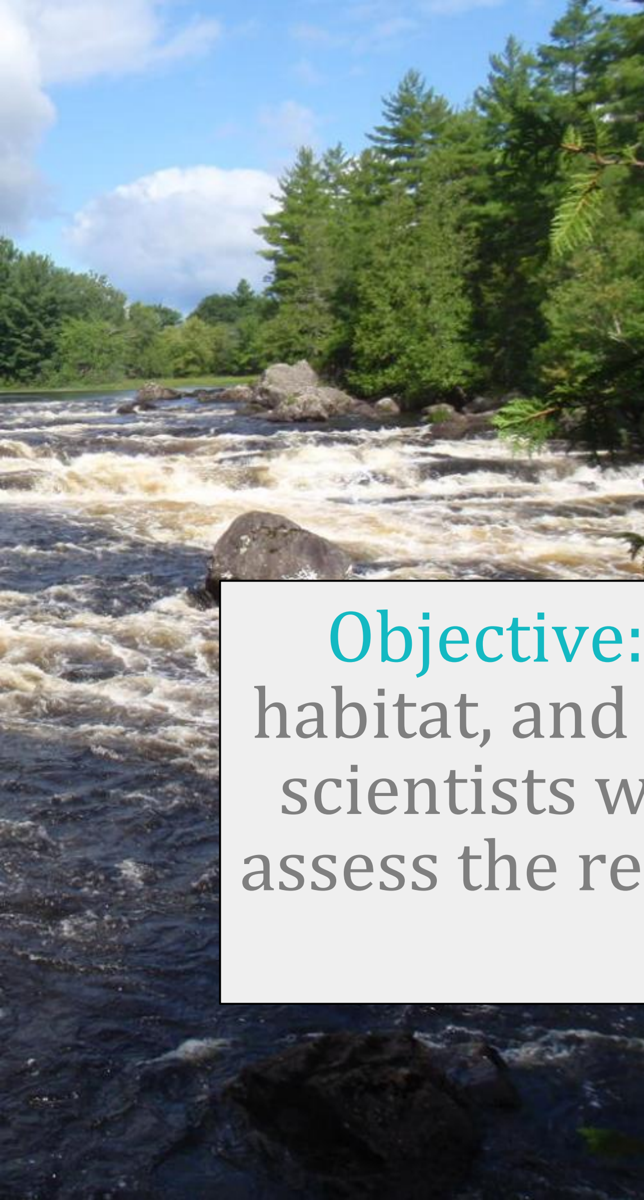
Northeast Habitat Climate Vulnerability Assessment

Emily Farr (NMFS Habitat Conservation)
Mark Nelson (NMFS Science & Technology)
Mike Johnson (NMFS GARFO)



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.

Habitats Assessed (52)

Marine (23 sub-classes)		Estuarine (19 sub-classes)		Riverine (10 sub-classes)	
Rocky Bottom	subtidal, offshore	Emergent Wetland	Mid-Atlantic, native	Unconsolidated Streambed/ Bank	Sand, tidal and non-tidal
	subtidal, nearshore		Mid-Atlantic, non-native		Mud, tidal and non-tidal
	subtidal, intertidal		New England, native	Emergent Wetland	Native, tidal
	artificial		New England, non-native		Native, non-tidal
Aquatic Bed	kelp algal bed	Reef (Mollusk)	Mollusk reef, subtidal		Non-native, tidal
	non-kelp algal bed		Mollusk reef, intertidal		Non-native, non-tidal
	rooted vascular		Cultured mollusk reef	Water Column	
…	…	…	…	…	…

