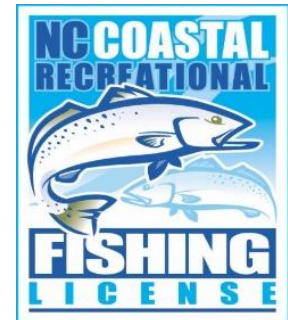


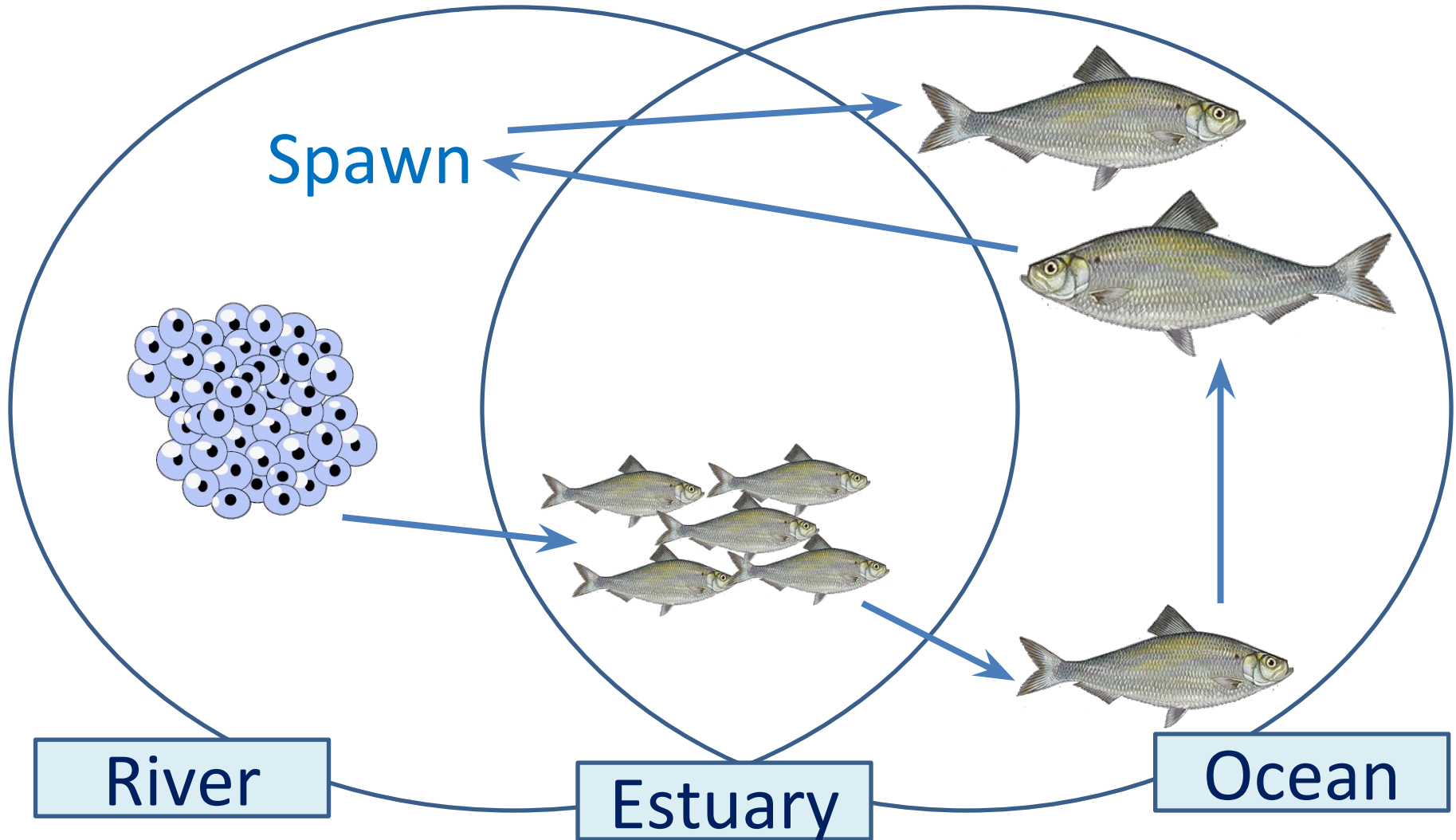
Influence of riparian zone land cover on blueback herring catch within the Albemarle Sound watershed

Steven Lombardo, Jeffrey Buckel, Ernie Hain,
Emily Griffith, Holly White

**NC STATE
UNIVERSITY**



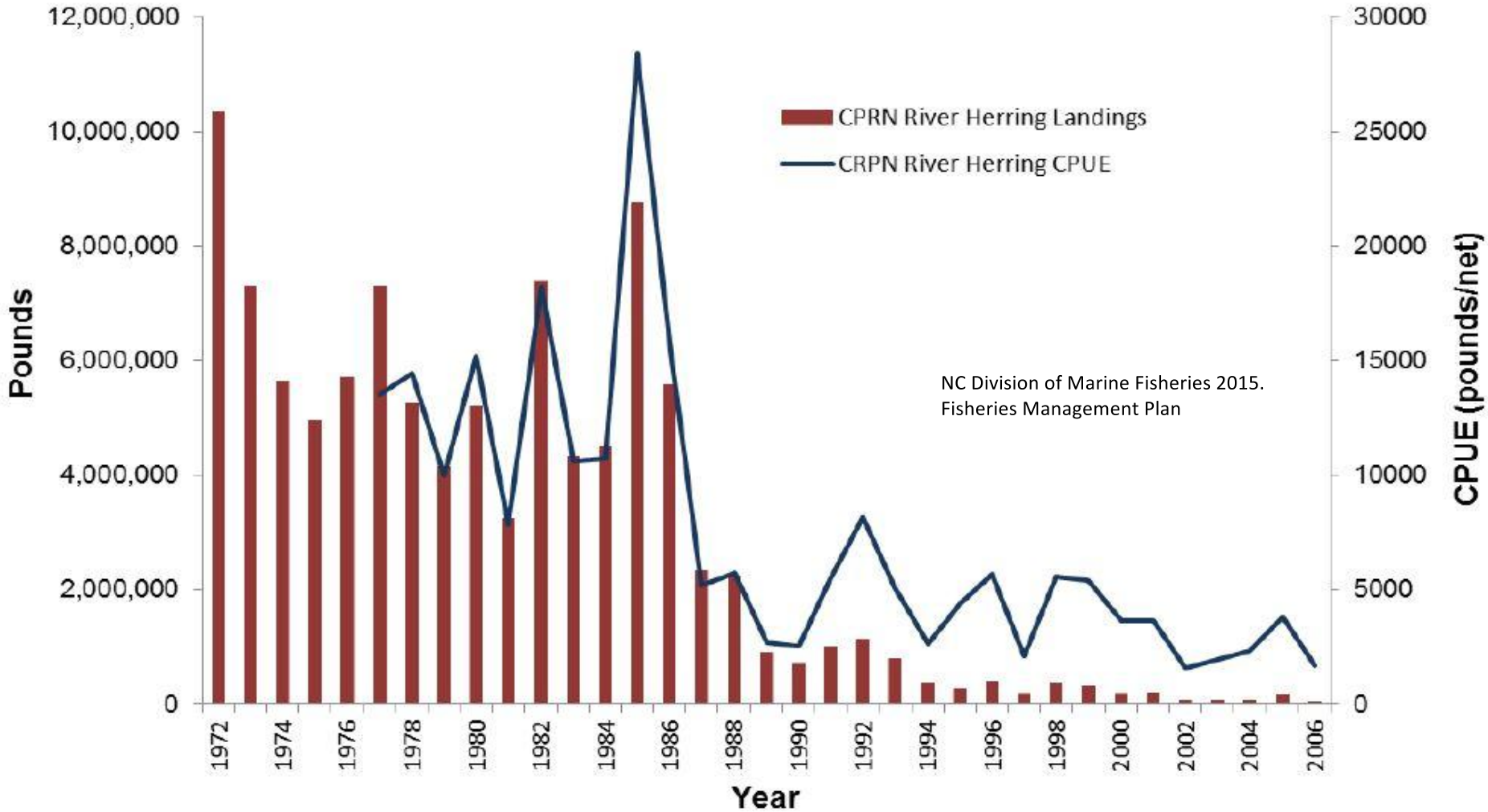
River Herring Life Cycle





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River Herring CPUE Chowan River, NC

