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# Structural complexity and location affect the habitat value of restored oyster reefs

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# Structural complexity and location affect the habitat value of restored oyster reefs

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## Background

- Structured habitats have been declining worldwide, having negative economic and ecological impacts
  - Coral reefs, seagrasses, mangroves, and saltmarshes have all suffered > 20% global decline
  - Oyster reefs have suffered the greatest decline with > 85% loss (Beck et al. 2011)
  - Chesapeake Bay oysters (*Crassotrea virginica*) now < 1% historic levels
- Beyond their direct economic benefits, oyster reefs provide a suite of valuable ecosystem services, which have become the target of more recent restoration efforts. These include:
  - Water filtration
  - Denitrification
  - Stabilization of benthic and intertidal habitats
  - Habitat, refuge, and foraging grounds
- Success in restoring lost ecosystem services may depend on reef design characteristics, location, and environmental conditions of the specific area targeted for restoration (Dame 1979; Peterson et al. 2003)

## Objectives

1. Quantify species composition, diversity, density, and biomass on restored oyster reefs in Virginia tributaries of the Chesapeake Bay
2. Examine the effect of structural complexity and location on faunal density, biomass and species composition.

**Overarching Goal:** To provide information to guide restoration efforts with regards to designing reefs to meet restoration goals of enhanced macrofaunal abundance and species diversity on oyster reefs.

## Hypotheses

1. Species diversity will increase with salinity and species composition will vary among tributaries
2. Species diversity and abundance will increase with increasing structural complexity

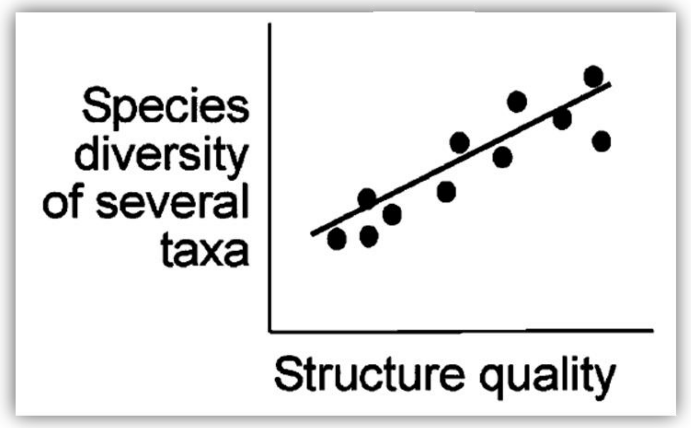
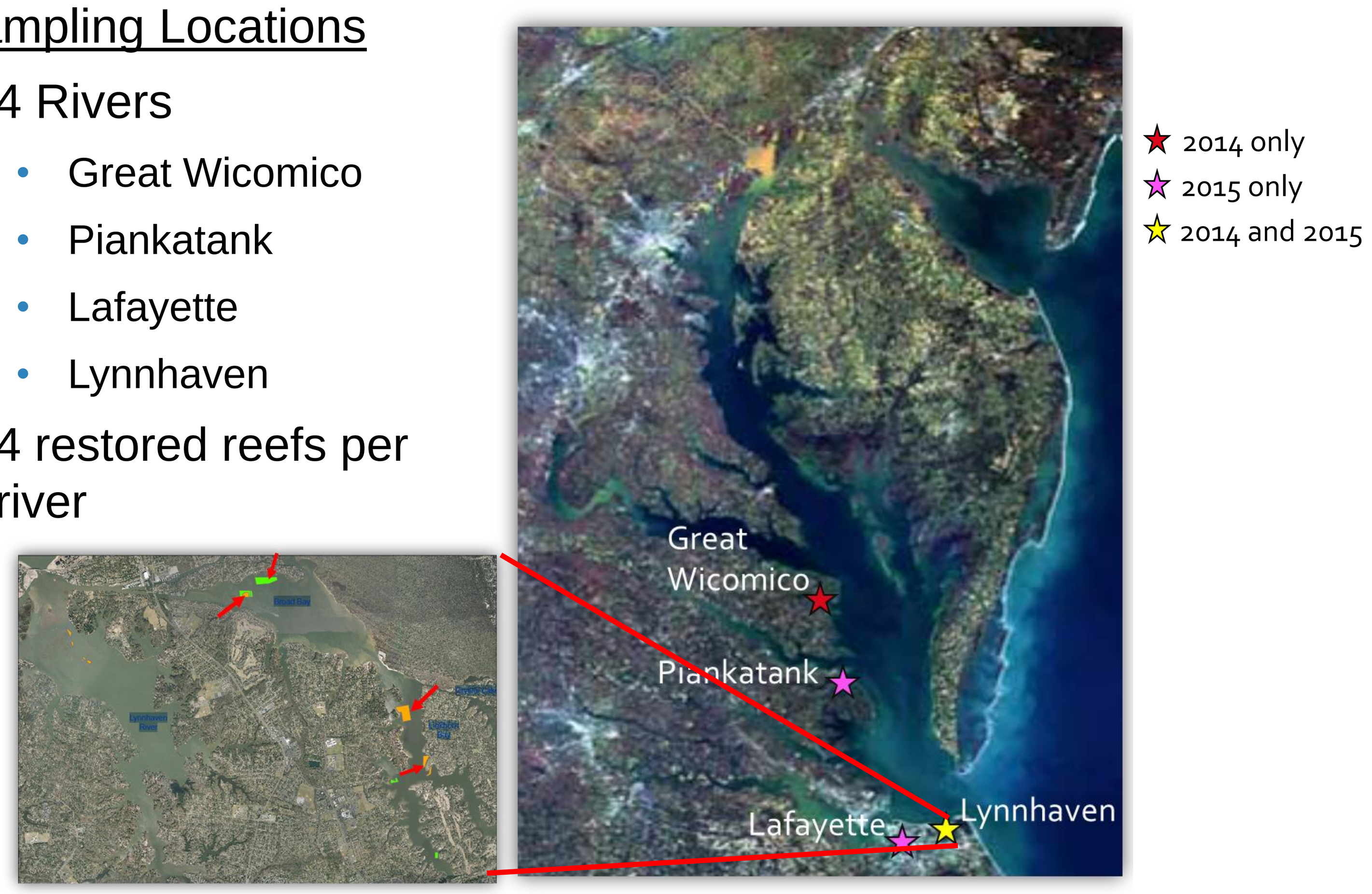



