Shallow water nursery habitats used by black sea bass and summer flounder in Chesapeake Bay and the coastal lagoons

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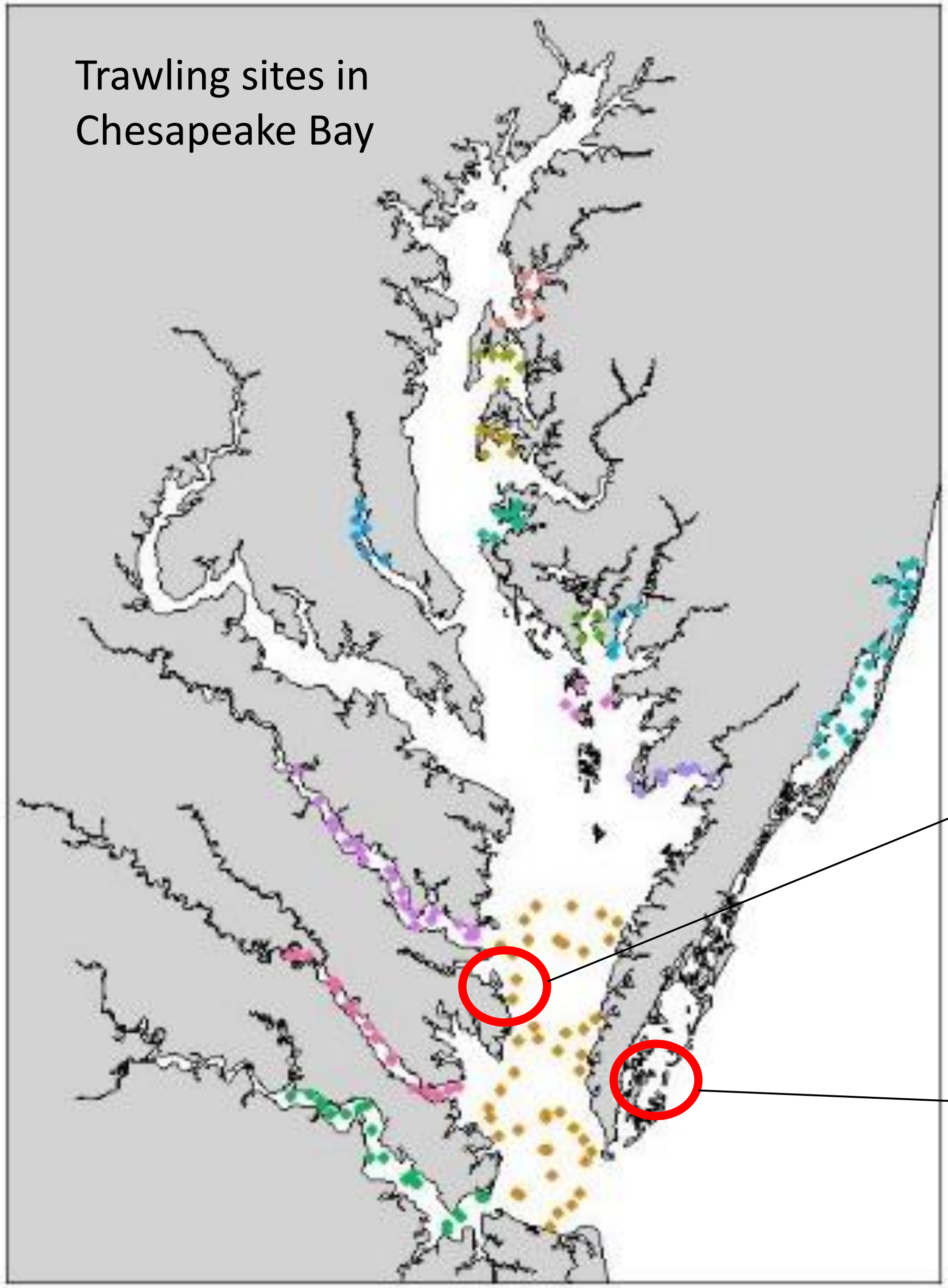
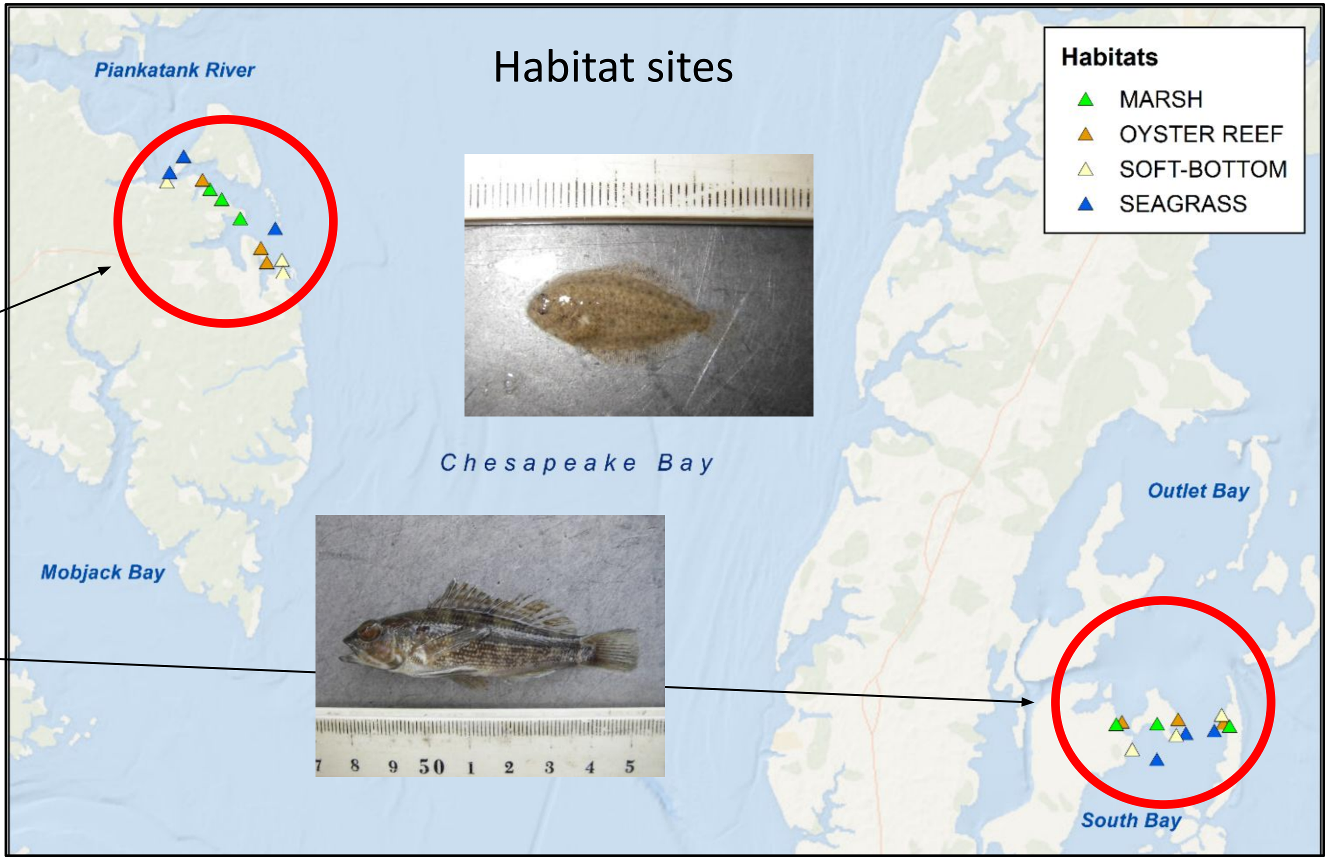
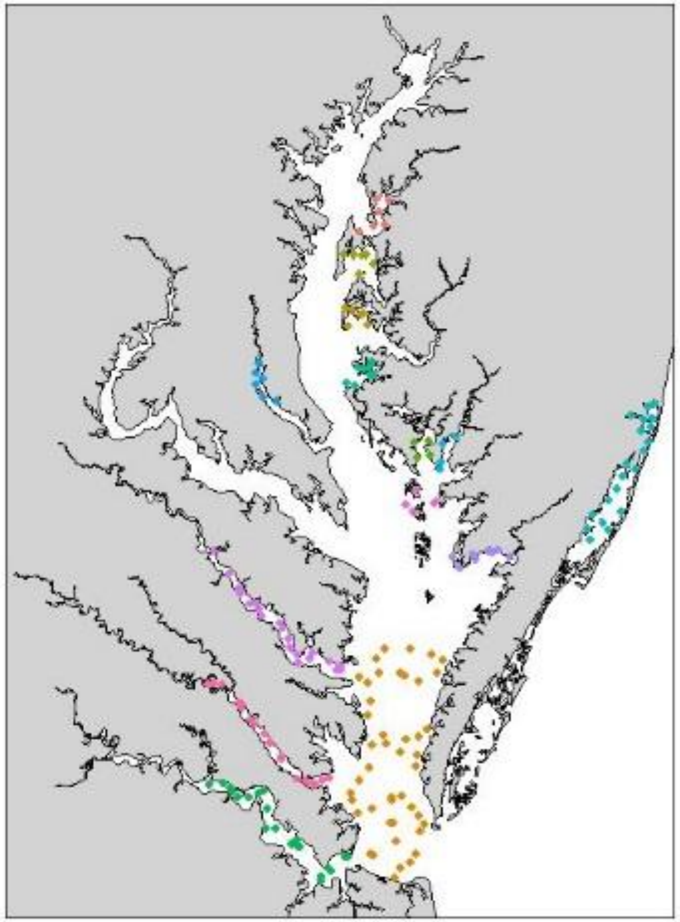
Objectives



1. Assess long-term (1989 to 2018) habitat conditions in nursery areas and annual recruitment of black sea bass and summer flounder
2. Assess small-scale nursery habitats used by black sea bass and summer flounder in Chesapeake Bay and the coastal lagoons