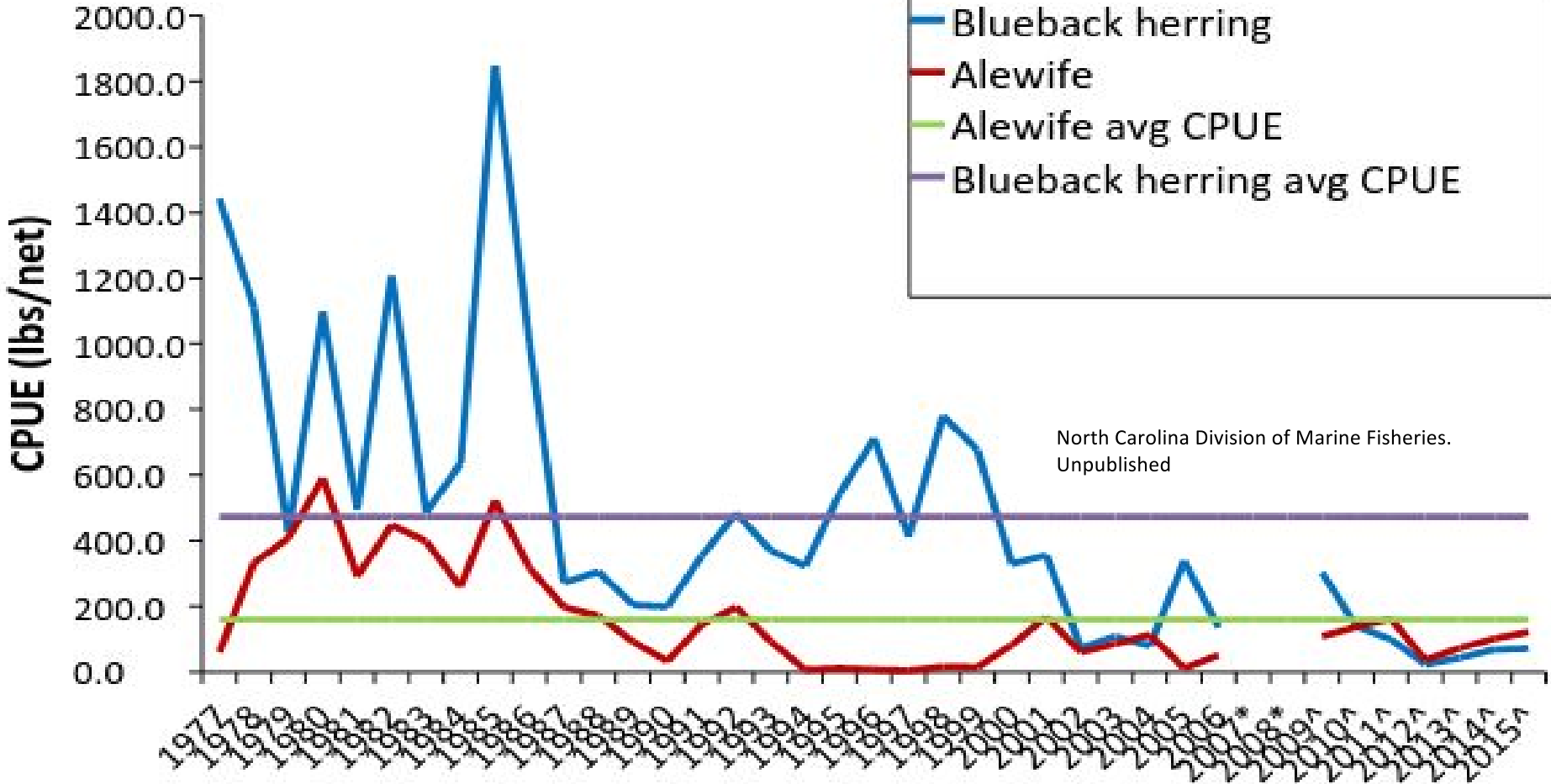


Collapse & Remediation

- Commercial Pressure
 - Moratorium
- Offshore Bycatch
 - Bycatch Cap
- Habitat Loss
 - Clean Water Act & Dam Removal

Current Status

River Herring CPUE Chowan River, NC



Questions

- Is water quality affecting the migration and presence of river herring?
- Do river herring respond to urbanization and agriculture/silviculture activities?

Spawning Habitat

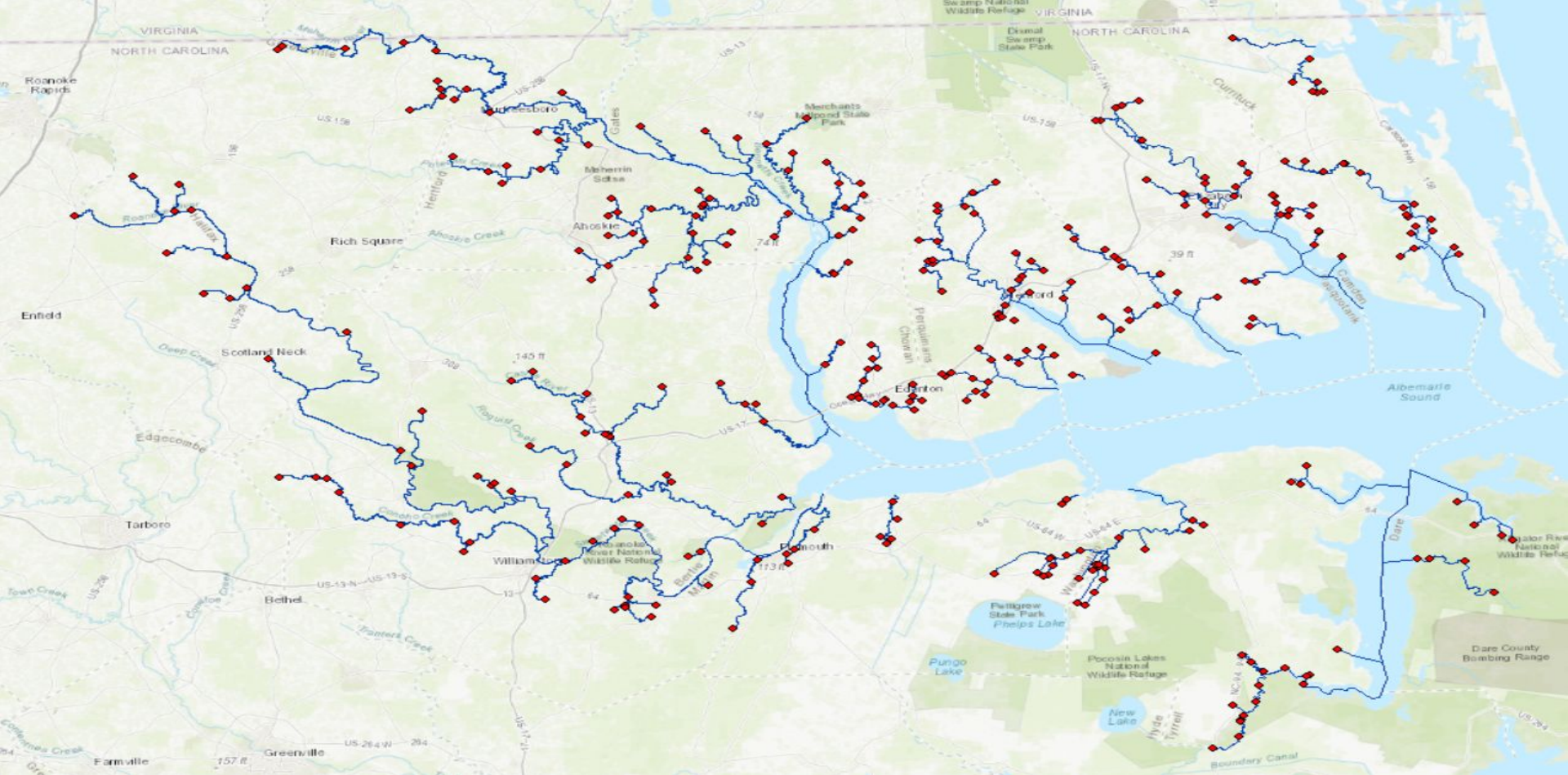


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Spawning Habitat



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- 9 years of data

- 2007 - 2016

- 233 stations, 13 rivers

- 9,650 sampling events

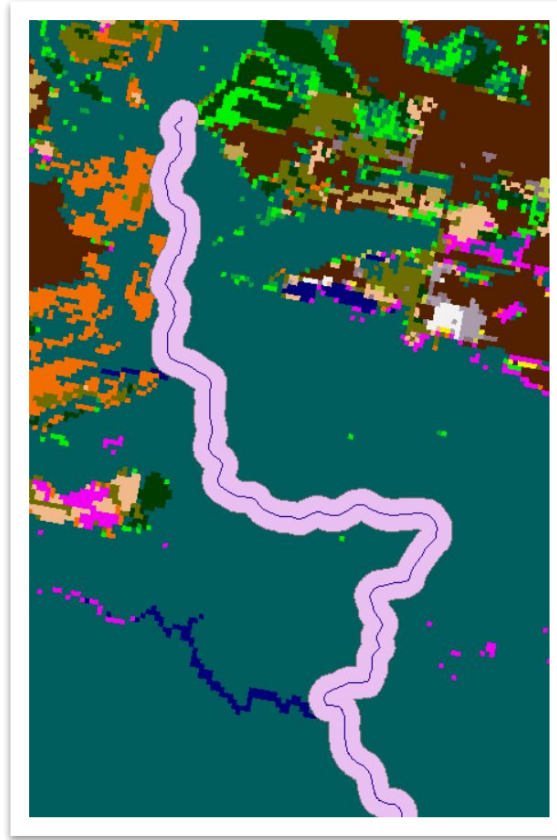
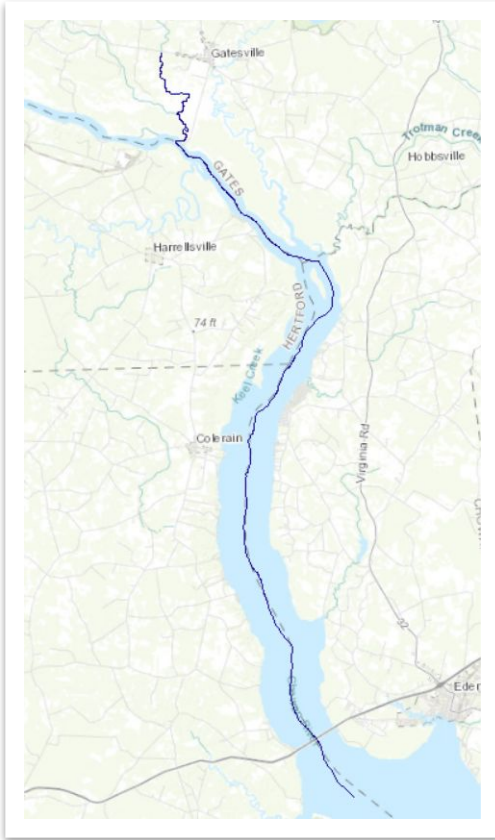
NC STATE

