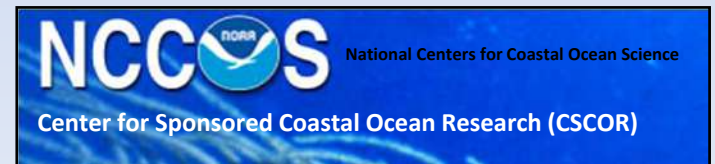


The Relationship Between Tributary Shorelines and Fish Assemblages and Blue Crab Abundance

**Center for the Inland Bays – Scientific and Technical Advisory Committee
February 18, 2011**

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University of Delaware
College of Earth, Ocean, and Environment
School of Marine Science and Policy
Lewes, DE USA**





Spartina alterniflora



Phragmites australis



Beach



Bulkhead



Riprap



Riprap-Sill

Overview of Research

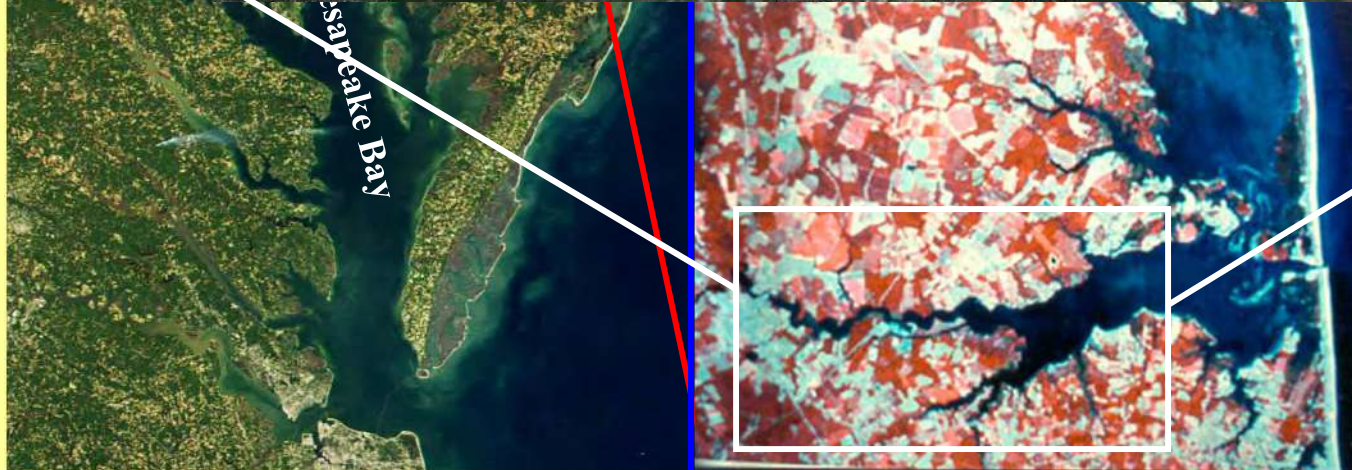
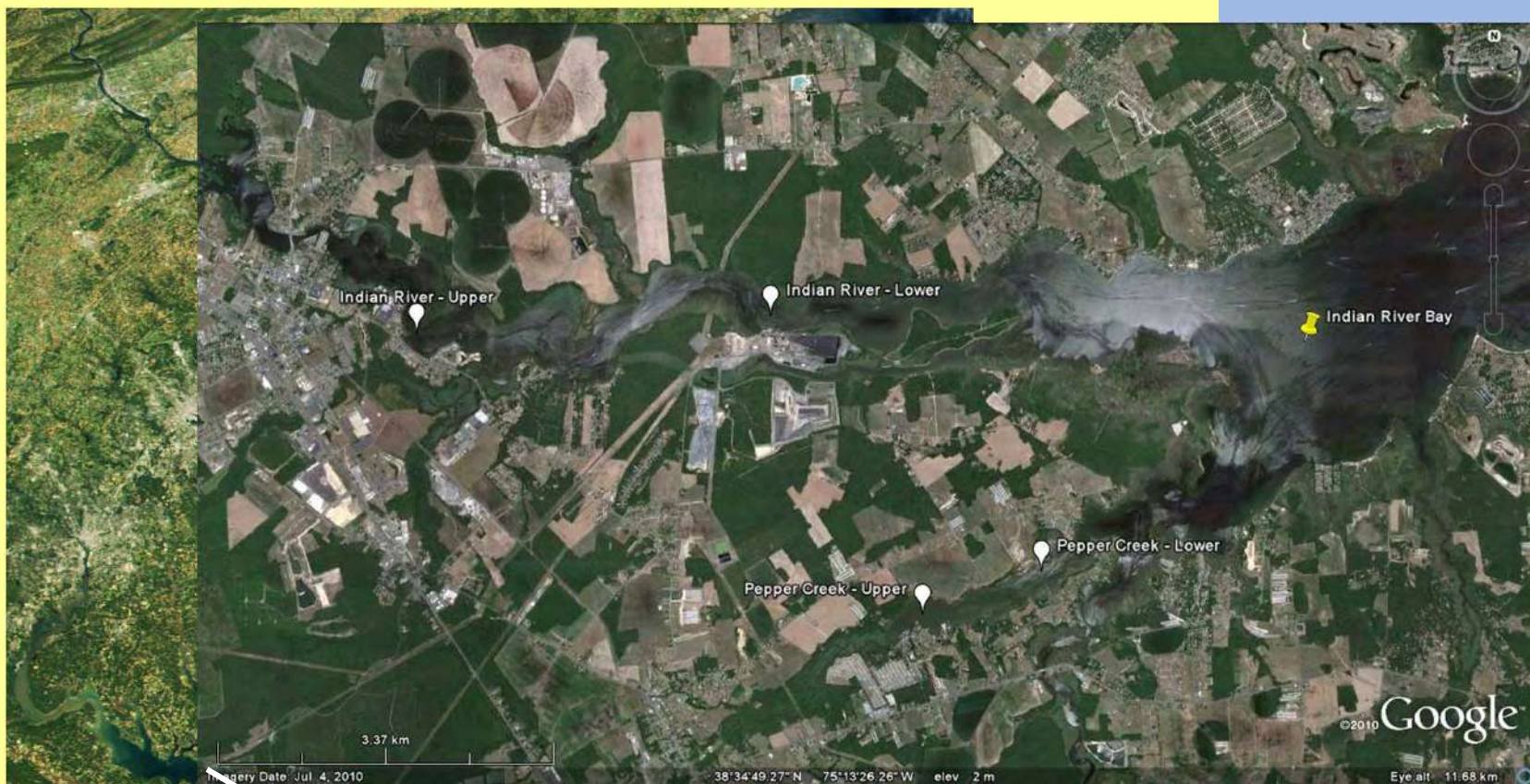
- Macrofauna shoreline sampling
 - Weekly seines for fish assemblage and blue crab abundance
- Diel-cycling hypoxia analysis along shoreline types
- Atlantic silverside egg deposition along shoreline types
- Riprap-sill macrofauna shoreline sampling



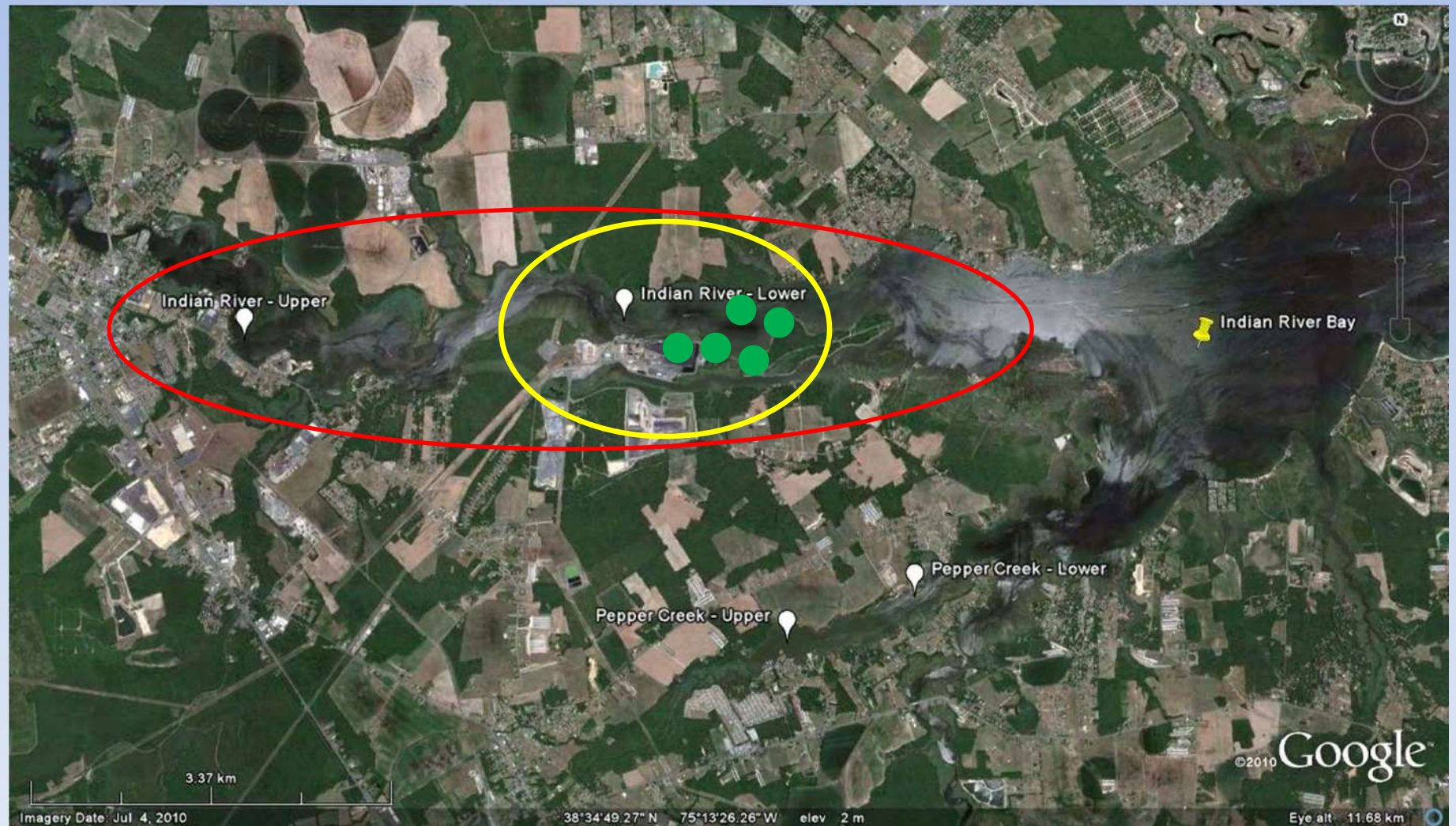
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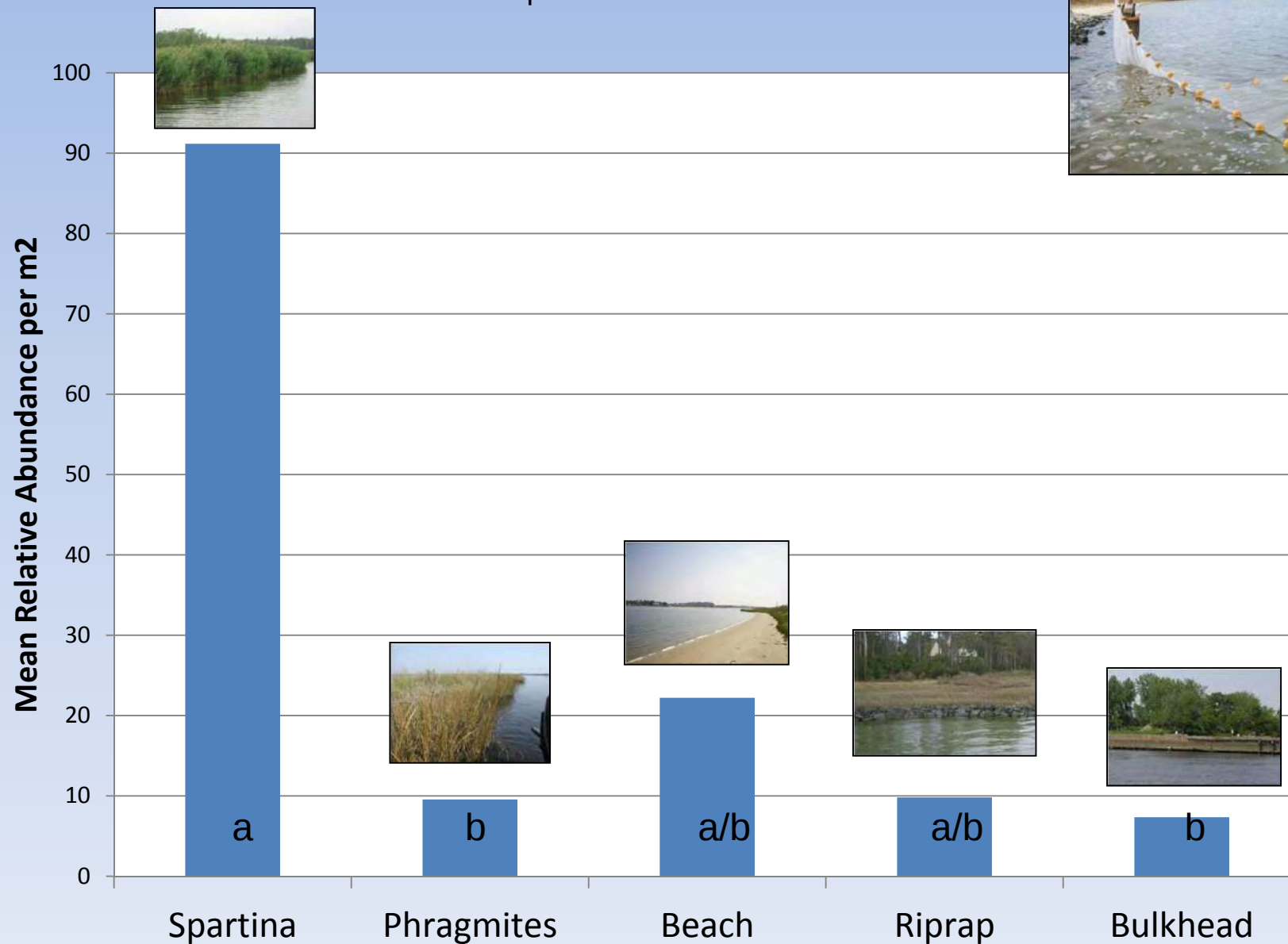


