The Impacts of Metal Contamination on Fish Locomotory and Sensory Abilities

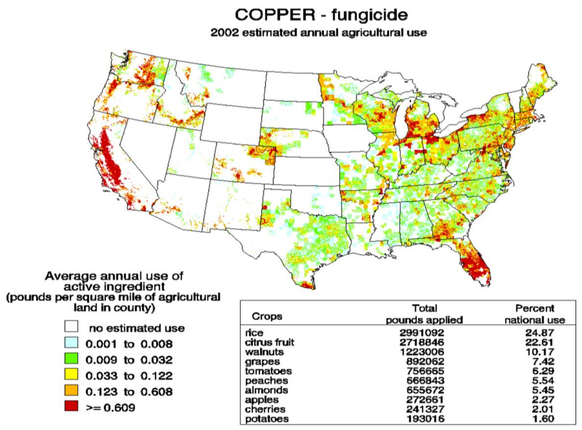
Rose Santana, Florida International University

Research Mentors: Dr. Todd Crowl, Dr. Jone Corrales, Tiffany Yanez

Background

Copper is an essential metal for life but only at very low concentrations:

- is heavily used in Florida
  e.g., fertilizer, fungicide, algaecide, herbicide
- does not degrade leading to its accumulation in aquatic ecosystems.
- causes sub-lethal adverse effects in fish at concentrations detected in the aquatic environment.



Crops	Total pounds applied	Percent national use
rice	2991092	24.87
citrus fruit	2718846	22.61
walnuts	1223006	10.17
grapes	892062	7.42
tomatoes	756665	6.29
peaches	666843	5.54
almonds	655672	5.45
apples	272661	2.27
cherries	241327	2.01
potatoes	193016	1.60

Figure 1. Copper usage as a fungicide across the U.S. Figure taken from http://water.usgs.gov/nawqa/pnsp/usage/maps/show_map.php?year=02&map=m5011

Preliminary Results

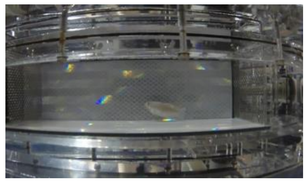


Figure 2. Swimming performance was used to assess locomotory abilities in fish.

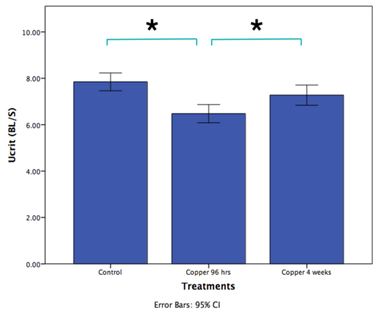


Figure 3. Preliminary results showed a decrease in Ucrit after a 96 h copper exposure and recovery in Ucrit after a 4 week depuration period. (N = 16, MANOVA, $p < 0.05$).

Goals and Hypothesis

Goal: To study the sub-lethal effects of copper on locomotory and sensory abilities in fish, specifically, **predator/prey interactions**.

Hypothesis: Exposure to copper at the water quality criteria (11.1 µg/L) established by the EPA will impair a fish's ability to avoid predation and establish new **populations.**

Research Methodology

Figure 4. Prey, Sailfin molly *(Poecilia Latipinna)*, a species native to Florida.

Figure 5. Predator, Largemouth bass (*Micropterus salmoides),* common in Florida and a natural predator of Sailfin molly. Dummy largemouth bass was used for the study.

Figure 6. Acute copper experiments. Fish were exposed to 11.1 or 0 (control) µg/L copper for 96 h with renewals at 48 h. During exposure, fish (N= 11 per treatment) were kept individually in buckets at 25 °C in an incubator.

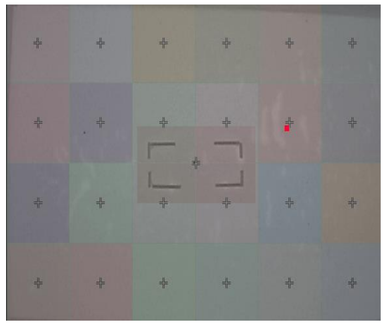


Figure 7. Predator/prey interaction assessment. At 96 h, fish were transferred to a behavioral observation chamber to test sensory abilities. After a 10 min acclimation, the following endpoints were measured in the absence (10 min) and then presence (10 min) of the predator: Total distance, velocity, and predator zone (frequency, duration, latency, and distance).

Results

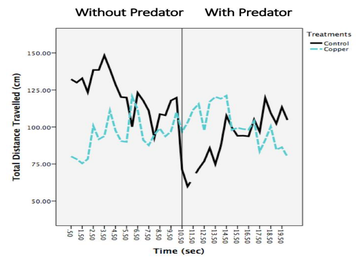


Figure 8. Total Distance. Mean total distance prey swam in the absence or presence of predator in 20 min following a 96 h copper exposure (N = 11 per treatment, t-test, $p < 0.05$).

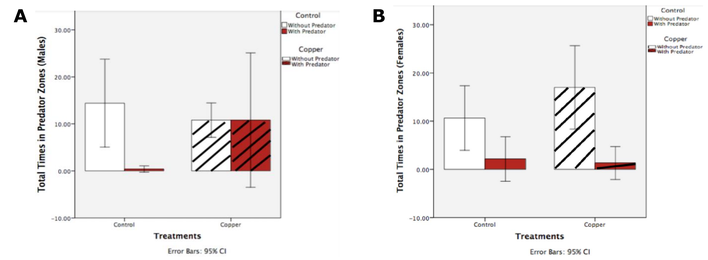


Figure 9. Frequency in Predator Zone. Total number of times male (A) or female (B) prey entered predator zone in 10 min following a 96 h copper exposure (N = 5 (A) or 6 (B) per treatment, t-test, $p < 0.05$).

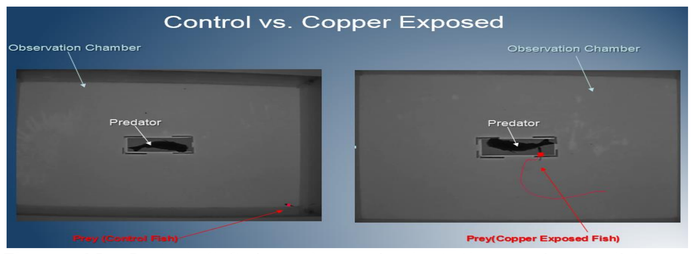
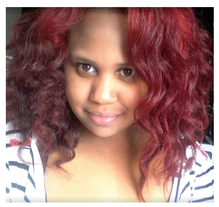


Figure 10. Control (left image) remained at the maximum distance possible from the predator, located in the center of the chamber. Copper exposed (right image) felt no fear and spent most of its time next to the predator, located in the center of the chamber

Future Work

- Perform behavior analysis experiments using chemical cues, as well as visual + chemical cues combined, as this would be the most likely scenario in the wild.
- Testing the effects of copper on predator/prey interactions across varying salinities.



FIU Center for Aquatic Chemistry and Environment
NSF Center of Research Excellence in Science and Technology
Contact: rsant189@fiu.edu

Acknowledgements: *This material is based upon work supported by the National Science Foundation under Grant No. HRD-1547798. This NSF Grant was awarded to Florida International University as part of the Centers of Research Excellence in Science and Technology (CREST) Program. Any opinions, findings, and conclusions or recommendations expressed in this material are those of the author(s) and do not necessarily reflect the views of the National Science Foundation. We would also like to thank Dr. Gardinali's lab for their assistance with analytical chemistry.*