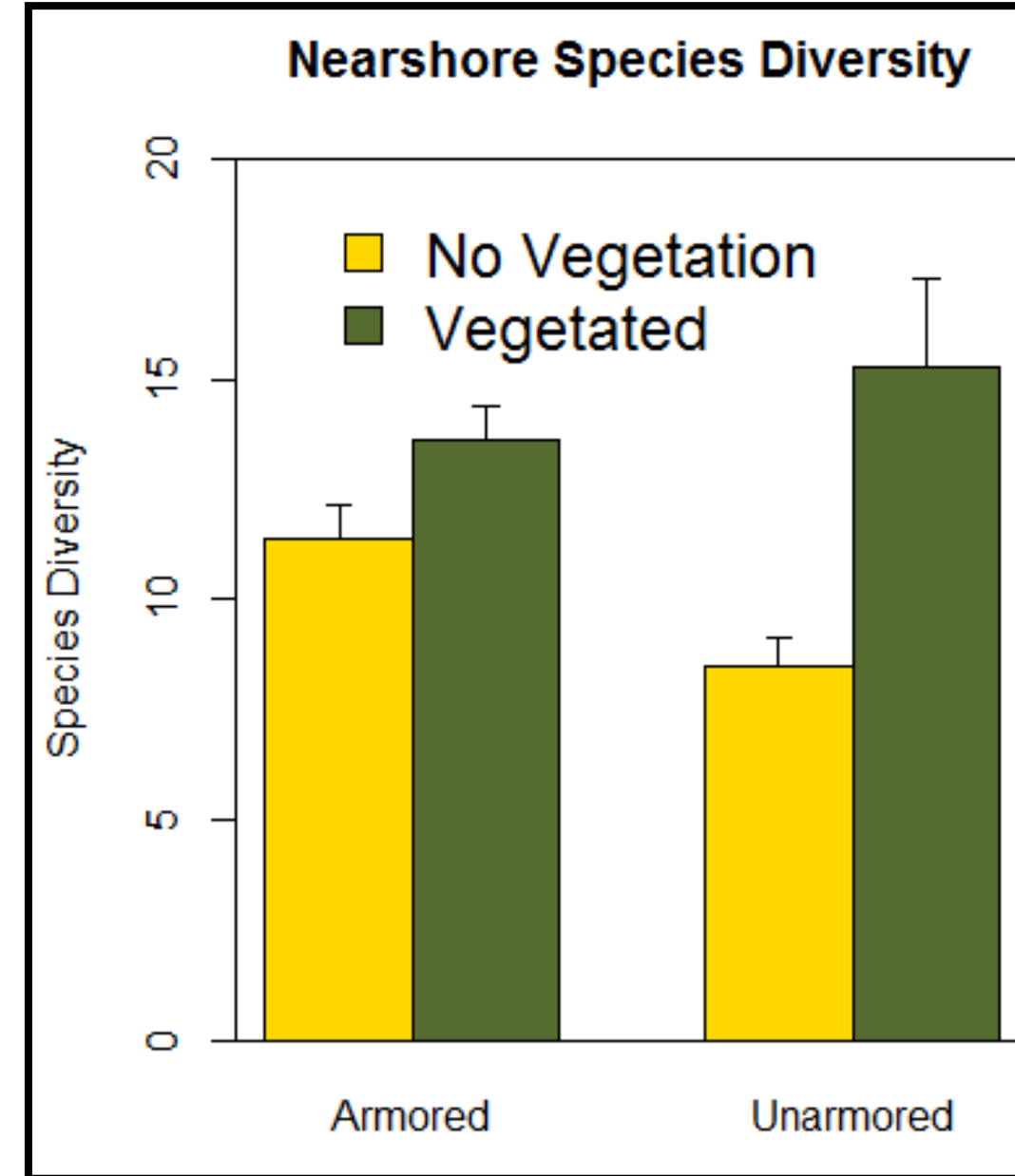


# Nearshore Fish Community Responses to Shoreline Types in Lake Erie

Martin A. Simonson<sup>1</sup>, Christine M. Mayer<sup>1</sup>, Song S. Qian<sup>1</sup>, Kristin K. Arend<sup>2</sup>, Jonathan Bossenbroek<sup>1</sup>, Eric J. Weimer<sup>3</sup>  
 1 – University of Toledo Lake Erie Center; 2 – Ohio DNR Old Woman Creek NERR; 3 – Ohio DNR Division of Wildlife - Sandusky

