Determining Sex Ratios and Sexual Maturities of Atlantic sturgeon (Acipenser oxyrinchus oxyrinchus) in the Saco River, ME

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Introduction

The Atlantic sturgeon (Acipenser oxyrinchus oxyrinchus) (fig. 1A) is a long-lived, anadromous fish species ranging from Labrador, CA to Florida, USA (Status Review Team (ASSRT), 2007). In the Saco River, located in the Gulf of Maine, Atlantic sturgeon were common in the 1920’s, but were extirpated by the 1950’s due to overfishing (fig. 1B). However, after a 60 year absence, Atlantic sturgeon reappeared in the Saco River in 2007. Although the reason for the return of this species to this river system remains unknown, research on basic life history information is necessary to facilitate the conservation of this federally protected species.

Understanding reproductive parameters such as sex ratios and sexual maturities are vital to effective management of any species. Unfortunately, this information is typically obtained by lethal, gross dissection, or stress inflicting endoscopy. Thus, in order to better understand these important life history parameters in Atlantic sturgeon, three non-invasive techniques (steroid hormone analysis, ultrasonography, and external morphological features) have been developed (Webb et al., 2002; Petochi et al., 2011; Vecsei et al., 2003).

These three methods are considered valid however, each technique has its limitations when used alone. For example, when using ultrasound imaging immature male and female sturgeon may show similar internal morphological features, making it difficult to decipher sex (Petochi et al., 2011). While in steroid hormone analysis, both mature males and females typically contain elevated concentrations of testosterone and estradiol respectively, which is an indication if an individual is male or female (Webb et al., 2002). However, immature individuals typically have low amounts of testosterone and estradiol, leading to inconsistencies in determining sex. When each of these techniques is used individually, misidentifications can be as high as 20%. Therefore, the aim of this study is to combine these three aforementioned techniques to increase the accuracy of sex determination to 90%.

Objectives

By using the three non-lethal techniques of ultrasound, steroid hormone analysis and external morphological features in combination, three major questions will be addressed:

(1) What is the sex ratio of Atlantic sturgeon in the Saco River?

(2) What is the maturity states of these individuals (i.e. immature or mature)?

(3) If mature, are the fish in spawning condition?

Methods

Capture

Atlantic sturgeon were collected using 6-inch and 12-inch gillnets, two to three times a week using the University of New England’s research vessel from April to November in 2013.

Sample Collection

At the time of capture, physical measurements were recorded and blood was drawn from the caudal vein of each sturgeon using a needle and vacutainer (fig. 2A) and placed on ice. Using an Ibex Pro portable ultrasonic with a convex transducer, the sturgeon were placed with the ventral side up to view gonads (fig. 2B). Finally, the urogenital region of each individual was examined for shape (Fig. 3).

Radioimmunoassay

The frozen plasma was processed via radioimmunoassay (RIA) following techniques modified from Sulikowski et al (2007) and Ciacia et al (2009).

Ultrasonography

After sampling, ultrasound images were analyzed using a scoring method where three categories will be evaluated: shade, far amount (immature sturgeon)/texture (mature sturgeon) and gonadal margins.

Results

Overall Sex Percentages 2012 & 2013

<table>
<thead>
<tr>
<th>Animal</th>
<th>Immature</th>
<th>Mature</th>
<th>Total %</th>
</tr>
</thead>
<tbody>
<tr>
<td>2012</td>
<td>50%</td>
<td>50%</td>
<td>100%</td>
</tr>
<tr>
<td>2013</td>
<td>50%</td>
<td>50%</td>
<td>100%</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Year</th>
<th>Immature n=460</th>
<th>Mature n=460</th>
<th>Total n=920</th>
</tr>
</thead>
<tbody>
<tr>
<td>2012</td>
<td>50%</td>
<td>50%</td>
<td>100%</td>
</tr>
<tr>
<td>2013</td>
<td>50%</td>
<td>50%</td>
<td>100%</td>
</tr>
</tbody>
</table>

Sexual Maturities

<table>
<thead>
<tr>
<th>Length</th>
<th>Immature (%)</th>
<th>Mature (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;100</td>
<td>50%</td>
<td>50%</td>
</tr>
<tr>
<td>100-150</td>
<td>40%</td>
<td>60%</td>
</tr>
<tr>
<td>&gt;150</td>
<td>60%</td>
<td>40%</td>
</tr>
</tbody>
</table>

Figure 6: Sex percentages (<100 cm TL) immature (100-150 cm TL) and mature (>150 cm TL) Atlantic sturgeon based on RIA data only. These percentages indicate that maturing individuals have the highest unknown rate due to many gonadal changes caused by large amounts of hormone activity.

Seasons

<table>
<thead>
<tr>
<th>Season</th>
<th>Mature (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Spring</td>
<td>24%</td>
</tr>
<tr>
<td>Summer</td>
<td>52%</td>
</tr>
<tr>
<td>Fall</td>
<td>24%</td>
</tr>
</tbody>
</table>

Figure 7: Sex percentages by seasons sampled (March-November) based on RIA data only. These percentages indicate that there is a large amount of males present in the Saco River in the fall and more females in the summer months.

Conservation Implications

Because of the endangered and threatened statuses of sturgeon populations in the United States, new accurate methods are needed to assess populations for better management. By utilizing ultrasound imaging, RIA and external morphological features for the first time together on Atlantic sturgeon, this project will produce accurate results while eliminating inaccuracies of each individual method. This validation will give way to a comprehensive understanding of the Saco River population, which can be utilized in evaluating other sturgeon and fish populations. Overall, the return of Atlantic sturgeon to the Saco River indicates the increased health of the river system, as well as the recovery of the East Coast population.

Acknowledgements

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References