Weekly Shoreline Macrofauna Sampling

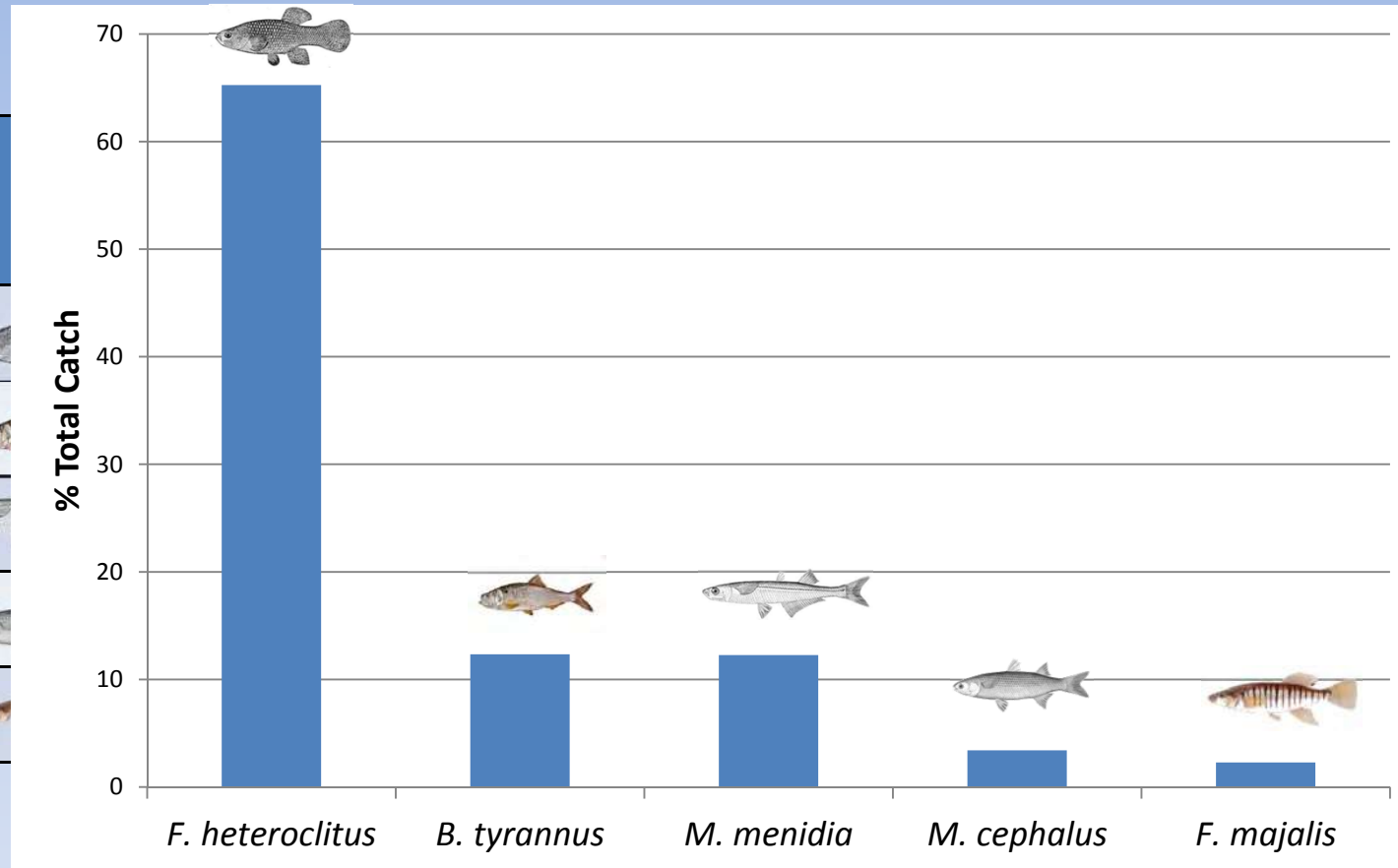


Shoreline Type - Fish Abundance

Mean abundance per two consecutive seine hauls

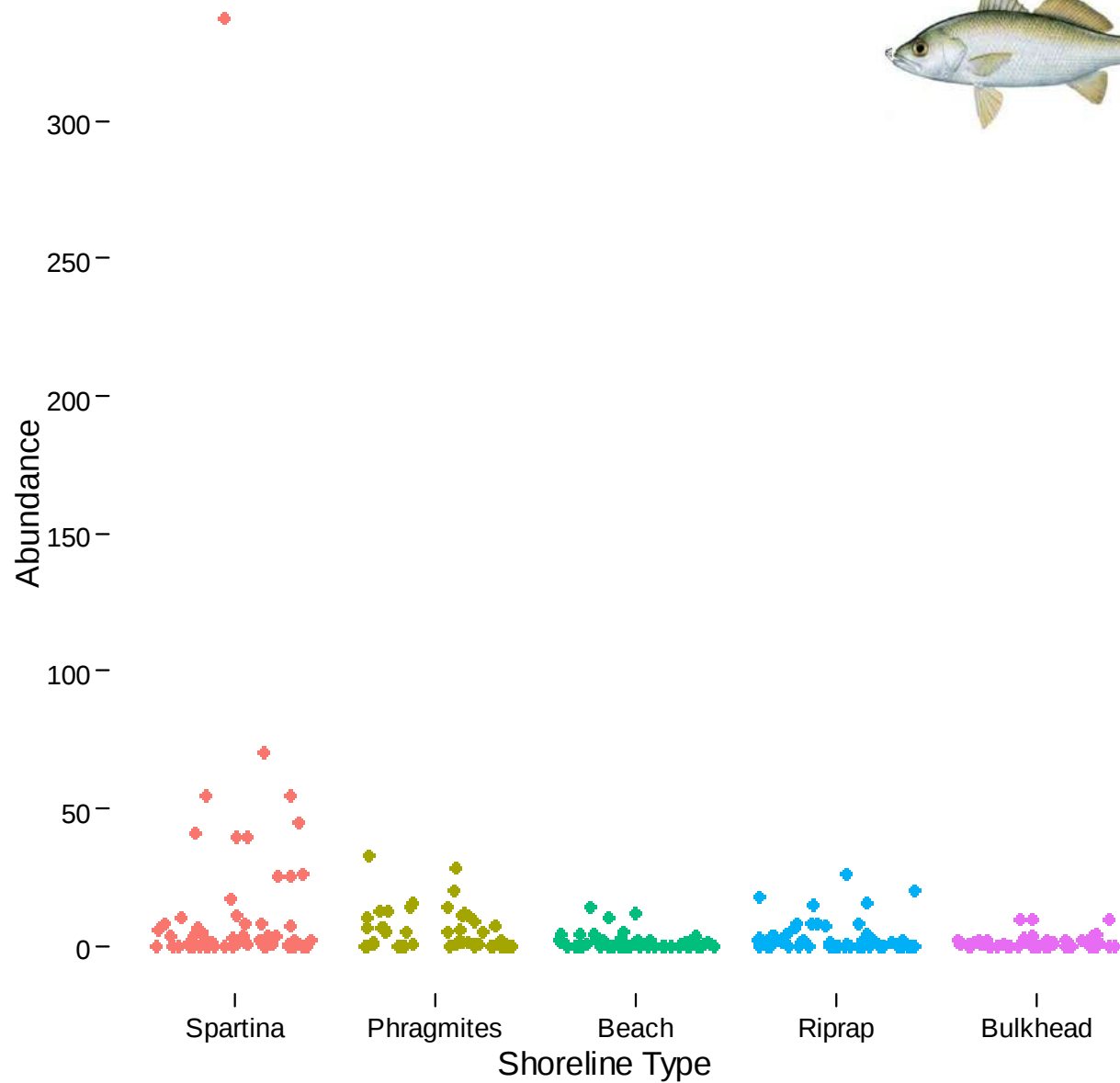
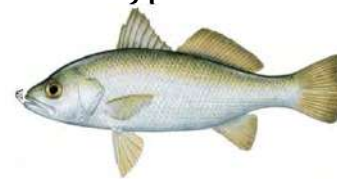


Species Abundance

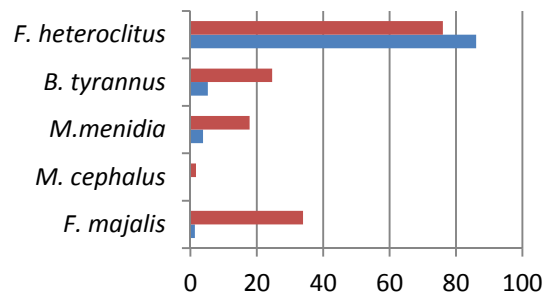


5 Species account for > 95% total catch
 96962 fish collected
 Largest collections ~500 mm American eel
 Mean length ~ 56 mm

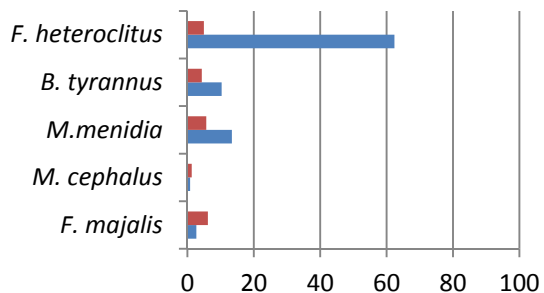
Bairdiella chrysoura Abundances by Shoreline Type



