

SUNY College of Environmental Science and Forestry

Digital Commons @ ESF

Cranberry Lake Biological Station

Environmental and Forest Biology

2017

Session A, 2017 First Place: Changes in activity levels of Rock Bass, Golden Shiner, and Brown Bullhead species in response to alarm pheromones released by Banded Killifish and Eastern Blacknose Dace

Devon Shaw

Joe Rubenstein

Shane Currey

Andrew Koch

Follow this and additional works at: <https://digitalcommons.esf.edu/clbs>



Part of the [Aquaculture and Fisheries Commons](#), [Biodiversity Commons](#), [Biology Commons](#), [Ecology and Evolutionary Biology Commons](#), [Entomology Commons](#), and the [Forest Sciences Commons](#)

Recommended Citation

Shaw, Devon; Rubenstein, Joe; Currey, Shane; and Koch, Andrew, "Session A, 2017 First Place: Changes in activity levels of Rock Bass, Golden Shiner, and Brown Bullhead species in response to alarm pheromones released by Banded Killifish and Eastern Blacknose Dace" (2017). *Cranberry Lake Biological Station*. 22. <https://digitalcommons.esf.edu/clbs/22>

This Presentation is brought to you for free and open access by the Environmental and Forest Biology at Digital Commons @ ESF. It has been accepted for inclusion in Cranberry Lake Biological Station by an authorized administrator of Digital Commons @ ESF. For more information, please contact digitalcommons@esf.edu, cjkoons@esf.edu.

Changes in activity levels of Rock Bass,
Golden Shiner, and Brown Bullhead
species in response to alarm pheromones
released by Banded Killifish and Eastern
Blacknose Dace

By Devon Shaw, Joe Rubenstein, Shane Currey, and Andrew Koch.
(AKA The Ferocious Fish Feelers)

Introduction

- Rationale
 - Minnows have epidermal cells which release alarm pheromones when attacked by a predator
 - Conspecifics and heterospecifics that live together can gain anti-predator advantage
 - Alarm pheromones may also attract secondary predators to deter their original predator (Chivers 1996).



Hyptheses

Ha 1: The average activity of Rock Bass, Golden Shiner, and Brown Bullhead will be greater in the presence of an alarm pheromone created by prey naturally found in their habitat than in the presence of an alarm pheromone released by prey from another habitat.

Ho 1: The average activity of Rock Bass, Golden Shiner, and Brown Bullhead will not be significantly greater in the presence of an alarm pheromone created by prey naturally found in their habitat than in the presence of an alarm pheromone released by prey from another habitat.




Ha 2: The average activity for Rock Bass, Brown Bullhead, and Golden Shiner will be significantly greater in the presence of an alarm pheromone than in the absence of a pheromone.

Ho 2: The average activity of Rock Bass, Brown Bullhead, and Golden Shiner will not be significantly different in the presence of an alarm pheromone than in the absence of an alarm pheromone.

Ha 3: Of the 3 species tested, Brown Bullhead will have the greatest average increase in activity when presented with an alarm pheromone.

Ho 3: There will be no significant difference in average activity between fish species when presented with an alarm pheromone.



Brown Bullhead

(*Ameiurus nebulosus*)

Habitat:

- Bottom dwelling fish
- Slower moving freshwaters in creeks, rivers, ponds, and lakes
- Vegetation and substrate
- Can endure low oxygenated waters of up to 0.2 ppm.
- Do well in polluted waters.

Food Habits:

- Opportunistic omnivores
 - Adults- insects, small fish, fish eggs, plants, worms, crayfish and almost anything they can get their mouths on.
 - Juveniles- zooplankton, insects, aquatic larvae, and plants
- (Barnes 2003)

Physiology:

- Use barbells to locate food
- Thousands of external taste buds
- Highly sensitive olfactory tissue
- Chemosensory cells covering body
- Mostly nocturnal



Rock Bass

(Ambloplites rupestris)

Habitat:

- Freshwater rivers, streams, lakes, and ponds
- Rocky and sandy clearwaters
- Heavily vegetated
- Tend to avoid fast moving water

Food Habits:

- Various species of plants
- Crustaceans, insects, aquatic larvae, small fish of many species including their own
- Primarily predaceous (Georgy & Hadley 1979)