Figure 1: Graph from Tews et al. 2004, illustrating the hypothesis that as structural quality, or complexity increases, species diversity is predicted to also increase

## Methods

Sampling Locations

- 4 Rivers
  - Great Wicomico
  - Piankatank
  - Lafayette
  - Lynnhaven
- 4 restored reefs per river




Sampling Methods and Lab Processing

- 4 benthic sampling trays embedded into each reef by VIMS divers (tray dimensions: $0.122m^2$ x 0.15m, 1mm mesh liner)
- 7-week soak time
- Surface complexity (rugosity) measured by "chain-link" method
- YSI measurements (DO, salinity, temp) and depth
- Sort, ID, and weigh species in lab
- Volumes: oyster clumps, dead shell, live single oysters, oyster boxes

Photos: (Left) Graduate student Melissa Karp measuring rugosity of oysters in tray, (Top) Tray deployed on a reef

## Results

- In 2014, 33 different species, from 5 taxa, were collected on restored oyster reefs
- Species composition differed between the rivers (figure 2)

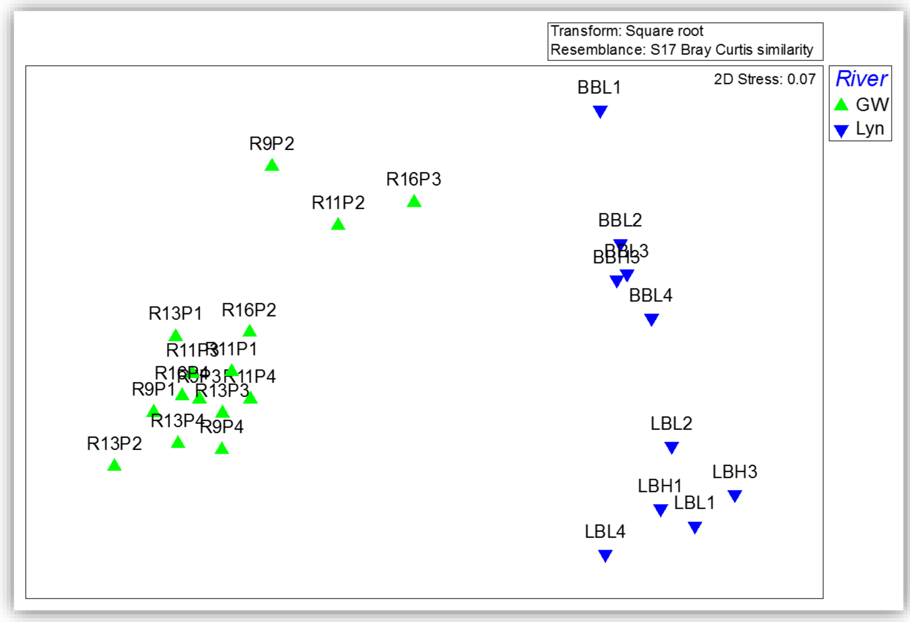
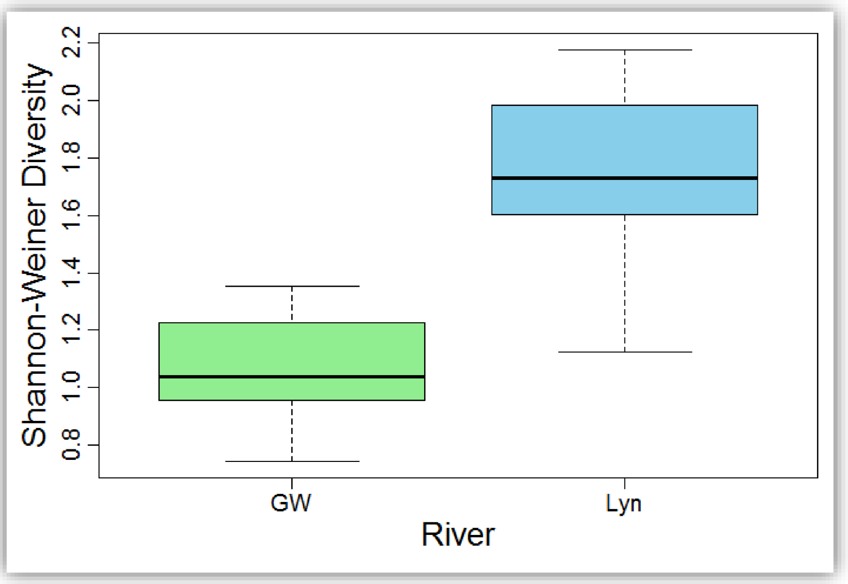



