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

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River Herring Life Cycle

- Spawn
- River
- Estuary
- Ocean
River Herring CPUE
Chowan River, NC

[Graph showing River Herring CPUE from 1972 to 2006, with peaks and troughs.]

NC Division of Marine Fisheries 2015.
Fisheries Management Plan

NC STATE
Collapse & Remediation

- Commercial Pressure
  - Moratorium

- Offshore Bycatch
  - Bycatch Cap

- Habitat Loss
  - Clean Water Act & Dam Removal
River Herring CPUE
Chowan River, NC

North Carolina Division of Marine Fisheries.
Unpublished
Questions

• Is water quality affecting the migration and presence of river herring?

• Do river herring respond to urbanization and agriculture/silviculture activities?
Spawning Habitat
Spawning Habitat
• 9 years of data
• 233 stations, 13 rivers
• 2007 - 2016
• 9,650 sampling events
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)
Principal Components Analysis (PCA)

PC2 (13.3% explained var.)

PC1 (26.9% explained var.)

LESS/NO AGRICULTURE/SILVICULTURE  AGRICULTURE/SILVICULTURE

LESS/NO URBANIZATION  URBANIZATION

NC STATE
Generalized Additive Model (GAM)

<table>
<thead>
<tr>
<th>Variables</th>
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<tbody>
<tr>
<td>Year</td>
</tr>
<tr>
<td>s(Ordinal Day)</td>
</tr>
<tr>
<td>s(Depth)</td>
</tr>
<tr>
<td>s(Distance Proportion)</td>
</tr>
<tr>
<td>s(pH)</td>
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<tr>
<td>System</td>
</tr>
<tr>
<td>s(PC1)</td>
</tr>
<tr>
<td>s(PC2)</td>
</tr>
<tr>
<td>s(PC1 * System)</td>
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<tr>
<td>s(PC2 * System)</td>
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Blueback Herring Model

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

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<thead>
<tr>
<th>Model Fit</th>
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<tr>
<td>Percent Deviance Explained</td>
<td>44.3%</td>
</tr>
<tr>
<td>ROC-AUC</td>
<td>0.937</td>
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Effect of Site Specific Parameters

Effect of Site Specific Parameters on Presence

Effect on Presence vs Ordinal Day

Effect on Presence vs Depth (m)

p=0.00

NC STATE
Effect of Water Quality

Effect on Presence of Species vs.
- Water Temperature (°C)
  - p=0.00
- pH
  - p=0.00
- Dissolved Oxygen (mg/L)
  - p=0.00
Effect of Land Cover by Watershed
Agriculture/Silviculture

Chowan River

Effect on Presence

Roanoke River

p=0.02

Meherrin River

Effect on Presence

p=0.43
Effect of Land Cover by Watershed Development/Urbanization

Pasquotank River

Effect on Presence

p=0.01

Roanoke River

Effect on Presence

p=0.54

Edenton Bay

Effect on Presence

p=0.09
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

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