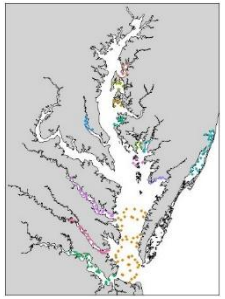


Data : Long-term habitat conditions

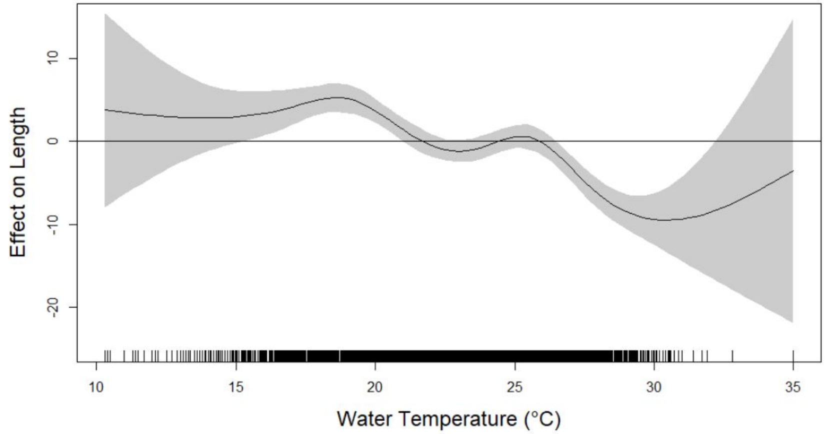


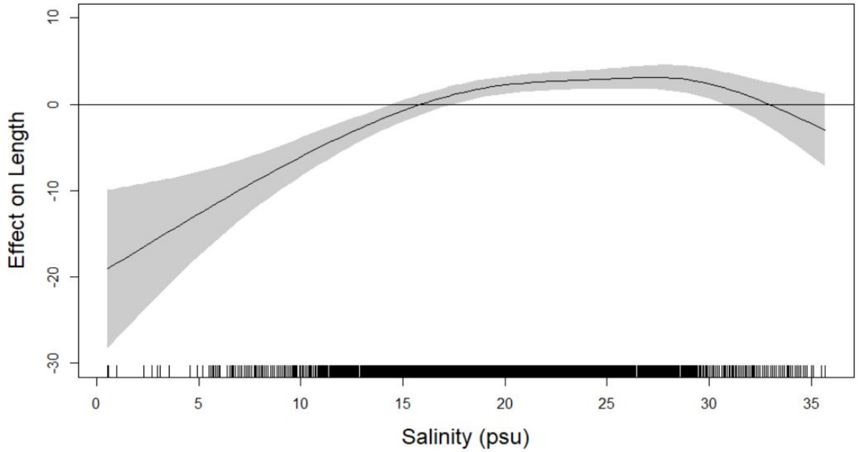
Locations of trawling sites in Chesapeake Bay and the coastal lagoons in MD and VA

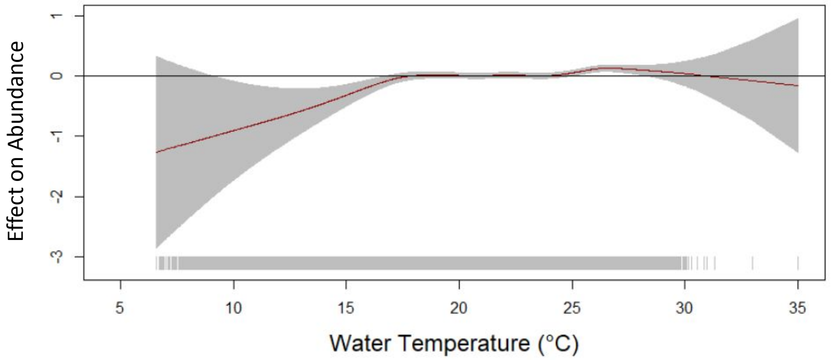
- Juvenile fish catch and size from trawl surveys
- Dynamic environmental conditions (e.g., temperature, salinity, DO)
- Proximity to structured habitats (e.g., marsh, oyster reef, seagrass)
- Generalized additive models – allows non-linear relationships

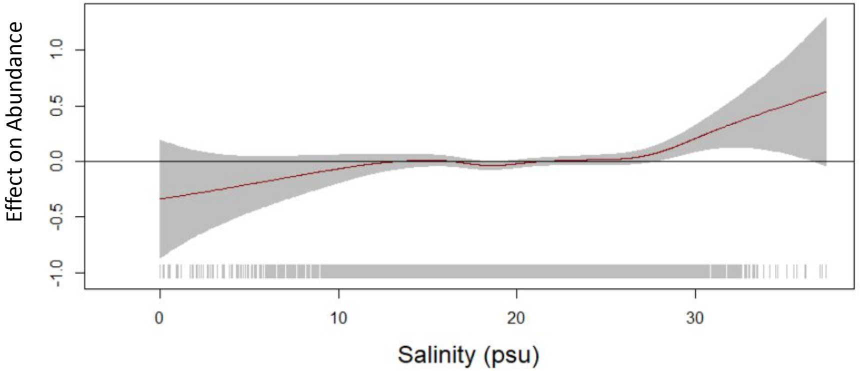


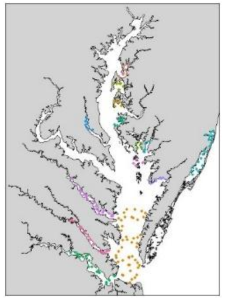
Long-term nursery habitat conditions
Summer flounder



