



The Energetic Impacts of the Trematode *Posthodiplostomum minimum* on Freshwater Sunfish

(*Lepomis spp.*)

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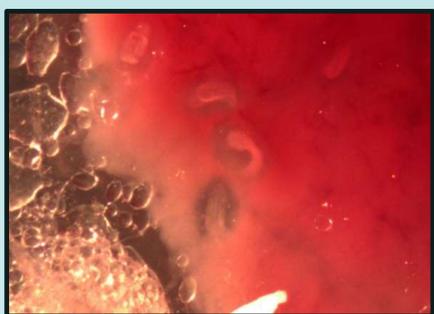


Introduction

The digenean trematode, *Posthodiplostomum minimum*, is perhaps the most common freshwater fish parasite found in North America, infecting more than 100 fish species in North America. However, relatively little is known regarding its energetic impacts on host fish. The trematode has a complex life cycle requiring three hosts: a snail first intermediate host, a fish second intermediate host, and a wading bird definitive host. In the snail hosts, parasite sporocysts release free-living cercariae that actively seek out fish hosts, and encyst as metacercaria in host organs (namely the heart and liver). This larval form is thought to harm fish health, making it more likely that the fish will be consumed by the definitive bird host (trophic transmission), but little quantitative support exists. Specifically, the extent to which encystment compromises fish aerobic capacity or survivorship is unclear. Here, we evaluate the energetic impacts of *P. minimum* on freshwater sunfish (*Lepomis spp.*), both in terms of aerobic performance and metabolic rate.

Objectives

- Experimentally measure aerobic performance and oxygen consumption in sunfish species
- Determine the infection status of each fish
- Statistically evaluate the relationships between infection status, fish size, species identity and fish aerobic performance and oxygen consumption



Methods

Sixteen sunfish, one rock bass and one creek chub were collected from a small natural pond outside of Carmichaels, PA. For the exhaustion trial, each fish was placed in a five gallon bucket in which a circulating current was produced using a power head pump. Fish naturally swim against current, and the time at which the fish observably became exhausted was recorded.

We used the rate of oxygen consumption as a surrogate measure for metabolic rate. In separate trials, the dissolved oxygen (DO) concentration of a filled 1.5 L beaker was measured prior to the introduction of each fish. Each fish was placed in the beaker for 15 minutes and the beaker top was sealed. The fish was then removed and the DO concentration was again recorded. After all previous data had been collected, each fish was pithed, weighed, measured, and dissected to determine infection load in the heart and liver. Statistical relationships were then evaluated in both univariate and multivariate procedures using the statistical software package JMP®.

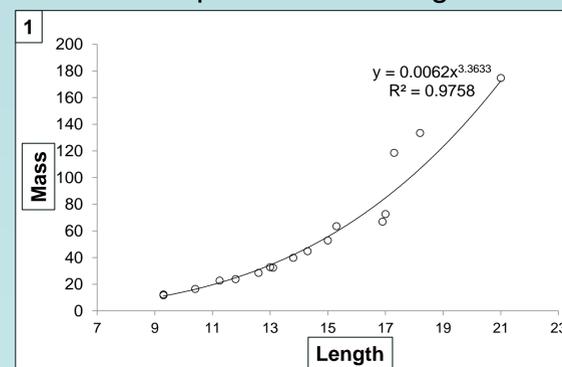
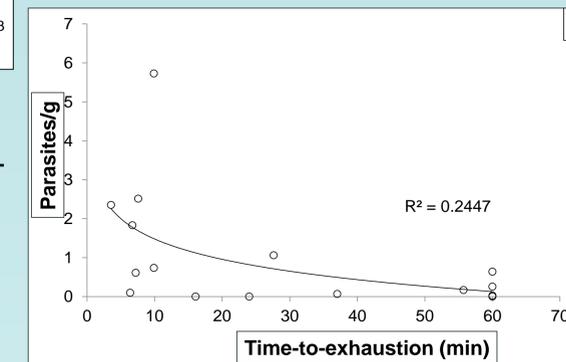


Figure 1. As is often seen in fish growth studies, there was a strong exponential relationship between fish mass and length.

Figure 2. Mass-specific infection intensity was correlated with the time-to-exhaustion in our performance trials. Several individuals with little to no infection persisted beyond 60 minutes, while many heavily burdened fish exhausted within the first 10 minutes.



Results

Only three fish were found without infections of *P. minimum*; an intensity of infection varied from 3 metacercariae to 414. Infection intensity was correlated with fish size, and this relationship was most pronounced among larger fish. In considering only sunfishes, there was a strong correlation between the mass and length of fish (Fig. 1), showing that fish that had a larger mass usually had a longer body as well. A simple univariate analysis also indicated that, after correcting for size, infection intensity had a negative impact on aerobic performance (Fig. 2), and this relationship was curvilinear. Using performance as a response variable, a Generalized Linear Model (GLM) revealed that species identity was the only significant predictor variable. Namely, the performance values for Green and Pumpkinseed Sunfishes were significantly correlated with performance ($p = 0.011$ and 0.049 , respectively). While this was also the case when respiration rate was the predictor variable, fish mass was the strongest correlate ($p = 0.0004$).

Conclusion

Even with a relatively small sample size, we detected a relationship between infection intensity and time-to-exhaustion in fish hosts. This supports the idea that encystment on the viscera (namely the heart) by *P. minimum* might make fish hosts more susceptible to predation, which trophically transmits the parasite to the definitive bird host. However, contrary to our prediction, no significant relationship was detected between infection intensity and standard metabolic rate as measure by the rate of oxygen consumption. Thus, further study is need to determine the energetic impacts of parasitism in this system.

Acknowledgements

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