Physiology:

- Large mouths and bright red eyes
- Diurnal
- Inner ear and lateral line for hearing and feeling water disturbances
- Large eyes for sight



Golden Shiner

(Notemigonus crysoleucas)

Habitat:

- Freshwater clean quiet and vegetated lakes, ponds, and swamps
- Backwaters and sluggish sections of creeks and small to medium rivers
- Tolerate low oxygen levels, and high temperatures and turbidity

Food Habits:

- Zooplankton, phytoplankton, small mollusks, insects, and aquatic larvae (Hall & Stewart 1979)

Physiology:

- Diurnal
- Detect water disturbance through lateral line
- Larger eyes for prey detection and predator avoidance



Tested Prey Species

Banded Killifish *(Fundulus diaphanus)*

Habitat:

- Quiet freshwaters of lakes and ponds
- sand , gravel or detritus covered bottoms
- Areas with submerged aquatic plants

Food Habits:

- Microcrustaceans, fish eggs, fly and other aquatic insects and larvae, other invertebrates and plant material



Eastern Blacknose Dace *(Rhinichthys atratulus)*

Habitat:

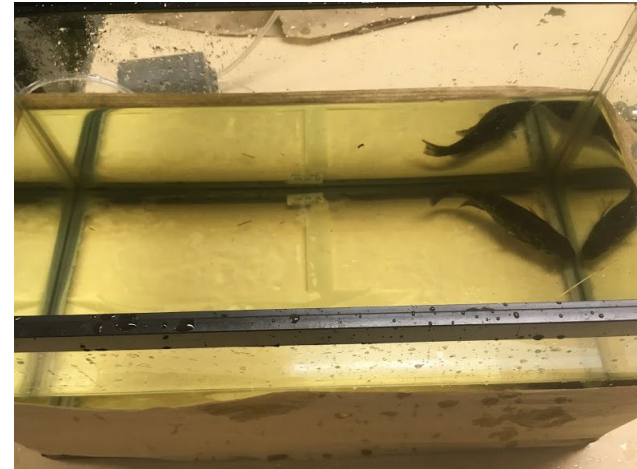
- Freshwater rocky runs and pools of headwaters, creeks and small rivers

Food Habits:

- Insects, aquatic larvae, diatoms and other algae

Methods

- Trap nets (4)
 - 3 tested areas → Sucker Brook Bay (2), Katherines Bay (1) and Chair Rock Flow (1)
- Minnow Traps
 - Killifish → Sucker Brook Bay and Katherines Bay (14)
 - Darknose Dace → Beaver Meadows (5)
- Rock Bass and Golden Shiners were tested during the day
- Brown Bullhead were tested at night
- Fish were put in tanks with clean water and left to unstress for 30 minutes
- Tanks
 - wrapped in paper towels
 - sectioned into quadrants