Our Approach

Habitat Vulnerability

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

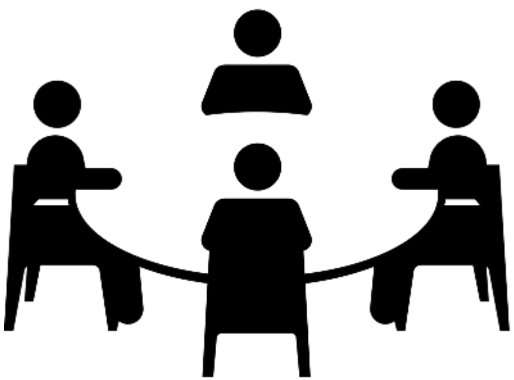
Our Approach

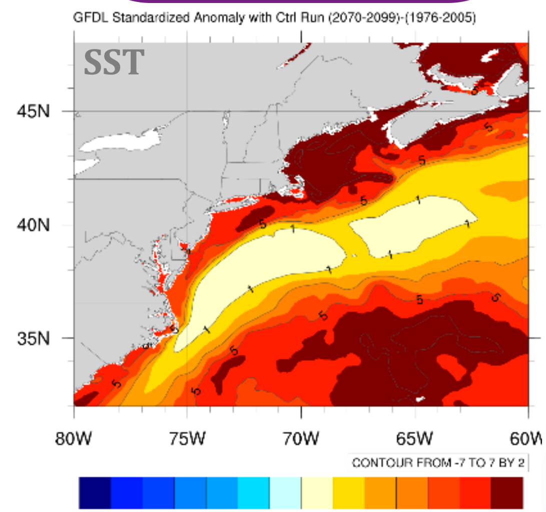
Trait-based
& expert elicitation
(scoring)