Figure 2: An nMDS plot comparing the species composition data for the Lynnhaven (Lyn) and Great Wicomico (GW) rivers. The two rivers form two distinct clumps. The species composition is significantly different between the two rivers (ANOSIM analysis: R= 0.956, p < 0.001).

## Results

- The Lynnhaven river reefs had significantly greater salinity and H' species diversity (22.4 psu and 1.91 respectively) on average compared to the Great Wicomico River (13.81 and 1.13 respectively) (figure 3)

Figure 3: Boxplots of species diversity for the Lynnhaven and Great Wicomico rivers. Both salinity and species diversity were significantly greater in the Lynnhaven river compared to the Great Wicomico (ANOVA: p < 0.001)




- Faunal density positively correlates with oyster clump volume (figure 4) and rugosity (surface complexity).

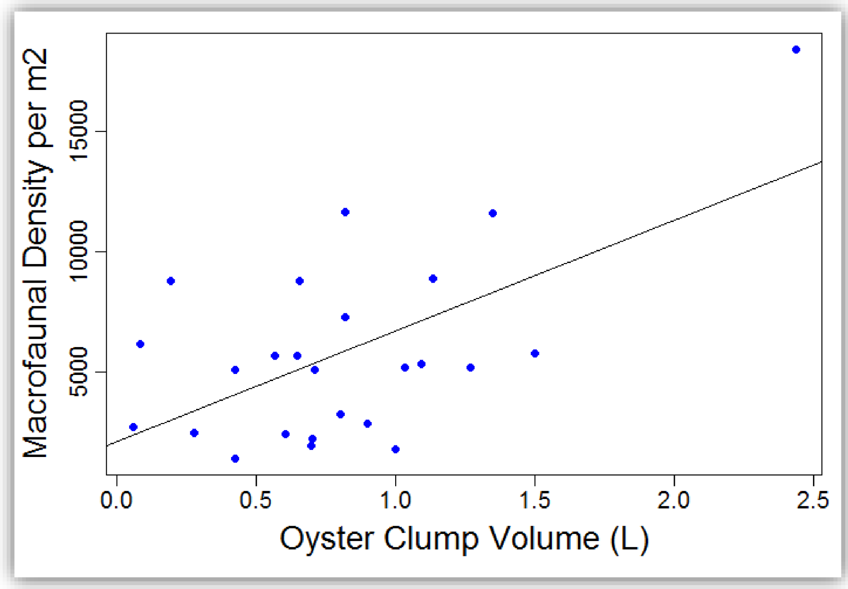



Figure 4: Relationship between faunal density and oyster clump volume ($r^2 = 0.33$, $p = 0.0016$)

## Conclusions

- Restored oyster reefs provide habitat for a host of different species
- Species composition of restored oyster reefs depends on the river in which they are located (figure 1)
- Salinity may be an important factor influencing the species diversity and composition on restored oyster reefs, with higher salinity supporting a greater diversity of organisms (figure 2)
- Increasing the structural complexity, such as amount of oyster clumps, of a restored oyster reef may help to increase its habitat value to benthic organisms, and increase the abundance of those organisms (figure 3)

***References:*** Beck et al. 2011. *BioScience* 61: 107-116; Dame, R.F. 1979. Proceedings of the National Shellfisheries Association 69:6-10.; Peterson et al. 2003. *Marine Ecology Progress Series* 264: 249-264.; Tews et al. 2004. *Journal of Biogeography* 31(1): 79-92.

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