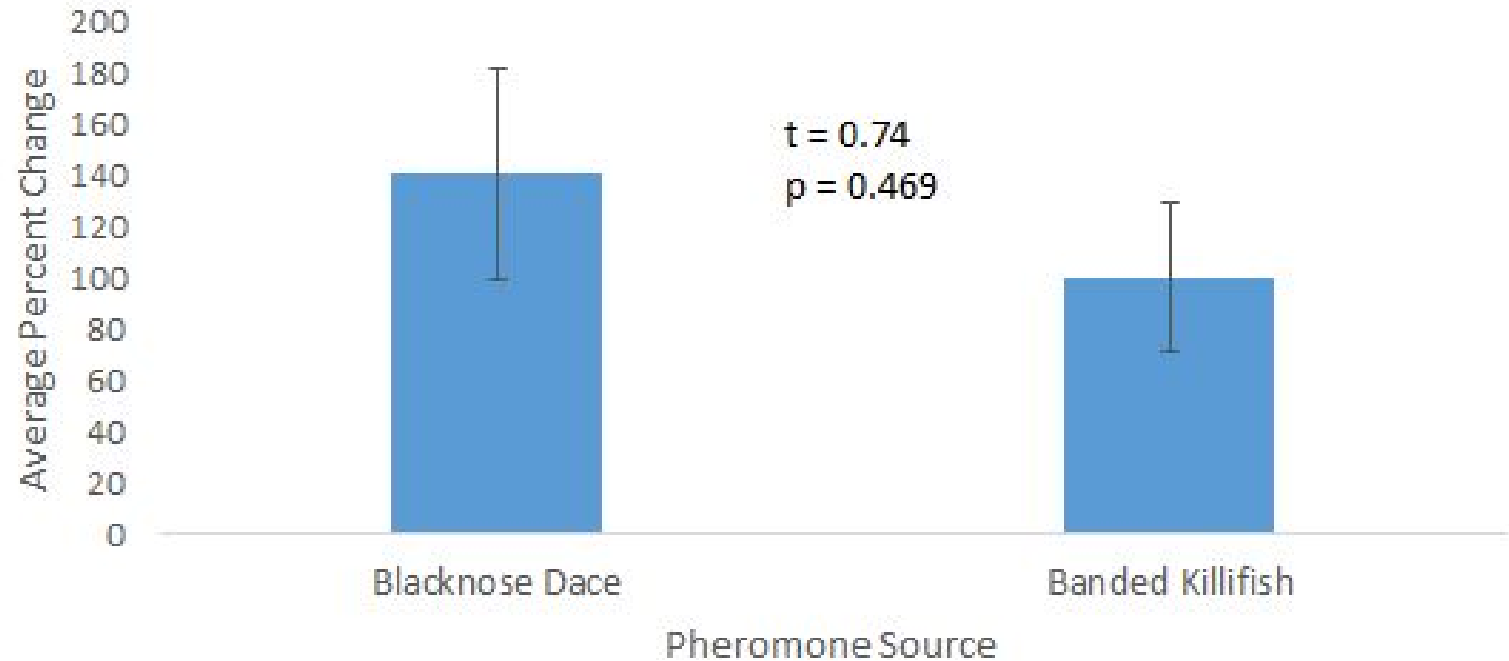
Methods

- 1 L of lake water was added and a baseline activity was recorded for 5 minutes
- Either 2 dace or 2 killifish were squeezed in a bucket containing 1L of water
- 5 minutes of activity was recorded
- Half of the caught fish were tested with killifish first and other half with dace first
- Half the water was removed and fresh water added to dilute pheromone
- Fish sat for 30 minutes
- Process repeated with other treatment
- Tanks filled with fresh water between fish species