## Introduction

- ~ 80% of Great Lakes fish species use the nearshore zone for:
  - Juvenile growth and development
  - Refuge from predators
- Shorelines highly modified by human development
  - Armoring for erosion control
  - Vegetation removal
- Ross (2013): higher number of fish species at vegetated sites



## Research Goal

Identify relationships between shoreline features and nearshore fish community attributes (e.g., species richness, relative abundances of ecological groups) in Lake Erie.

## Shoreline Characteristics

### Armoring

- Artificial shoreline structure designed to reduce erosion
- ~ 80% of Ohio's Lake Erie coastline is armored
- Removes physical link between land and water



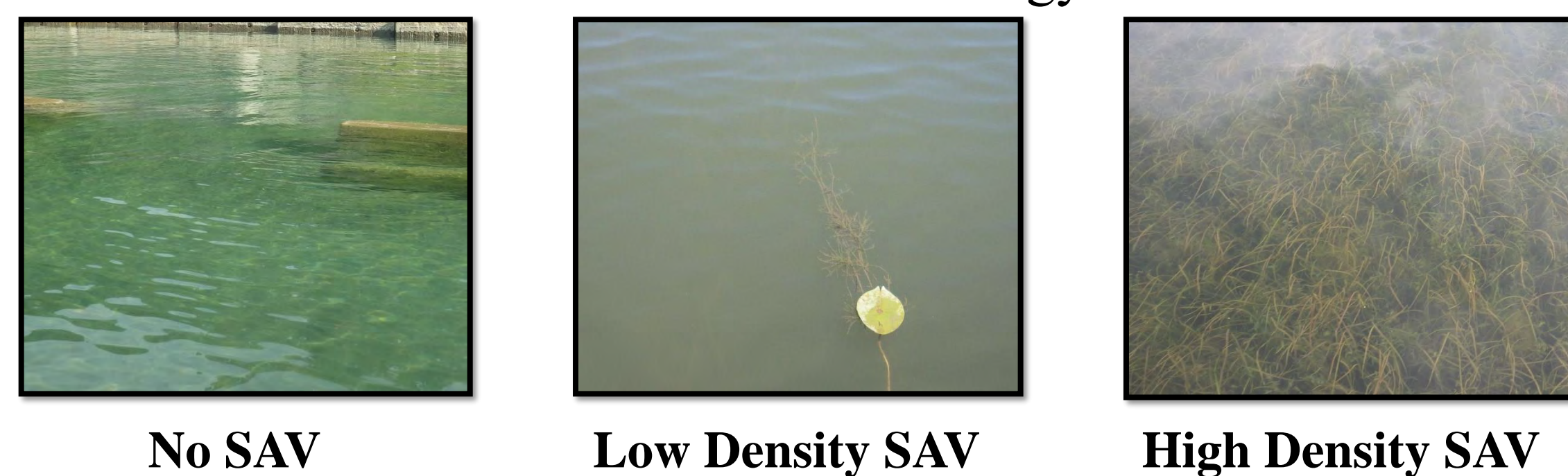
### Terrestrial Vegetation

- Shorelines naturally accumulate woody debris; and plants hold the soil in place
- Landowners remove plants/debris for a clean beach and unobstructed view
- Installation of armor often requires vegetation removal



### Submerged Aquatic Vegetation (SAV)

- SAV is a significant driver of biodiversity
- Lower relative predation pressure and higher food availability in areas with SAV
- Presence of SAV result of shoreline wave energy



