Estimating Biomass and Ecosystem Modelling in Relation to Habitat Availability for North Atlantic Diadromous Forage Fish Species

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Outline

- Fish Species
- Dams
- Historic and Current Sources
- Methodology
- Results and Discussion
- Modelling Applications
- Acknowledgements
American Shad and River Herring

Figure 2.—Distributions of alewife and blueback herring.

Alosa sappidissima

Alosa pseudoharengus

Alosa aestivalis
Waterway alteration and Dams
Historic and Current Sources

- Commissioner of Fisheries Reports (CoF)
- Atlantic States Marine Fisheries Commission (ASMFC) Stock Assessments

http://www.bayjournal.com/article/american_shads_decline_a_mystery
http://beaufortartist.blogspot.com
Methodology - Mapping

- National Hydrographic Dataset (NHD)
- Flow Accumulation (FAC) grid 30x30m
- Coefficients and Exponents from Brockmen (2010)

\[ W_{\text{bankfull}} = A \times D^B \]

<table>
<thead>
<tr>
<th>Region</th>
<th>A</th>
<th>B</th>
</tr>
</thead>
<tbody>
<tr>
<td>Region 01</td>
<td>20</td>
<td>0.4</td>
</tr>
<tr>
<td>Region 02</td>
<td>14</td>
<td>0.45</td>
</tr>
<tr>
<td>Region 03</td>
<td>14</td>
<td>0.4</td>
</tr>
</tbody>
</table>
Methodology – Biomass Scenarios

- Pristine
- Mid-Industrial Revolution
- Current

\[ f_\alpha = \frac{\left(\frac{100C}{85}\right)}{\bar{w}} \]
## Results – Mapping

<table>
<thead>
<tr>
<th>Region/HUC</th>
<th>Pre-Dam km²</th>
<th>Post-Dam km²</th>
<th>% Habitat Lost</th>
</tr>
</thead>
<tbody>
<tr>
<td>North Atlantic -01</td>
<td>996.3</td>
<td>110.7</td>
<td>88.9</td>
</tr>
<tr>
<td>Mid-Atlantic – 02</td>
<td>1638.7</td>
<td>251.3</td>
<td>84.7</td>
</tr>
<tr>
<td>South Atlantic – 03</td>
<td>1583</td>
<td>774.2</td>
<td>51.1</td>
</tr>
<tr>
<td>Total</td>
<td>4,218</td>
<td>1,136</td>
<td>73.1</td>
</tr>
</tbody>
</table>
## Results – Biomass Scenarios

<table>
<thead>
<tr>
<th>Region</th>
<th>Pristine</th>
<th>Mid-Industrial Revolution</th>
<th>Current</th>
</tr>
</thead>
<tbody>
<tr>
<td>North Atlantic</td>
<td>11,815,660</td>
<td>1,312,851</td>
<td>133,314</td>
</tr>
<tr>
<td>Mid-Atlantic</td>
<td>321,420,124</td>
<td>49,290,826</td>
<td>614,700</td>
</tr>
<tr>
<td>South Atlantic</td>
<td>22,542,411</td>
<td>11,024,848</td>
<td>738,285</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>355,778,194</strong></td>
<td><strong>61,628,525</strong></td>
<td><strong>1,486,299</strong></td>
</tr>
</tbody>
</table>
# Results – Biomass Scenarios

<table>
<thead>
<tr>
<th>Region</th>
<th>Pristine</th>
<th>Mid-Industrial Revolution</th>
<th>Current</th>
</tr>
</thead>
<tbody>
<tr>
<td>North Atlantic</td>
<td>63,340,311</td>
<td>7,037,812</td>
<td>310,216</td>
</tr>
<tr>
<td>Mid-Atlantic</td>
<td>405,291,002</td>
<td>62,152,700</td>
<td>2,868,027</td>
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<tr>
<td>South Atlantic</td>
<td>8,537,436</td>
<td>4,175,415</td>
<td>1,883,783</td>
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<tr>
<td>Total</td>
<td>477,168,748</td>
<td>73,365,927</td>
<td>5,062,026</td>
</tr>
</tbody>
</table>
Discussion

- Realistic estimates of available habitat
- Immense losses in the spawning stock biomass, seen in conservative estimates
- Comparison with similar studies

Our Study
55-2,441 river herring/acre

Hall 2012
446 alewife/acre

Flagg 2007
117-235 alewife/acre
Modelling Applications

- Northwest Atlantic Large Marine Ecosystem model (EMAX)
- Economic Implications of population increases
References


Brockman, R.R. 2010. Hydraulic geometry relationships and regional curves for the inner and outer Bluegrass regions of Kentucky. MS Thesis, University of Kentucky. 281 pgs.: 
http://uknowledge.uky.edu/cgi/viewcontent.cgi?article=1055&context=gradschool_theses.


Acknowledgements

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- Coastal Studies Institute
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- River Herring TEWG