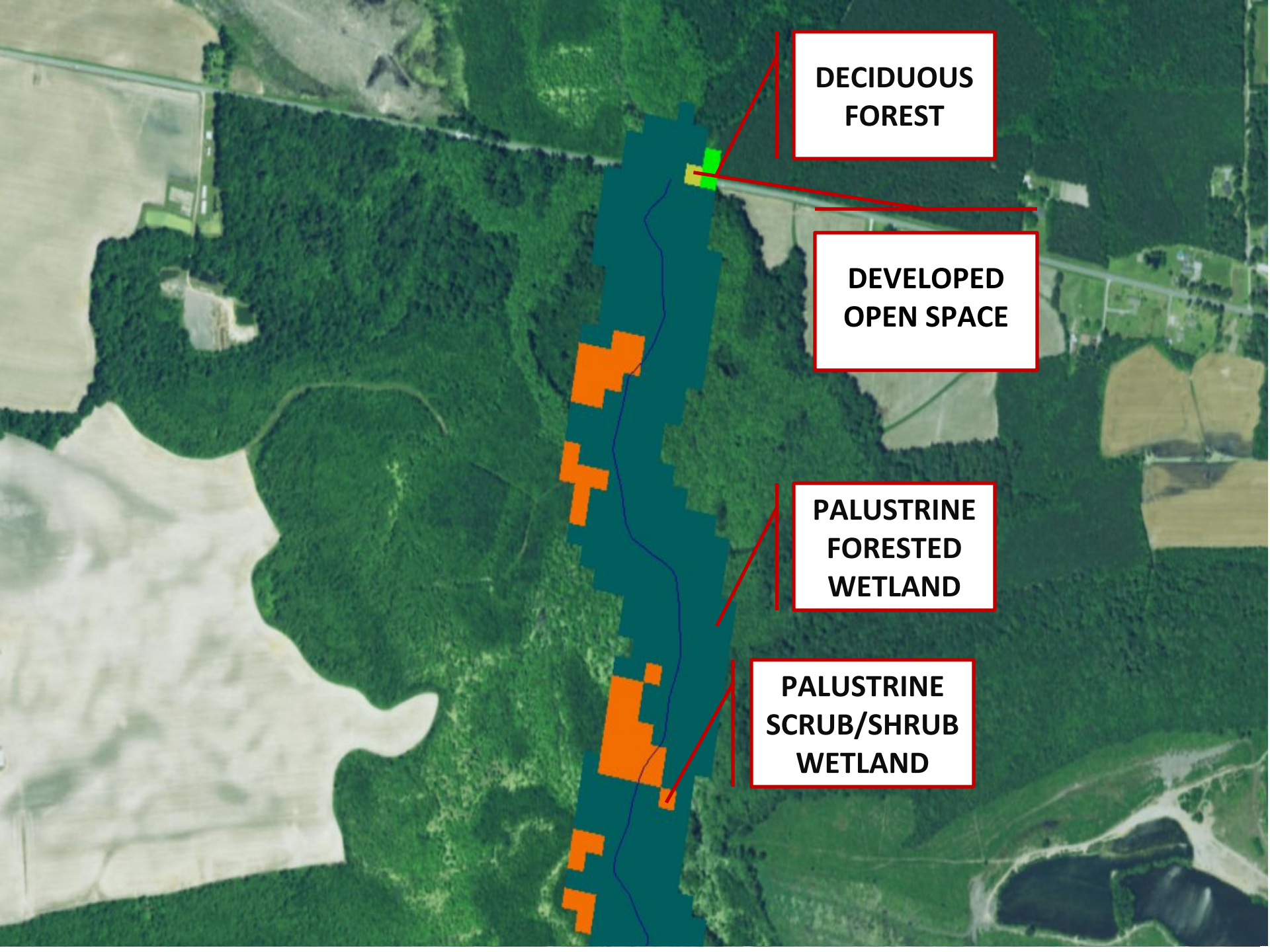
Model Construction

- Model presence probabilities for blueback herring
 1. Extract riparian zone land cover classifications (pixel count/area in m²)
 - NOAA C-CAP 2010 (DOC 2013)
 2. PCA to summarize land cover
 - *Stats* (R Core Team 2017)
 3. GAM with a binomial distribution and thin plate splines
 - *MGCV* (S. Wood 2011)

Model Construction

Extract riparian zone land cover along stream segment



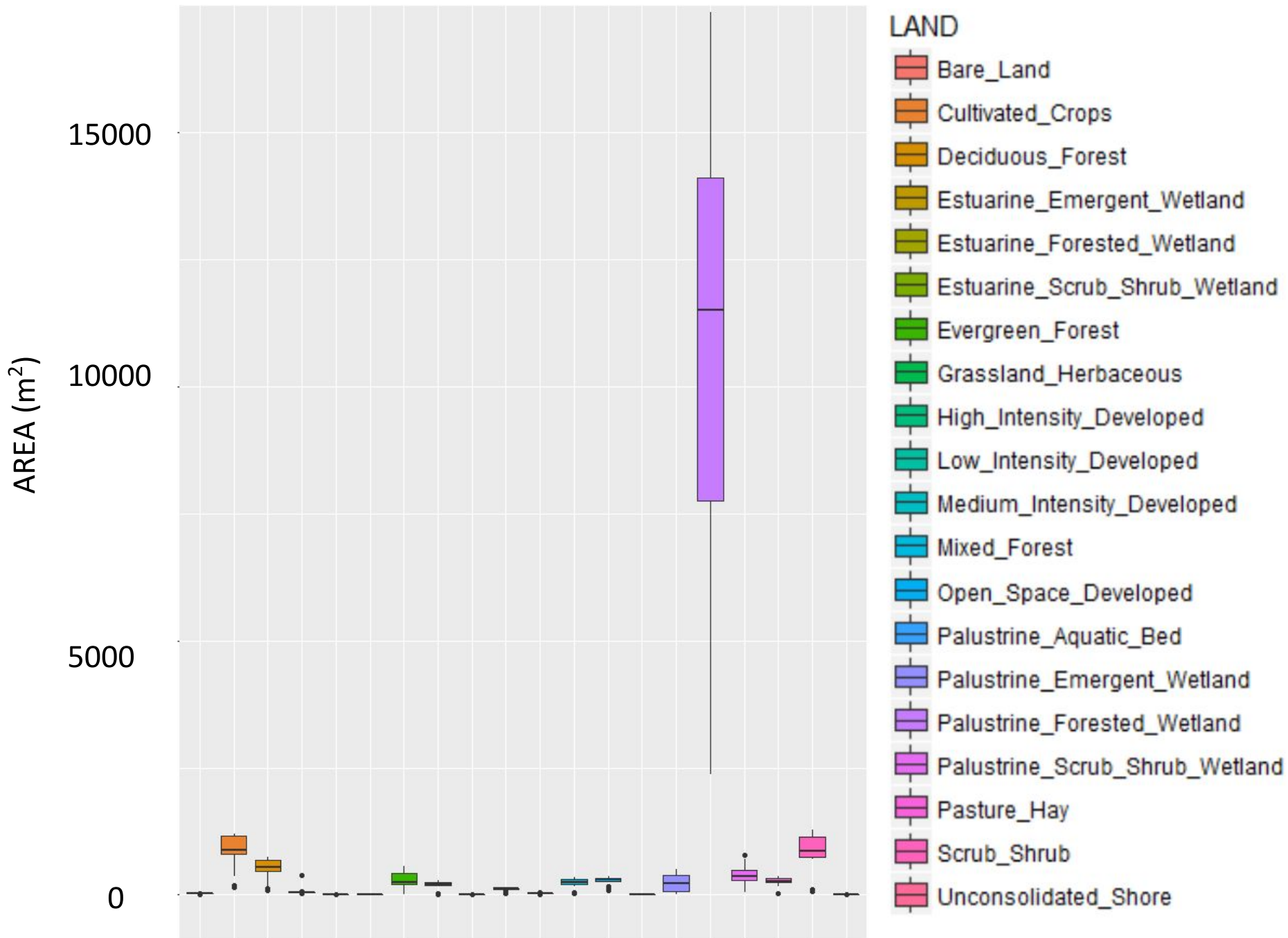


**DECIDUOUS
FOREST**

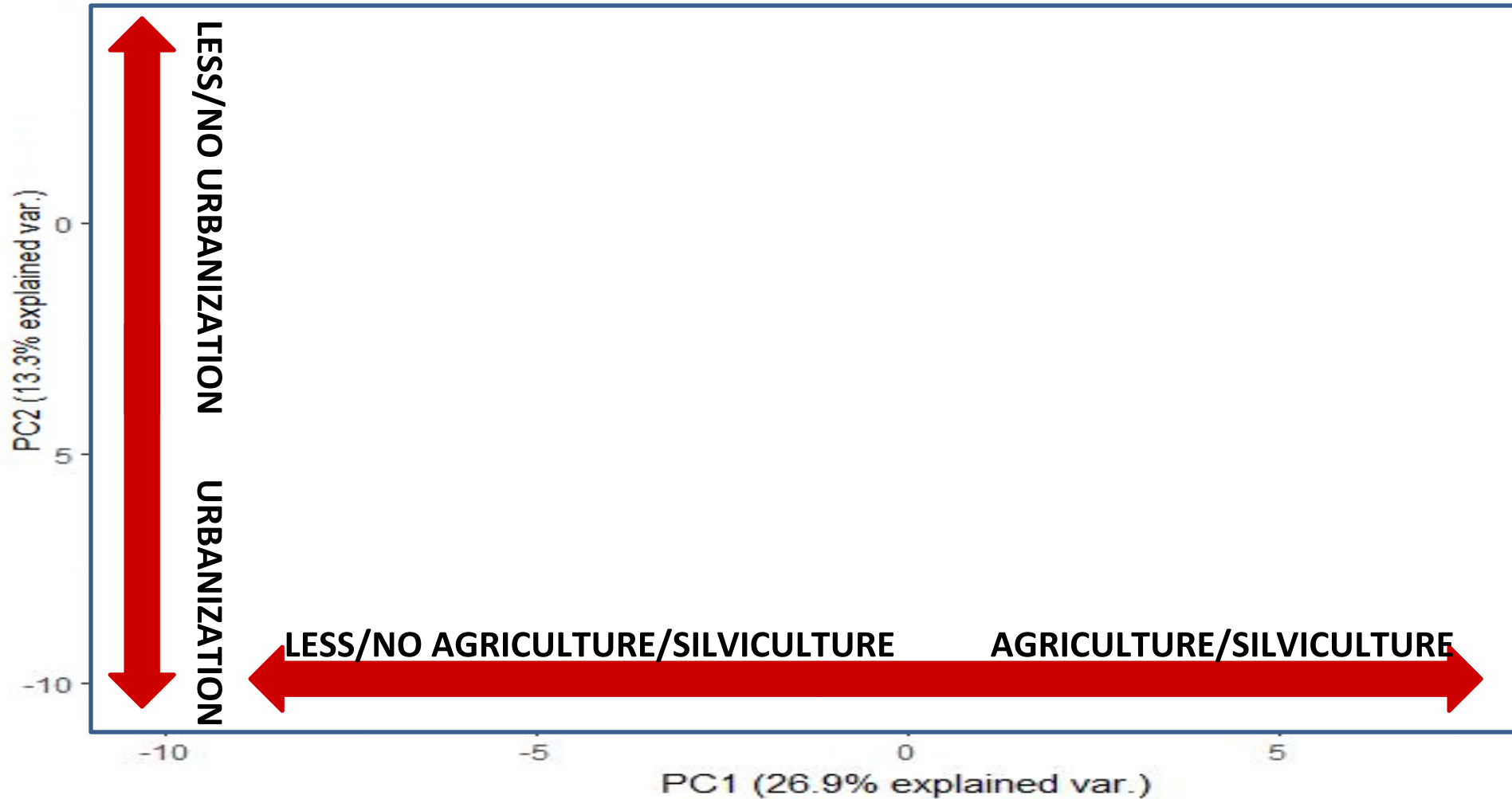
**DEVELOPED
OPEN SPACE**

**PALUSTRINE
FORESTED
WETLAND**

**PALUSTRINE
SCRUB/SHRUB
WETLAND**



Principal Components Analysis (PCA)



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Generalized Additive Model (GAM)

Variables

Year

s(Ordinal Day)

s(Depth)

s(Distance Proportion)

s(pH)

System

s(PC1)

s(PC2)

s(PC1 * System)