Habitat Vulnerability

Sensitivity

Exposure

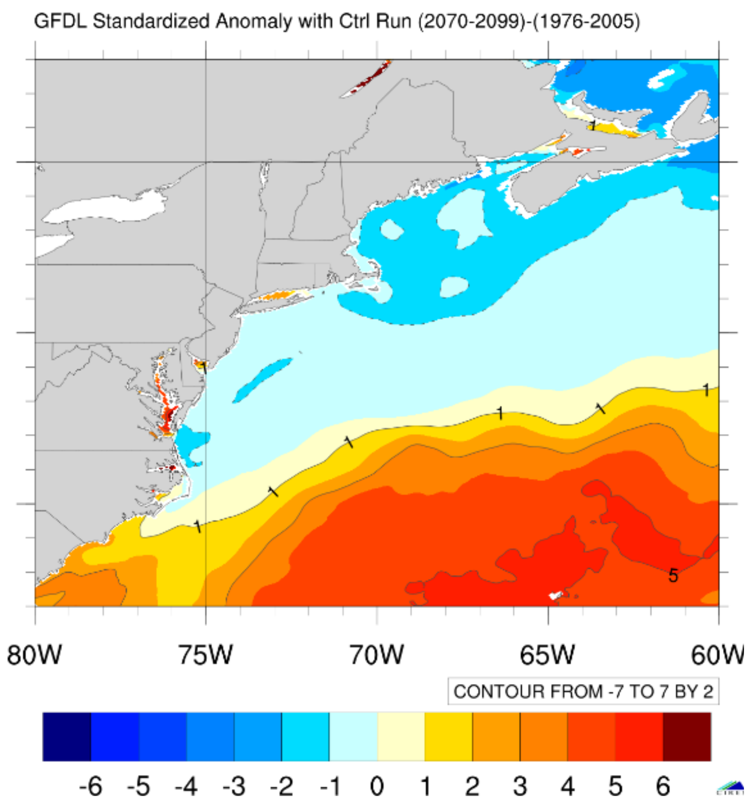




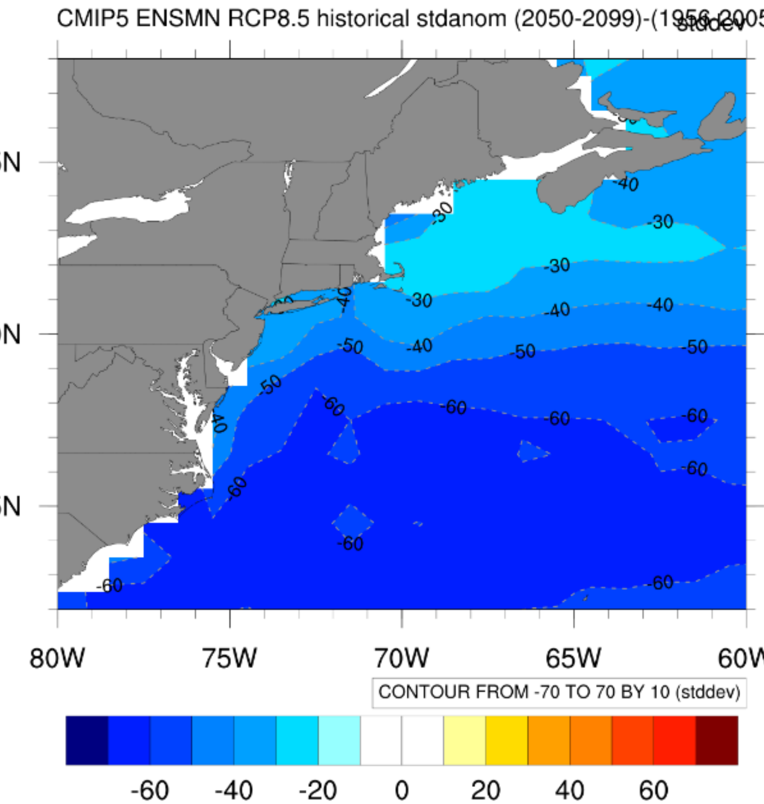
NOAA FISHERIES

Climate Exposure

sea surface salinity (ROMS-NWA)



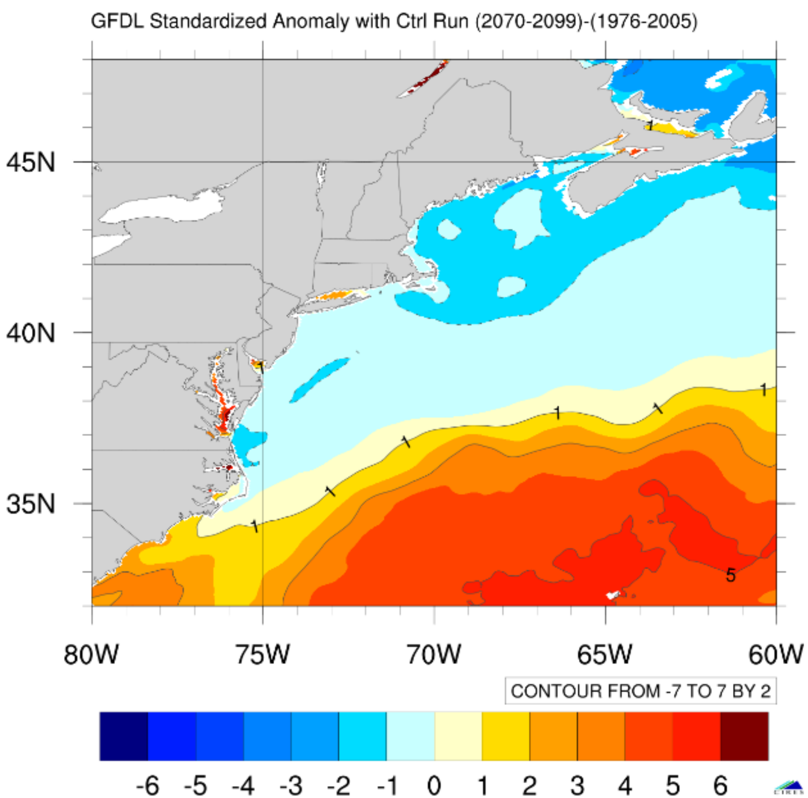
pH (CMIP5)



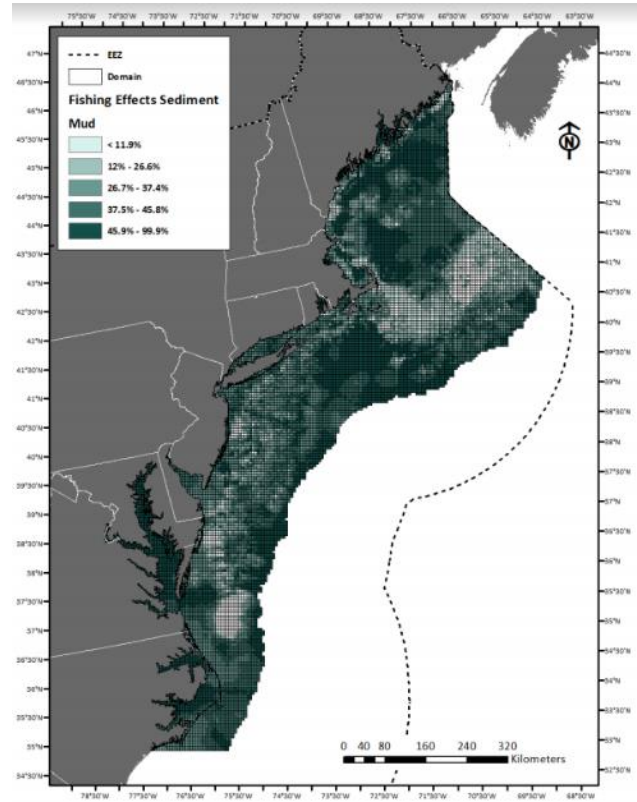
Scoring Bins	
Low	0-1.5
Moderate	1.5-4
High	4-5.5
Very High	5.5+