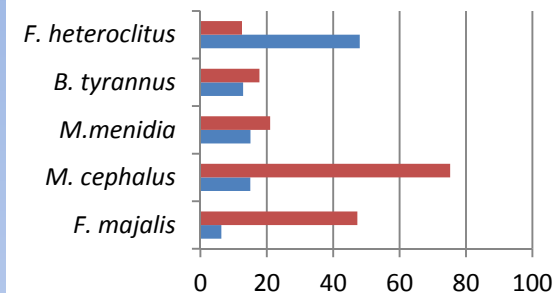
Spartina



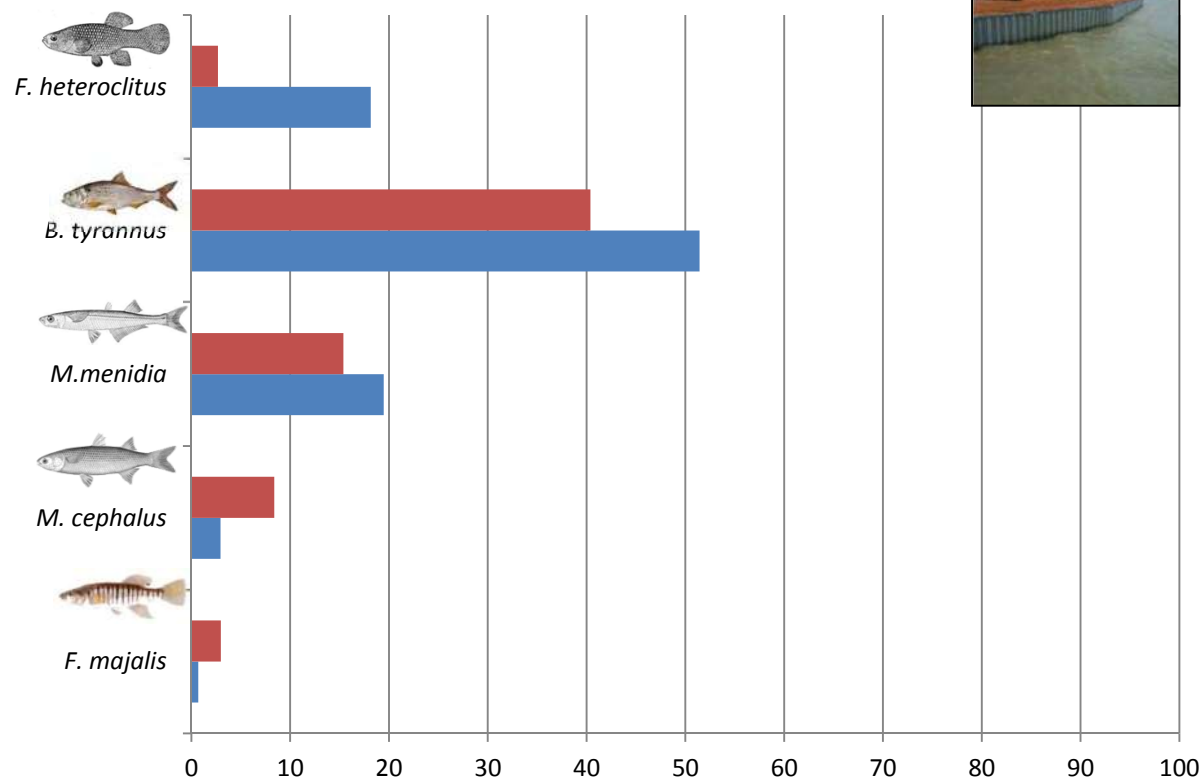
Phragmites



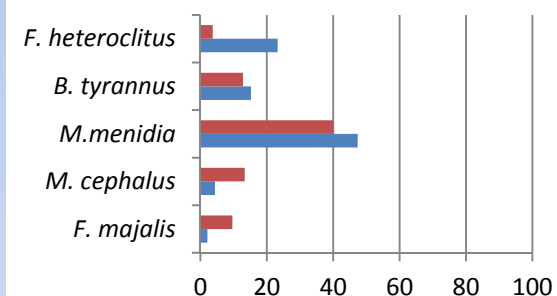
Beach



Bulkhead

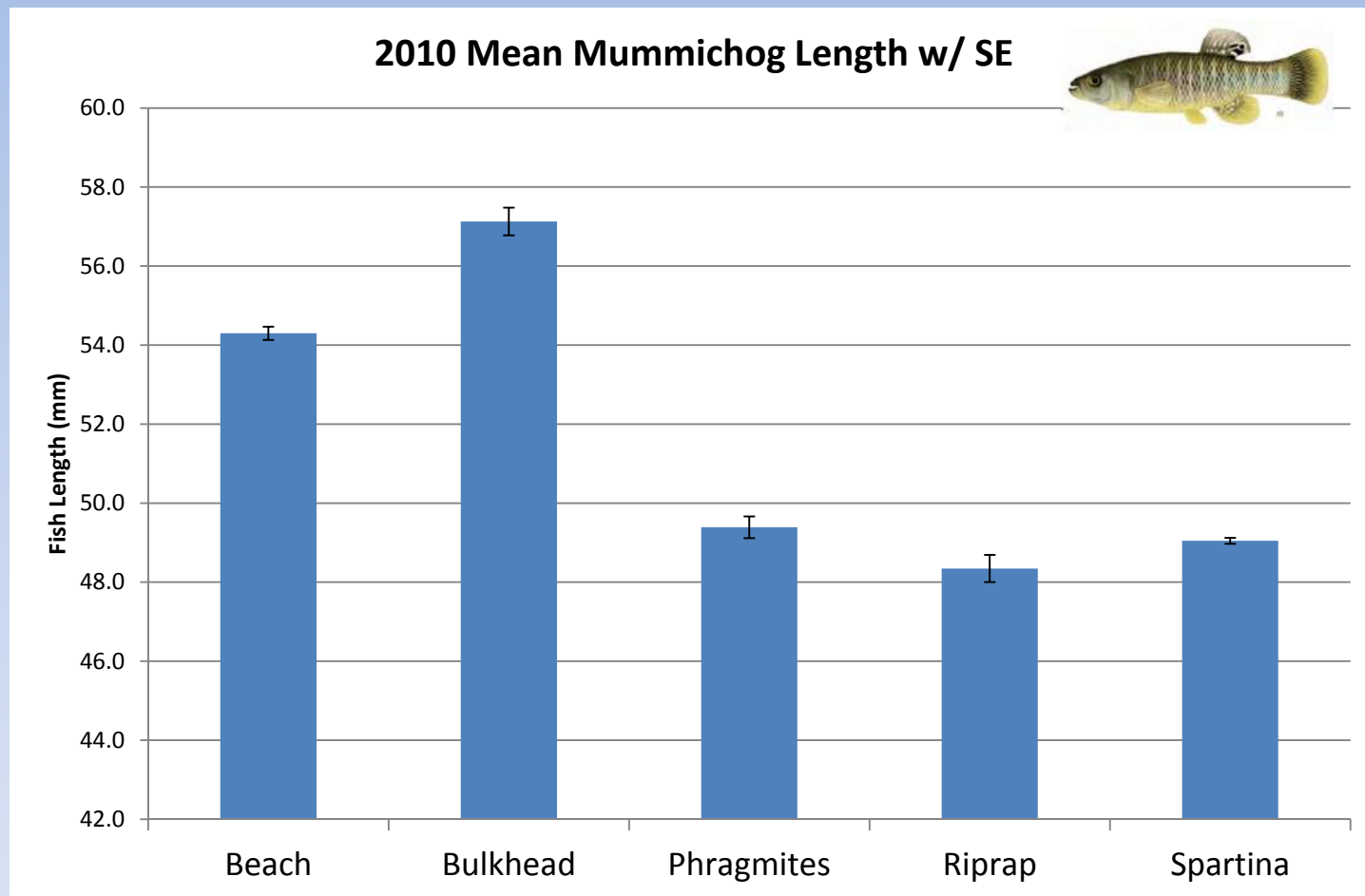


Riprap

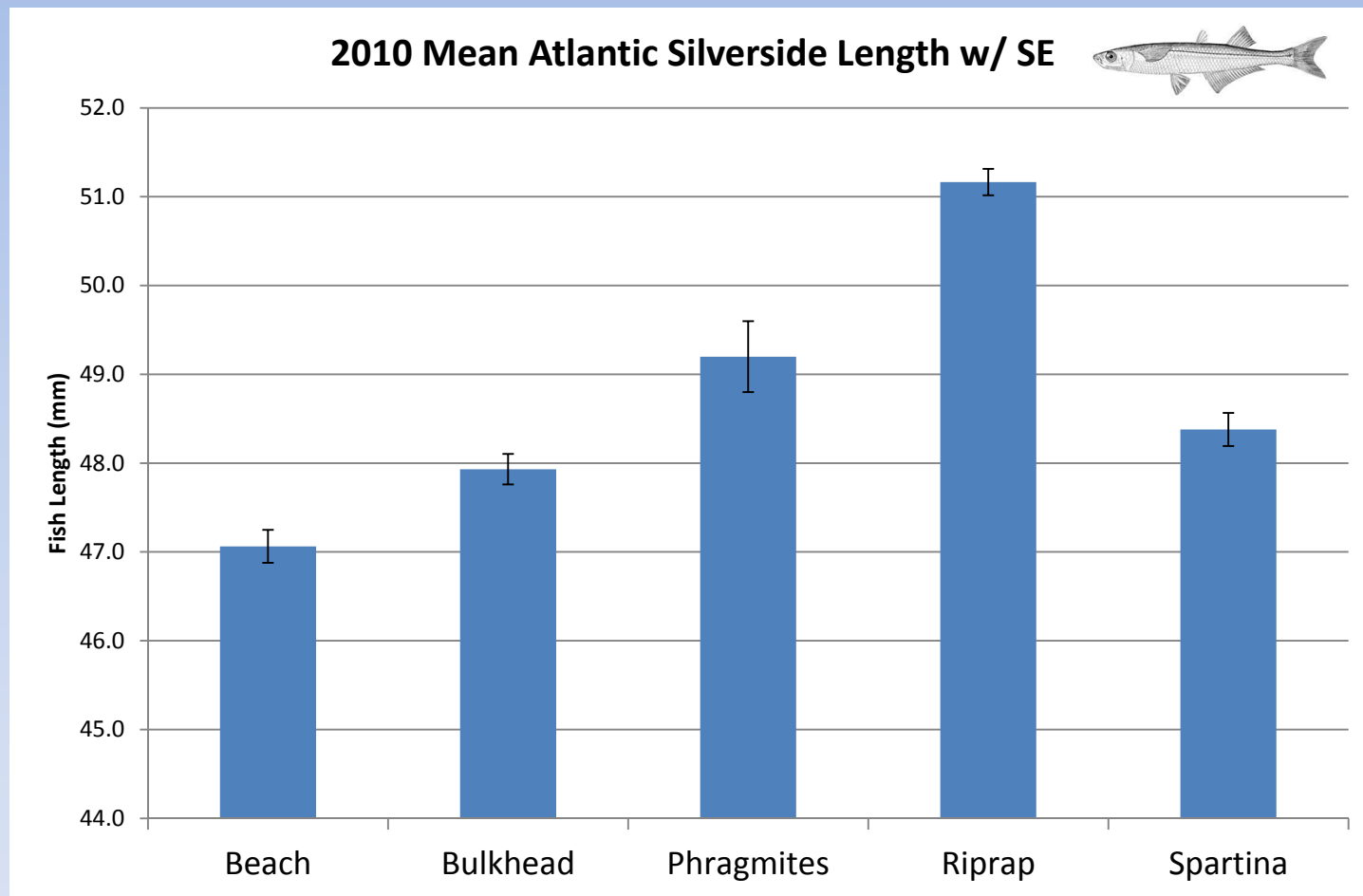


Red Bars – % of species abundance from shoreline type
Blue Bars – % of catch at shoreline type