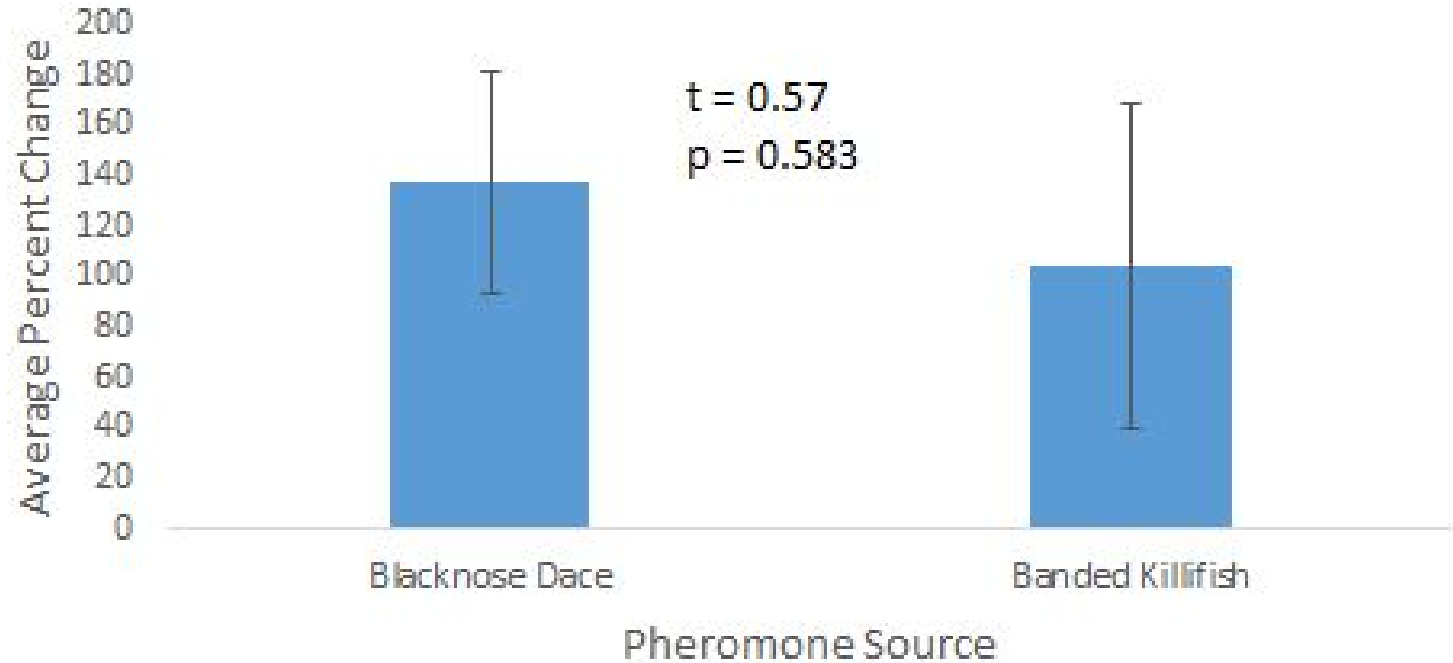


Results

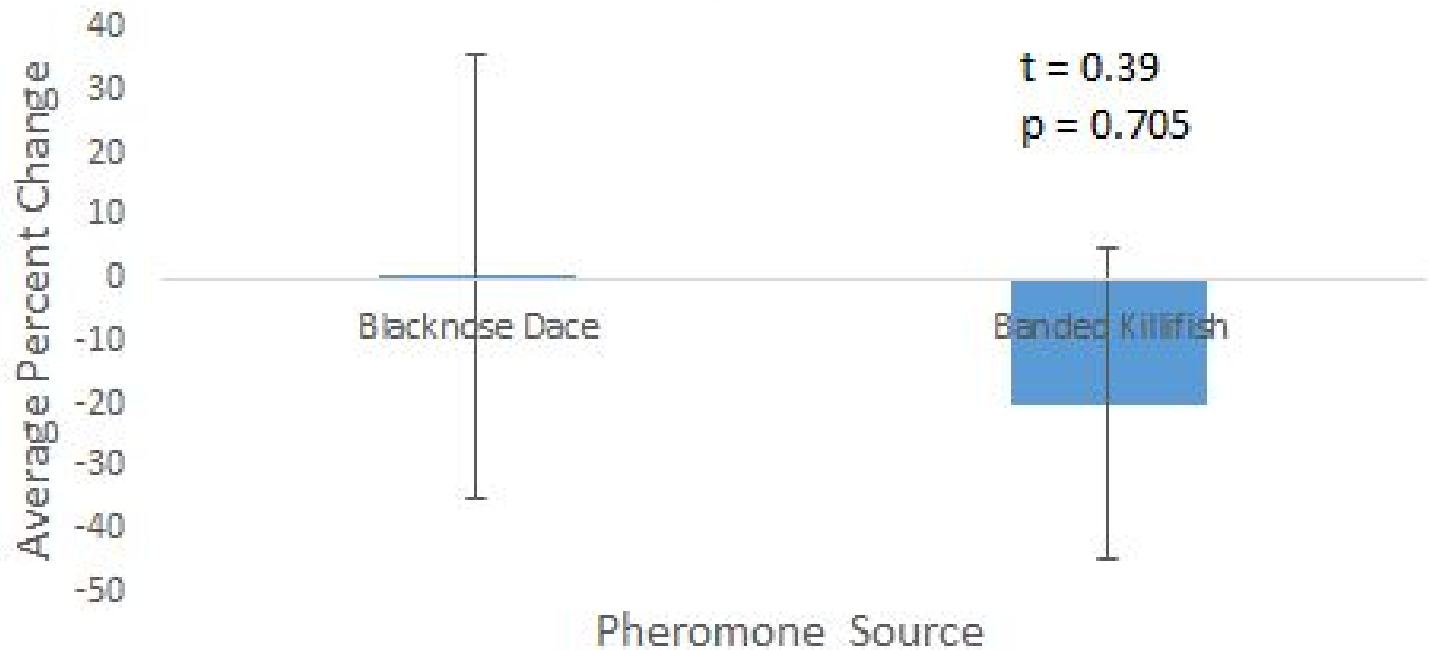
Rock Bass Mean Percent Change induced by Pheromone