Climate Exposure

sea surface salinity (ROMS-NWA)



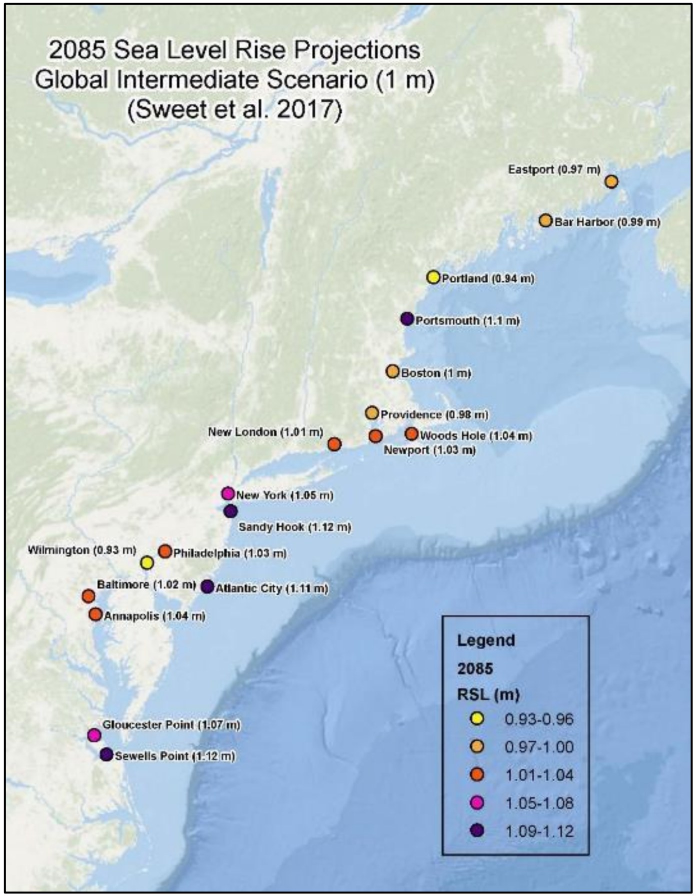
Marine/Estuarine
Unconsolidated Bottom: Mud