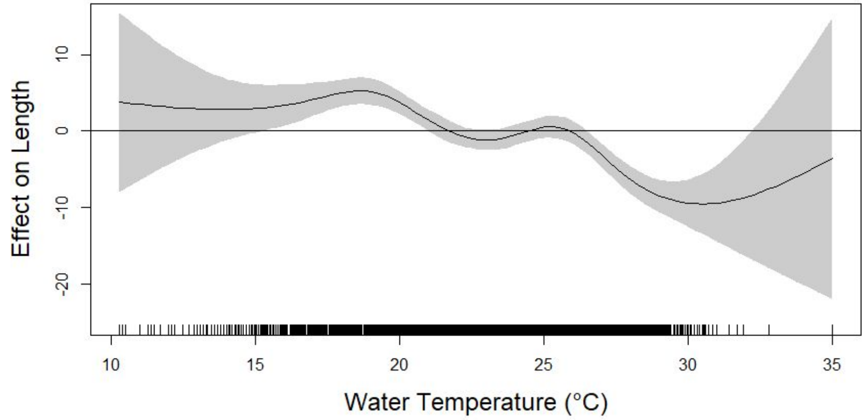




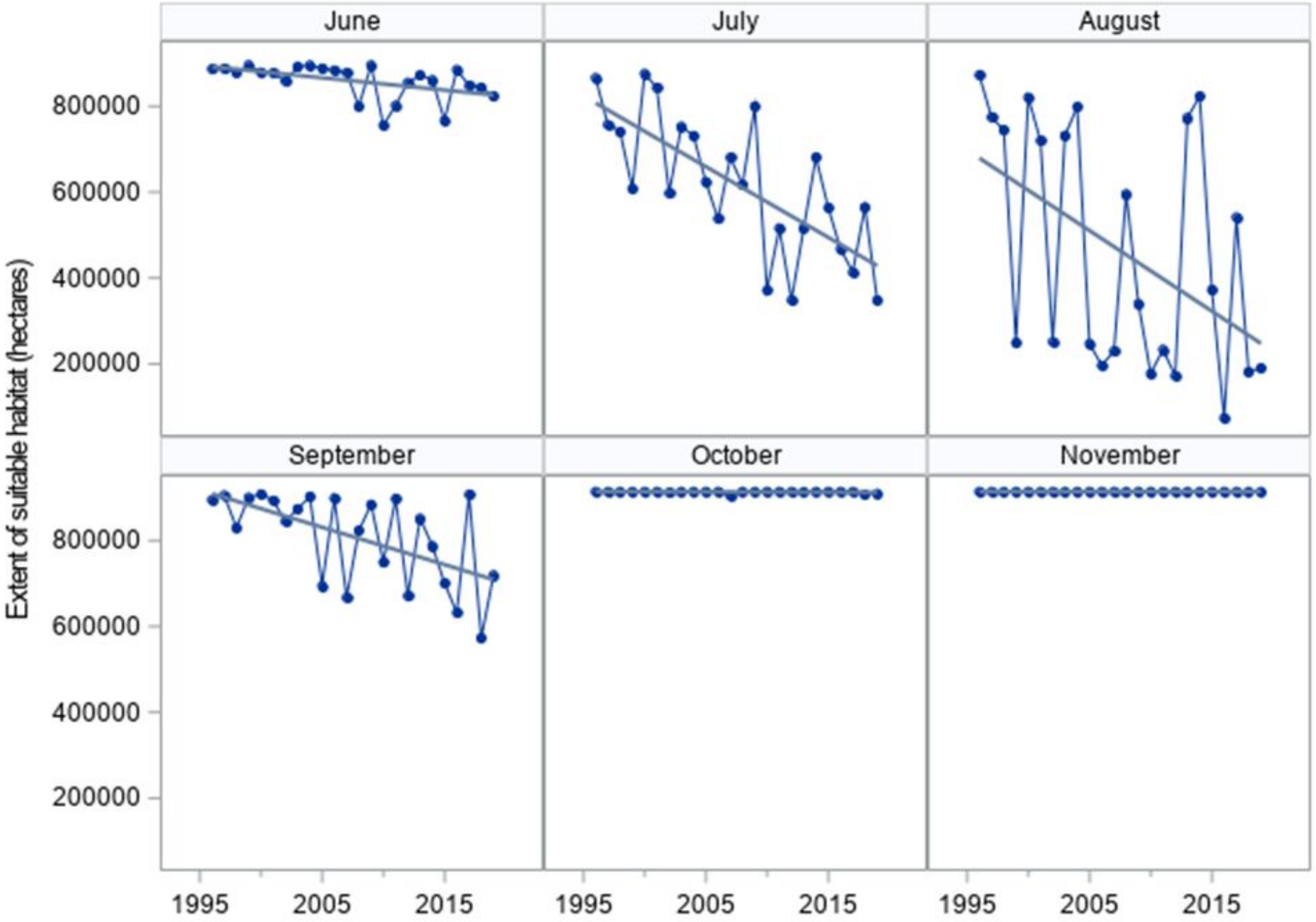


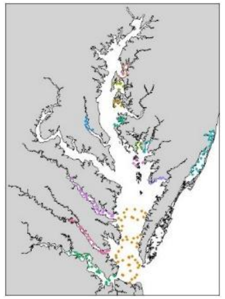


Long-term nursery habitat conditions
Summer flounder

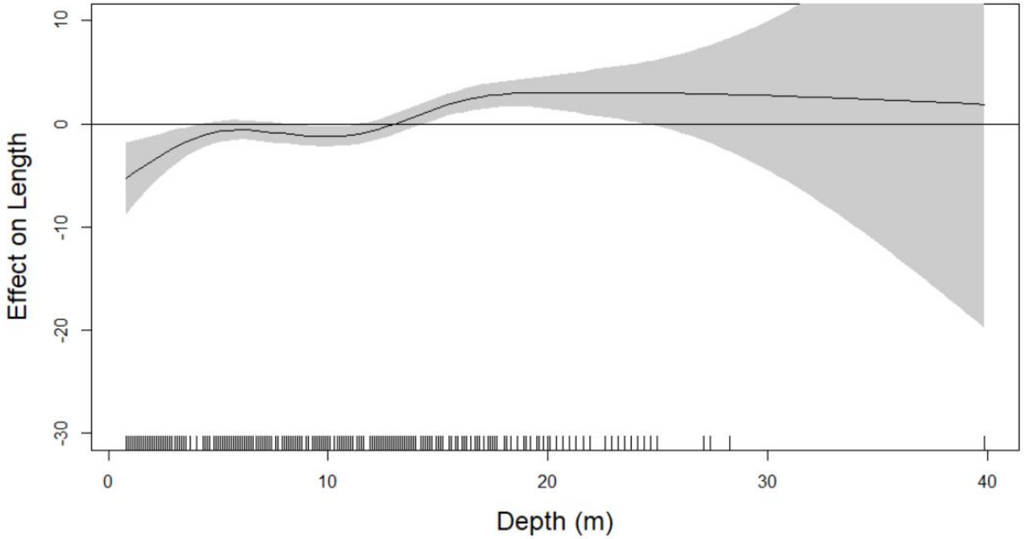


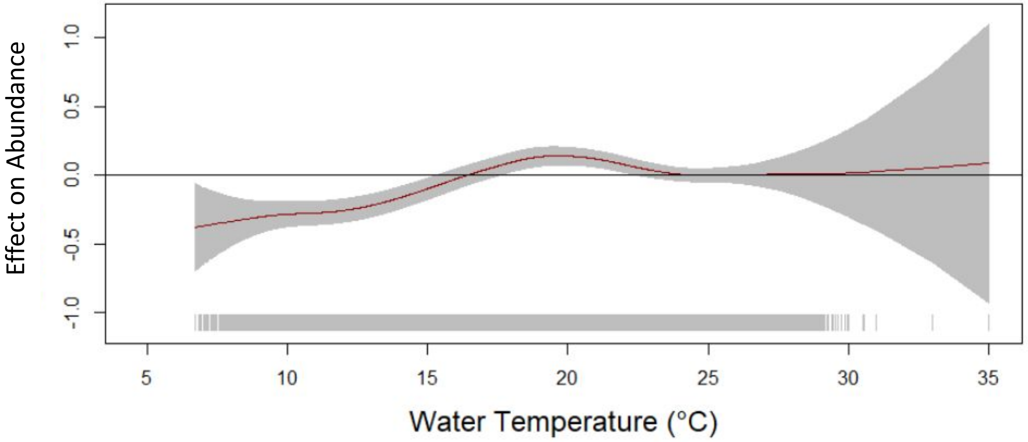
Monthly mean habitat extent

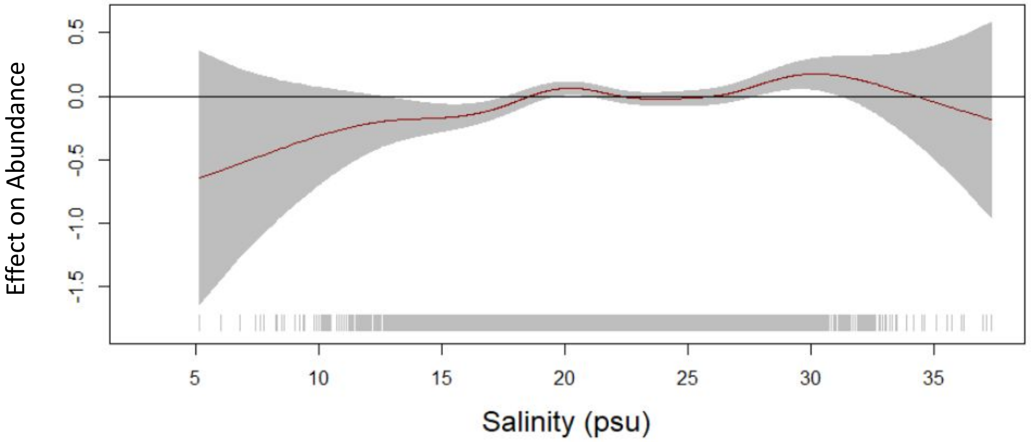




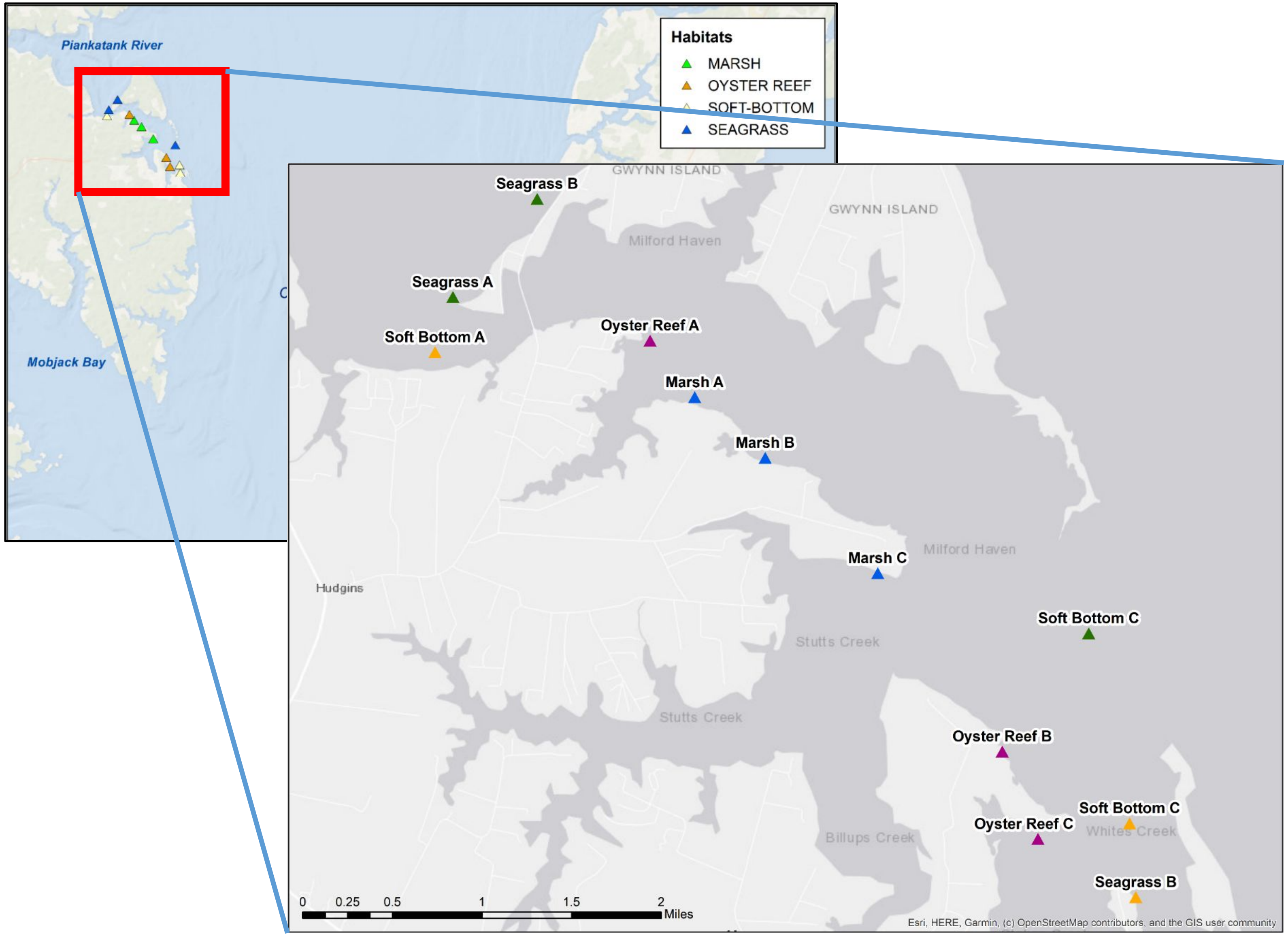
Long-term nursery habitat conditions
Black sea bass







Data : Small-scale nursery habitat use



- Bay habitats - Piankatank River
- Seaside lagoons- Oyster, VA
- Marsh
- Seagrass
- Oyster reef
- Soft bottom
- Fyke nets (June – October)

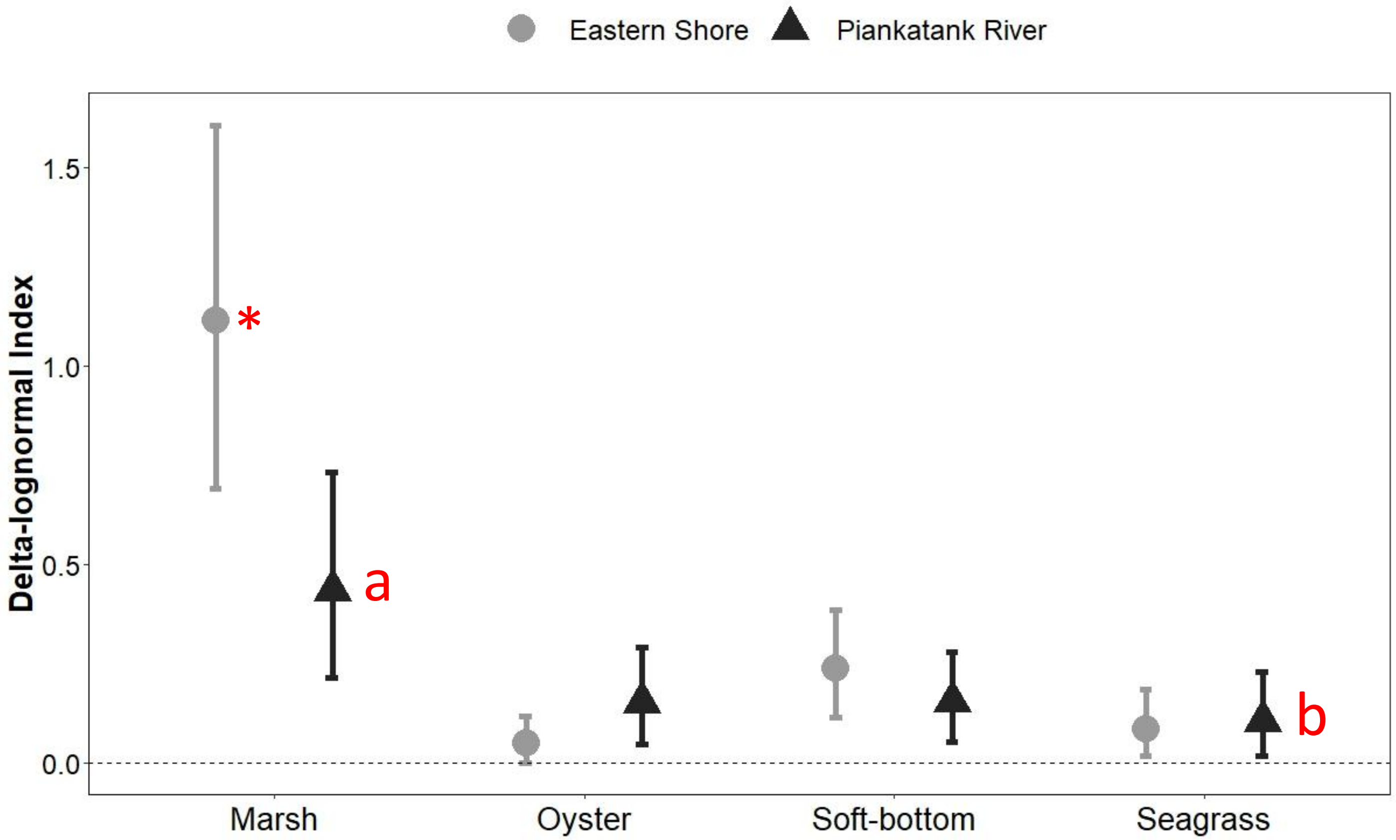
Small-scale nursery habitat use

Number of fish captured in each habitat

Habitat	Black sea bass	Summer flounder
Marsh	8	74
Oyster reef	27	10
Soft-bottom	14	18
Seagrass	44	9