Golden Shiner Mean Percent Change induced by Pheromome



Brown Bullhead Mean Percent Change induced by Pheromone

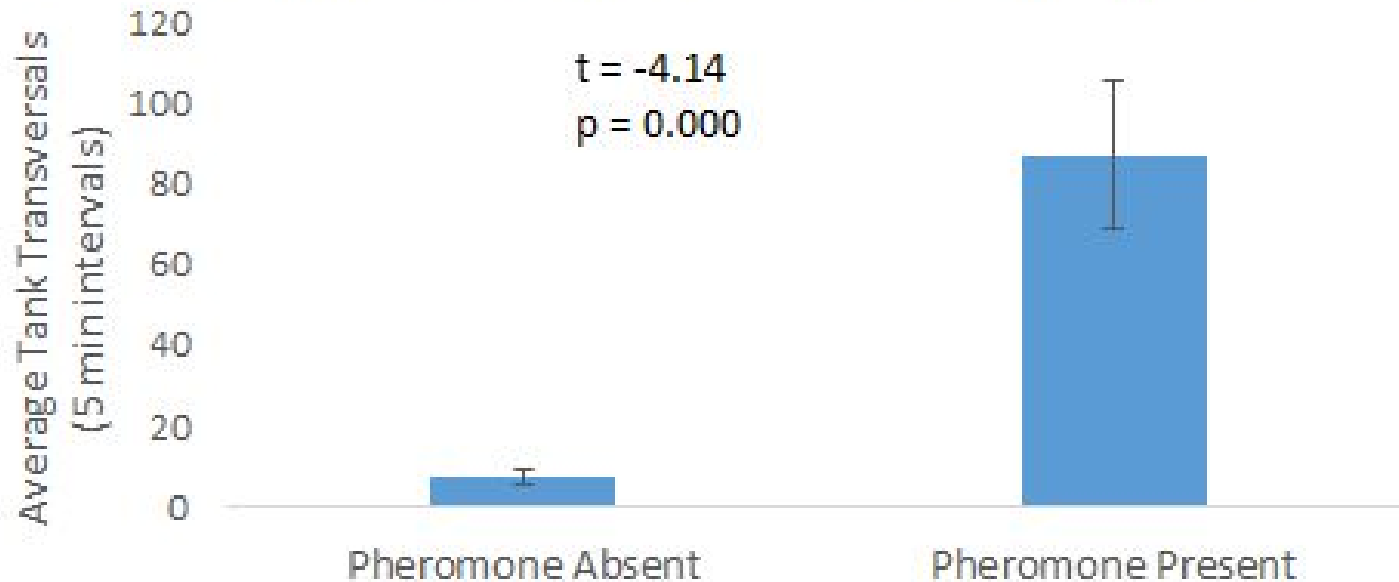


Fail to reject H_0 1

- The average activity of fish tested was not significantly greater in the presence of an alarm pheromone created by prey naturally found in their habitat than in the presence of an alarm pheromone released by prey from another habitat.



Rock Bass, Golden Shiner, and Brown Bullhead Mean Percent Change induced by Pheromone