## Sampling Nearshore Fish

- 312 Miles of Ohio's Lake Erie Shoreline
- 51 sites, sampled unevenly, 2011-2016
- Comprehensive of shoreline types
- Sampled once per summer, at night
- Followed contour of shore, < 2m deep
- 130 sample events
- 25,947 fish; 15 families; 51 species

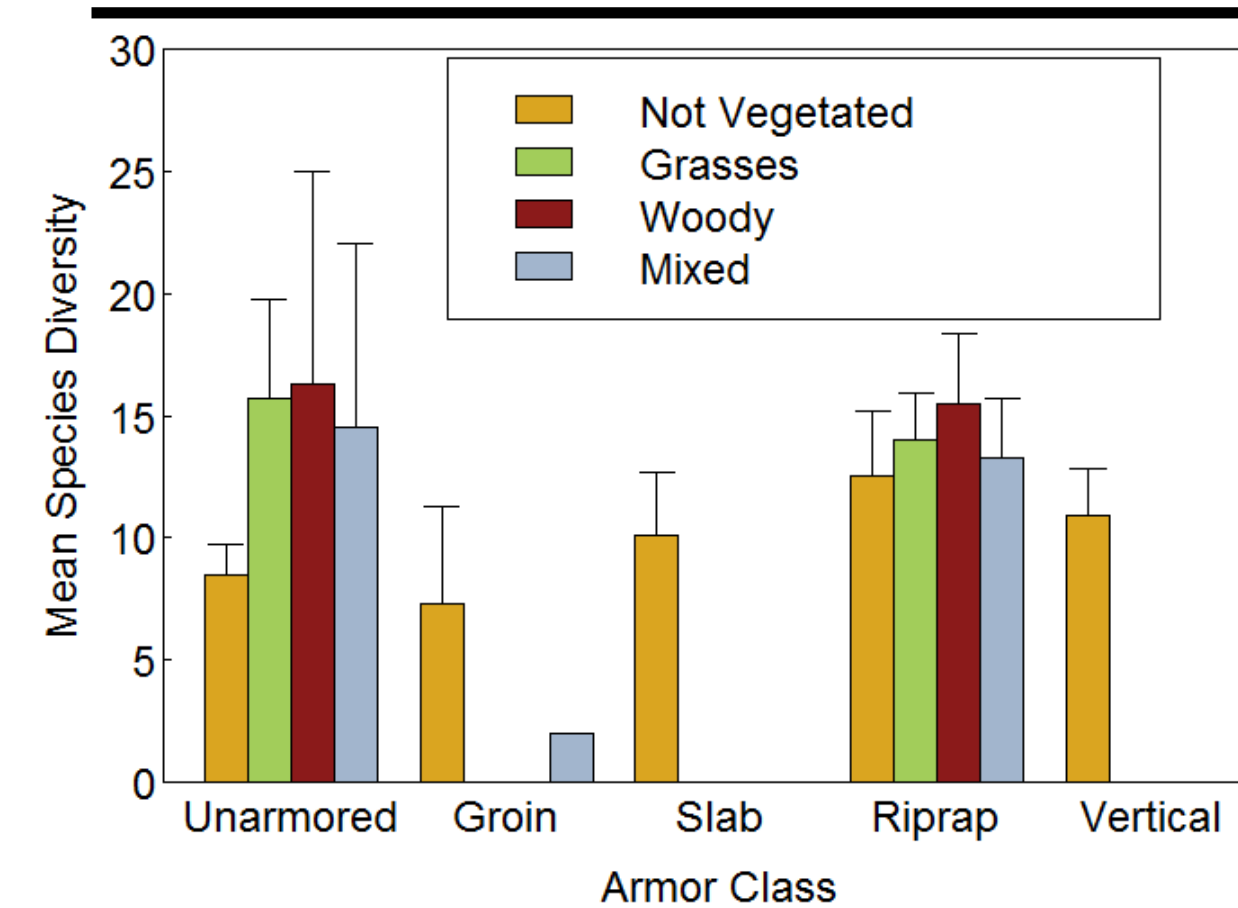


## Study Area



## Results

### Interaction between shoreline armoring and vegetation



- Vegetation positively affected diversity at unarmored sites, but did not affect diversity at riprap sites
- Slab and Vertical have no vegetation touching the water, no interaction
- Analysis of Deviance used to assess interaction of shoreline features

