Histology of Alarm Substance Cells in Relation to Parasite Load and Fish Size for Creek Chub (Semotilus atromaculatus)

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INTRODUCTION
It is generally thought that alarm substance cells (ASC) in fish epidermis evolved as a means of reducing predation risks via the release of a chemical substance these cells hold. It has been recently hypothesized, however, that the evolution and presence of ASC in fish may have more of a relationship with parasitism than predation. The goal of our study was to determine if an increase infestation of the black spot parasite (Neascus pyriformis) in creek chub (Semotilus atromaculatus) also correlates with an increase in the density of ASC. Additionally, we wanted to determine whether there was a correlation between epidermal surface area and ASC density. To our knowledge, this is the first study to field test this recently developed parasitism hypothesis concerning the evolutionary origins of ASC in freshwater fish.

METHODS
- 103 creek chub were collected from seven Wisconsin streams as well as from Minnesota and Stevens Point museum archives.
- We extracted a section of epidermis from the nape of the fish and subjected the samples to a dehydration and fixation process.
- The tissue sections were stained using varying concentrations of ethanol, Schiff’s reagent, and Eosin Y counter stain to color the alarm substance cells.
- Slides were imaged by randomly selecting one tissue section per slide under 20x magnification.
- From the image, we counted the number of alarm cells present and extracted surface area and thickness measurements.

RESULTS

HISTOLOGY
ASCs and mucous cells in the creek chub epidermis.

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SUMMARY
We identified two patterns in the distribution of epidermal ASC never before documented in wild fish. They are:
- that ASC densities decline with fish size but
- increase in fish with relatively higher black spot infestations.

SUPPORT FOR IMMUNITY HYPOTHESIS?
Two related lines of evidence:
1) Size relationships for black spot and ASC are nearly identical. We discount the alternative explanation that ASC distribution is based on predation because predation risk does not likely vary continuously with size (Mittelbach 1981).
2) Our results are comparable to the experimental findings of Chivers et al (2007); fish with heavier parasite burden contained more ASC.
Future work will focus on measuring more fish to determine whether these findings can be generalized to other populations and species.

LITERATURE CITED