Small-scale nursery habitat use

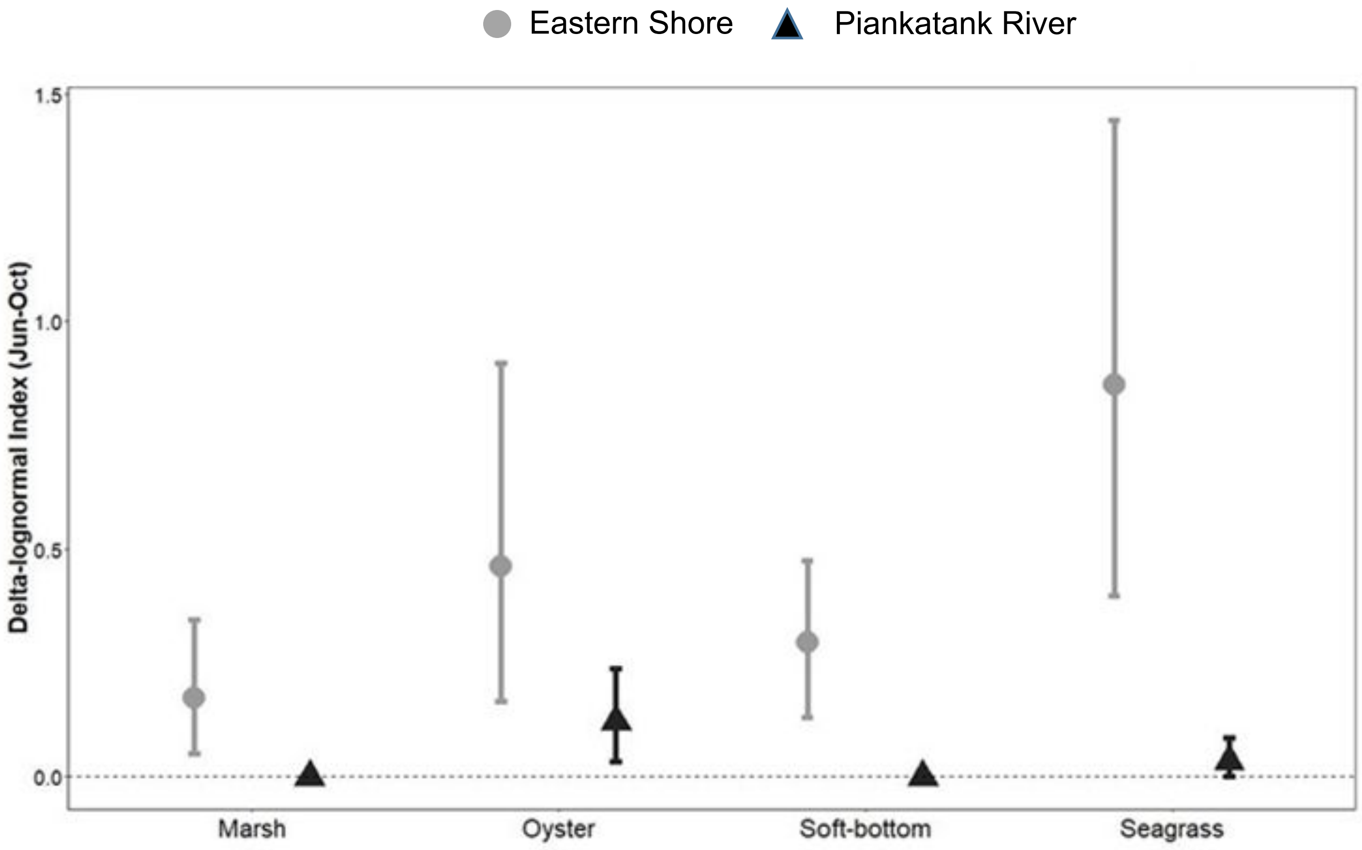
Summer flounder



- More Summer flounder in marsh sites at ES
- More Summer flounder in marsh sites compared with seagrass sites in PR

Small-scale nursery habitat use

Black sea bass



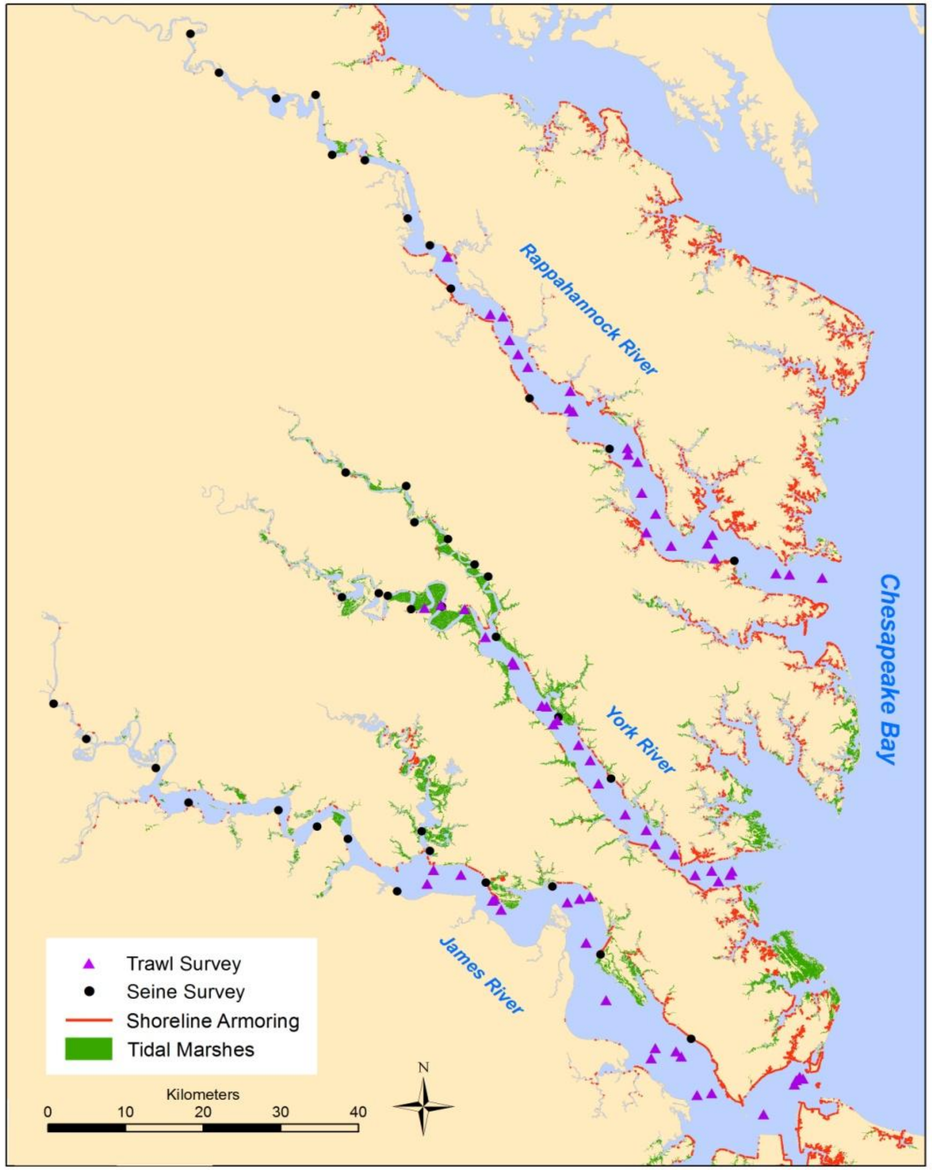
- Large variance limits our ability to detect differences
- More Black sea bass in seagrass sites at ES compared with seagrass sites in PR

Shallow water nursery habitats used by black sea bass and summer flounder - Summary

- Greater mean abundances of juvenile summer flounder and black seabass in ES sites compared with PK sites (also true for seatrout and spot)
- Within ES and PK, relative abundance of juvenile summer flounder was greatest in marsh habitats
  - Highly productive, offer prey, and may provide protection from predation
  - Climate change may lead to increased marsh coverage due to sea level rise
  - Need to develop policies for conversion of uplands into marshes in the future
- Greater % structured sites in ES – could be used as an example of areas to conserve or restore elsewhere
- BSB marginally associated with oyster habitats in early summer, but not late summer – size related? May be important to maintain habitat mosaics
- Water temperature exceeded threshold (25.9 ^{o}C) for juvenile summer flounder and the proportion of the bay has declined between 47% and 64% since 1996