Analysis of Deviance Table – Species Diversity				
Treatment	Deviance Residuals	DF	Residual Deviance	Pr(>Chi)
Null		99	257.2	
Shoreline Armoring	8.909	98	248.29	< 0.01
Shoreline Terrestrial Vegetation	21.601	95	226.69	< 0.001
Shoreline SAV	55.376	93	171.31	< 0.001
Armor * Terrestrial Vegetation	8.520	90	162.79	< 0.05
Armor * SAV	9.897	89	152.89	< 0.01
Terrestrial Vegetation * SAV	14.740	86	138.15	< 0.01
Armor * Terrestrial Vegetation * SAV	0.000	86	138.15	

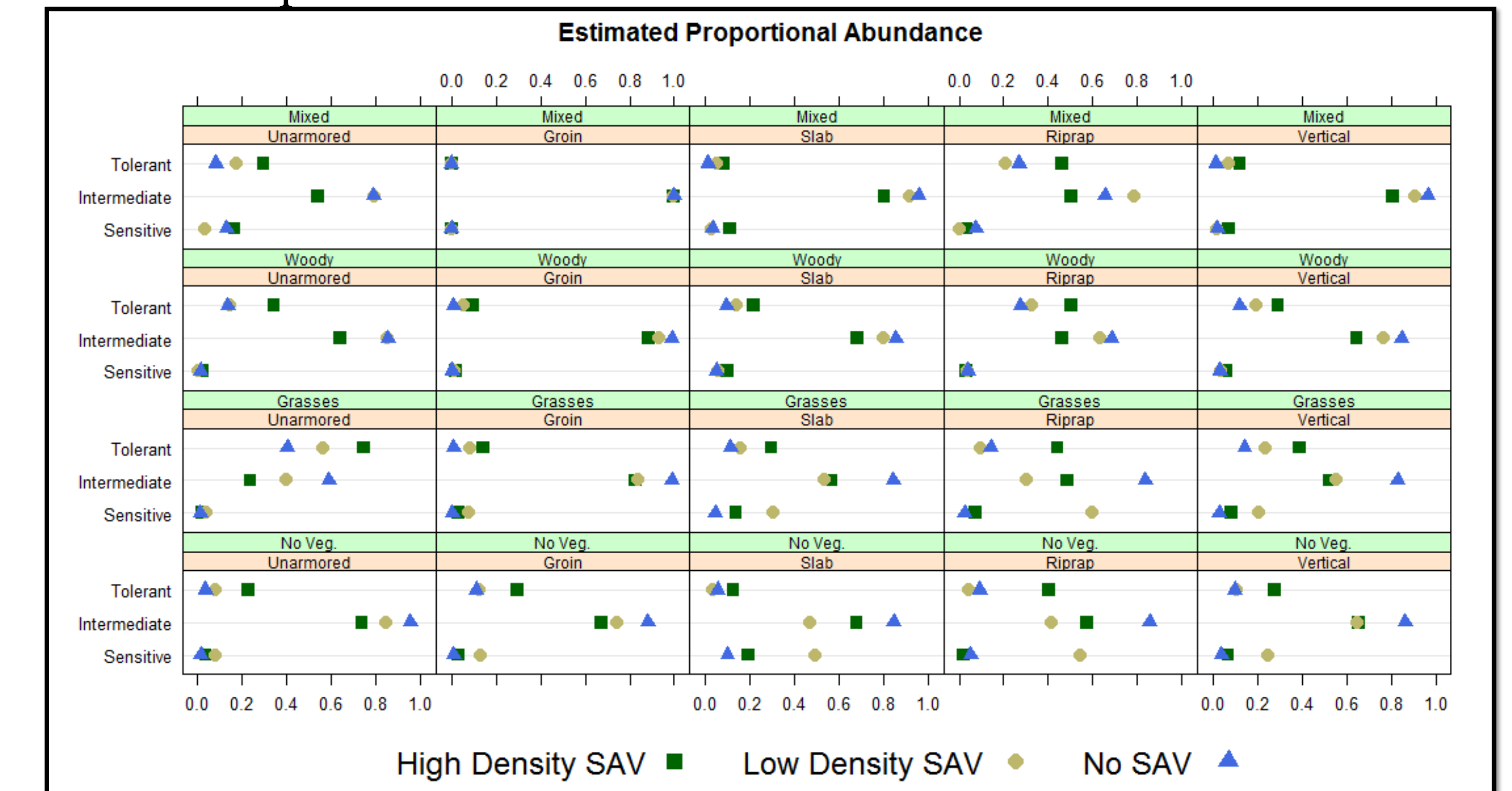
### Statistical Method: Multinomial Analysis