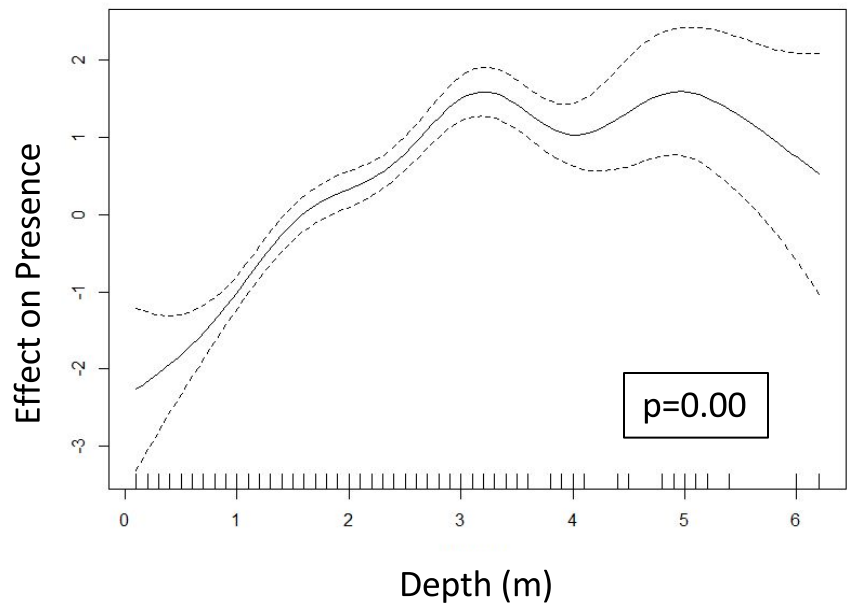
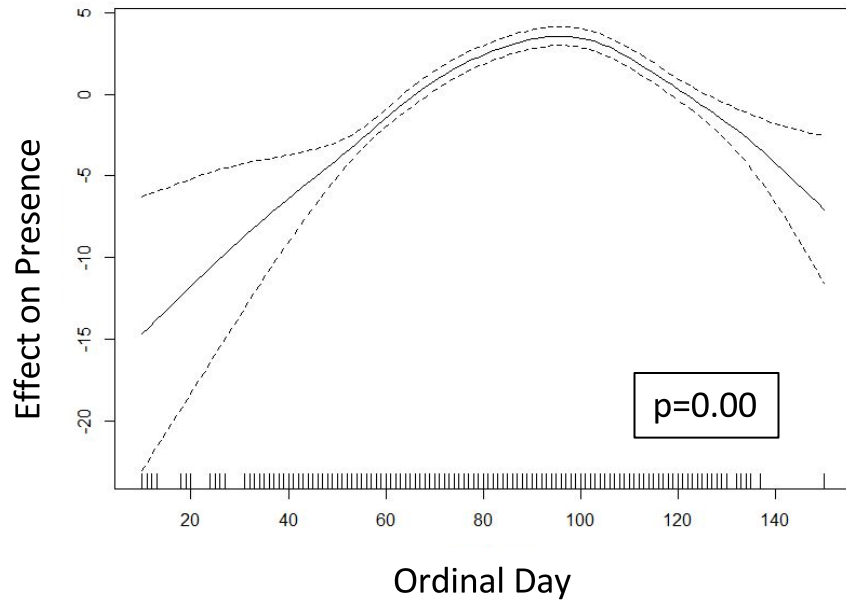
s(PC2 * System)

Blueback Herring Model

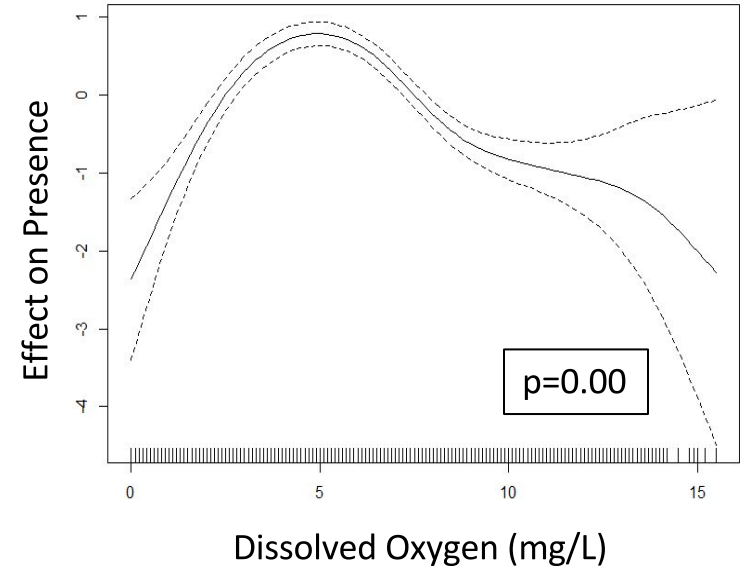
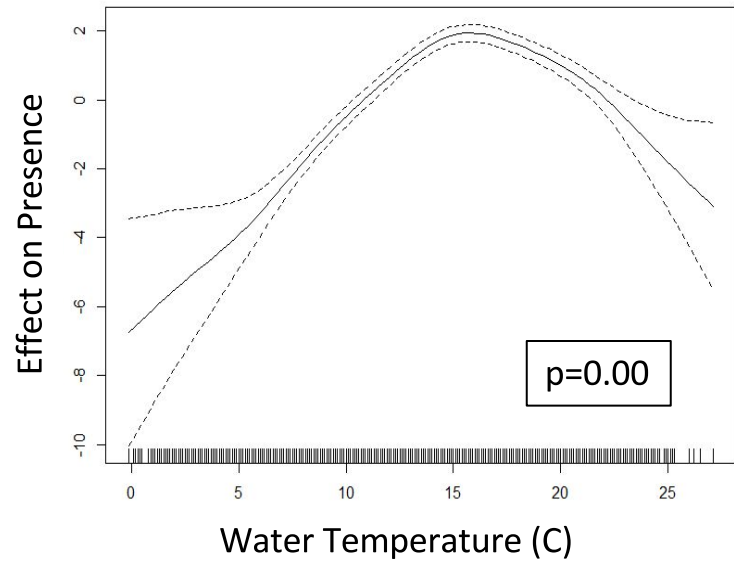
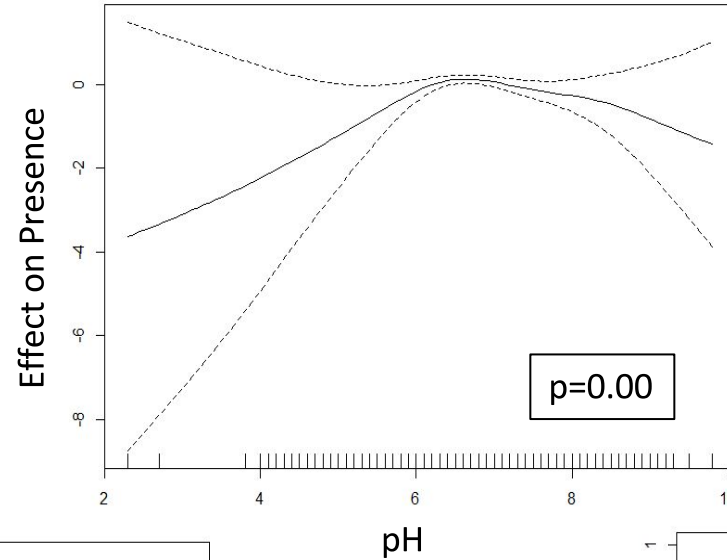
- Model Fit
 - AIC
 - Percent Deviance Explained
 - Receiver Operating Characteristic (ROC)
 - Likelihood Ratio Test

