The Development of Round Goby Bioacoustic Traps

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Introduction

Introduced to the Laurentian Great Lakes via ballast water from trans-Atlantic voyages by 1990, the round goby (*Neogobius melanostomus*) joined the list of invasive species in the Duluth-Superior harbor in 1995. The round goby is a relatively small and aggressive benthic fish, which directly competes with native species for resources and habitat. One of the reasons for the round goby's success as an invader is its reproductive strategy, which includes multiple spawning events within the spawning season and a nest-guarding male that uses vocalizations to attract females. In addition, round gobies will prey upon the eggs of native fish, such as lake trout, *Salvelinus namaycush* (Chotkowski and Mardsen 1999, Jonas *et al*. 2005, Fitzsimons *et al.* 2006), lake sturgeon, *Acipenser fulvescens* (Nichols *et al*. 2003) and smallmouth bass, *Micropterus dolomieu* (Steinhart *et al.* 2004). The round gobies' aggressive behavior and reproductive strategy, has led to direct competition with native species and has enabled them to become a major component of the benthic community in the Laurentian Great Lakes.
Fortunately, the goby's vocalizations can be used to attract females for removal, decreasing reproductive success and releasing pressure on native fish. Preliminary trials conducted in August of 2010, showed female phonotaxis to low frequency stimuli. However the number of female gobies entering the trap (standard wire mesh minnow trap) needs to be increased for this new method to be practical. The objective of this project was to develop a fish trap that would increase the capture and retention rate of the round goby.

Methods

Four new trap entrances were designed and tested against a standard wire mesh minnow trap (Fig. 4). All trap types developed incorporated entrance with lower angles than those of the standard wire mesh minnow trap (35°) and the width of the entrance funnel was increased. Trap prototypes were made from black ¼" plastic mesh and tested using Silver Cup fish feed; this allowed for simple testing of the design without the combination of bioacoustics. Tests were conducted over 24-hour periods using a 2.13m x 0.61mx 0.55m holding tank with rocks and PVC pipes placed in the tank basin; this was done to mimic the benthic environment, providing interstitial spaces other than those created by the trap for the gobies to occupy (Fig. 7). Round gobies were measured in standard length before being placed in the tank; gobies were put into the tank 20 minutes prior to the placement of a trap. The experiments conducted include: the capture rate of the dome-shaped double entrance trap (Fig. 3); the capture rate of the standard wire mesh minnow trap, to act as a control; and a direct comparison between the dome-shaped trap and wire mesh minnow trap.

Results

Results shown for traps that caught more than one round Goby. The dome-shaped double entrance trap was the most successful with an 85% capture rate (Fig. 2) and 0% escape rate over a 24-hour period (n=2). The wire mesh minnow trap had an 11% capture rate (Fig. 5) and a 25% escape rate (n=1). When round gobies were tested with both the dome and the minnow trap in the tank simultaneously, the dome-shaped trap had a 30% success rate while the minnow trap had a 5% success rate (Fig. 6).

Conclusion

When given the option of multiple shelters, rocks, and another trap, nearly a third of the round gobies tested still chose the domed design. This is a high capture rate and would be enough to impact the population. Although these experiments were conducted using bait pellets rather than bioacoustics, the preliminary results show that the dome-shaped double entrance did consistently catch more and retain more gobies than the original trap. This suggests that our redesigned entrance may better target the round goby and will increase the practicality of the bioacoustic traps.

Future Work

The domed double entrance traps will be tested using low frequency pure tones in the Duluth-Superior Harbor. Mating calls of the male round gobies will be collected at the UMD research farm in 1 m diameter tanks using hydrophones. Positive phonotaxis should attract females exclusively to the traps for removal; once this has been demonstrated, traps can be deployed on a broader basis to target round gobies in multiple locations.