Additional fish & shallow habitat studies

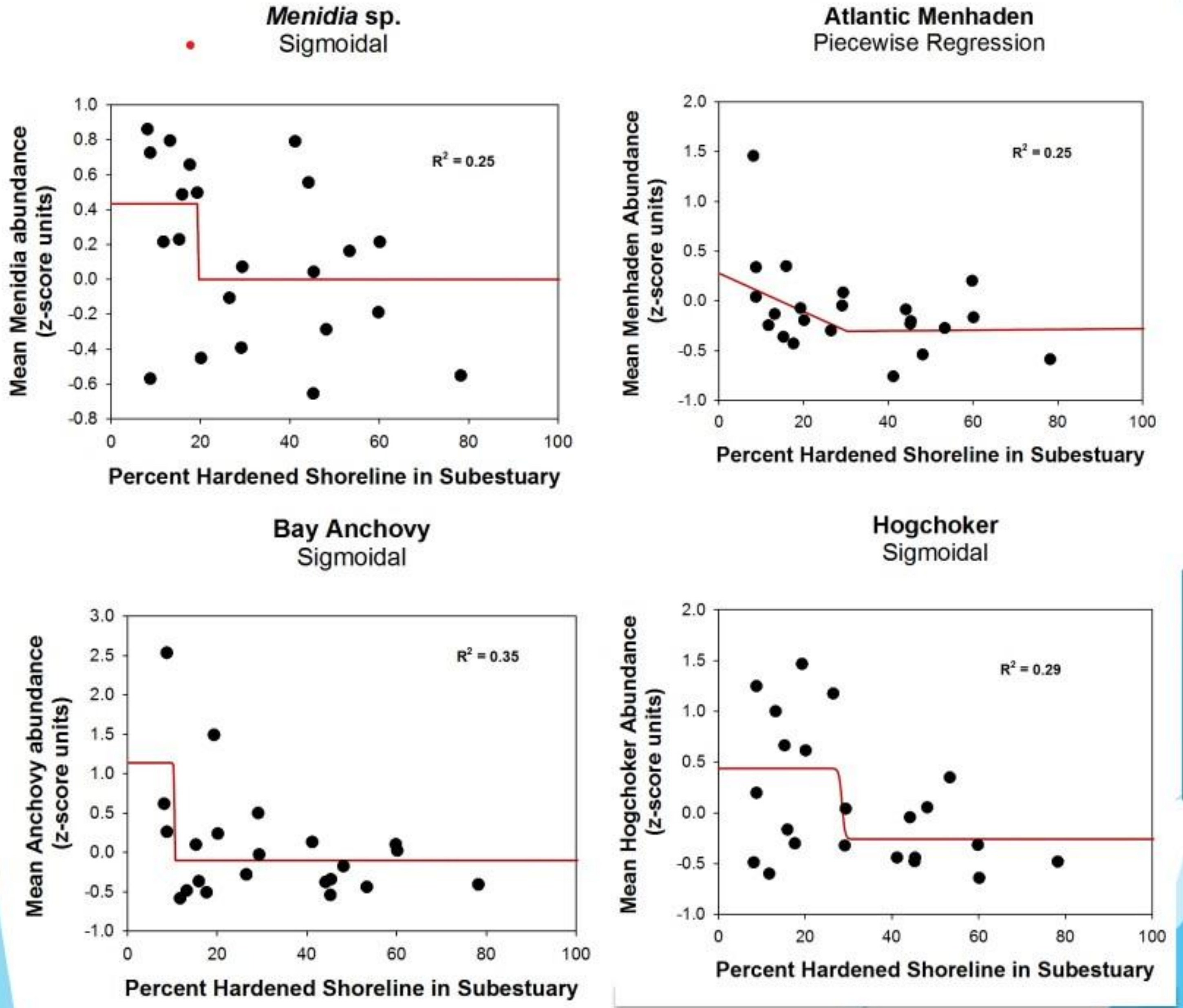
- Threshold effects of altered shorelines – Seitz et al.
- Shorescape development on forage fish production – Tuckey et al.
- Extent of suitable habitats for juvenile striped bass – Dixon et al.



UPDATE: Bay Wide Approach: Threshold effects of altered shorelines and other stressors on forage species in Chesapeake Bay

PIs Rochelle Seitz & Rom Lipcius,
Gabby Saluta (VIMS),
Denise Breitburg, Tom Jordan, Don Weller (SERC),
and Matt Kornis (USFWS)

Results: Curves for thresholds - forage fish



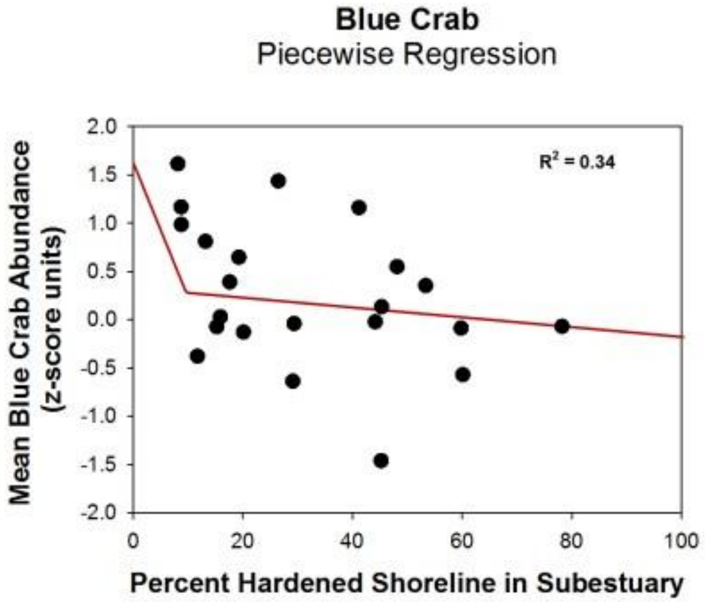
All improved over linear:

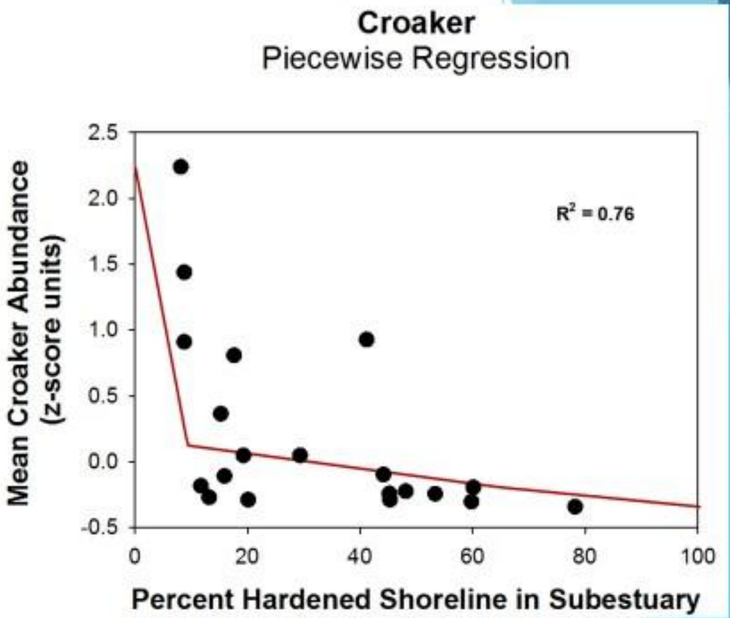
- *Menidia* R^2 0.25>0.16
- Anchovy R^2 0.35>0.13
- Menhaden R^2 0.25>0.18
- Hogchoker R^2 0.29>0.19

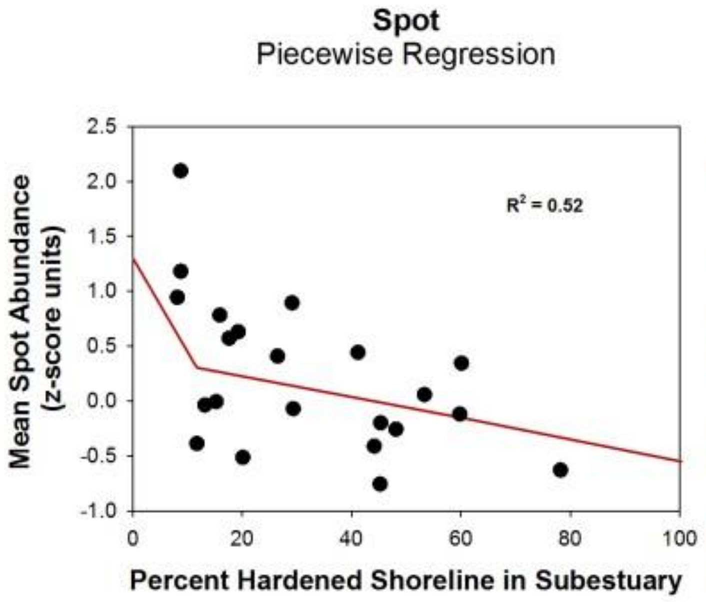
Threshold levels:

- *Menidia* 20%
- Anchovy 10%
- Menhaden 30%
- Hogchoker 30%

Results: Curves for thresholds - Crab, Spot, Croaker







All improved over linear:
- Crab R^2 0.34>0.16
- Spot R^2 0.52>0.29
- Croaker R^2 0.76>0.29

Threshold levels:
- Crab 10%
- Spot 10%
- Croaker 10%

Quantifying the relative effects of shorescape development on forage fish production in the York River subestuary, 2000 - 2016