Model Fit	
Percent Deviance Explained	44.3%
ROC-AUC	0.937

Effect of Site Specific Parameters



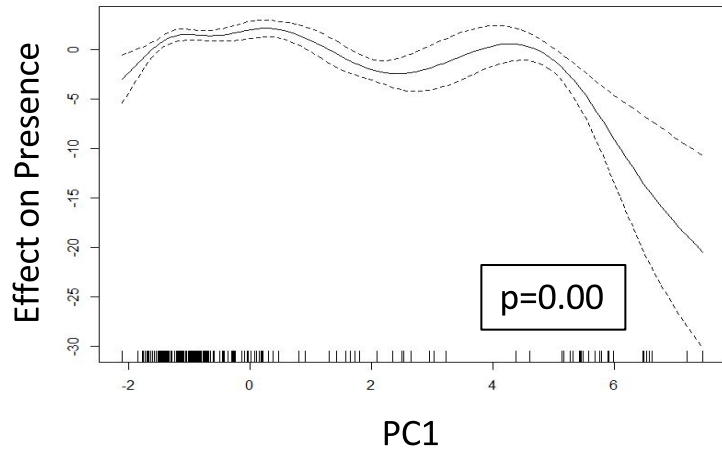
Effect of Water Quality



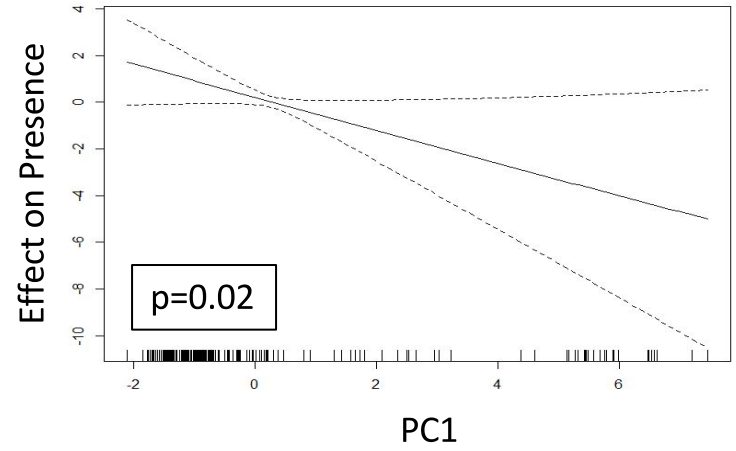
Effect of Land Cover by Watershed

Agriculture/Silviculture

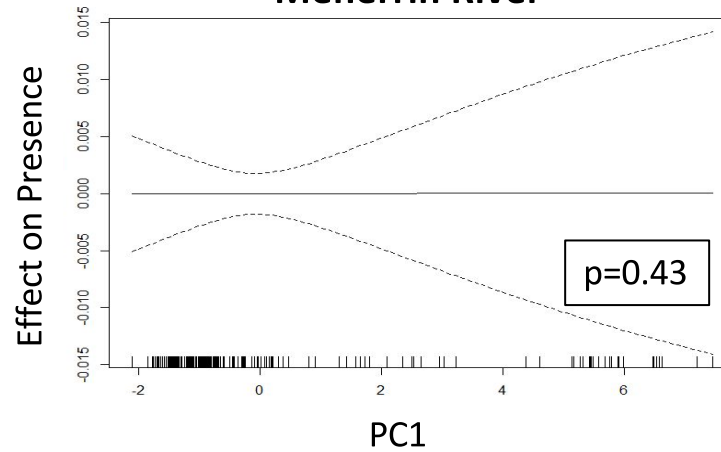
Chowan River



Roanoke River



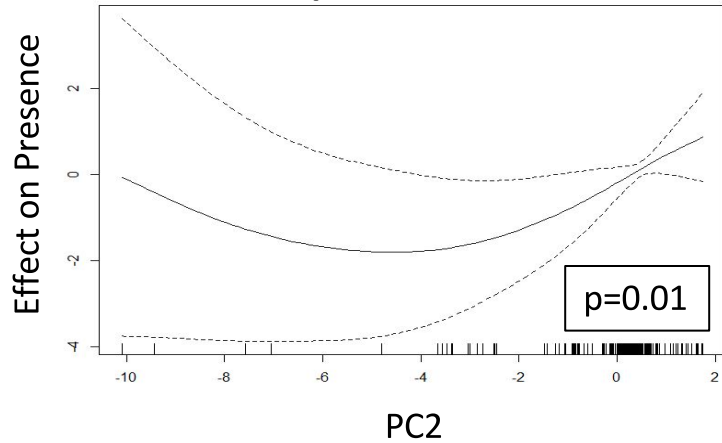
Meherrin River



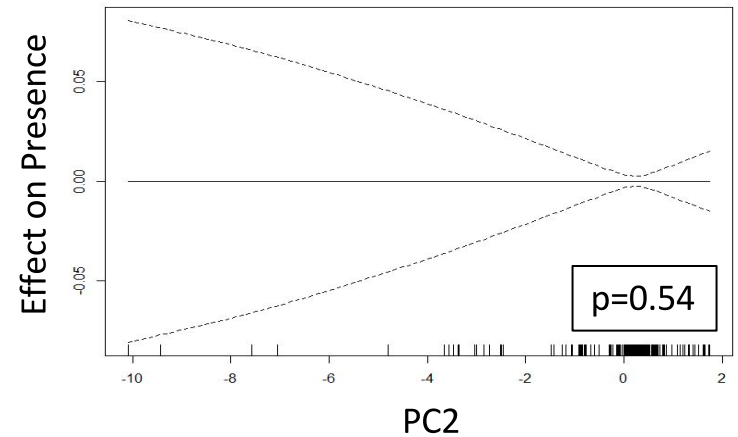
Effect of Land Cover by Watershed

Development/Urbanization

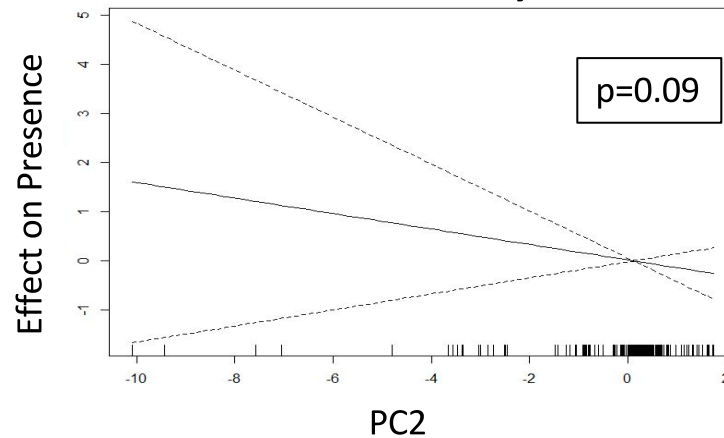
Pasquotank River



Roanoke River



Edenton Bay



Conclusions

- Blueback herring are sensitive to seasonal habitat conditions: ordinal day, water temperature, DO
- Agriculture and silviculture have negative effects on blueback herring habitat use in 5 of 13 river systems
- Development and urbanization show a negative effect on blueback herring habitat use in 2 of 13 river systems

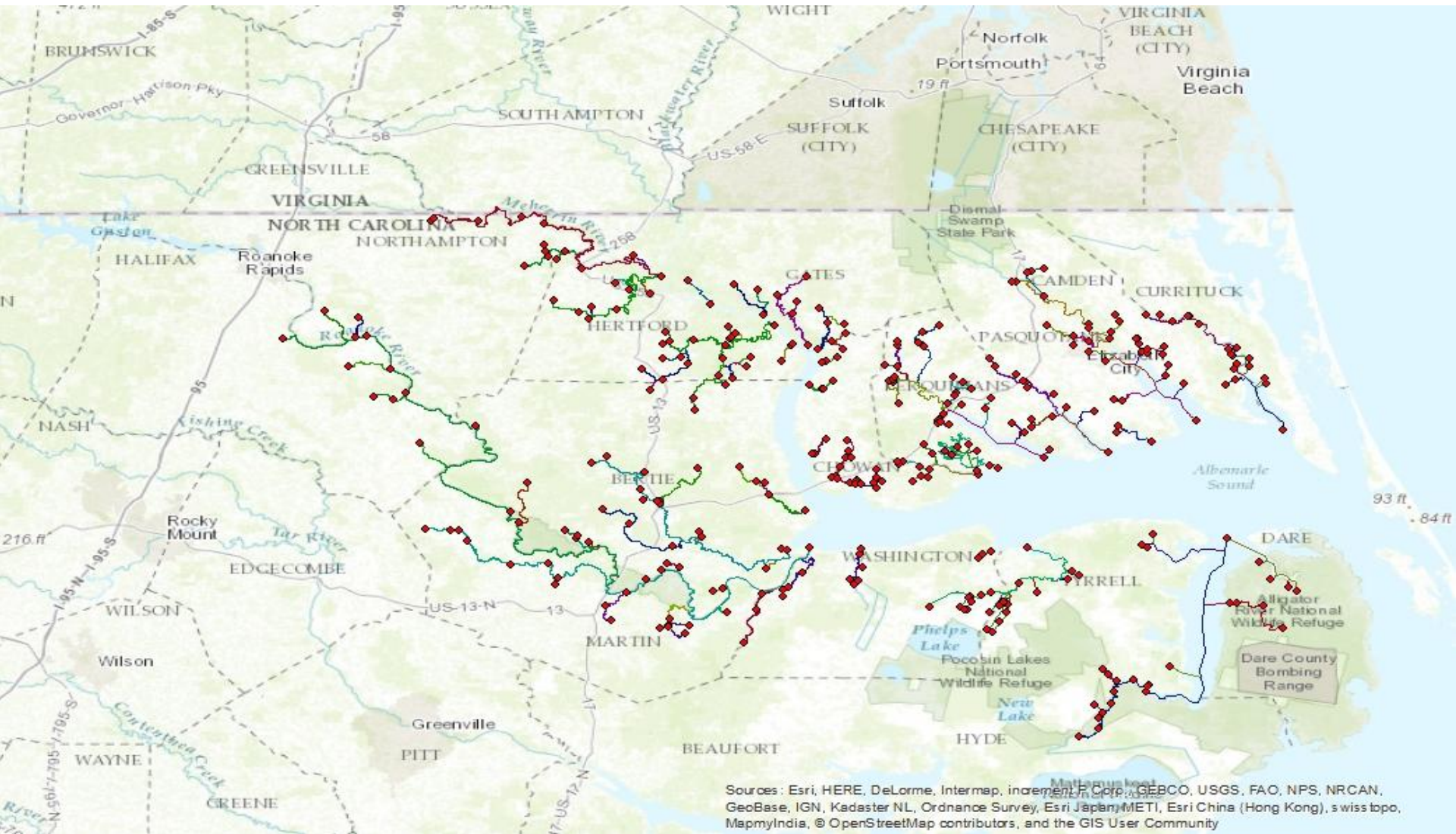
Future Research

- Conduct survey at culvert influences to determine the effects of culvert presence and condition
- Sample in more developed/urbanized locations to bolster the dataset

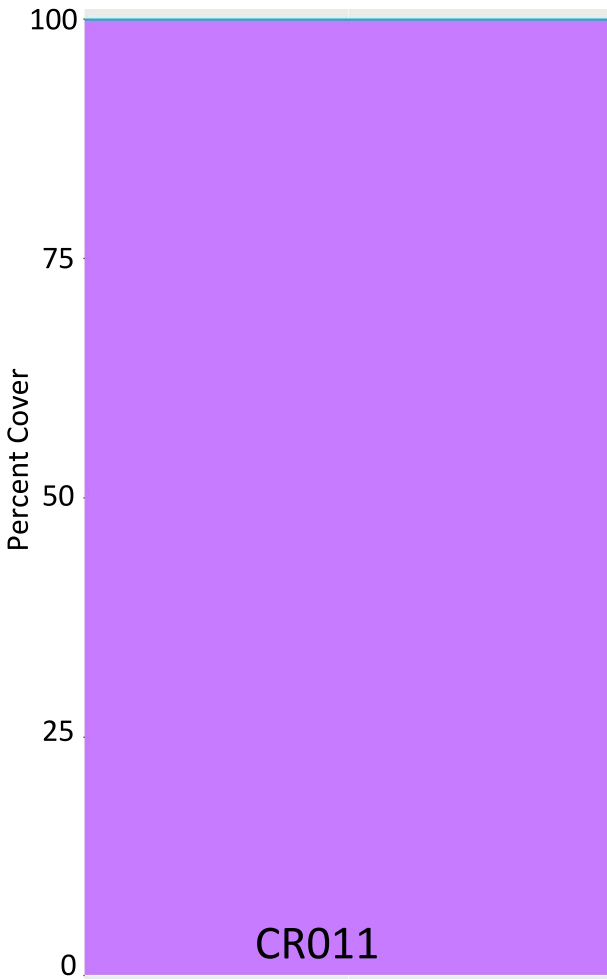
Conclusions

- Blueback herring are sensitive to seasonal habitat conditions: ordinal day, water temperature, DO
- Agriculture and silviculture have negative effects on blueback herring habitat use in 5 of 13 river systems
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PC1 – Agriculture Axis

