Jun 22nd, 10:45 AM - 11:00 AM

Case Studies VI: Dynamics of the 2015 Spawning Migration of American Shad (Alosa sapidissima) in the Connecticut River

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*National Marine Fisheries Service*

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Dynamics of the 2015 spawning migration of American shad (Alosa sapidissima) in the Connecticut River

Jason M. Boucher, PhD
Richard S. McBride, PhD

Fish Passage Conference 2016
June 22, 2016

2. Integrated Statistics
American shad (*Alosa sapidissima*)

- Range from Canada to the St. Johns River, Florida
- Home to natal river to spawn
- Latitudinal variability in parity:
  - St. Johns River, FL: 0%
  - York River: 23%
  - Connecticut River: 38%
  - St. John River, NB: 73%
Project Scope & Methods

- **Major goals**
  - Estimate & compare annual fecundity
  - Estimate spawning rates and batch fecundity
  - Estimate ages and parity (virgin/repeat)
  - Estimate condition

- **Aging and fecundity workup**
  - Aging
    - Scales by CT-DEEP (Jacque Benway)
    - Otoliths by MA-DMF (Scott Elzey)
  - Reproductive biology
    - Ovary histology (Mass Histology, E. Towle)
    - Oocyte size distribution (E. Towle)
    - Fecundity (E. Towle)
  - Condition by USGS (Steve McCormick)
Sampling Protocol & Locations

- Weekly from 4/30 – 6/30
- Two locations per week
- Sample from 0800 – 1300
- 30 females and 15 males
Fish Collected

- Total of 640 individuals:
  - 239 males
  - 401 females

<table>
<thead>
<tr>
<th>Location</th>
<th>Females</th>
<th>Males</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vernon Dam</td>
<td>45</td>
<td>41</td>
</tr>
<tr>
<td>Cabot Power Station</td>
<td>78</td>
<td>45</td>
</tr>
<tr>
<td>Hadley Power Station</td>
<td>177</td>
<td>96</td>
</tr>
<tr>
<td>Lower River</td>
<td>28</td>
<td>5</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Sex</th>
<th>Fork Length</th>
<th>Body Weight</th>
<th>Somatic Weight</th>
<th>Gonad Weight</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Means</td>
<td>Group</td>
<td>Means</td>
<td>Group</td>
</tr>
<tr>
<td>Female</td>
<td>450.56</td>
<td>a</td>
<td>1264.93</td>
<td>a</td>
</tr>
<tr>
<td>Male</td>
<td>403.03</td>
<td>b</td>
<td>828.75</td>
<td>b</td>
</tr>
</tbody>
</table>
Size Distribution

- Vernon Dam
- Cabot Power Station
- Hadley Power Station
- Lower River

**Females**
- Fork length of male American shad in 2015
- p < 0.05

**Males**
- Fork length of female American shad in 2015
- p > 0.05

- Body weight of male American shad in 2015
- p < 0.05

- Gonado weight of female American shad in 2015
- p < 0.05

- Gonado weight of male American shad in 2015
- p < 0.05
**Otolith-Derived Ages**

*No significant difference in age between locations or time*

- **Vernon Dam**
- **Cabot Power Station**
- **Hadley Power Station**
- **Lower River**

### Mean age-at-maturity (Leggett & Carscadden 1978):

**Females:** 4.8  
**Males:** 4.1

**Mean**

**Females:** Mean = 5.14  
**Males:** Mean = 4.58

**Age truncation**

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**NOAA Fisheries**

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Repeat Spawners

<table>
<thead>
<tr>
<th>Location</th>
<th>Females</th>
<th>Males</th>
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</thead>
<tbody>
<tr>
<td>Vernon Dam</td>
<td>6/3</td>
<td>1</td>
</tr>
<tr>
<td>Cabot Power Station</td>
<td>5/13</td>
<td>1</td>
</tr>
<tr>
<td>Hadley Power Station</td>
<td>5/19</td>
<td>2*</td>
</tr>
<tr>
<td></td>
<td>5/26</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>6/18</td>
<td>1 (ds)</td>
</tr>
<tr>
<td>Lower River</td>
<td>4/30</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>5/5</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>5/6</td>
<td>1*</td>
</tr>
</tbody>
</table>

Ratio of repeat spawners:
- Total: 13:640 2%
- Females: 10:401 2.5%
- Males: 3:239 1.2%

Historical data:
- 38%
- 32%
- 46%
Connecticut River PAFs

<table>
<thead>
<tr>
<th>Study</th>
<th>Method</th>
<th>Annual Fecundity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Leggett (1969)</td>
<td>Determinate</td>
<td>256,000</td>
</tr>
<tr>
<td>McBride et al (in prep)</td>
<td>Determinate</td>
<td>303,000 ± 73,400</td>
</tr>
<tr>
<td>Current study</td>
<td>Indeterminate</td>
<td>325,100 ± 11,300</td>
</tr>
</tbody>
</table>

Student's t-test, $P > 0.05$
Annual Fecundity Estimates

<table>
<thead>
<tr>
<th>Location</th>
<th>Potential Annual Fecundity (n)</th>
<th>Thousands</th>
</tr>
</thead>
<tbody>
<tr>
<td>St. Johns River (FL)</td>
<td></td>
<td>400</td>
</tr>
<tr>
<td>York River</td>
<td></td>
<td>300</td>
</tr>
<tr>
<td>Connecticut River</td>
<td></td>
<td>200</td>
</tr>
<tr>
<td>St. John River (NB)</td>
<td></td>
<td>100</td>
</tr>
<tr>
<td>Miramichi River</td>
<td></td>
<td>50</td>
</tr>
</tbody>
</table>

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“... intraspecies variation in reproductive characteristics represents a fine tuning of life history to long term features of the environment by natural selection.”
– Leggett & Carscadden (1978)
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  - Ted Castro-Santos
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  - Robert Johnston

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  - Joe Lucas

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