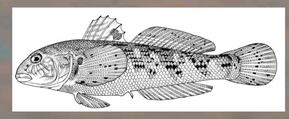

Figure 1. Round goby (*Neogobius melanostomus)*

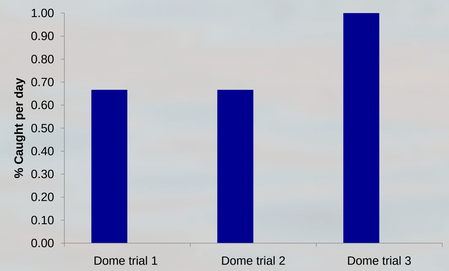

Figure 2. Dome-shaped Trap Catch Rate

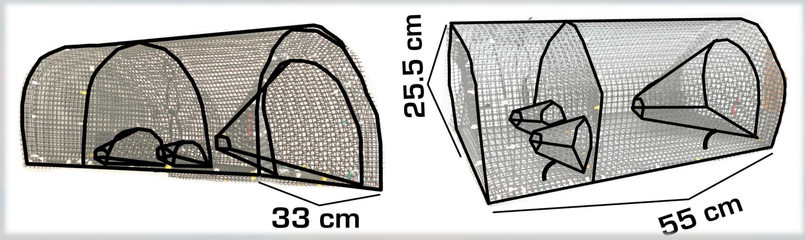

Figure 3. Dome-shaped double entrance Trap Outline. Dimensions: 33 cm wide, 55 cm in length. 25.5 cm in height. Primary entrance length is 21.6 cm, while the secondary entrances are 10 cm in length. Both entrance angles are less than 15°.

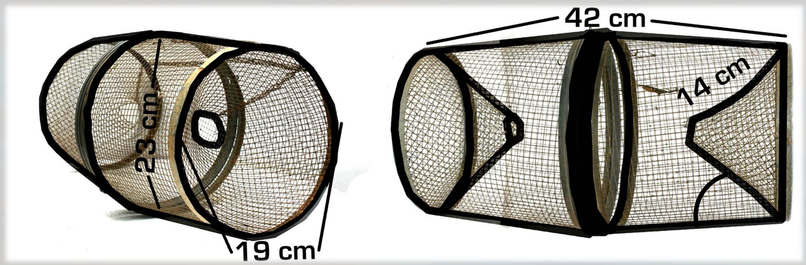

Figure 4. Standard Minnow Trap Outline. Dimensions: 42 cm in length, 23 cm in the middle width and 19 cm at the entrances. Entrance length measured 14 cm with a 35° angle.

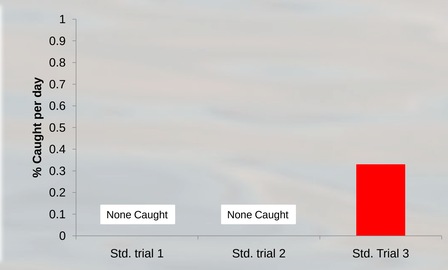

Figure 5. Wire Mesh Minnow Trap Catch Rate (Control)

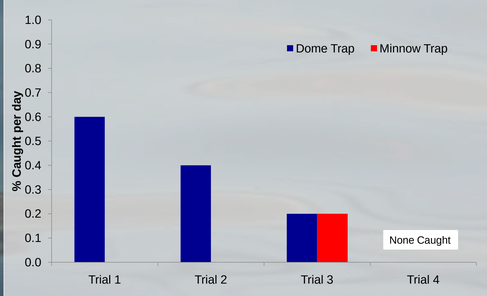

Figure 6. Dome-Shape Vs. Wire Mesh Minnow Catch Rate

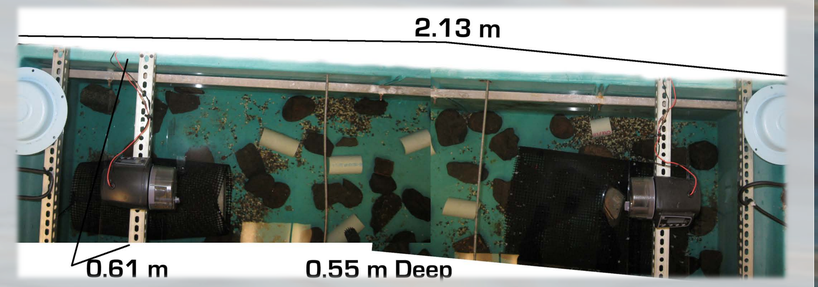

Figure 7. Traps deployed in a 2.13m x 0.61mx 0.55m tank for 24-hours with 5 gobies per trial. All traps were baited with Silver Cup Fish Feed.

Acknowledgements

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References

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