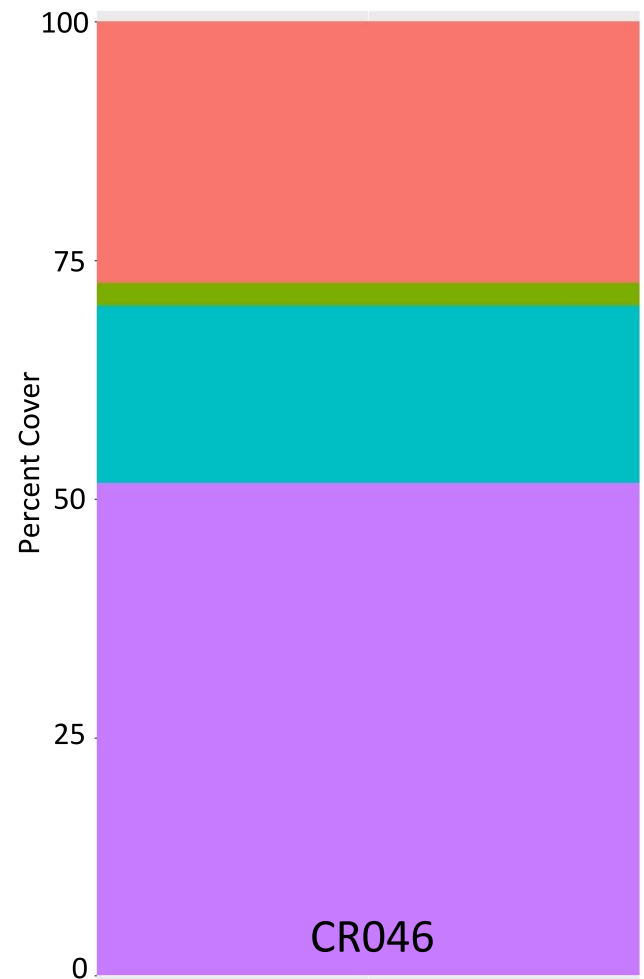


PC1 – Agriculture Axis



CR011

-  Agriculture / Silviculture
-  Developed
-  Forest / Grassland
-  Undeveloped / Wetland



CR046

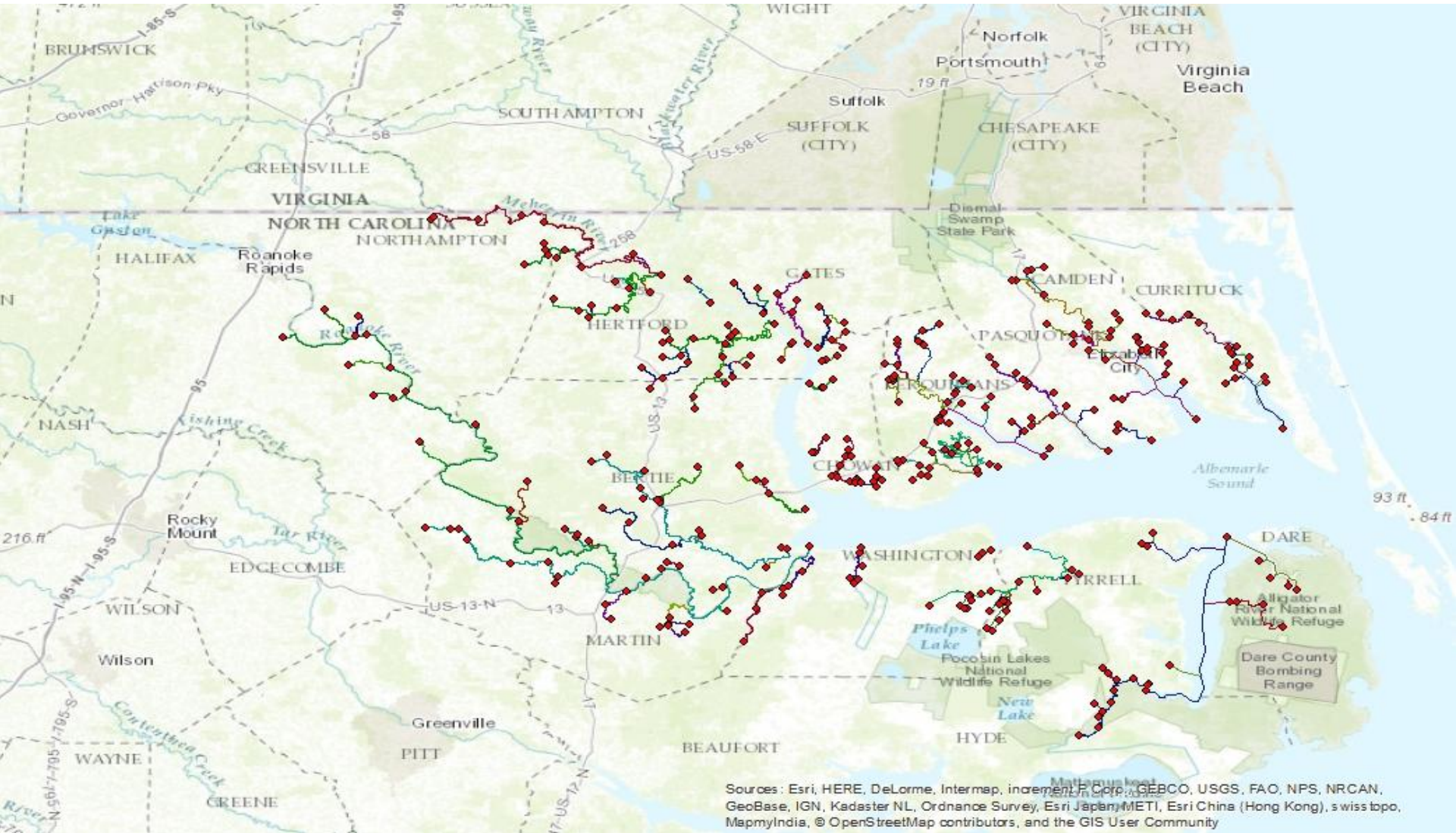
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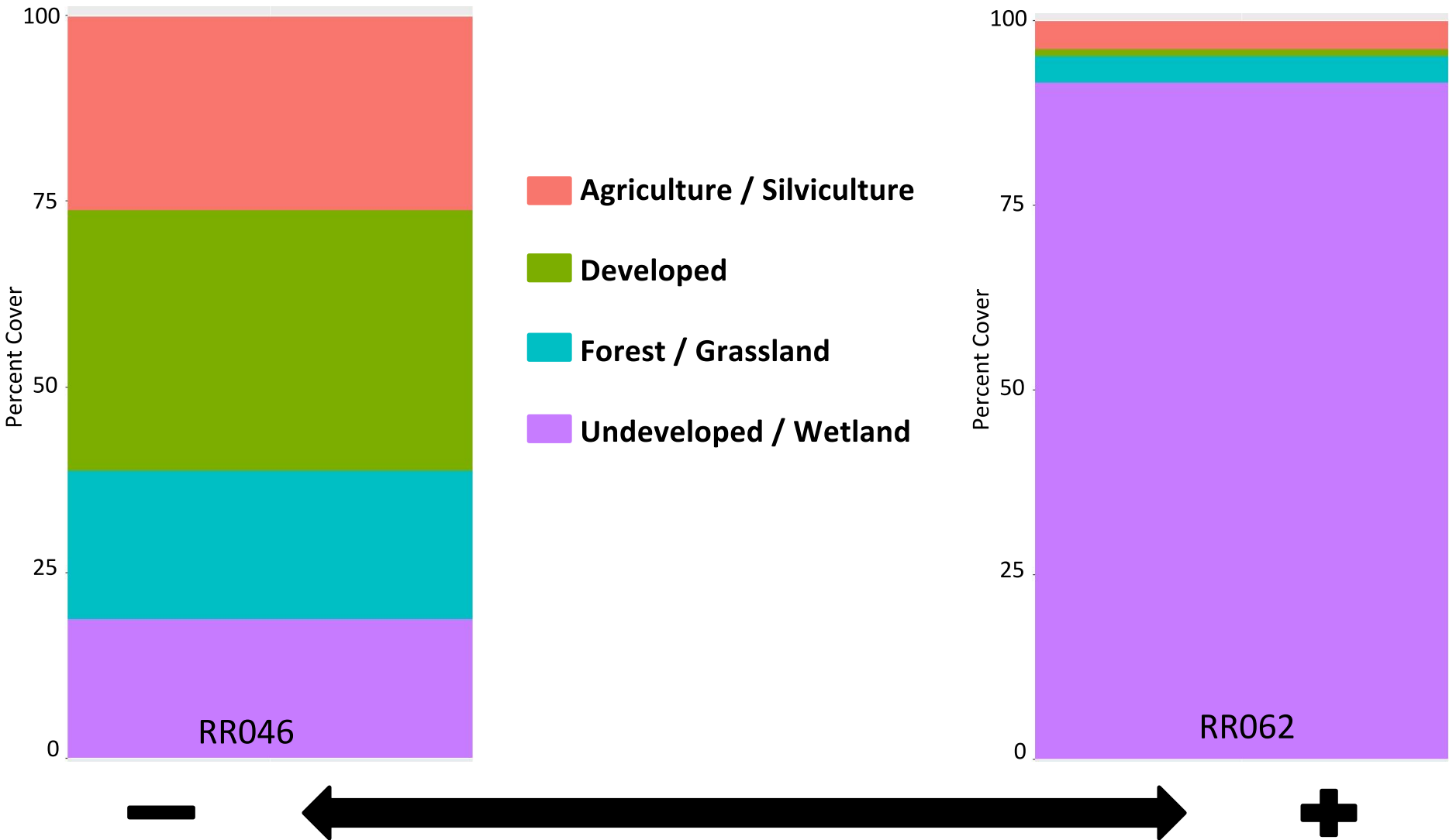
+