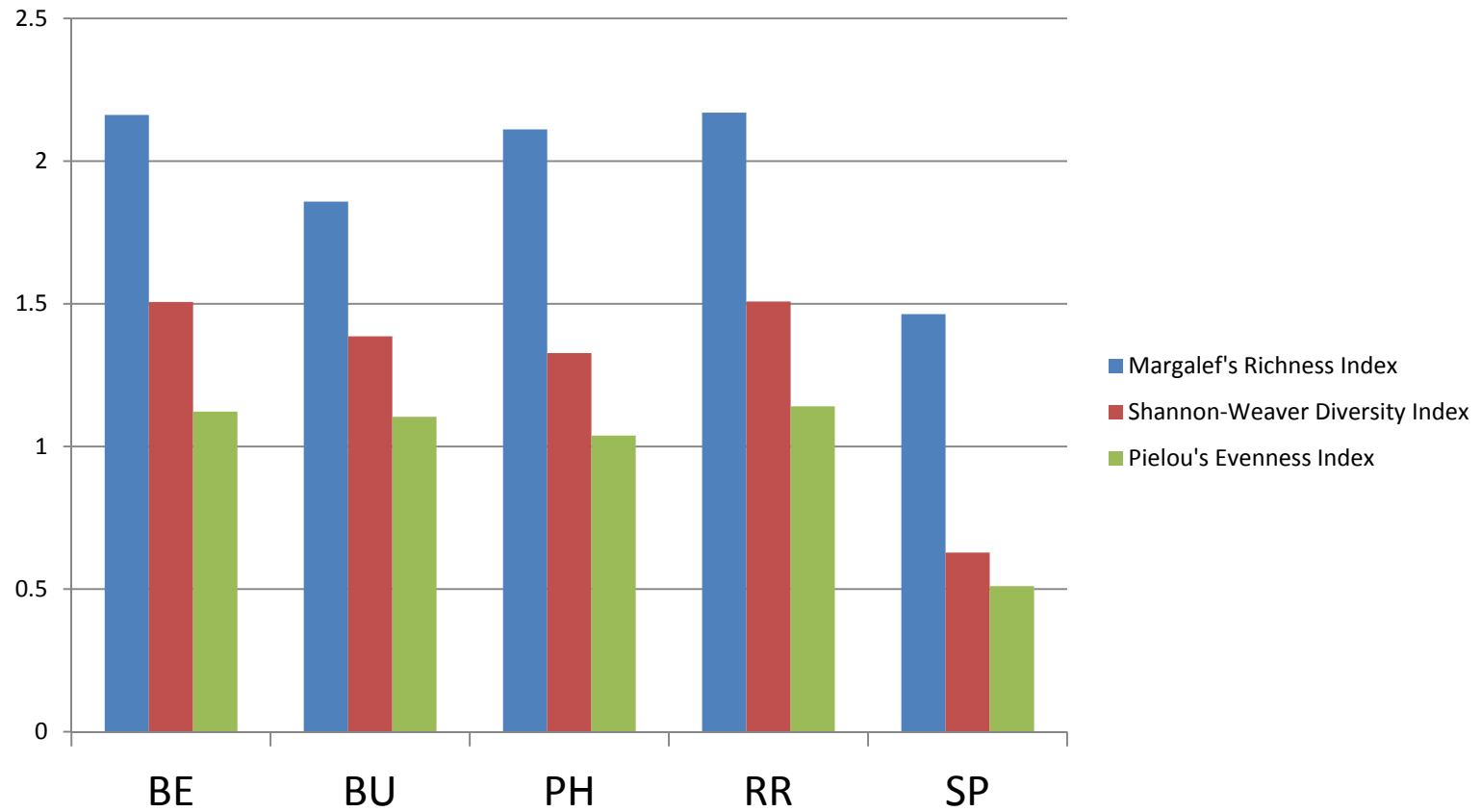
Fish Length



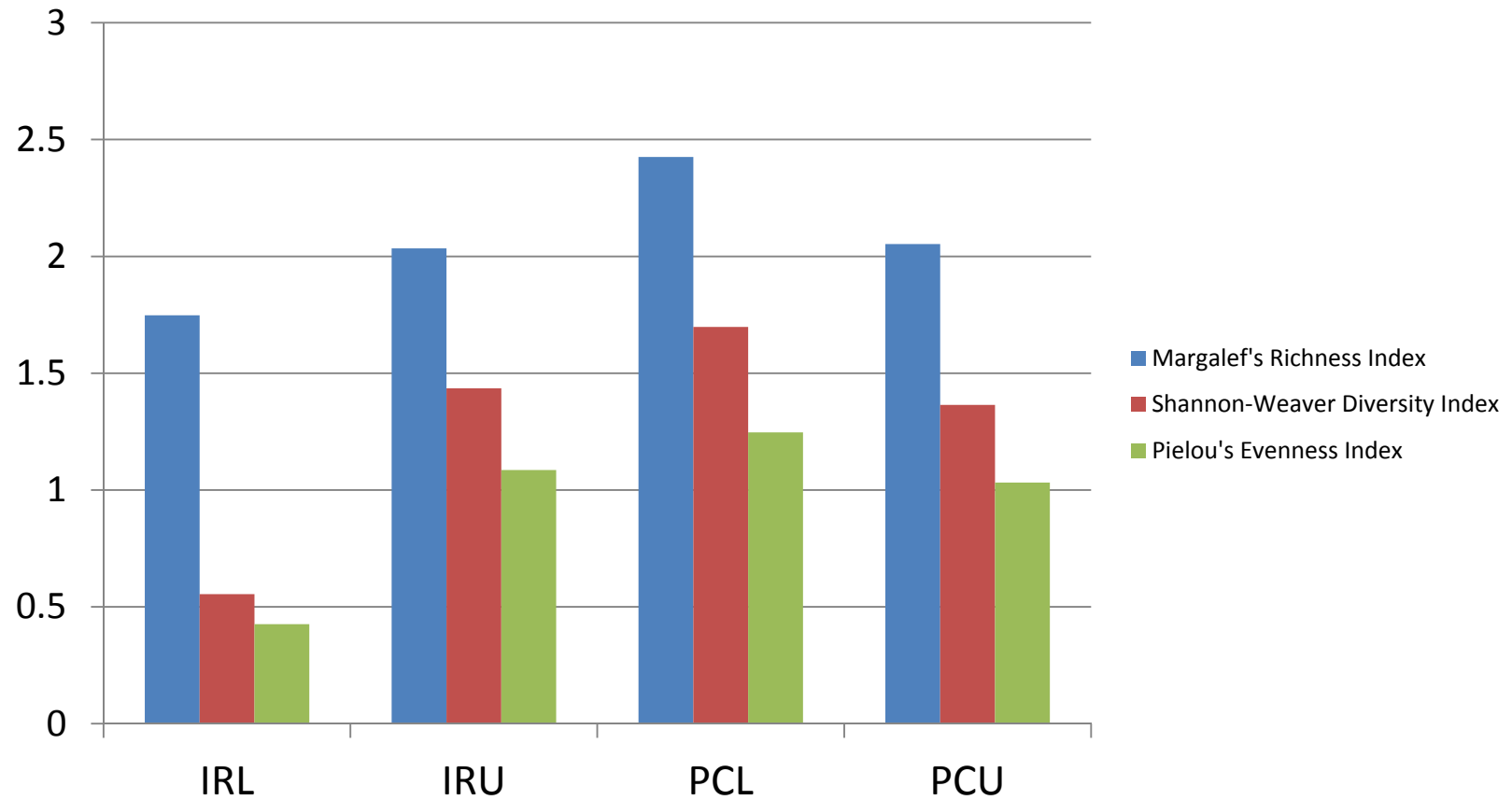
Fish Length



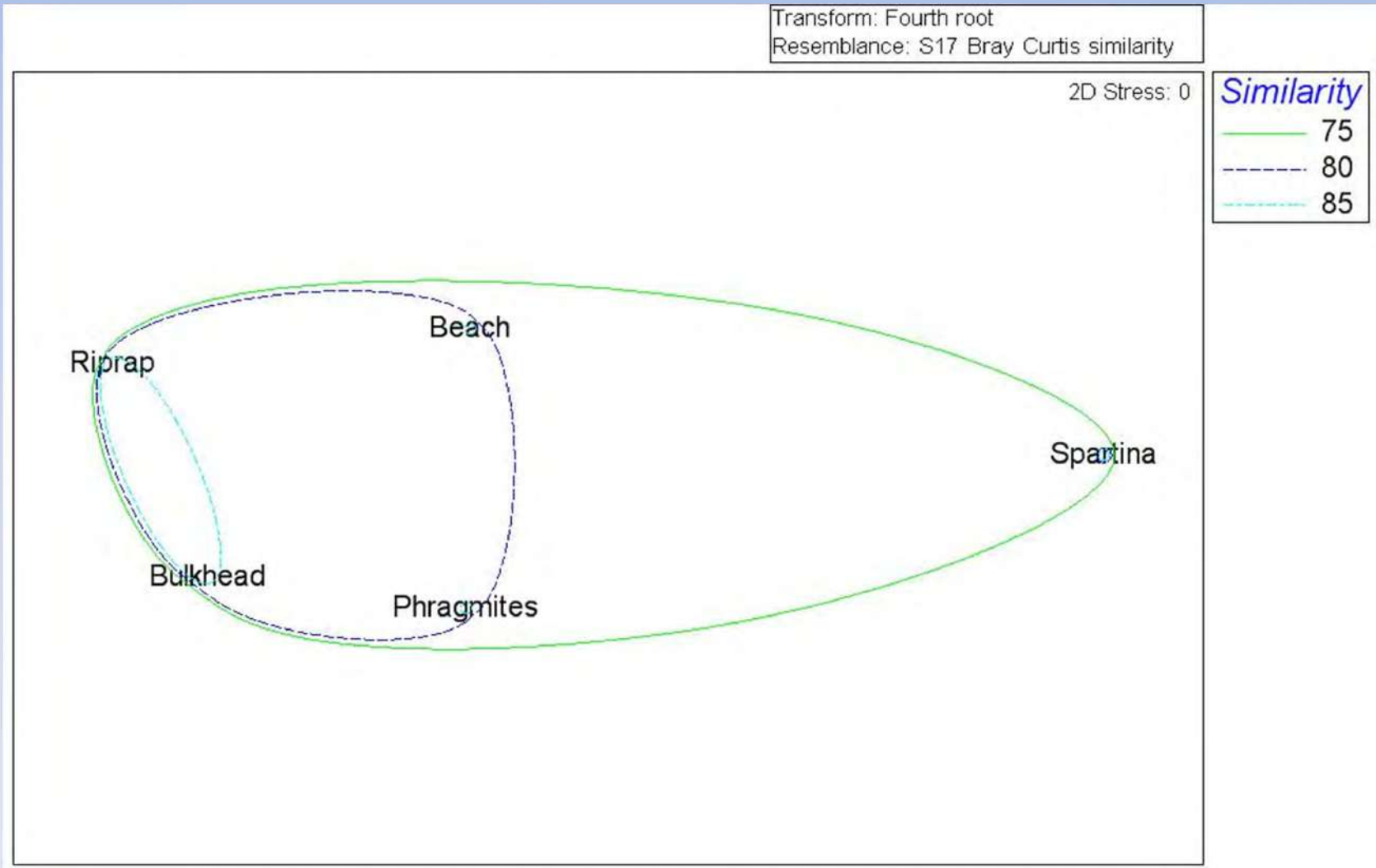
Fish Assemblage Index Scores by Shoreline Type