Troy D. Tuckey
Mary C. Fabrizio
Donna M. Bilkovic
Julie Herman

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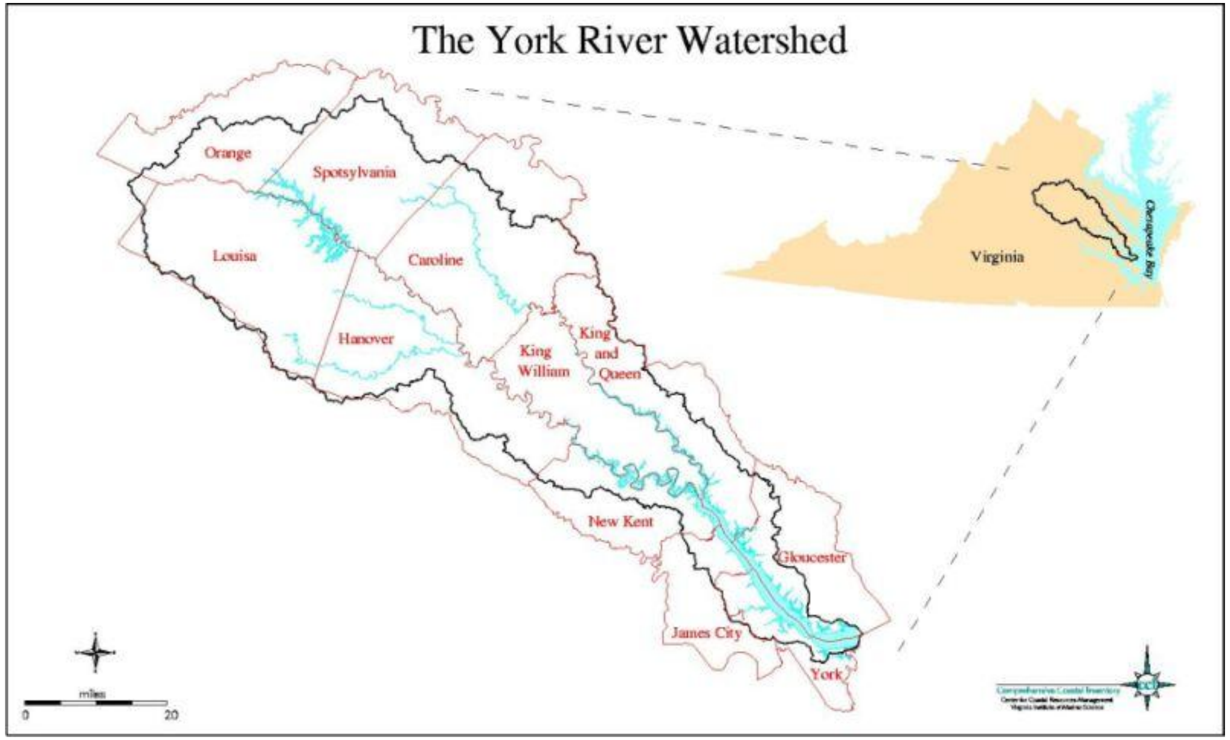
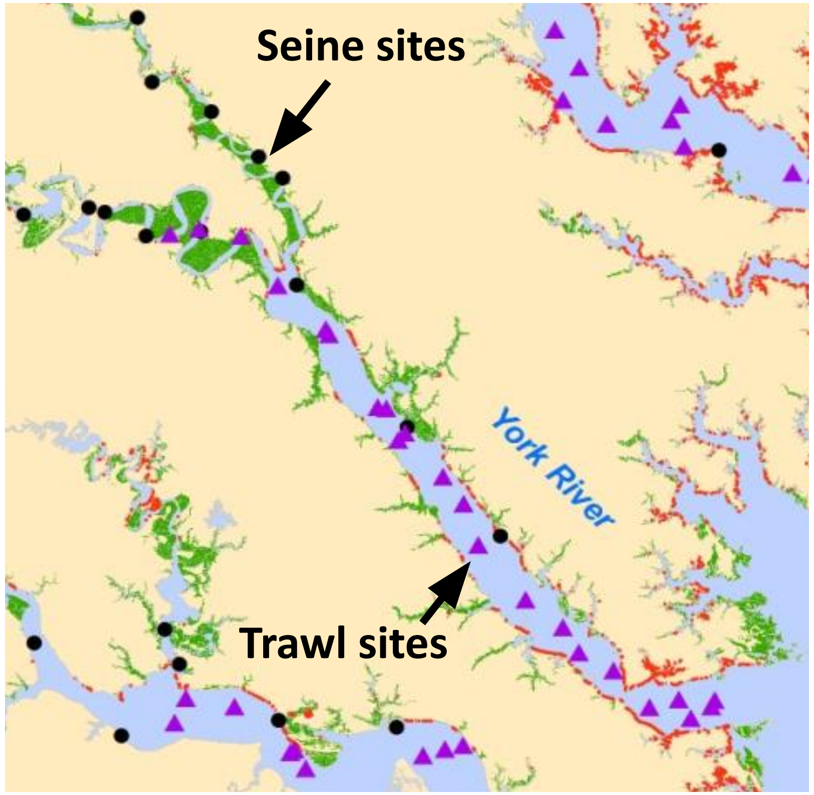
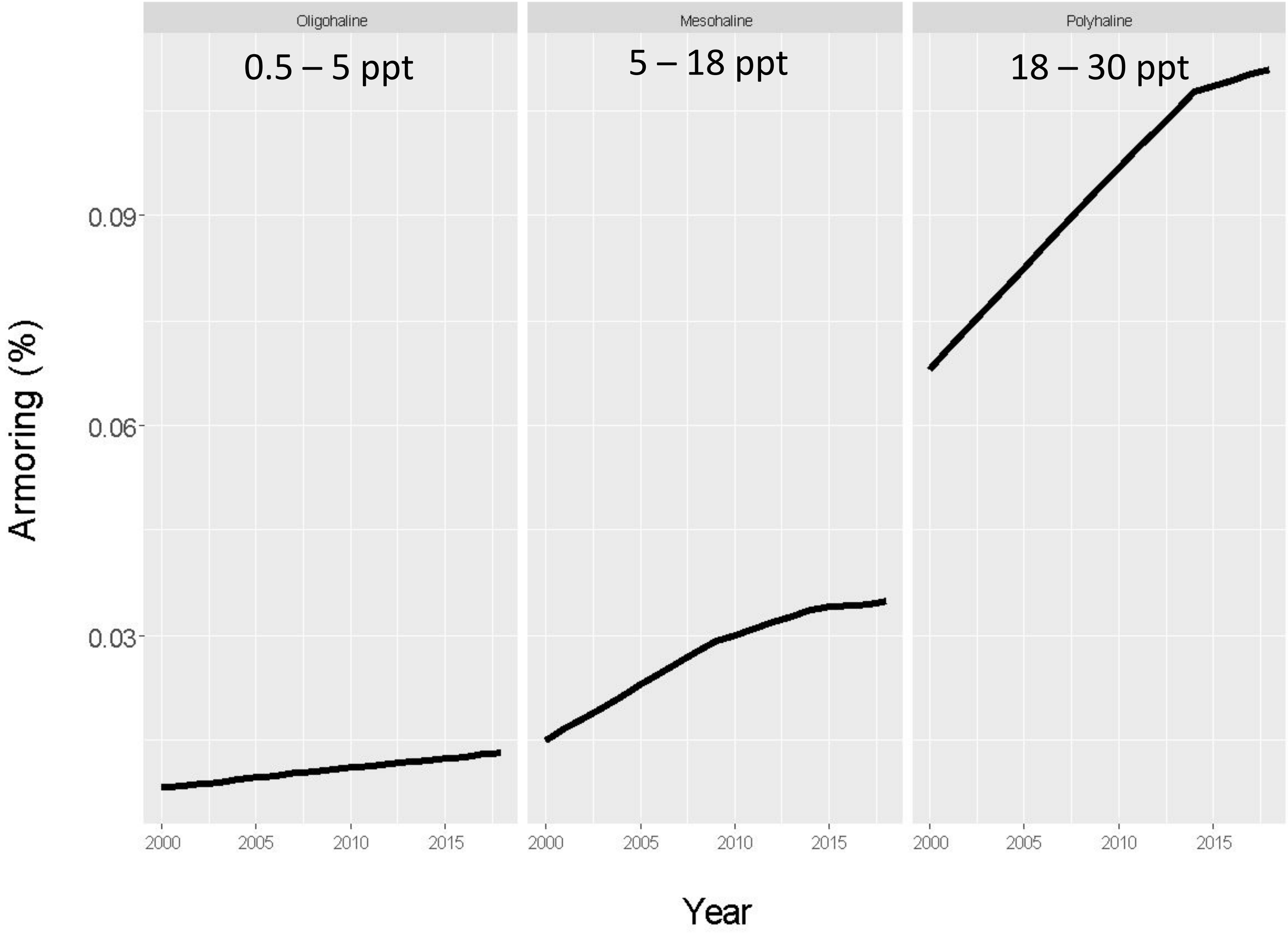


Funding through: CBTRUST Chesapeake Bay Trust Goal Implementation Team Initiative

Methods


Seine sites
York River
Trawl sites


Oligohaline
Mesohaline
Polyhaline
0.5 – 5 ppt
5 – 18 ppt
18 – 30 ppt
Armoring (%)
0.09
0.06
0.03
2000
2005
2010
2015
Year

Methods – Data analysis

- Forage quality (abundance, size, biomass)
- 15 species: American shad, Atlantic croaker, Atlantic silverside, banded killifish, bay anchovy, blackcheek tonguefish, blue crab, blueback herring, kingfish, mummichog, spotted hake, spot, summer flounder, weakfish, white perch (Ihde et al. 2015)
- Generalized additive models (GAMs)

Mean length, abundance, or biomass ~ armoring + water temp + salinity + SAV + land use + flow + abundance

Results

- Armoring was not significant for species counts
- A significant effect of armoring on mean length for some species
- A significant effect of armoring on biomass for some species

	Trawl Survey			Seine Survey		
Species	Counts	Length	Biomass	Counts	Length	Biomass
American shad	.	.	.	ns	ns	
Atlantic croaker	ns			ns	ns	
Atlantic silverside	.	.	.	ns	ns	ns
Banded killifish	.	.	.	ns	ns	
Bay anchovy	ns			ns	ns	
Blackcheek tongue	ns		ns	.	.	.
Blueback herring	ns		ns	ns		ns
Blue crab	ns	ns		.	.	.
Kingfish	ns	ns		.	.	.
Mummichog	.	.	.	ns		
Spot	ns			ns		
Spotted hake	ns	ns		.	.	.
Summer flounder	ns	ns		.	.	.
Weakfish	ns			.	.	.
White perch	ns			ns		ns

Armoring

Positive

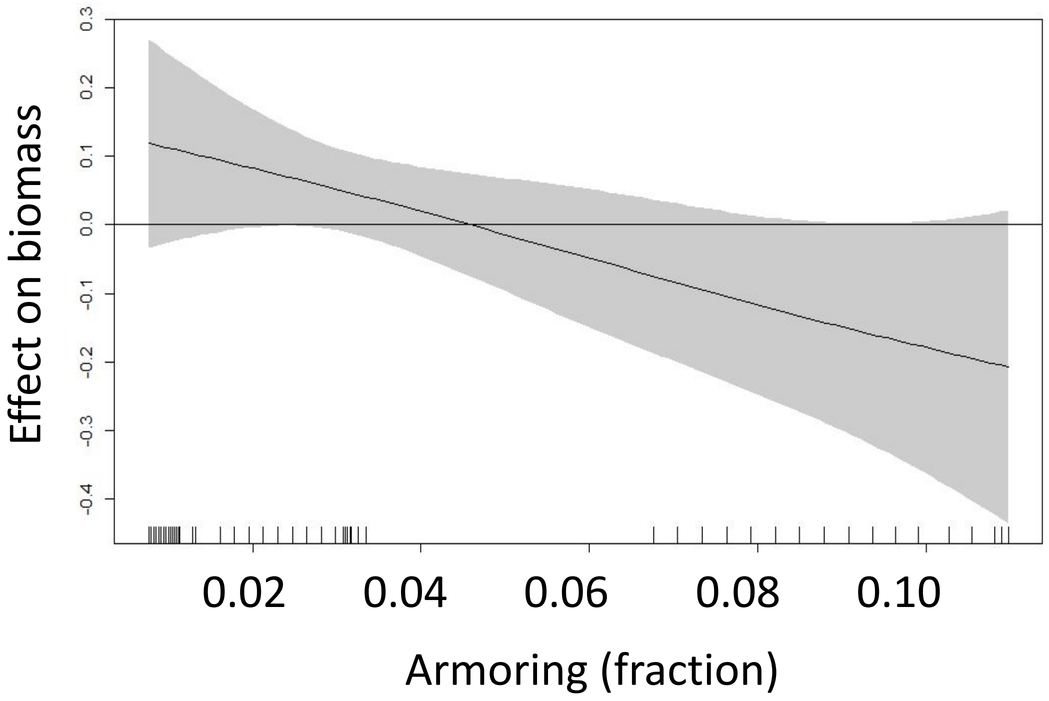
Mixed

Negative

ns – not significant

Results - Weakfish

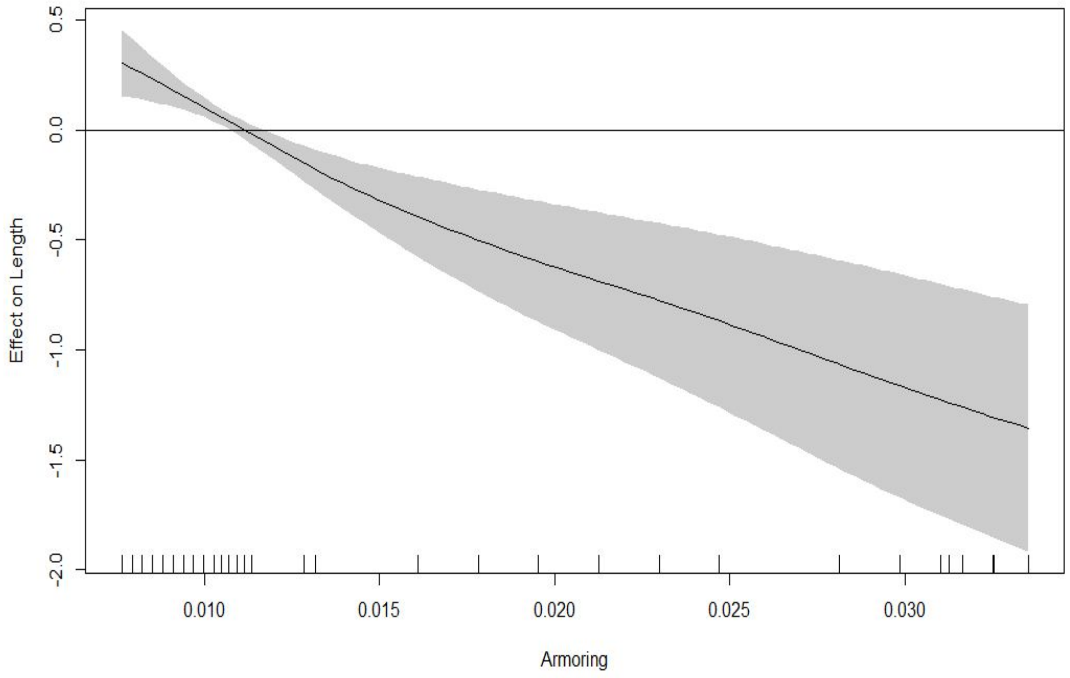
- Armoring has a negative effect on biomass (trawl survey)



