Recruitment trends of Atlantic and shortnose sturgeon in the Altamaha River, Georgia: Are we on the road to recovery?

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Objectives

1. Quantify annual recruitment of ATL and SNS
2. Identify key factors affecting annual recruitment of ATL and SNS
3. Using information from 1 and 2,
   - simulate historic SNS abundance
   - assess population trend in ATL
Sampling

- Anchored monofilament gill and trammel nets soaked primarily on slack tides

- 91.4 m length x 3.3 m depth
  - Gill nets: 7.6, 10.2, and 15.2-cm (stretched mesh)
  - Trammel: 7.6 x 30.4 cm

- Each ATL and SNS weighed, measured, and PIT tagged
Recruitment Estimation

- Huggins closed-capture model to estimate Age-1 abundance of SNS and ATL

- Linear regression and AICc to evaluate different explanatory variables
Population Simulation - SNS

- Shortnose sturgeon
  - Estimate historic recruitment ➔ historic flow levels
  - Age-structured population model to estimate historic abundance
  - Current abundance estimates compared to historic abundance as to evaluate “recovery status”
RESULTS - ATL
## Catch (Age-1 ATL)

<table>
<thead>
<tr>
<th>Year</th>
<th>Marked</th>
<th>Recaptured</th>
<th>Effort (nets)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2004</td>
<td>79</td>
<td>4</td>
<td>93</td>
</tr>
<tr>
<td>2005</td>
<td>227</td>
<td>24</td>
<td>98</td>
</tr>
<tr>
<td>2006</td>
<td>53</td>
<td>2</td>
<td>90</td>
</tr>
<tr>
<td>2007</td>
<td>220</td>
<td>14</td>
<td>118</td>
</tr>
<tr>
<td>2008</td>
<td>131</td>
<td>10</td>
<td>161</td>
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<tr>
<td>2009</td>
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<td>344</td>
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<tr>
<td>Total</td>
<td>2046</td>
<td>131</td>
<td>1122</td>
</tr>
</tbody>
</table>

Introduction | Methods | Results | Conclusions
Recruitment (ATL)

Introduction

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# Recruitment Model

<table>
<thead>
<tr>
<th>Model</th>
<th>Parameters</th>
<th>AICc</th>
<th>ΔAICc</th>
<th>Relative likelihood</th>
<th>Weight</th>
<th>r²</th>
</tr>
</thead>
<tbody>
<tr>
<td>Years post moratorium</td>
<td>3</td>
<td>25.091</td>
<td>0.000</td>
<td>1.000</td>
<td>0.657</td>
<td>0.659</td>
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<tr>
<td>Average summer flow</td>
<td>3</td>
<td>29.260</td>
<td>4.169</td>
<td>0.124</td>
<td>0.082</td>
<td>0.380</td>
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</tbody>
</table>

Models with <0.066 weight of evidence:

- Average summer temperature
- Low flow duration: summer
- High flow duration: fall
- High flow duration: summer
- High flow duration: spring
- High flow duration: spring through early summer
Effects of Moratorium

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Age 1 Abundance

Years post moratorium

R² = 0.658
Density Dependence (ATL)

\[ y = -0.0335x + 374.22 \]
\[ R^2 = 0.8307 \]
RESULTS - SNS
Adult Abundance (SNS)

Introduction  Methods  Results  Conclusions
## Age-1 SNS Catch

<table>
<thead>
<tr>
<th>Year</th>
<th>Marked</th>
<th>Recaptured</th>
<th>Effort (nets)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2004</td>
<td>252</td>
<td>8</td>
<td>104</td>
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<tr>
<td>2005</td>
<td>8</td>
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<td>2006</td>
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<td>2008</td>
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<td>2009</td>
<td>5</td>
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<td>218</td>
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<tr>
<td>2010</td>
<td>86</td>
<td>8</td>
<td>344</td>
</tr>
<tr>
<td>Total</td>
<td>436</td>
<td>19</td>
<td>1173</td>
</tr>
</tbody>
</table>
### Recruitment Model

<table>
<thead>
<tr>
<th>Model</th>
<th>Parameters</th>
<th>AICc</th>
<th>ΔAICc</th>
<th>Relative likelihood</th>
<th>Weight</th>
<th>r²</th>
</tr>
</thead>
<tbody>
<tr>
<td>High flow duration: spring and early summer</td>
<td>3</td>
<td>14.200</td>
<td>0.000</td>
<td>1.000</td>
<td>0.980</td>
<td>0.980</td>
</tr>
</tbody>
</table>

Models with <0.010 weight of evidence:

- High flow duration: spring
- Summer temperature: hours >30.1°C
- High flow duration: summer
- High flow duration: spring and fall
- High flow duration: spring through summer and fall
- Fall low flow duration

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Recruitment vs Flow

**Introduction**

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The graph shows the relationship between high flow duration (days) in the spring-early summer and age-1 abundance. The equation $R^2 = 0.980$ indicates a strong correlation. The data points are plotted on a graph with the x-axis representing the high flow duration and the y-axis representing age-1 abundance.
Density Dependence (SNS)

The graph shows the relationship between Age-1 SNS Abundance and Average SNS Age-1 FL (mm). The equation for the line of best fit is:

\[ y = -0.0124x + 360.37 \]

with

\[ R^2 = 0.8041 \]
Simulation II - Historic Abundance (SNS)

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Status - 2010

Adult SNS Abundance

Introduction  Methods  Results  Conclusions
Management Implications - ATS

– ATL recruitment suggest moratorium may be working
  • Recent increase in recruitment coincides with maturation of first protected cohorts (1996)
  • Next few years will be critical to positive population trend

– Proposed Listing Rule specifically cites Altamaha population as: “neither increasing nor decreasing”
Simulation modeling suggest that the Altamaha SNS population is currently within the range of historic abundance, but current threats include:

• bycatch
• increasing human demands for water

– Density dependent growth patterns in juvenile SNS and ATL suggest that suitable nursery habitat is a key limiting factor (critical habitat) for both ATL and SNS in southern rivers
Management Implications - ATL

SNS recruitment linked to spring river flows
- 100x variation in recruitment 2004-2010
- Flow regime changes may have population level effects
- Future years of recruitment data will confirm/refine models

Simulation modeling suggests that the Altamaha SNS population is currently within the range of historic abundances, but ongoing threats include:
- bycatch
- Potential chances in flow regime
Acknowledgements

• National Marine Fisheries Service
• Georgia Department of Natural Resources
• GCE-LTER
• David Higginbotham
• Dr. Jim Peterson
• Hunter Roop, Ryan Harrell, Brian Leo, Robert Bahn, Andrew Taylor, Matthew Streich, Brock Dibble, Jonathon Brown, Tim Clay, Paul Schueller, Rob DeVries