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PC2 – Development Axis

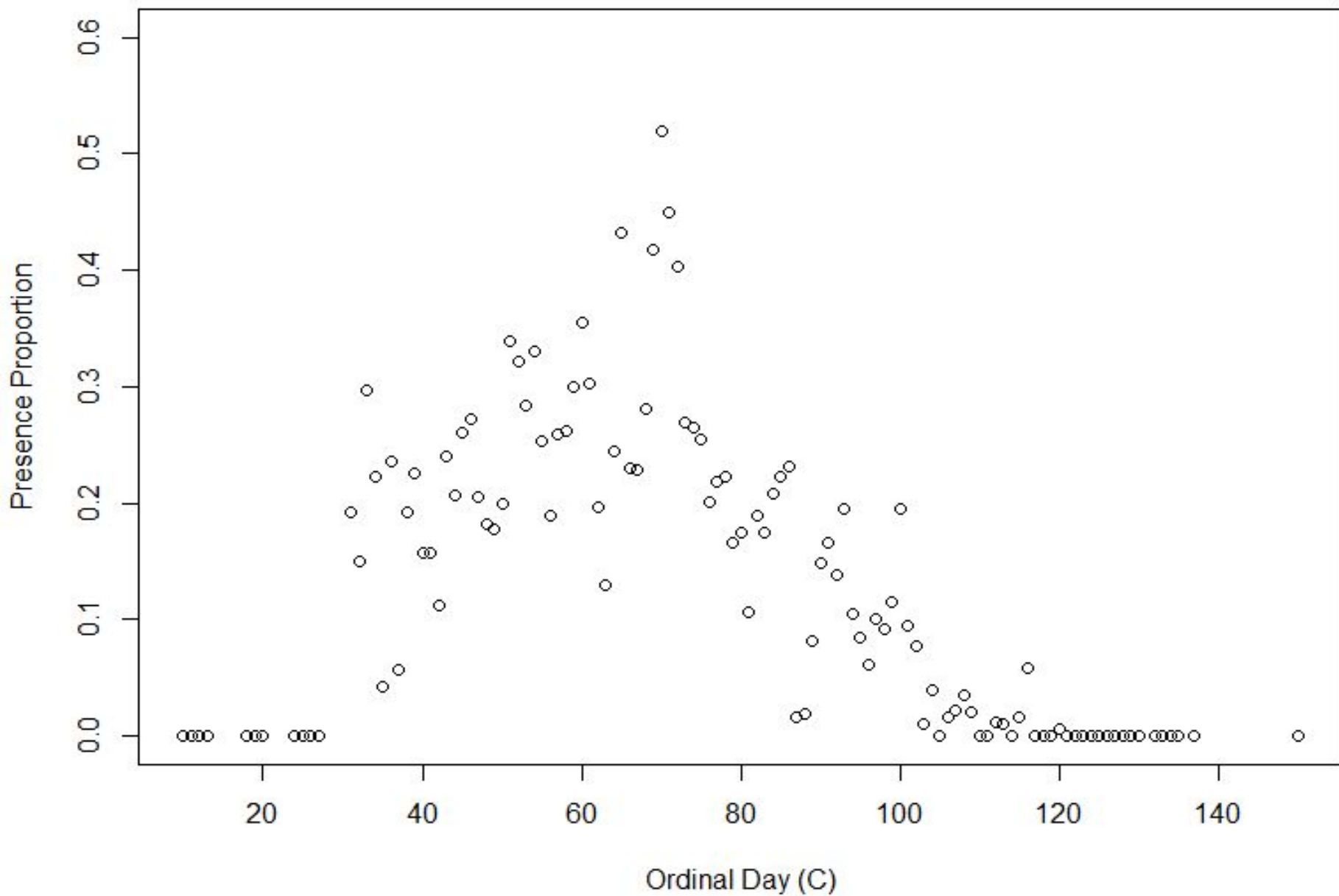


PC2 – Development Axis

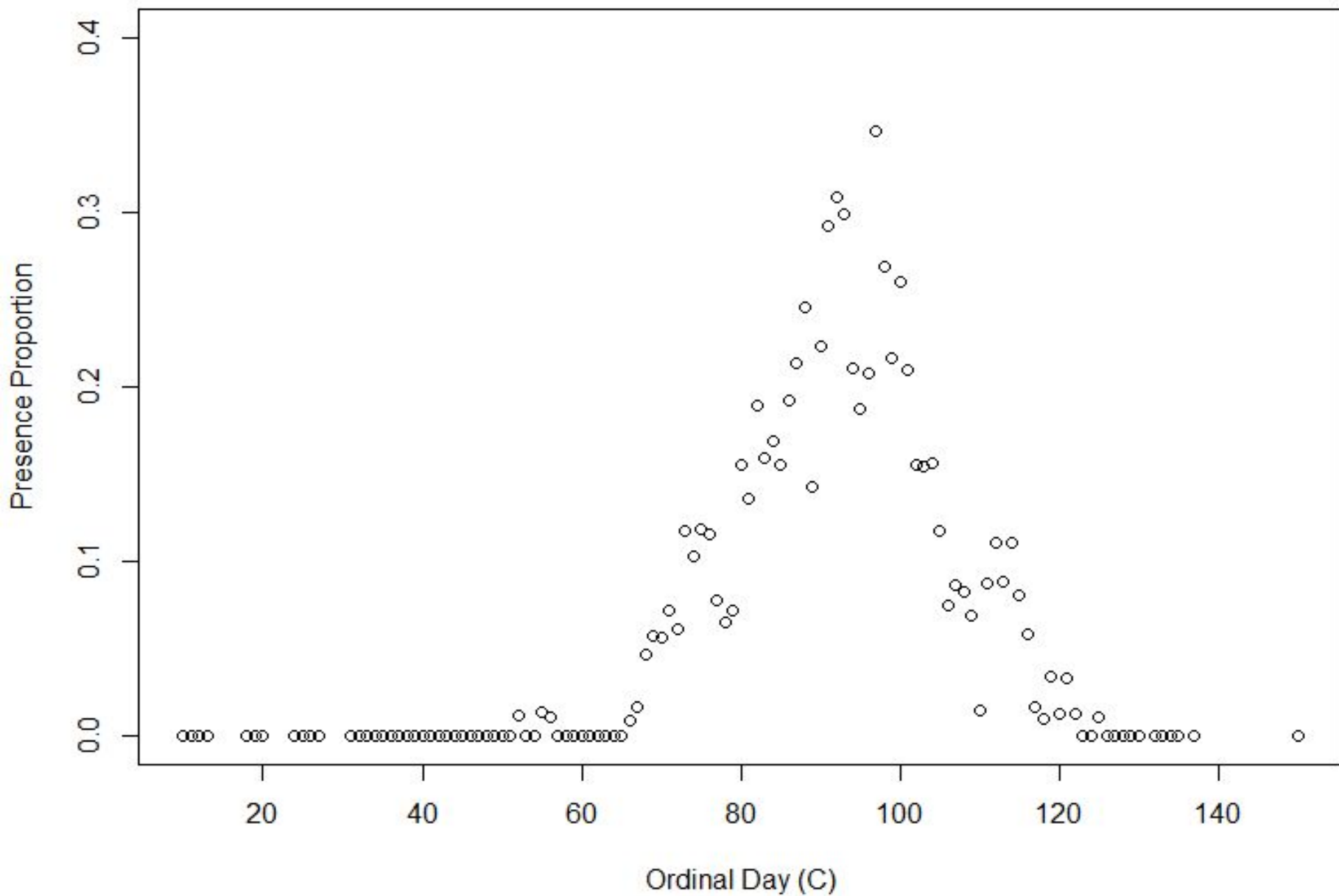


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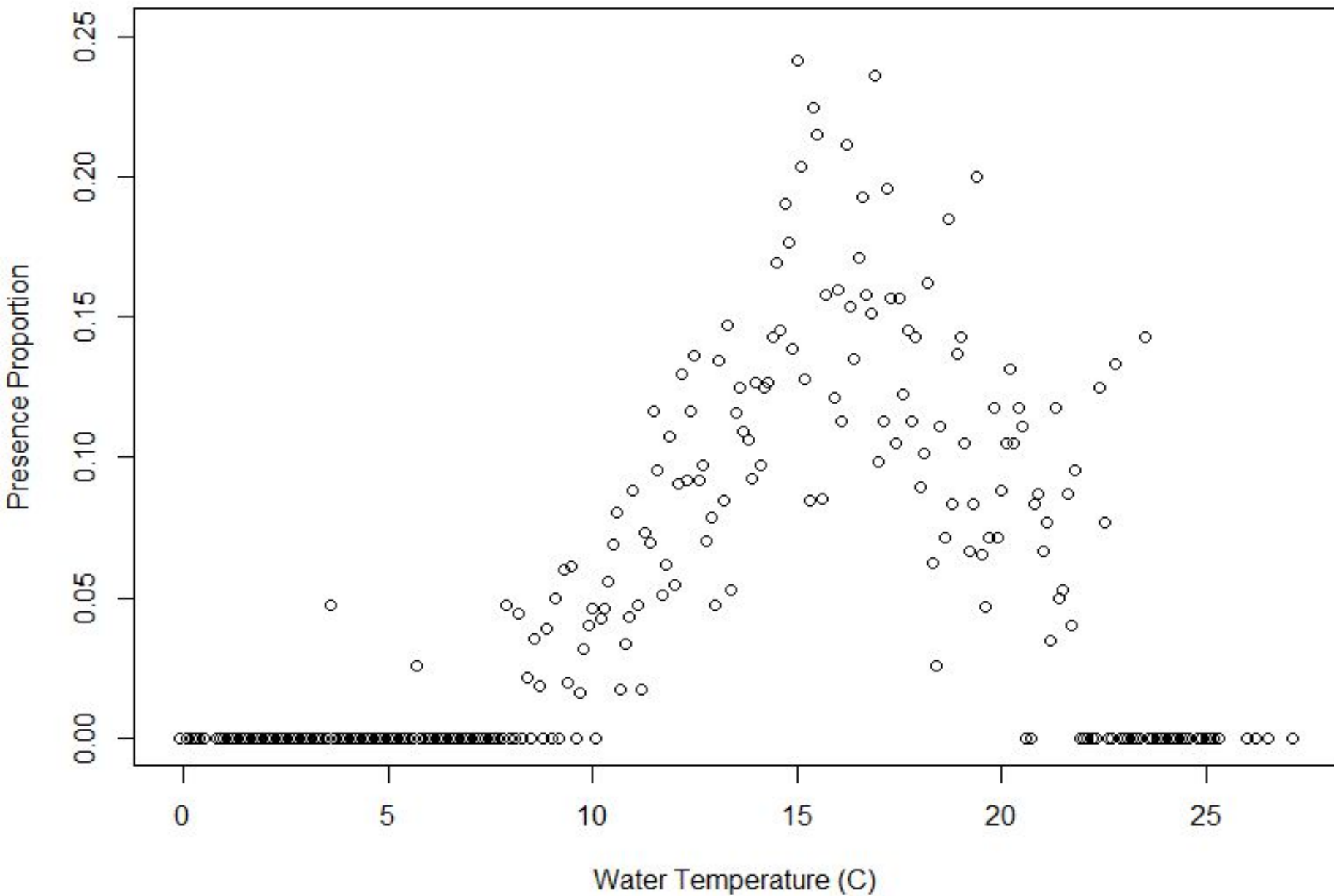
Alewife Presence Proportion by Ordinal Day