- Assess changes in fish community at shoreline types, relative abundances of ecological groups were estimated combining shoreline factors into a multinomial model
- Changes in fish community structure examined by grouping taxa:

Tolerance			Native or Exotic	
Based on Ohio EPA criteria for biological indicators of water quality; Qualitative Habitat Evaluation Index			Based on The Zoogeography of North American Freshwater Fishes, Hocutt + Wiley (1986)	
Intermediate Tolerance	Highly Sensitive	Tolerant	Exotic	Native
19,465 fish	1,750 fish	4,732 fish	7,625 fish	18,322 fish
<ul style="list-style-type: none"> <li>Gizzard Shad</li> <li>Round Goby</li> <li>White Bass</li> <li>Largemouth Bass</li> <li>Quillback</li> </ul>	<ul style="list-style-type: none"> <li>Mimic Shiner</li> <li>Logperch</li> <li>Smallmouth Bass</li> <li>Redhorse spp.</li> </ul>	<ul style="list-style-type: none"> <li>Common Carp</li> <li>Freshwater Drum</li> <li>Bluegill</li> <li>Goldfish</li> <li>Yellow Bullhead</li> </ul>	<ul style="list-style-type: none"> <li>Goldfish</li> <li>Common Carp</li> <li>White Perch</li> <li>Round Goby</li> </ul>	<ul style="list-style-type: none"> <li>Quillback</li> <li>Northern Pike</li> <li>Emerald Shiner</li> <li>Bluegill</li> <li>Largemouth Bass</li> <li>Redhorse spp.</li> </ul>