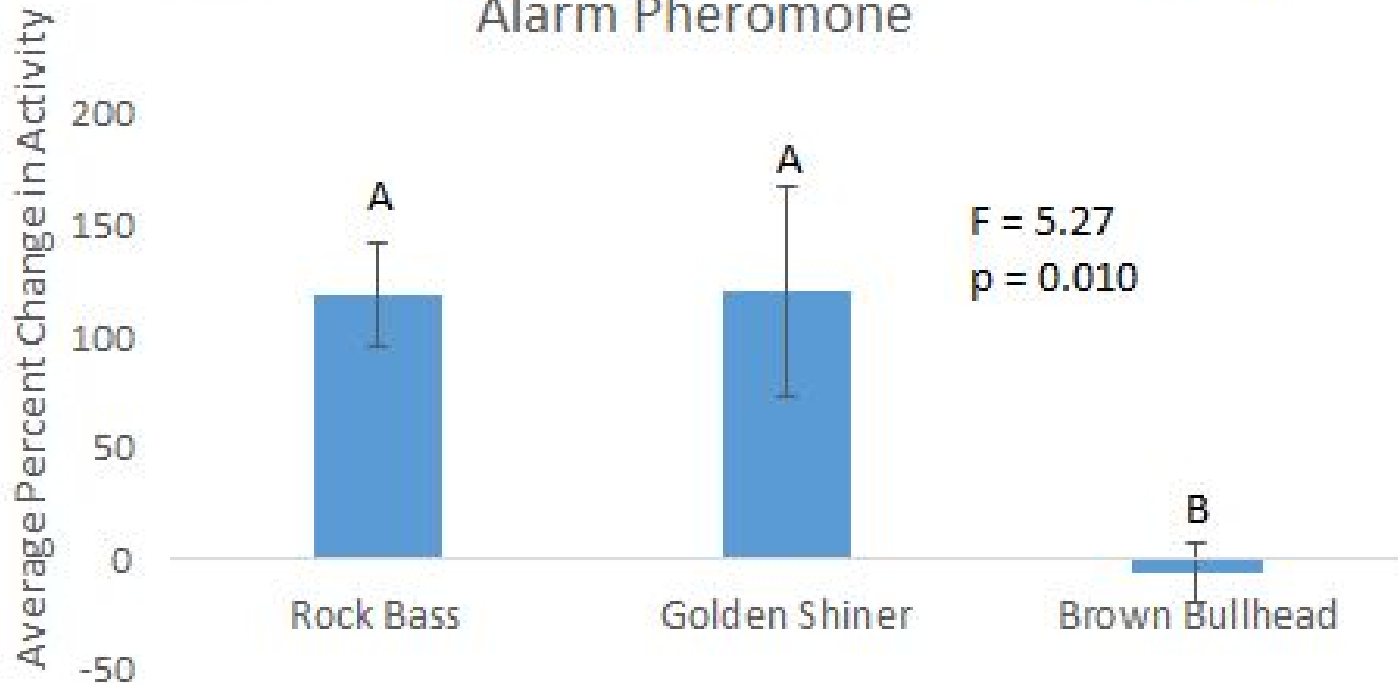


Reject Ho 2

- There is a significant difference in the average activity of Rock Bass, Brown Bullhead, and Golden Shiner in the presence of an alarm pheromone than in its absence