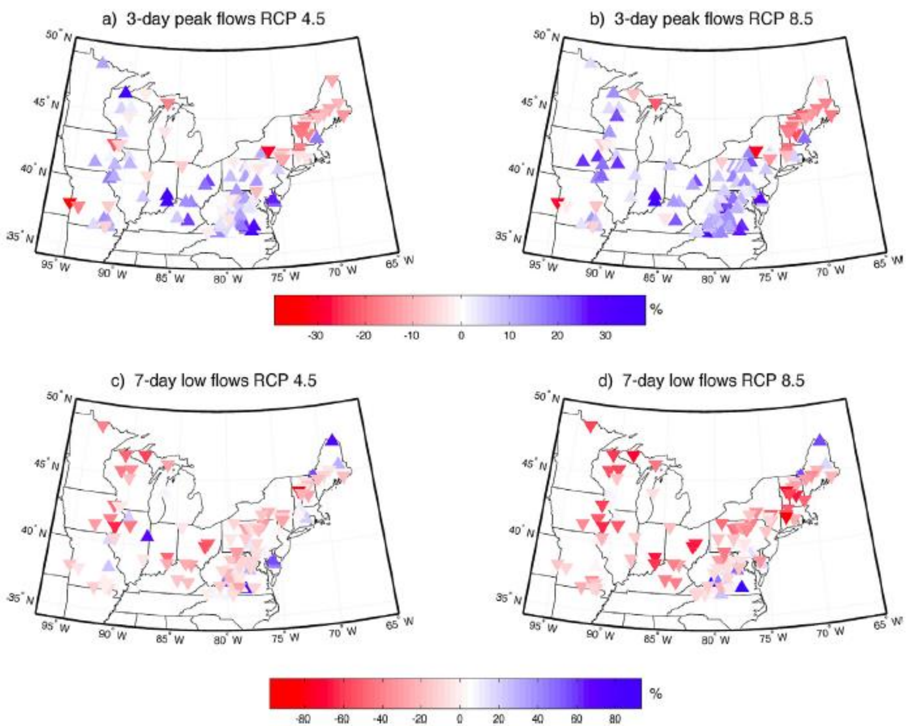


Scoring Bins	
Low	0-1.5
Moderate	1.5-4
High	4-5.5
Very High	5.5+

NOAA FISHERIES

Climate Exposure

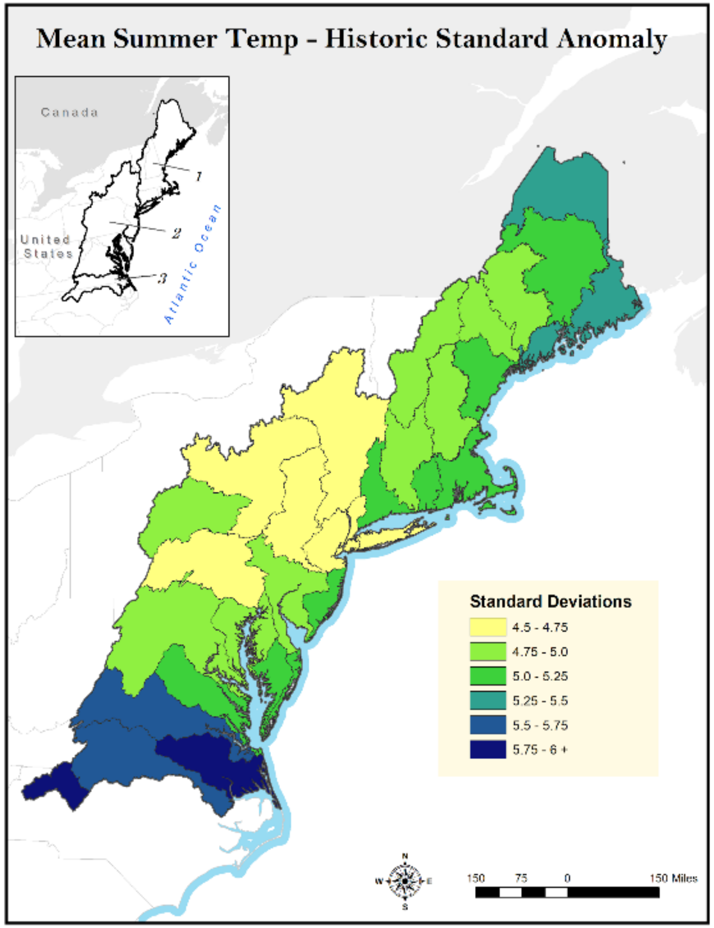




Percentage changes in the magnitude of the 100-year return period 3-day peak flow (top panels) and 7-day low flows (bottom panels). (Demaria et al. 2015)

NOAA FISHERIES

Climate Exposure



USGS SHEDS Stream Temperature Model (Letcher et al. 2016)

Vulnerability Score

Table 3. Logic rule for calculating overall species' climate exposure and biological sensitivity. The scoring rubric is based on a logic model where a certain number of individual scores above a certain threshold are used to determine the overall climate exposure and overall biological sensitivity.

Overall Sensitivity or Exposure Score	Numeric Score	Logic Rule
Very High	4	3 of more attributes or factors mean $\geq$ 3.5
High	3	2 of more attributes or factors mean $\geq$ 3.0
Moderate	2	2 of more attributes or factors mean $\geq$ 2.5
Low	1	All other scores

Sensitivity Component Score x Exposure Component Score = Overall Vulnerability Rank

NOAA FISHERIES

Presentation of Results

Fig 3. Overall climate vulnerability score. For specie... ps see Table 1. Overall climate vulnerability is denoted by color: low (green), moderate (yellow), high (orange), and very ... is denoted by text font and text color: very high certainty (>95%, black, bold font), high certainty (90–95%, black, italic font) ..., white or gray, bold font), low certainty (<66%, white or gray, italic font).