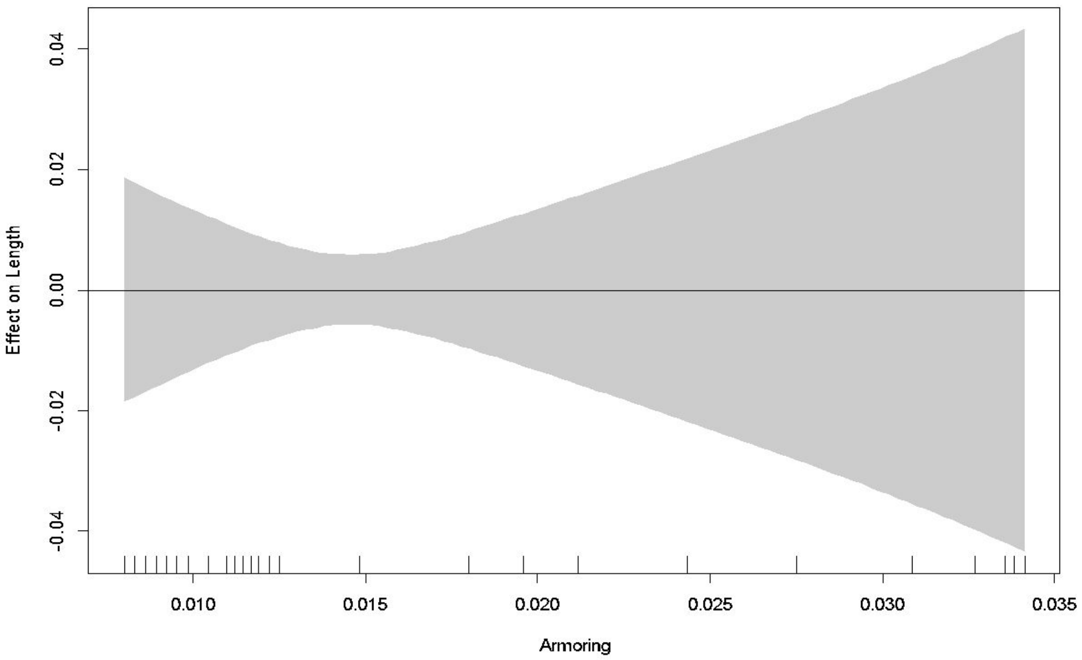
Results – White perch

- Negative effect of armoring on length, biomass
- Consistent pattern between surveys

White perch from seine survey



White perch from trawl survey



Conclusions

- Results vary by species and forage quality metric
- Armoring was not significant for relative abundance of any species – relatively low level of shoreline development in this system
- Results vary depending on source of fish (trawl/offshore vs. seine/nearshore)
- Detailed shoreline characterizations are critical

Extent of Suitable Habitats for Juvenile Striped Bass: Dynamics and Implications for Recruitment in Chesapeake Bay

Rachel L. Dixon[1], Mary C. Fabrizio[1], Troy D. Tuckey[1], Aaron J. Bever[2]

1 VIMS | William & Mary
Virginia Institute of Marine Science

2 Anchor QEA

Habitat extent may contribute to production

- High-quality habitats support greater numbers of recruits, but productivity varies within and between tributaries

- Habitats that facilitate the supply of YOY fish to the population are critical for sustaining the stock

Photo credit: VIMS Juvenile Trawl Survey

<u>Objectives:</u>

- Characterize habitat conditions that support juvenile striped bass in Chesapeake Bay
- Assess whether the extent of suitable habitat has changed over time
- Examine the relationship between habitat and fish abundance

Houde and Rutherford 1993; Kraus and Secor 2005; Able et al. 2012

Fishery Data (CPUE)

Environmental covariates

→ Boosted Regression Trees → Suitability Indices (SIs) → Habitat Suitability Index (HSI)

Characterize suitable habitats at the time of catch

Project Bay-wide

Age-0 (Shoreline habitats)

SI – Bottom DO

SI – DO Stratification

SI – Current Speed

→

HSI

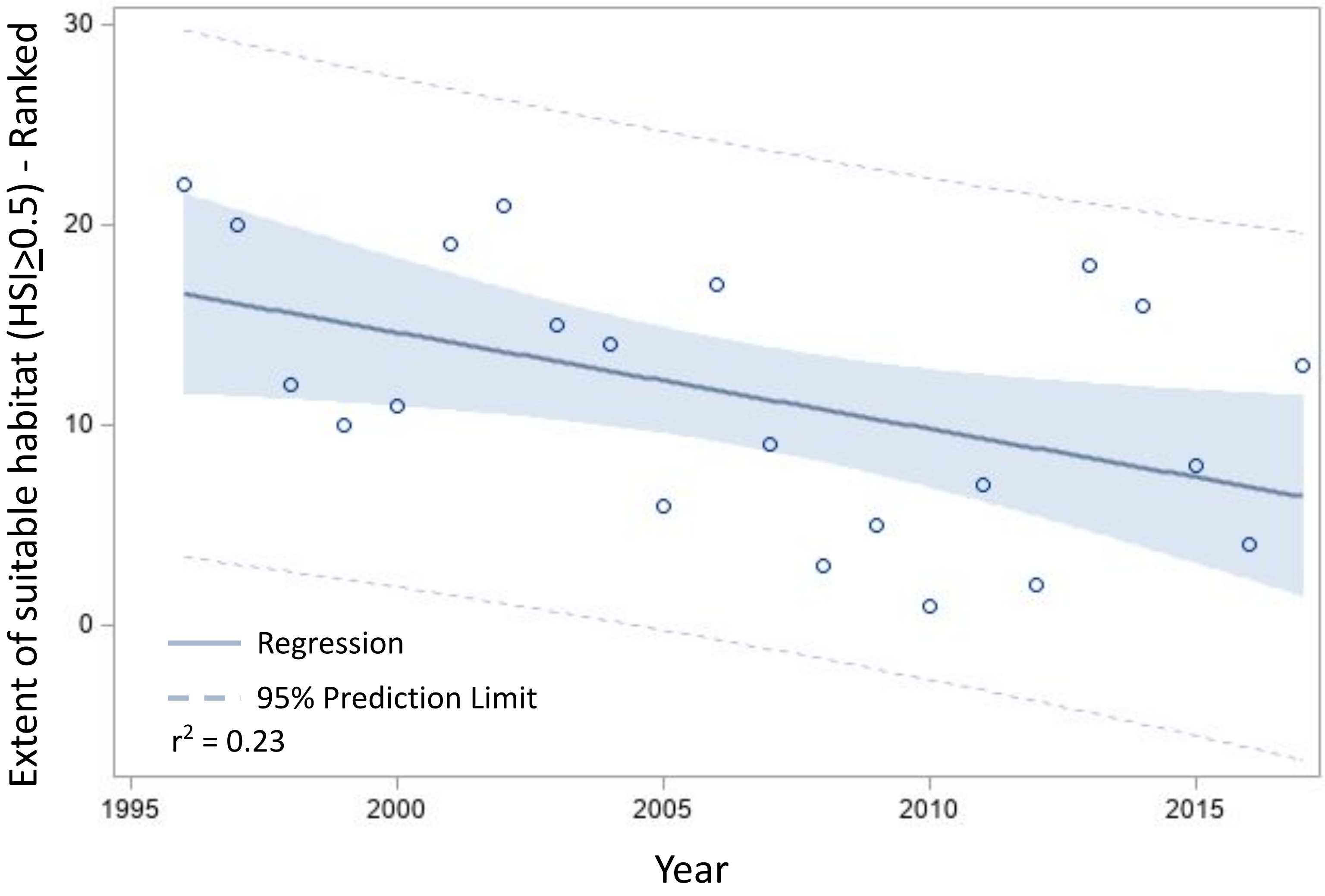
0 □ 1

“Suitable” $\geq$ 0.5

Tanaka and Chen 2015 (American lobster); Fabrizio et al. 2021 (forage fishes)

Age-0 (Shoreline habitats)

Does the extent of suitable habitat for age-0 striped bass change over time?

