Jun 9th, 4:10 PM - 4:30 PM

Evaluation of Fish Passage Following Installation of a Rock Arch Rapids at Lock and Dam #1, Cape Fear River, North Carolina

J. Raabe
University of Wisconsin - Madison

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Evaluation of Fish Passage Following Installation of a Rock Arch Rapids at Lock and Dam #1, Cape Fear River, North Carolina

Joshua K. Raabe, Timothy A. Ellis & Joseph E. Hightower
ACKNOWLEDGMENTS

• Army Corps of Engineers:
  • Frank Yelverton & Tom Charles

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  • Wilson Laney

• NC Division of Marine Fisheries:
  • Chip Collier

• Field assistance:
  • Kyle Hussey, Taylor Jackson, Paul Begue
  • NC Division of Marine Fisheries
  • NC Wildlife Resources Commission
CAPE FEAR RIVER

- Coastal river
- Wilmington, NC
- Lock & dams (LD):
  - Limited navigation
  - Water supply
  - Impede fish

Atlantic Ocean

South Carolina

LD-3, rkm 186
LD-2, rkm 149
LD-1, rkm 97
FISH PASSAGE

• Past efforts:
  • Steeppass fishway: limited to no use
  • Locking: modified procedures in spring

• Recent efforts:
  • Mitigation for deepening Wilmington Harbor
    • Endangered shortnose sturgeon
  • Considerations: removal, bypass, fishways
ROCK ARCH RAPIDS
• Series of arches
• Pools in center
• $\Delta$ elevation: 4.3 m
• Width: 85 – 110 m
• Length: 75 – 90 m
• Slope: 3.3 – 5.0%
• June ’11 - Nov. ’12
• $13$ million
ROCK ARCH RAPIDS

• Designed by Dr. Luther Aadland
  • Plenary speaker, tomorrow, 9:15 am

• Successful applications in Midwest

• Cape Fear River:
  • Largest application to date
  • First application on Atlantic coast
  • First quantitative evaluation
OBJECTIVES

• Evaluate passage at LD-1 rock arch rapids
• Evaluate passage at LD-2 & 3 via lockage
  • Percentage passed
  • Environmental factors
  • Rate (rapid, delayed)
SPECIES

• American shad
  - *Alosa sapidissima*

• Striped bass
  - *Morone saxatilis*

• Flathead catfish
  - *Pylodictis olivaris*
ACOUSTIC TELEMETRY

• Primarily captured w/ electrofishing

• Striped bass & flathead catfish:
  • Internal transmitters, >500 days

• American shad:
  • Gastric insertion, >100 days

• Receivers:
  • Continuous monitoring
  • 2013 - present
RECEIVER LOCATIONS

• Lock & Dams:
  • Downstream
  • Chamber
  • Upstream
  • Additional at LD-1

• Additional receivers throughout system
PASSAGE METRICS

• Percent passage: passed / available
  • Tagged fish detected at LD (after surgery, fallback)

• Rates: time from arrival to passage
LD-1 PASSAGE

2013:
- American shad: 16 / 32 = 50%
- Striped bass: 9 / 43 = 21%
- Flathead catfish: 17 / 20 = 80%

Preliminary 2014:
- 16 / 24 = 67%
- 18 / 79 = 23%
- 6 / 14 = 43%
  ▪ As of May 28
STRIPPED BASS: LD-1 PASSAGE

Number detected

Date (2013)

Passed
Available

0 2 4 6 8 10 12 14 16 18 20
LD-1 PASSAGE: GAGE

- American shad
- Striped bass
- Flathead catfish

Number Passed

Date (2013):
- 3/31
- 4/7
- 4/14
- 4/21
- 4/28
- 5/5
- 5/12
- 5/19

Discharge (cms):
- 0
- 25
- 50
- 75
- 100
- 125
- 150
- 175
- 200
- 225
- 250
- 275
- 300

Legend:
- Blue: American shad
- Yellow: Striped bass
- Red: Flathead catfish
- Black: Discharge
LD-1 PASSAGE: TEMPERATURE

<table>
<thead>
<tr>
<th>Date</th>
<th>Temperature (°C)</th>
<th>Number Passed</th>
</tr>
</thead>
<tbody>
<tr>
<td>3/30</td>
<td></td>
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</tr>
<tr>
<td>4/6</td>
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<td>4/13</td>
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<td>4/20</td>
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<td>4/27</td>
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<td>5/4</td>
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<tr>
<td>5/11</td>
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<tr>
<td>5/18</td>
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<tr>
<td>LD-1</td>
<td>LD-2</td>
<td>LD-3</td>
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<td>------</td>
</tr>
<tr>
<td>50</td>
<td>36</td>
<td>100</td>
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<tr>
<td>67</td>
<td>TBD</td>
<td>TBD</td>
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<tr>
<td>18 - 61</td>
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<td>25</td>
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<td>65</td>
<td>85</td>
<td>64</td>
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<tr>
<td>LD-1</td>
<td>LD-2</td>
<td>LD-3</td>
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<td>21</td>
<td>78</td>
<td>100</td>
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<tr>
<td>23</td>
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<td>61</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>77 - 86</td>
<td>75 - 100</td>
<td>44 - 50</td>
</tr>
</tbody>
</table>
COMMON PATTERNS

LD-1
LD-2
LD-3
## 2013 LD RATES (DAYS)

<table>
<thead>
<tr>
<th></th>
<th>LD-1</th>
<th>LD-2</th>
<th>LD-3</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>AS</strong></td>
<td>18.4(2.2 – 36.8)</td>
<td>3.0(0.8 – 4.9)</td>
<td>4.9(0.3 – 12.3)</td>
</tr>
<tr>
<td><strong>STB</strong></td>
<td>4.1(0.2 – 15.9)</td>
<td>5.2(0.1 – 29.5)</td>
<td>5.5(0.2 – 29.7)</td>
</tr>
<tr>
<td><strong>FLC</strong></td>
<td>9.1(3.4 – 29.4)</td>
<td>5.8(0.1 – 18.1)</td>
<td>-</td>
</tr>
</tbody>
</table>
FLATHEAD CATFISH PREDATION
DISCUSSION: ROCK ARCH RAPIDS

- American shad: passage comparable or higher than locking
  - Slightly lower than “nature-like” fishway on tributary (Raabe & Hightower)
  - Higher than pool & weir, lower than vertical slot (Sullivan 2004)
  - Rate of passage a concern (energy, predation, harvest)

- Striped bass: passage lower than locking
  - Limited evaluations at other fishways
  - Depth, velocity, turbulence, spacing?

- Flathead catfish: high passage, no previous comparisons
  - Multiple upstream & downstream movements
  - Predation concerns
FUTURE DIRECTIONS

• Complete 2014 data collection & analyses
• Army Corps of Engineers considering:
  • Modifications to structure, flow measurements & modeling, additional monitoring (tagged fish & egg sampling)