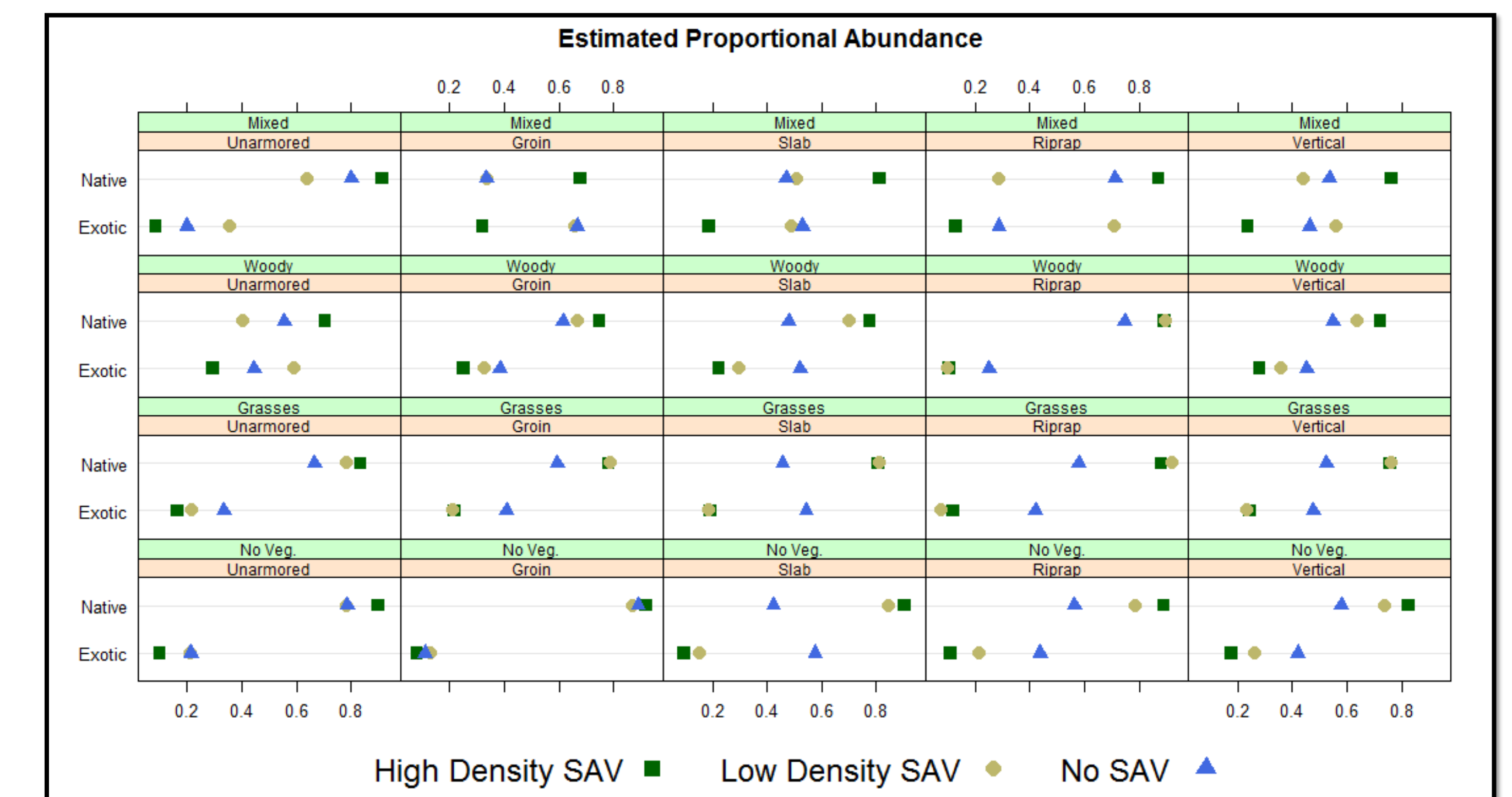
## Estimated Proportional Abundance: Tolerance Groups

- Figure shows changes in tolerance groups in response to combinations of shoreline features. Columns: Armor. Rows: Plants. Points: SAV.
- Sensitive species more abundant at armored sites with low SAV



## Estimated Proportional Abundance: Native or Exotic

- Only 4 exotic fish species comprise 29.4% of total fish in sample set
- More native species at unarmored sites and sites with SAV



## Future Direction

- Coastal armor structures periodically need maintenance or replacement, therefore understanding which shoreline features promote a productive fishery can inform future shoreline development.
- Baseline data at sites where modification occurs (e.g., fish passage)
- Quantify habitat features via underwater sonar and aerial imagery

## Acknowledgements

Dr. Chris Mayer, Dr. Song Qian, Dr. Jon Bossenbroek, Dr. Kristin Arend, Ben Kuhaneck, Rachel Johnson, Bill Nelson, Casey Yanos, Holly Embke, Nicole King, Mark DuFour, Jason Fischer, Jason Ross, Jordan Budrevich, Alex Lytten, Eva Kramer, Eric Weimer, John Deller, Geoff Steinhart, Chris Vandergoot, Brad Hasselbach, Brittany Mullikin, Carey Knight, Scudder Mackey, Lynn Garrity, James Park, Scott Winkler, Anita Simic, Prabha Rupasinge, Matthew Romanko, Ann-Marie Gorman, & many more!