Alewife – *Alosa pseudoharengus*

Overall Vulnerability Rank = Very High

Biological Sensitivity = High
Climate Exposure = Very Hig...
Data Quality = 79% of s...

Alosa ...	Expert Scores	Data Quality	Expert Scores Plots (Portion by Category)
	2.5	1.4	
...essors	3.3	2.2	
...n Growth Rate	2.2	1.4	
Spawning Cycle	3.2	2.9	
Complexity in Reproduction	3.2	3.0	
Early Life History Requirements	3.3	2.4	
Sensitivity to Ocean Acidification	1.5	1.8	
Prey Specialization	1.5	3.0	
Habitat Specialization	2.6	3.0	

Low
Moderate
High
Very High

Alewife (*Alosa pseudoharengus*)

Overall Climate Vulnerability Rank: **Very High** (100% certainty from bootstrap analysis).

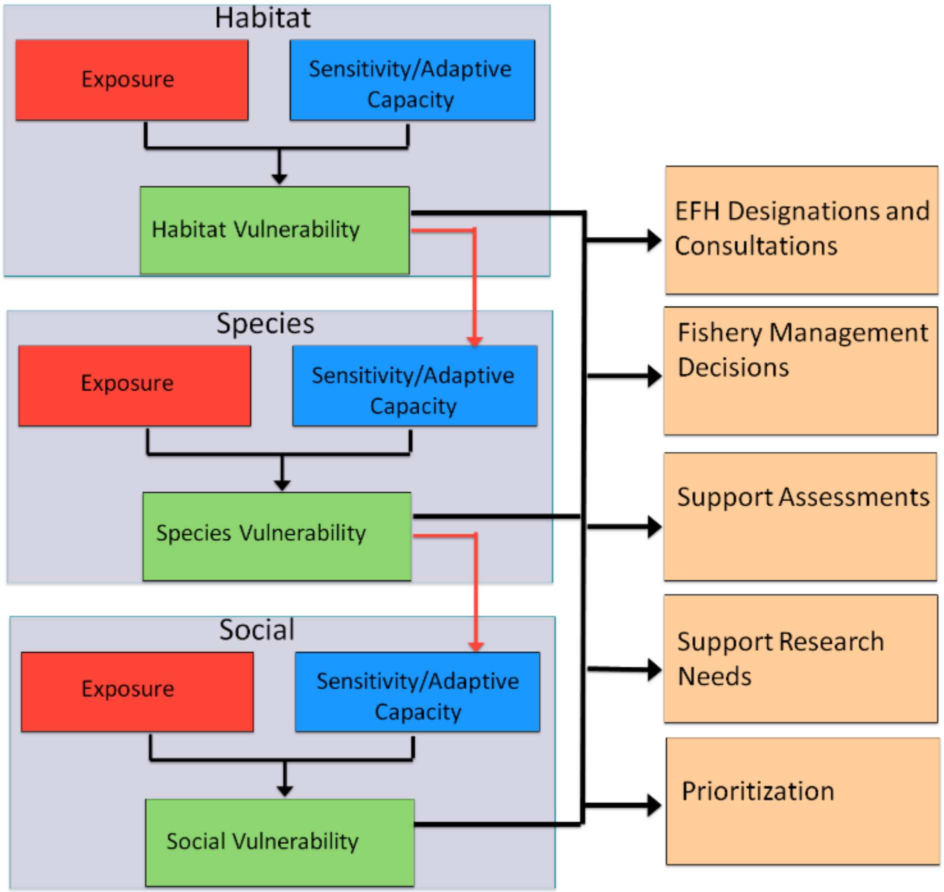
Climate Exposure: **Very High.** Three exposure factors contributed to this score: Ocean Surface Temperature (4.0), Ocean Acidification (4.0) and Air Temperature (4.0). Alewife are anadromous, spawning in freshwater, developing in freshwater and estuarine habitats, feeding as adults in marine habitats.