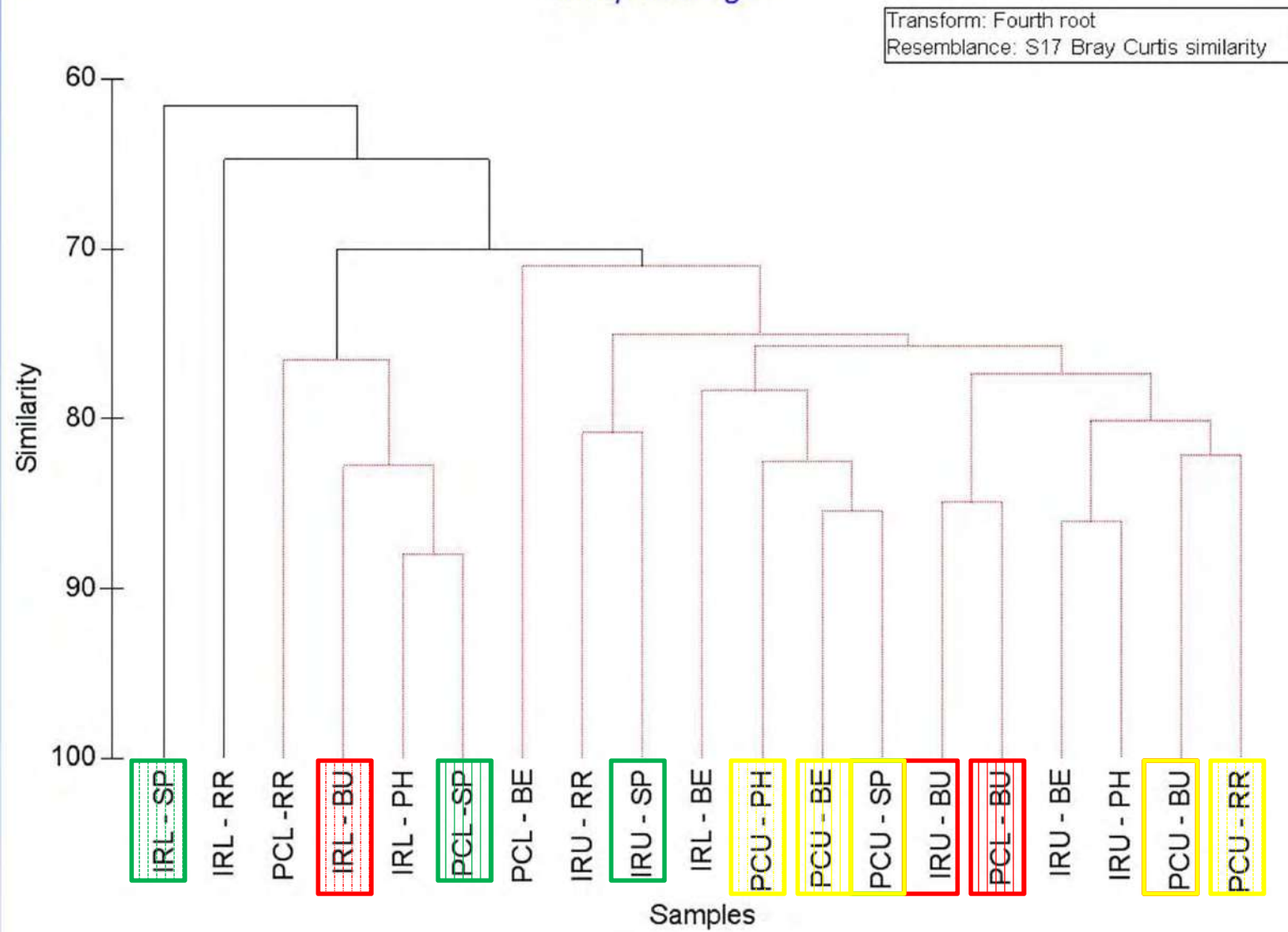
Fish Assemblage Index Scores by Creek Section



Multi-Dimensional Scaling



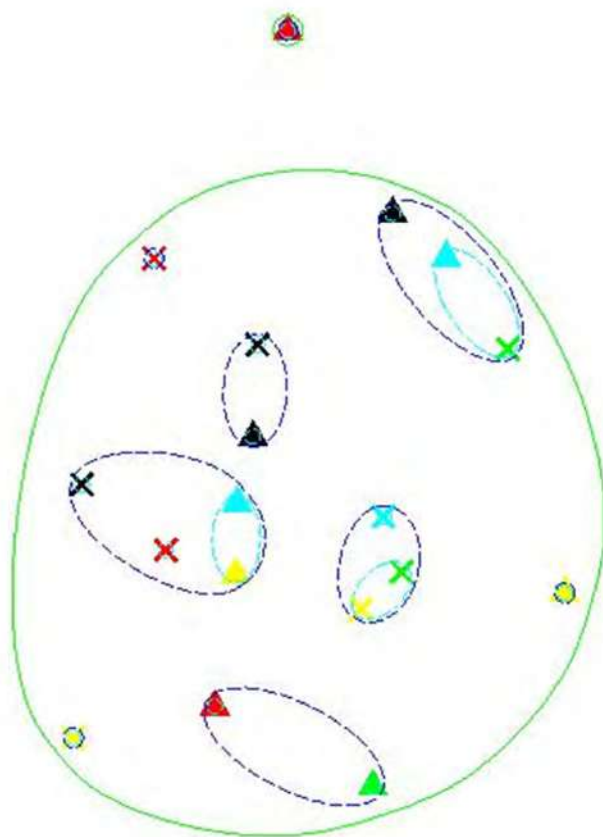
Group average



Transform: Fourth root

Resemblance: S17 Bray Curtis similarity

2D Stress: 0.16



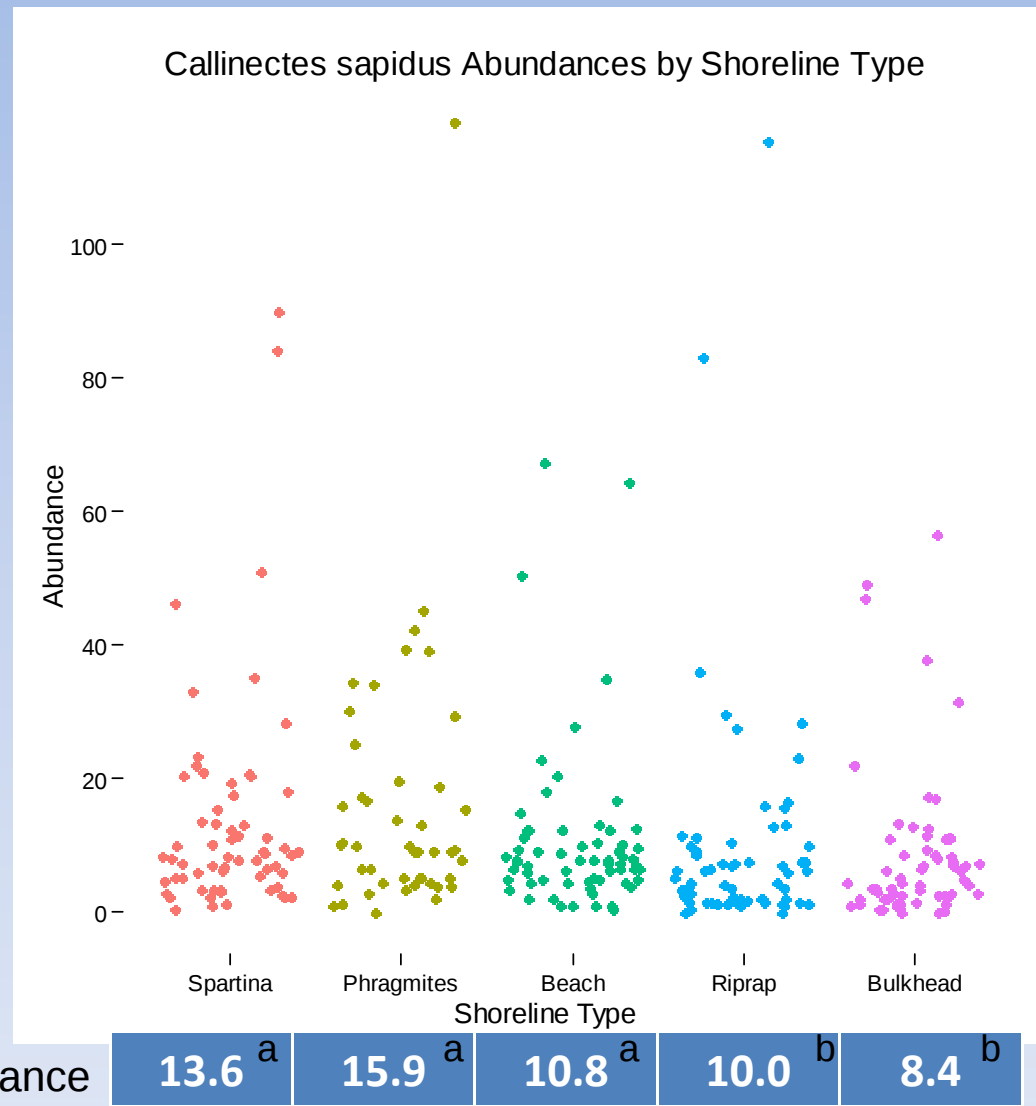
Location

▲ IRU-BU	× PCU-BU
▲ IRU-RR	× PCU-RR
▲ IRU-BE	× PCU-BE
▲ IRU-PH	× PCU-PH
▲ IRU-SP	× PCU-SP
▲ IRL-BU	× PCL-BU
▲ IRL-RR	× PCL-RR
▲ IRL-BE	× PCL-BE
▲ IRL-PH	× PCL-SP
▲ IRL-SP	

