Sensitivity of lake sturgeon population dynamics and genetics to demographic paramet

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Introduction

Lake sturgeon *Acipenser fulvescens* restoration is a priority throughout the Great Lakes basin, where sturgeon have been reduced to less than 1% of historic levels due to habitat degradation, overharvest, and fragmentation of spawning populations. The population parameters most important to long-term lake sturgeon persistence are unknown.

Objective

To determine which population parameters for lake sturgeon have the greatest influence upon the rates of extinction, average inbreeding coefficients, and percentage of alleles lost in a 250 year simulation.

Methods

- An individual-based model that represented demographics and genetics was developed where age, sex, and genetic makeup of each individual in the population was tracked
- Model included age specific mortality rates and represented a polygamous mating system
- Genes followed Mendelian modes of inheritance
- Inbreeding, f_x, was calculated via path analysis:

$$f_x = \sum_{i-1}^{P} \left[\frac{1}{2}\right]^n (1 + f_A)$$

- Model parameters were estimated from the literature and empirical data
- Parameters were perturbed across a range of plausible values
- Recorded rate of extinction, average inbreeding coefficient, and percentage of alleles lost
- Sensitivity (*S*) was expressed as the percent difference in the output when the parameter was changed, compared to the value when all of the parameters are set at their mean:

$$S = \frac{(R_a - R_n)/R_n}{(P_a - P_n)/P_n}$$

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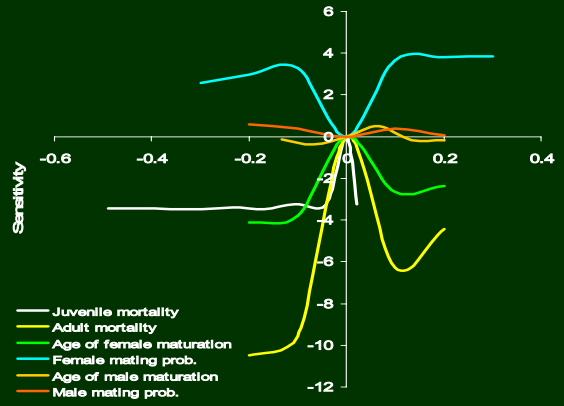

Figure 1. Percent change in parameter versus sensitivity for average percent of genes retained for lake sturgeon.

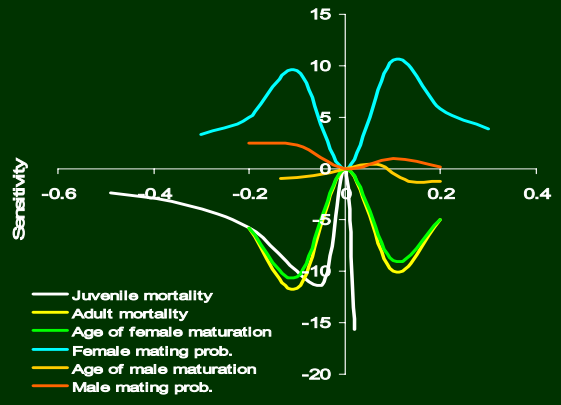

Figure 2. Percent change in parameter versus sensitivity for percent of increasing populations for lake sturgeon.

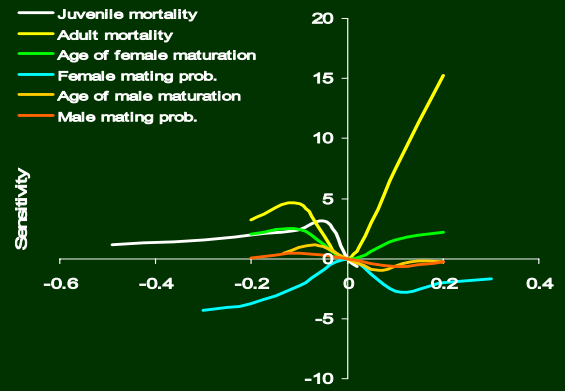

Figure 3. Percent change in parameter versus sensitivity for final mean inbreeding for lake sturgeon.

Conclusions

- Adult mortality was the most sensitive. Reducing the adult mortality of lake sturgeon will thus have the largest impact on population persistence, gene retention, and inbreeding.
- Juvenile mortality, adult mortality, age at first maturation for females, an the probability of mating for females were hypersensitive parameters.
- The probability of mating for males and the age at first maturation for males were insensitive parameters.

Management Implications

- Management options are available for reducing both juvenile and adult mortality rates. Stocking, stream-side rearing, reduced harvest, and protection from poaching during the spawning season could all lead to reduced mortality rates for sturgeon and will help foster the sustainabilit of lake sturgeon for the future.

Acknowledgments

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