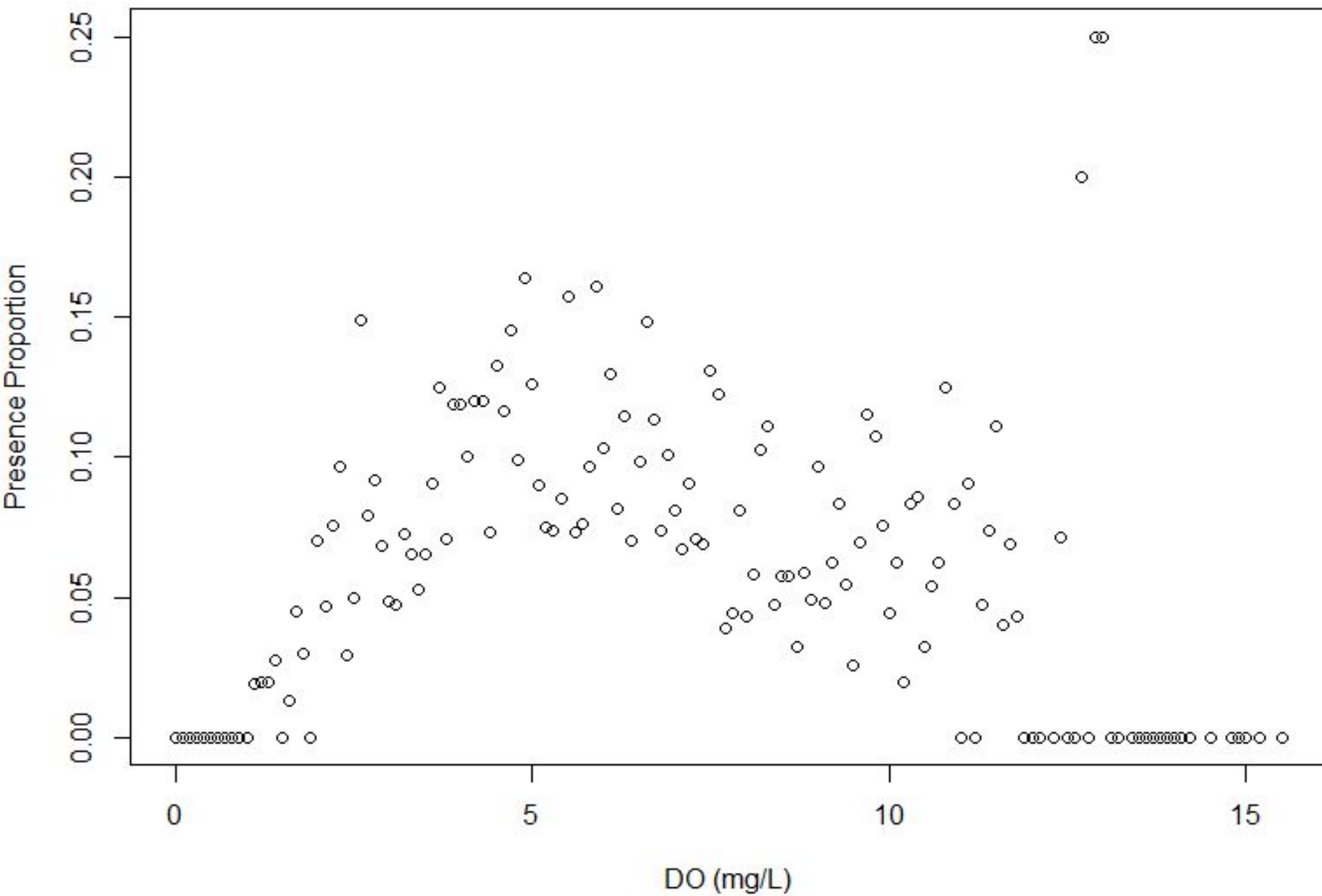
Blueback Herring Presence Proportion by Ordinal Day



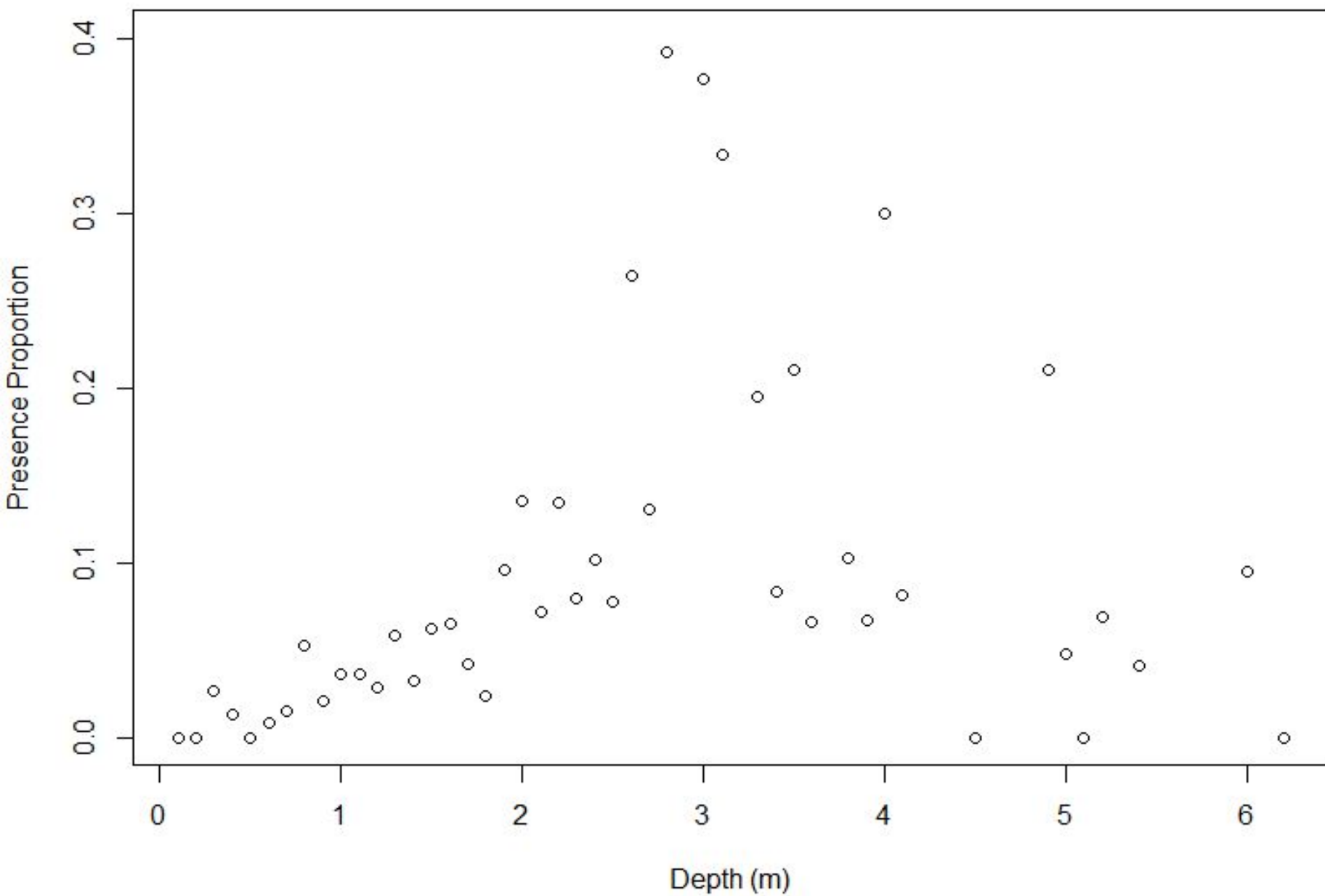
Blueback Herring Presence Proportion by Water Temperature



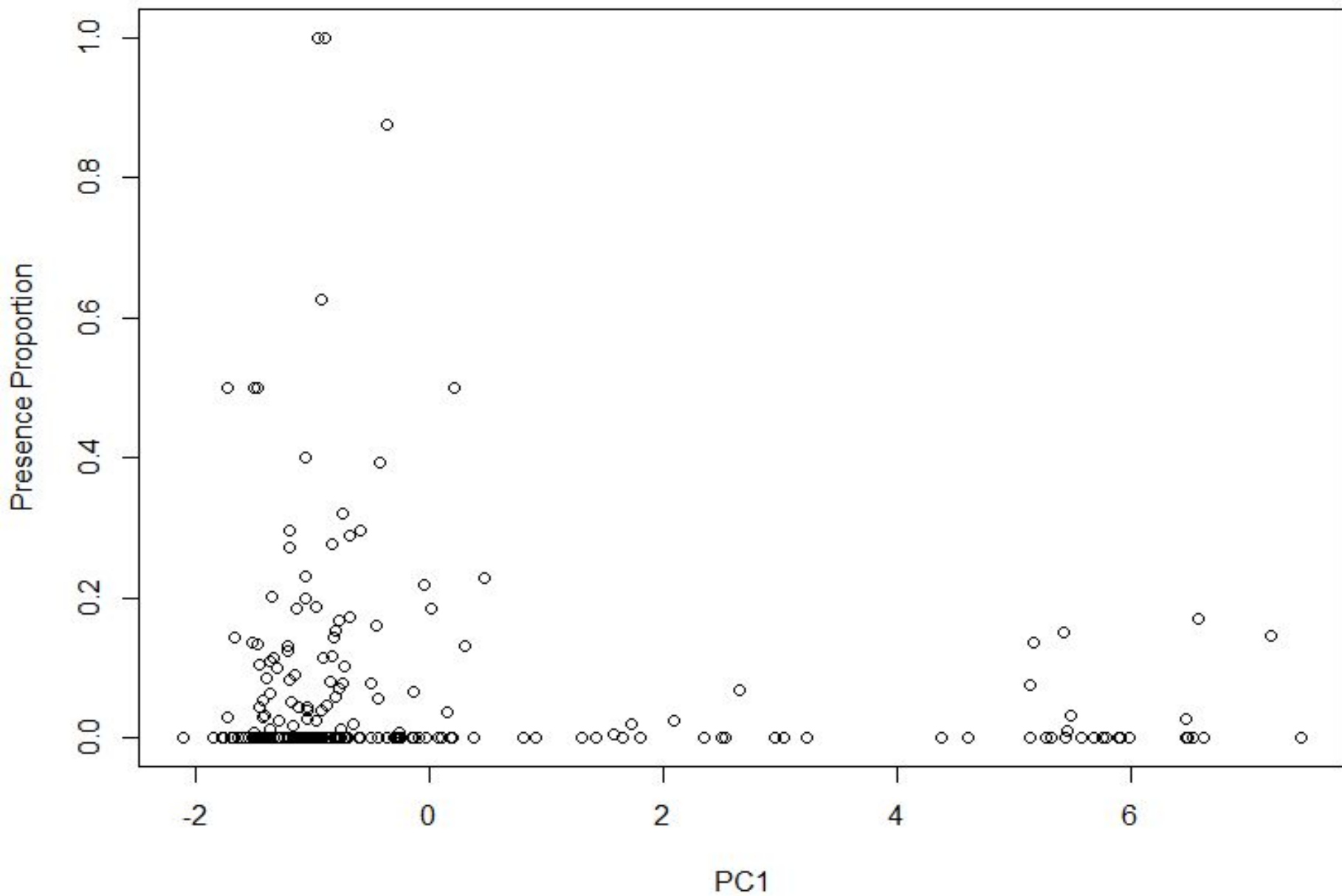
Blueback Herring Presence Proportion by Dissolved Oxygen



Blueback Herring Presence Proportion by Depth



Blueback Herring Presence Proportion by PC1



Blueback Herring Presence Proportion by PC2