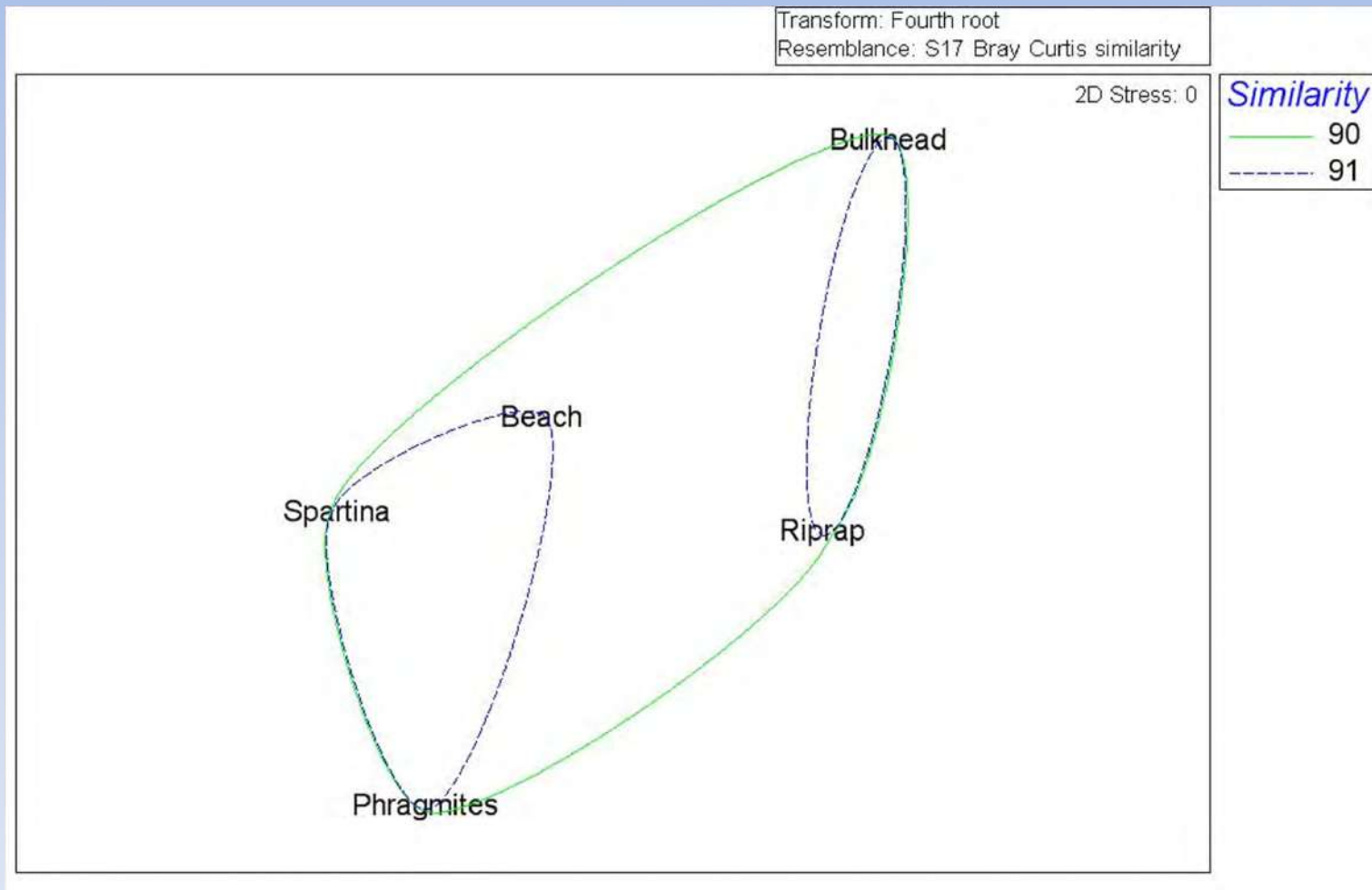
Similarity

—	70
- - -	80
- . -	85

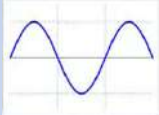
Blue Crab



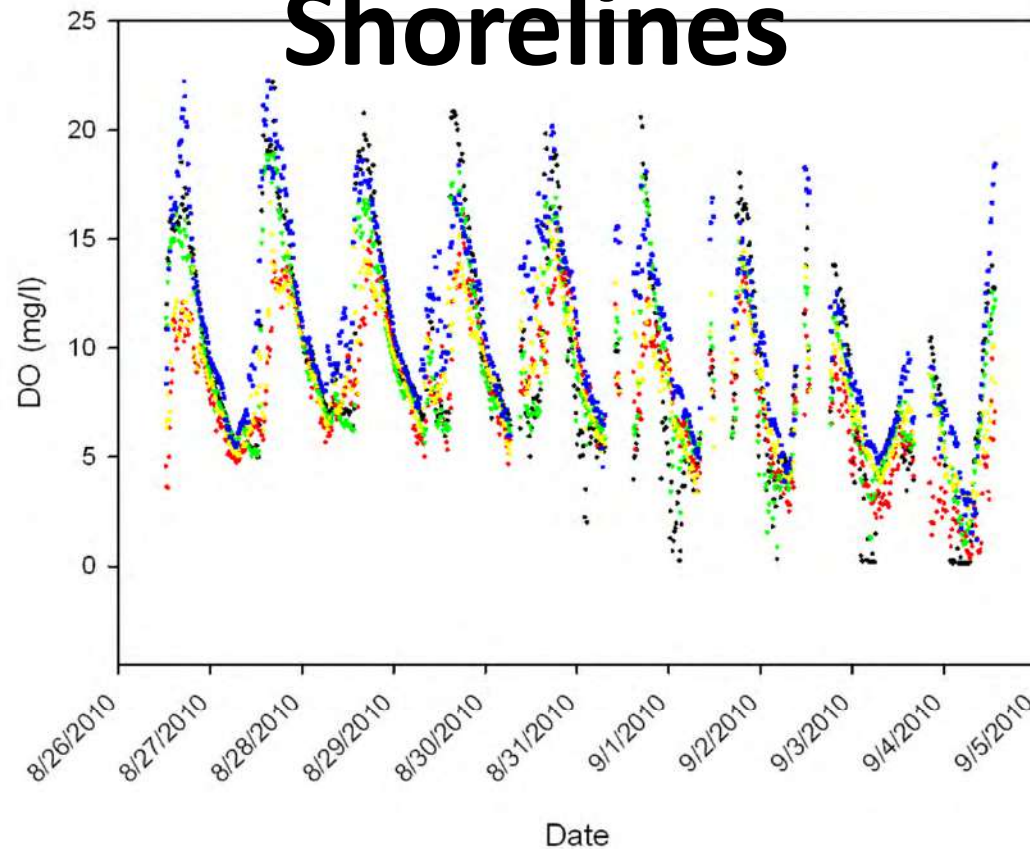
Blue Crab MDS



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Diel – Cycling Hypoxia Along Shorelines



- Beach
- Bulkhead
- Phragmites
- Riprap
- Spartina



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Atlantic Silverside

- Extremely abundant forage fish
- Widely distributed
- Important food source
 - striped bass
 - Atlantic mackerel
 - bluefish
 - others



fishbase.org

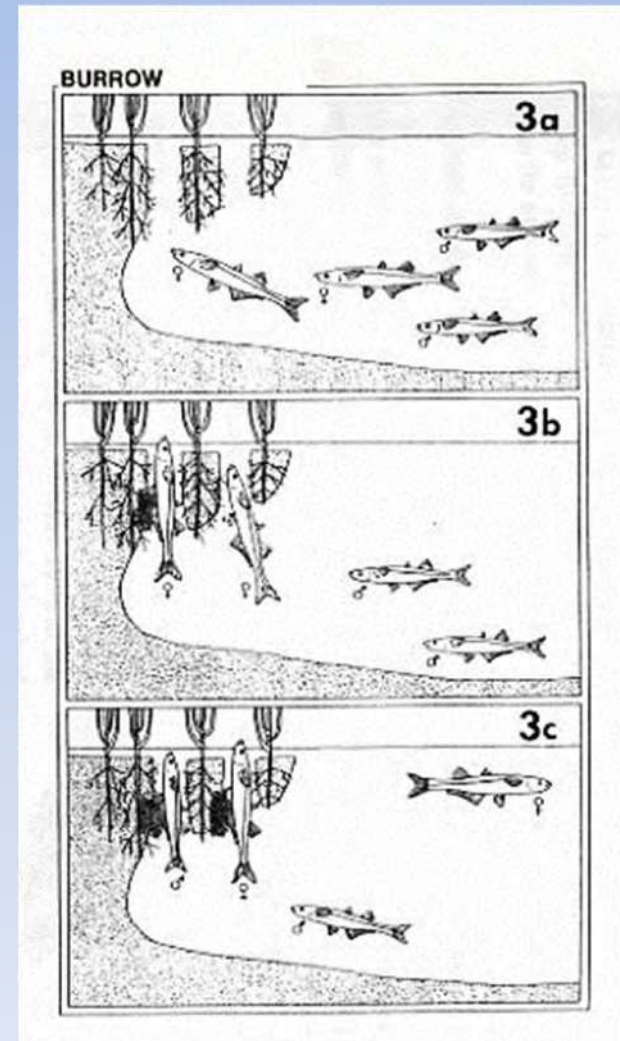


(Merriman 1941; Bayliff 1950; Bigelow and Schroeder 1953; Schaefer 1971)



Spawning

- Eggs are demersal, adhesive
- Laid in shallow waters of estuarine intertidal zones (Kuntz and Radcliffe 1917; Hildebrand 1922; Middaugh 1981)
- Numerous substrates for egg attachment noted -
 - submerged vegetation (Bayliff 1950)
 - eelgrass (Middaugh 1981)
 - Mud crab burrows (Middaugh et al. 1981)
 - *Spartina alterniflora* (Middaugh et al. 1981)
 - filamentous algae (Conover 1982)
 - sand (Wang 1974)
 - beach trash (Nichols 1908)