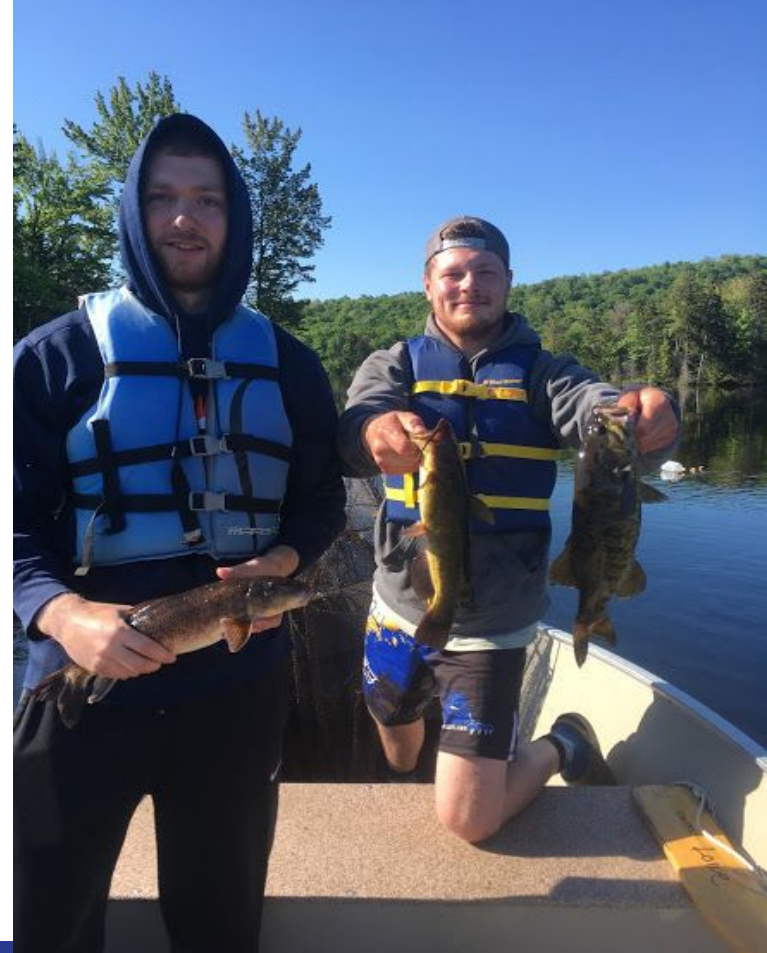


Average Change in Activity for Rock Bass, Golden Shiner, and Brown Bullhead in the Presence of an Alarm Pheromone



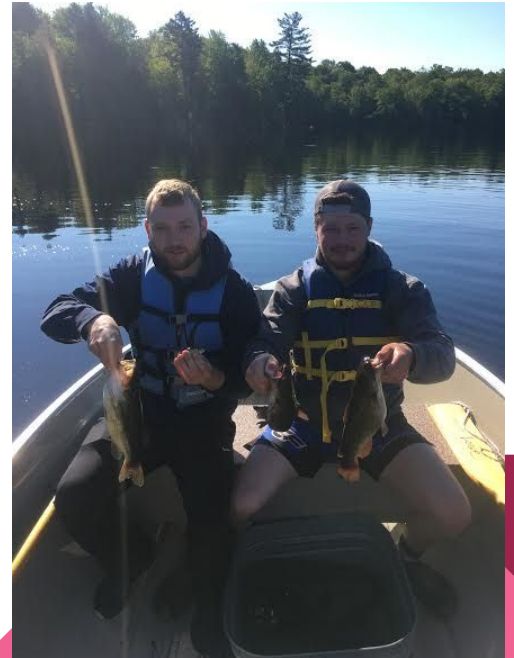
Reject Ho 3

- There is a significant difference in the average activity between fish species when presented with an alarm pheromone



Discussion

- Fish varied in their response to pheromone, even within species (Stensmyr 2012)
 - Rock Bass
 - Bullhead
- Pheromone is Pheromone
- Why weren't the Bullhead active?
- Drawbacks
 - Didn't change entire tank between trials
 - How much pheromone is being produced?
 - Stress levels alter activity?
- Follow up studies




Conclusions

- Brown Bullhead, Golden Shiner and Rock Bass are all capable of detecting minnow pheromones but react in very different ways. The source of the pheromone used did not impact the activity of each species significantly
- Pheromone receptors can have a broad range in their reception capabilities
- Interspecies pheromone communication may be more prevalent than we think, allowing new possibilities for studying hard to find organisms



Citations

- Barnes, G.E. & Hicks, B.J. (2003). Brown bullhead catfish (*Ameiurus nebulosus*) in Lake Taupo. In Munro, R. (Ed). Managing invasive freshwater fish in New Zealand. *Department of Conservation*. 10-12 May 2001, Hamilton, (pp. 27-35). Wellington, New Zealand:
- Chivers, D. P., Brown, G. E., & R. Jan F., S. (1996). The Evolution of Chemical Alarm Signals: Attracting Predators Benefits Alarm Signal Senders. *The American Naturalist*, (4). 649.
- George, E., & Hadley, W. (1979). Food and habitat partitioning between rock bass (*Ambloplites rupestris*) and smallmouth bass (*Micropterus dolomieu*) young of the year. *Transactions Of The American Fisheries Society*, 108(3), 253-261.
- Hall, D., & Stewart, A. (1979). Diel Foraging Behavior and Prey Selection in the Golden Shiner (*Notemigonus crysoleucas*). *Journal Of The Fisheries Research Board Of Canada*, 36(9), 1029-1039.
- Stensmyr, M., & Maderspacher, F. (2012). Pheromones: Fish fear factor. *Current Biology*, 22(6), R183-R186.
- 

Questions?

