Alternative reproductive tactics in invasive round goby (*Neogobius melanostomus*):

How fish increase fitness by doing less

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Introduction

Alternative reproductive tactics, or ARTs, are common in fish, and have evolved independently at least 26 times (Mank and Avise 2006). In round goby (*Neogobius melanostomus*) there are two male tactics: paternal males and sneaker males. Parental males attract females to their nest, where she lays eggs, and the parental male then fertilizes and guards the eggs until they hatch. Sneaker males can cheat this system by investing energy in teste growth instead of somatic growth. Sneakers will swim in while paternal males are fertilizing eggs and release their own sperm, effectively stealing fertilizations from the parental male (Parker 1990). Sneakers and Parental males are thought to be best differentiated by color and gonad morphology (Marentette et al. 2009). Evidence for these tactics in round goby have been observed in native populations and some invasive populations, however ARTs can be lost in small founding populations (Corl et al 2010), and their presence has never been recorded in Lake Michigan.

Round Goby Parental Male

Round Goby Sneaker Male

1. Are alternative reproductive tactics present in Lake Michigan populations of round goby?

2. What are the morphological differences between sneakers and parental males?

Methods

We sampled 264 round goby from four drowned river mouths along the Eastern side of Lake Michigan with minnow traps. We went to each site every other week for ten weeks from June to August. Then we dissected the fish to obtain the testis and accessory gland mass for each fish.

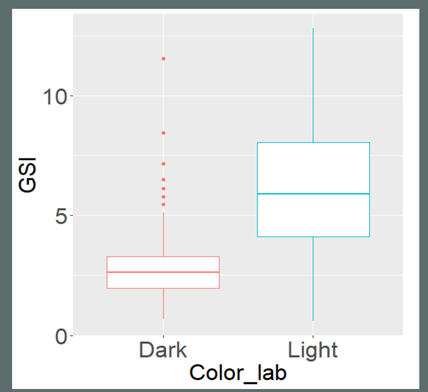


Figure 1

Gonadal somatic index (GSI) of dark and light males, calculated as

$$GSI = \frac{Total\ Gonad\ Mass}{Total\ Mass} \times 100$$

p < 0.05

n = 73

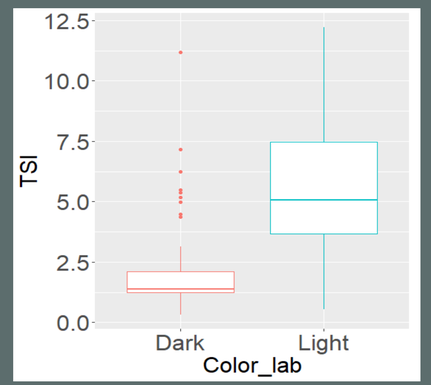


Figure 2

Testes somatic index (TSI) of dark and light males, calculated as

$$TSI = \frac{Testes\ Mass}{Total\ Mass} \times 100$$

p < 0.05 **n = 73**

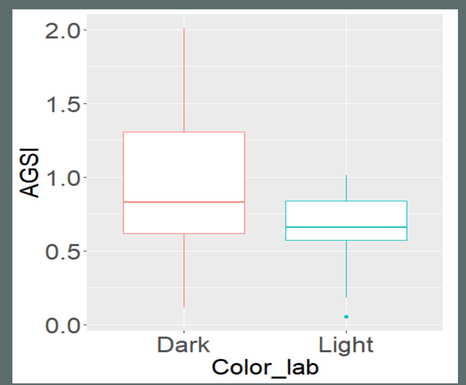


Figure 3

Accessory gland somatic index (AGSI) of dark and light males, calculated as

$$AGSI = \frac{Accessory\ Gland\ Mass}{Total\ Mass} \times 100$$

p > 0.05 **n = 73**

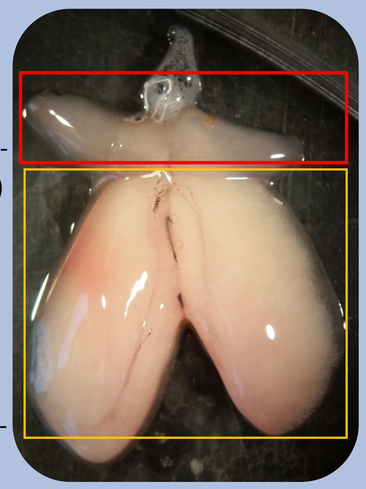
Acknowledgements

Dr. James McNair, Stiner Family, NOAA

This project has been approved by Grand Valley State University's IACUC, 19-20-A, Expires October 26, 2020

Discussion

We found clear evidence for two separate morphologies of reproductive round goby males in Lake Michigan populations. Across all of our sites, we found that light reproductive males made up 16% of males and 23% of reproductive males. This is the same as has been observed in other populations (McCallum et al. 2019). We also found that differences in GSI between the tactics are driven by differential investment in testes (yellow box), while accessory gland investment (red box) was not significantly different. Previous studies of round goby have seen differences in AGSI between the two morphs (Marentette et al. 2009).



ARTs are found across a variety of popular game fish, including salmon, perch, and walleye. Moving forward we hope to create models to understand how fishing pressure affects the proportion of sneakers in a population. These models can help managers to determine catch limits and size limits for different fisheries.

Literature cited

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