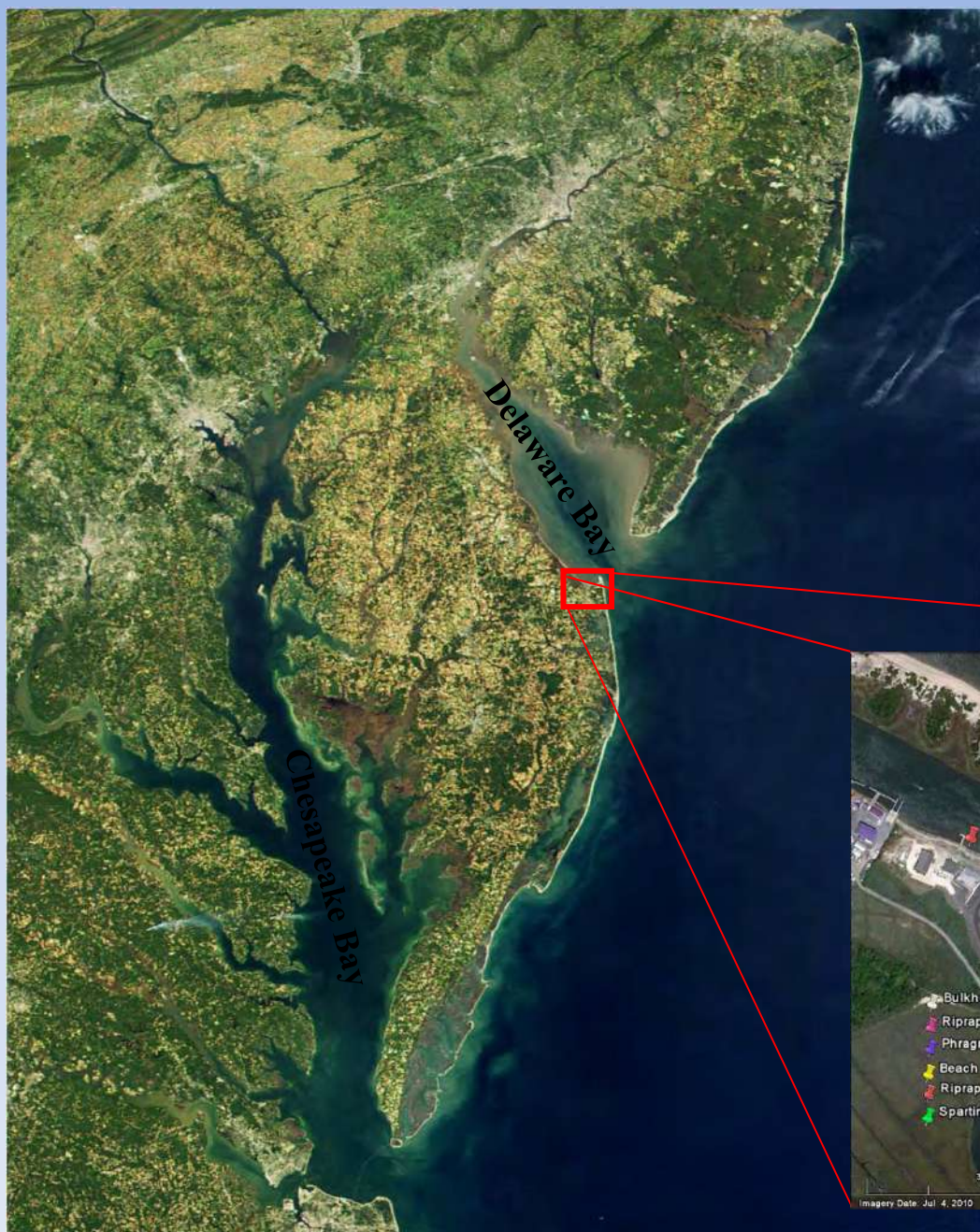
From Middaugh et al. 1981



Objectives

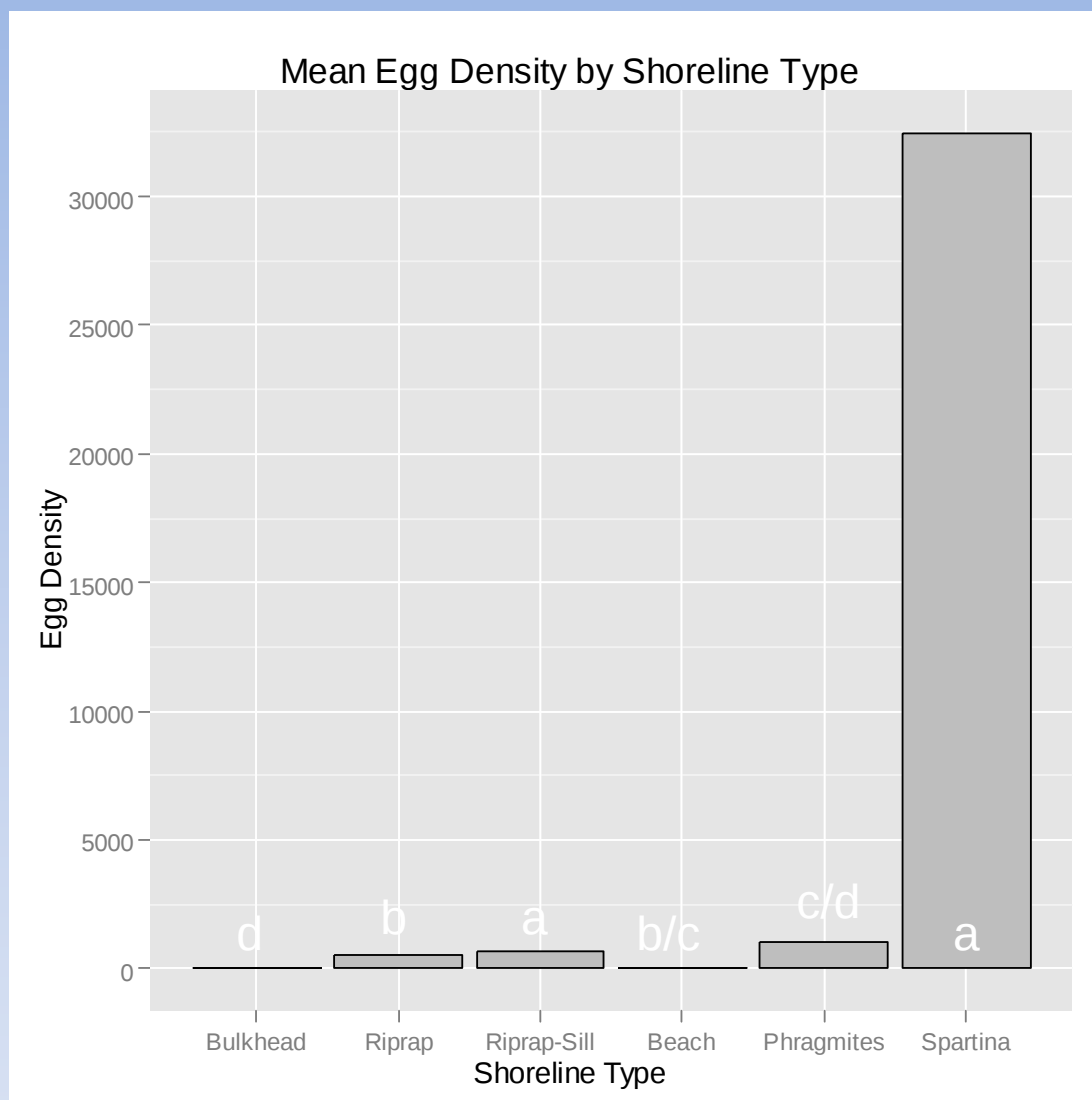
1. Quantify density of eggs laid at six shoreline types at the mouth of Delaware Bay
2. Quantify density of eggs laid on substrates at the mouth of Delaware Bay
3. Determine if a relationship exists among shoreline type and substrate use for deposition of *Menidia* eggs







Google Earth



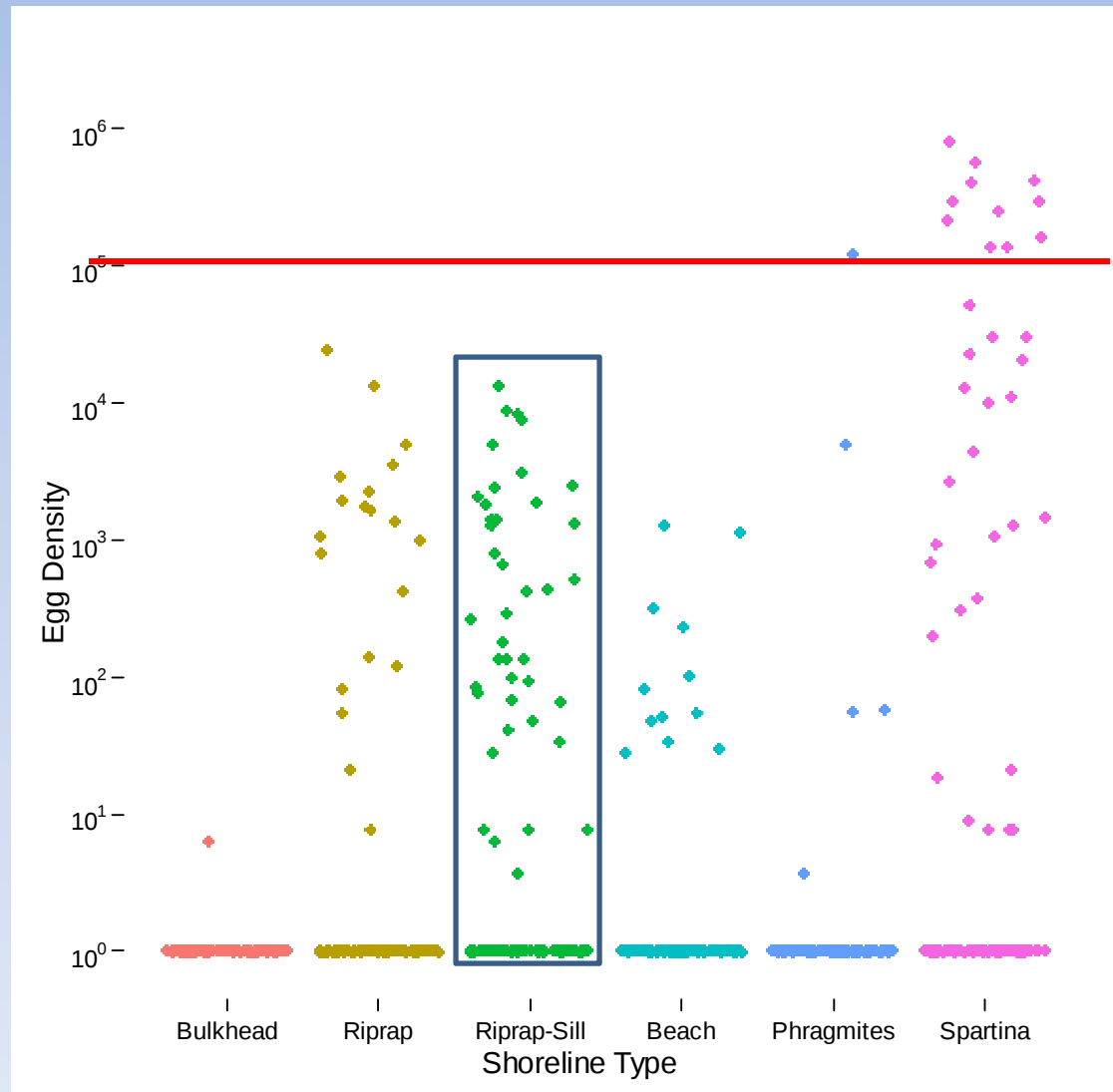
$p < .01$

Total egg abundance percentages -

Bulkhead	Riprap	Riprap-Sill	Beach	Phragmites	Spartina
< .01 %	1.50%	1.60%	0.08%	3.00%	94.00%