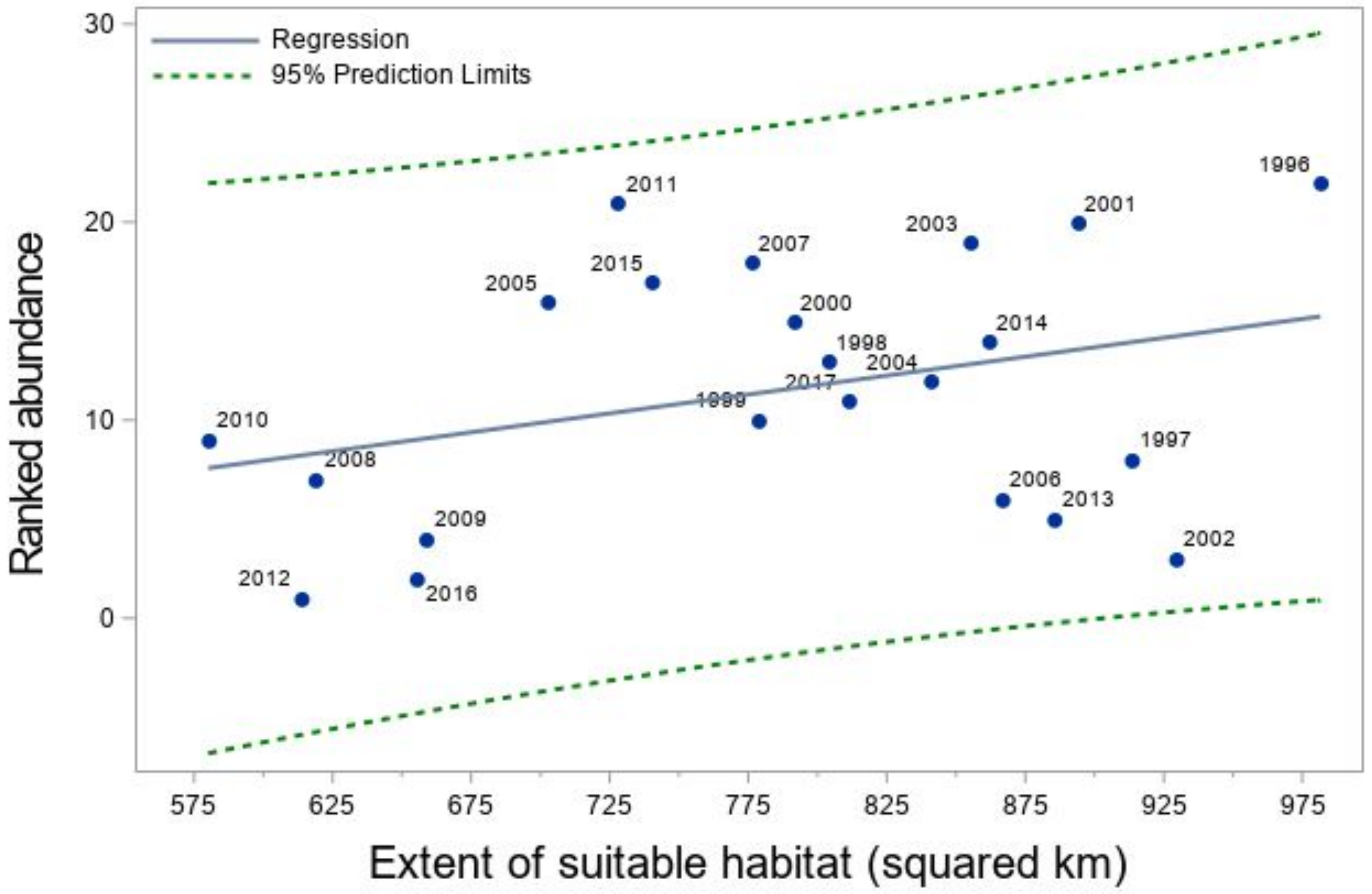


The extent of suitable shoreline habitats (≤2 m) for age-0 striped bass in early summer (June-July) decreased significantly from 1996 to 2017 (F=6.04, *P*=0.02).

Conditions in shoreline habitats have changed since 1996 during this period.

Age-0 (Shoreline habitats)

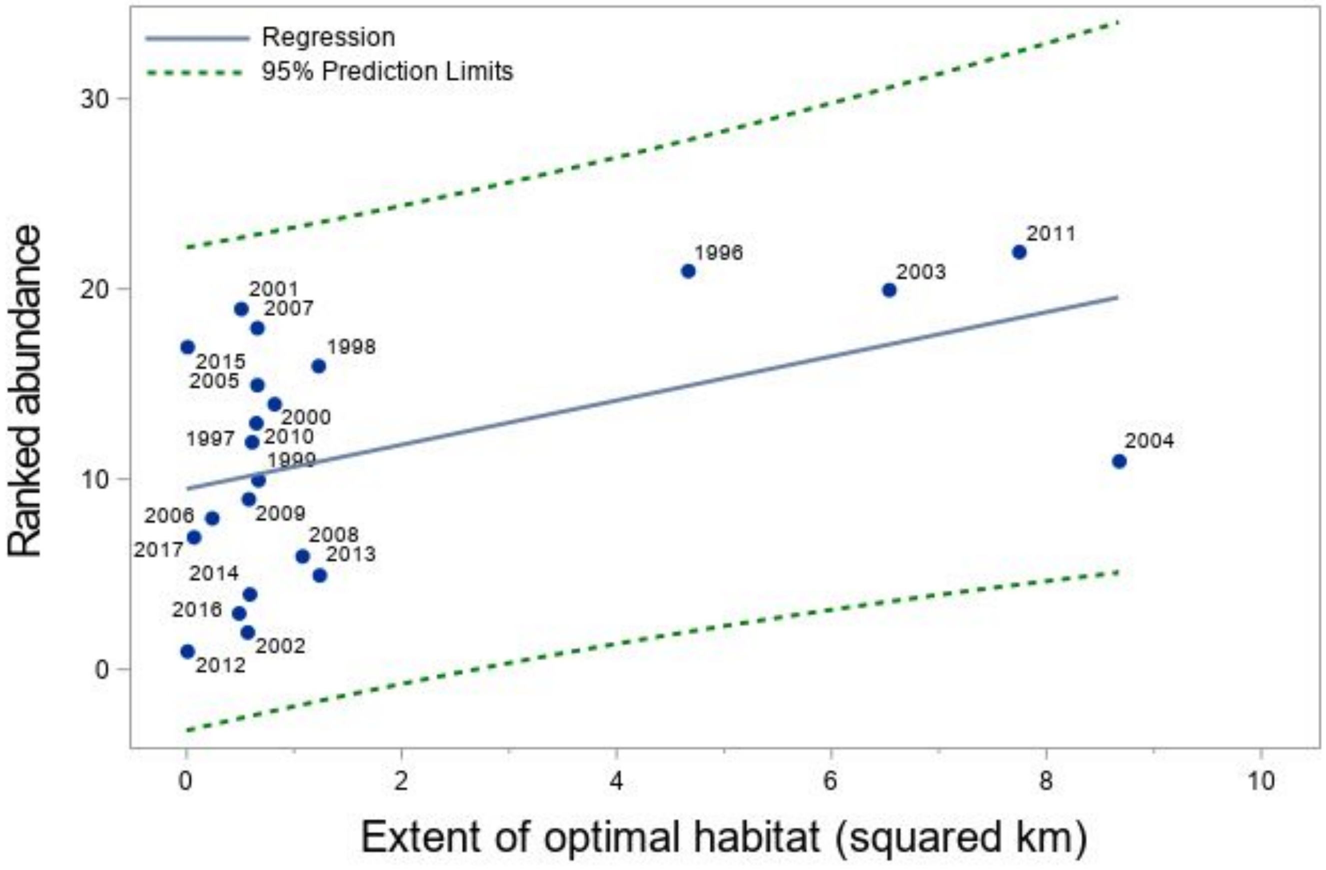
Bay-wide relative abundance of age-0 striped bass increases with increasing extent of suitable habitat (HSI ≥ 0.5)**

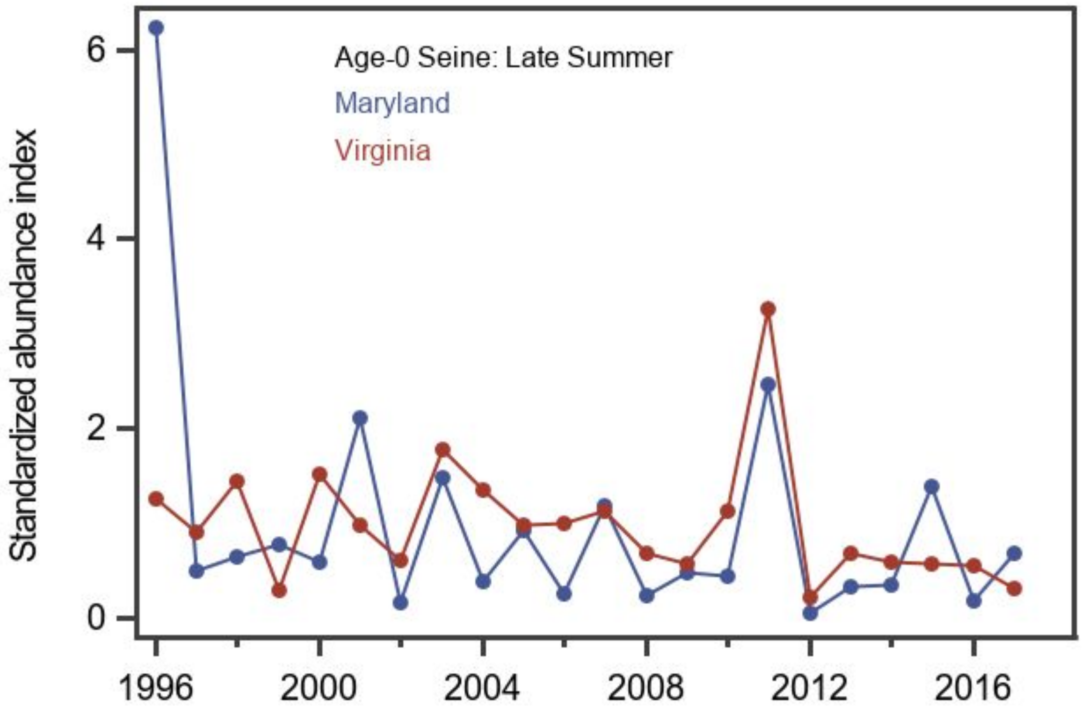


**However, this trend was not significant, despite the loss in habitat during this period ($F=2.43$, $P=0.13$)

Relative abundance of age-0 striped bass increases (significantly) with increasing extent of <u>optimal</u> habitat (HSI > 0.7)

As the extent of optimal-quality shoreline habitats (HSI > 0.7) increased, higher abundances of age-0 striped bass were supported, particularly in late summer (F=5.51, *P*=0.03).





Major Findings

1. **Conditions that defined suitable and optimal habitats varied across seasons and among years**
    - "Suitability" is a function of covariates selected, and factors impacting estimation of abundance

2. **Juvenile striped bass use less-than-ideal habitats**
    - Tolerate broad variations in some conditions; habitat use reflects a combination of conditions
    - Other biotic factors also likely influence fish-habitat relationships

3. **Early evidence that habitat conditions are changing over time**
    - Significant decline in the extent of suitable habitats for age-0 fish captured by seines in early summer (June-July), a critical period for YOY striped bass

4. **Suitable habitat may be limiting for juvenile striped bass**
    - Consistent pattern in the relationship between abundance and extent of suitable habitat
    - Decline in suitability may contribute to observed declines in abundance

Management Implications

Water quality conditions were key predictors of habitat suitability

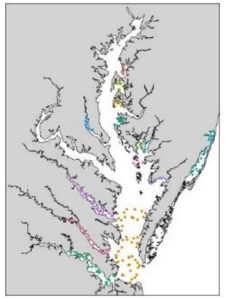
- Dissolved oxygen, current speed
- Changing conditions in response to climate change and management efforts (e.g., TMDLs)

Local conditions may be important to consider

- Tributary-specific trends; inform future management or monitoring efforts
- May drive some seasonal declines in suitable habitat

Photo credit: VIMS Juvenile Trawl Survey

Questions?



Long-term nursery habitat conditions
Summer flounder