Biological Sensitivity: **High.** Four sensitivity attributes scored above 3.0: Other Stressors (3.3), Early Life History Requirements (3.3), Spawning Cycle (3.2), Complexity in Reproduction (3.2). Alewife are anadromous and exposed to a number of other stressors including habitat destruction, blockage to spawning habitats, and contaminants (Limburg and Waldman, 2009). Spawning time varies latitudinally and is linked to spring warming (Monroe, 2002). Eggs and larvae inhabit freshwaters and then juveniles move to estuarine and ocean waters.

Distributional Vulnerability Rank: **Low** (62% certainty from bootstrap analysis). Alewife have a relatively high degree of spawning site fidelity, limiting the ability of the species to shift distribution.

Example Result Products from Fish Climate Vulnerability Assessment

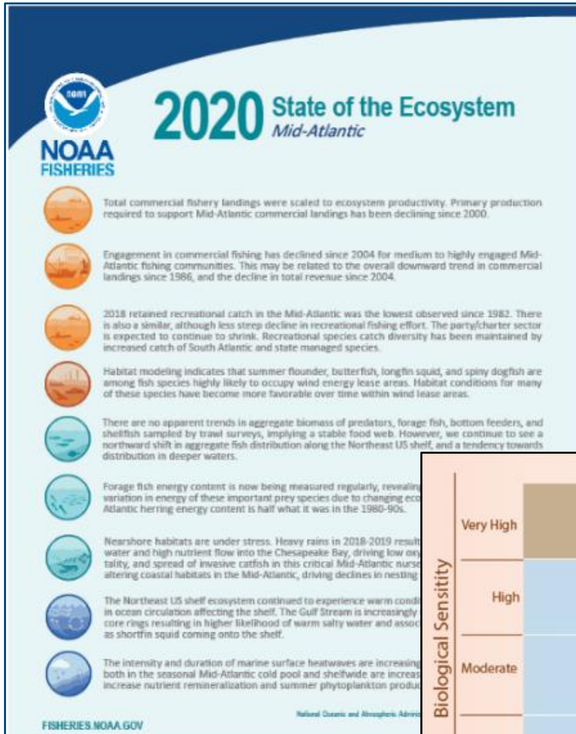
How will the results be used?



- Prioritize conservation & restoration
- EFH consultations & 5-year reviews
- Ecosystem context for fisheries management decisions
- Framework replicated in other regions

NOAA FISHERIES

Other potential avenues



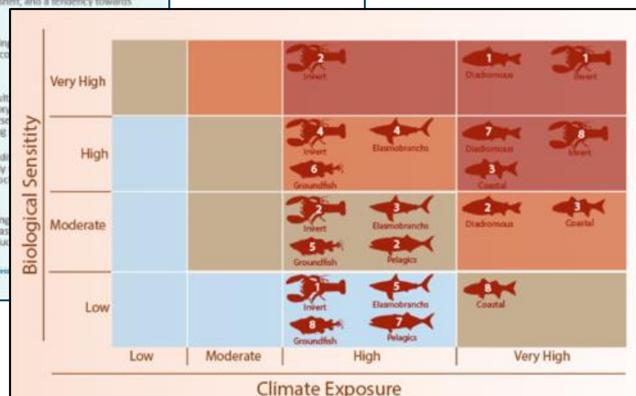
Risk Assessment Update 2020

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

…ults; l=low risk (green), lm= low-moderate risk (yellow), mh=moderate to high risk

…v	RecVal	FishRes1	FishRes4	FleetDiv	Social	ComFood	RecFood
	h	l	mh	l	lm	h	mh



NOAA FISHERIES

Questions?

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

Project Participants: Vince Guida, Ursula Howson, Douglas Christel, Matthew Lettrich, Rory Saunders, David Stevenson, Brian Grieve, Wendy Morrison, Thomas Noji, Vince Saba, Roger Griffis, Peg Brady, Tony Marshak, Lou Chiarella, Kenric Osgood, Bruce Vogt, Mark Monaco, Donna Johnson, Michael Alexander, Diane Borgaard, Peter Auster, Jon Grabowski, Dave Packer, Damian Brady, Renee Mercaldo-Allen, Phil Colarusso, Mathias Collins, Christopher Meaney, Frank Borsuk, Matthew Cashman, James Hawkes

NOAA FISHERIES