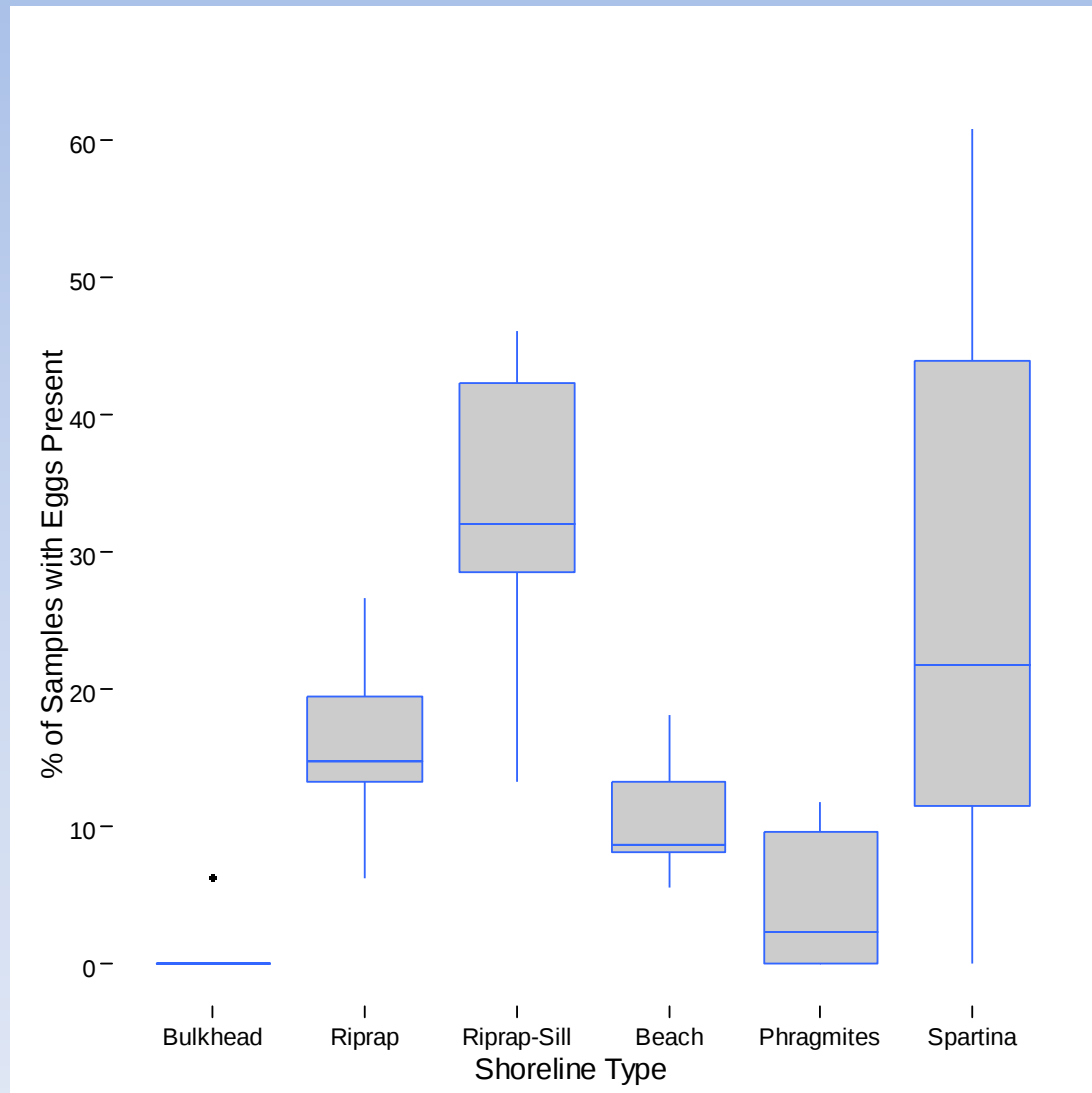


Shoreline Results





Shoreline Results



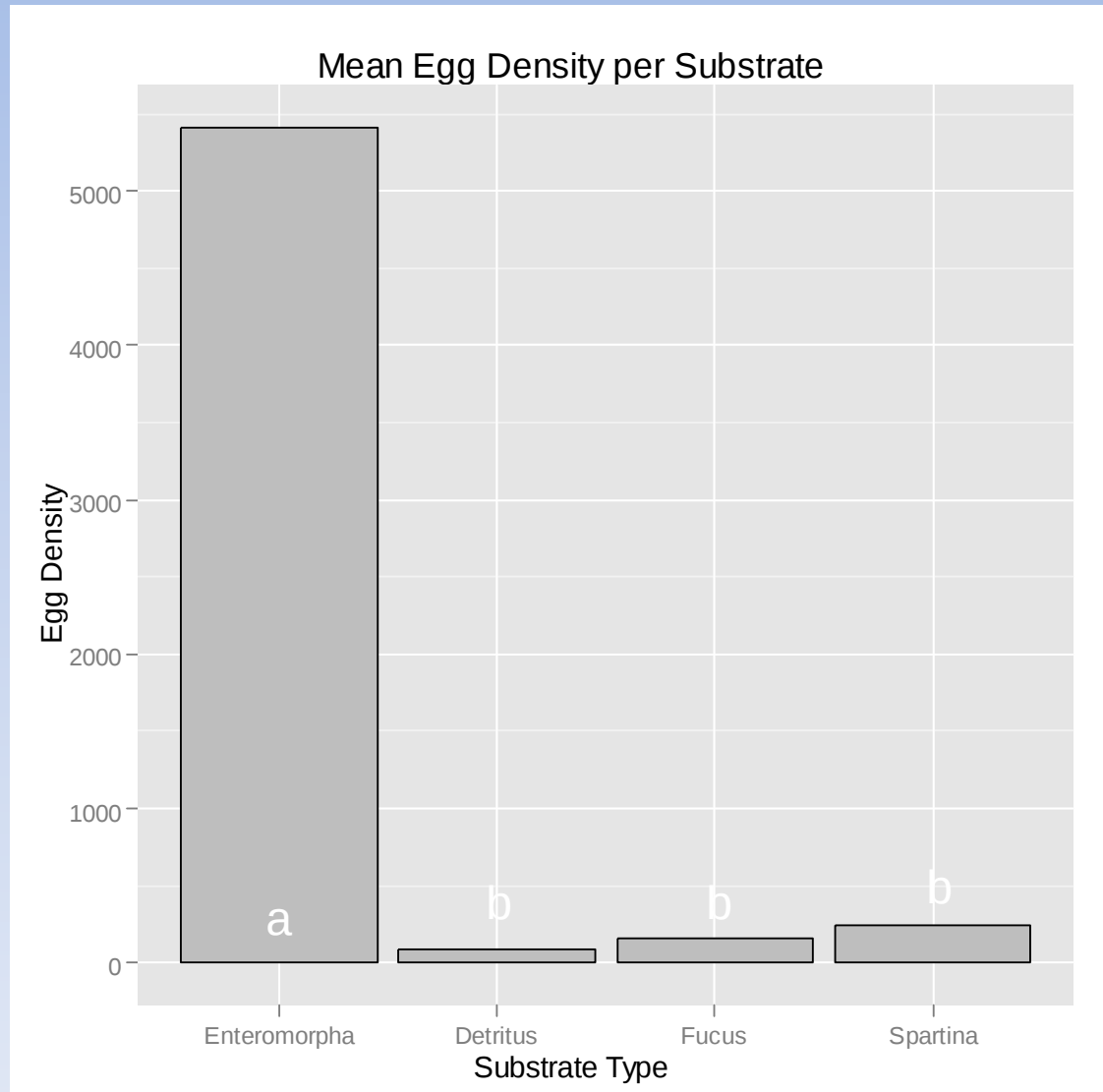
Shoreline Type Conclusion

- *Spartina* > 93% total eggs
- *Spartina* and Riprap-Sill = statistically greatest egg densities
- Other hardened/unhardened shorelines had low egg densities



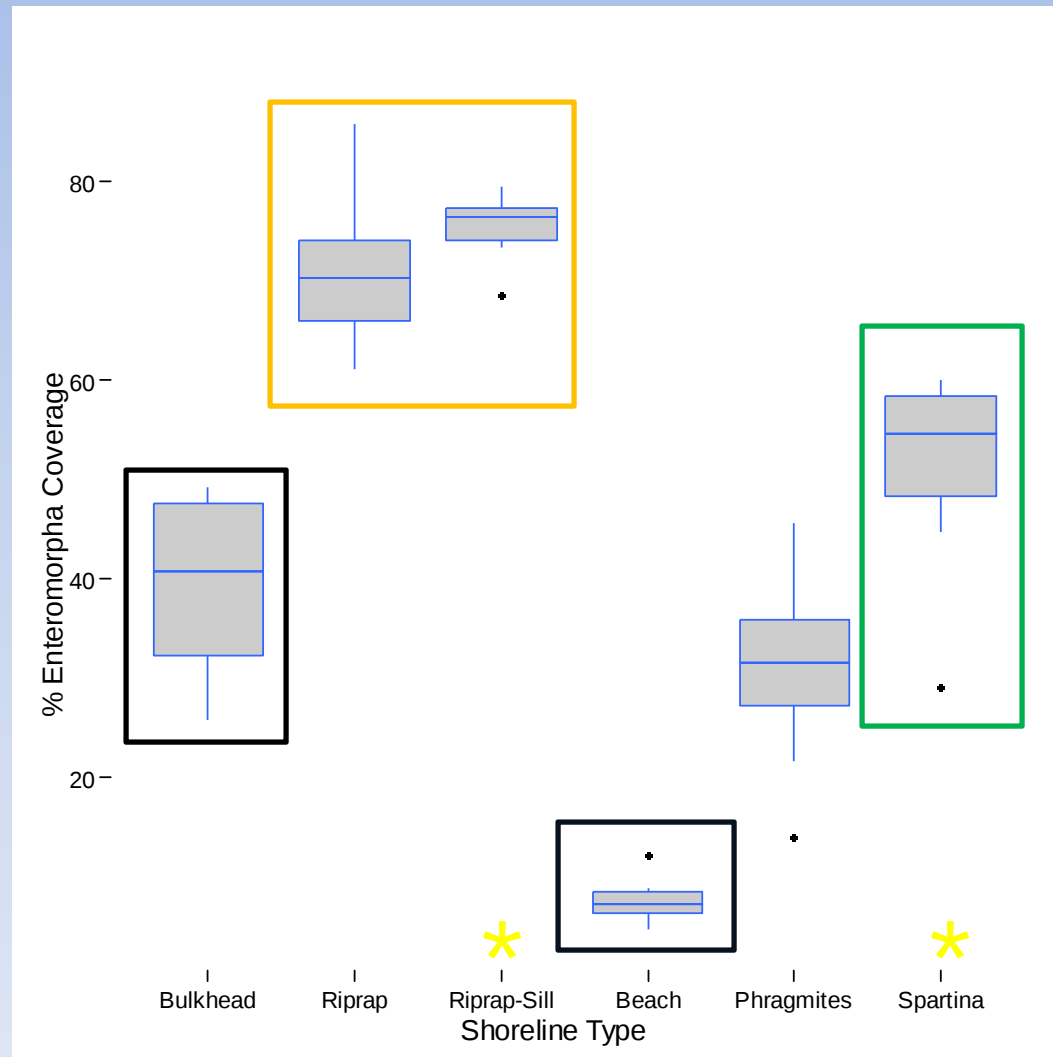


Substrate Results





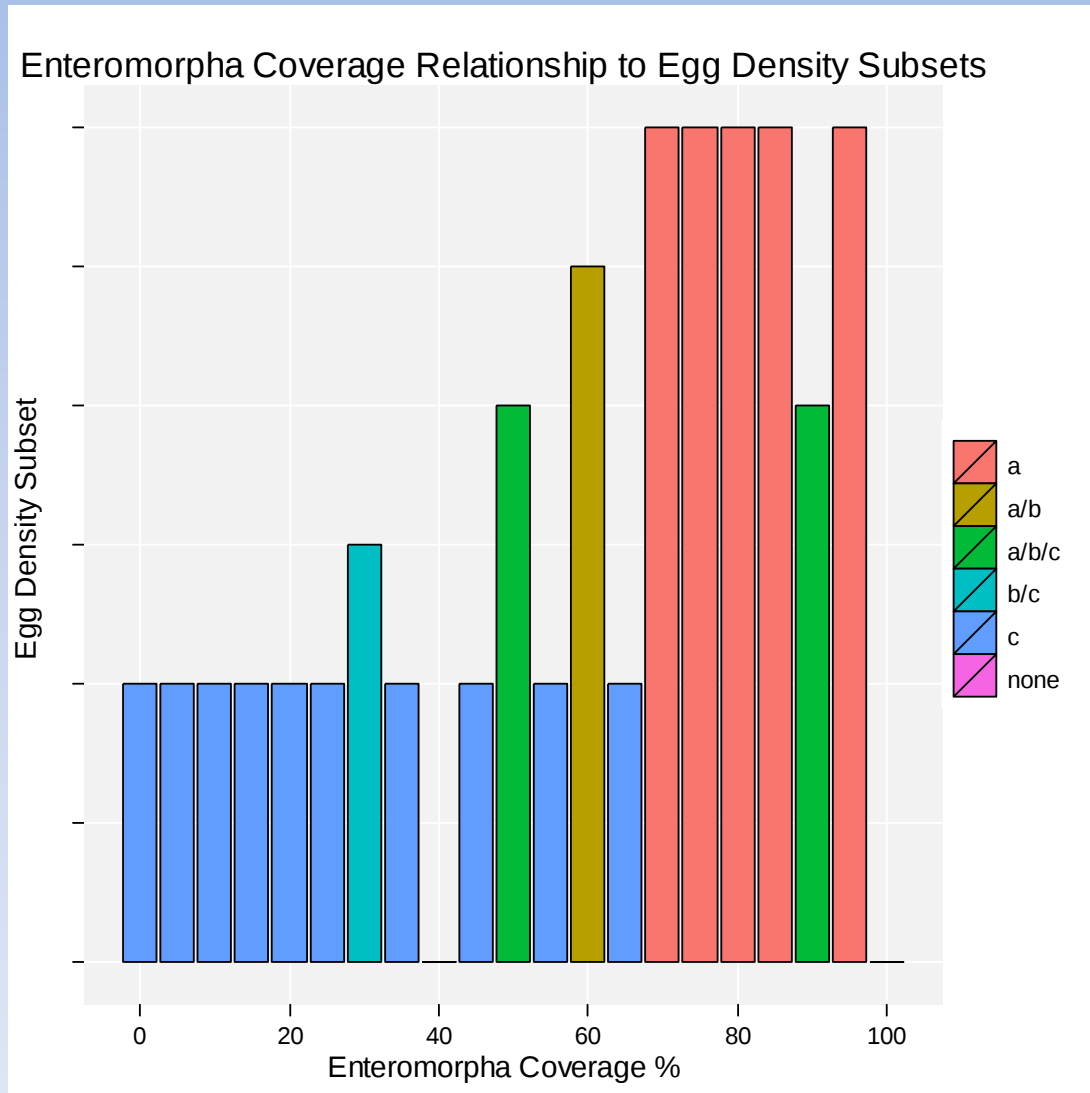
Results



$p < .01$



Results



$p < .01$

Substrate Conclusion



- *Enteromorpha* spp. had highest egg densities of any substrate.
- Other substrates used minimally:
 - *Spartina*
 - Detritus
 - *Fucus*
 - *Ulva*
 - Rock



Conclusions

- Shoreline type significant determinant of deposition density
 - 93 % of eggs from *Spartina*
 - Riprap-Sill also utilized regularly
- Substrate selection is similar among shoreline types
 - *Enteromorpha* spp. most utilized



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Riprap-Sill Macrofaunal Sampling

- Sampled bi-weekly 6/18/10 - 9/19/10
 - Riprap-sill
 - Riprap
 - Spartina
- Seine
 - Flood tide
 - Ebb tide
- Minnow pots



Questions? Comments?