AQUATIC INVASIVE SPECIES

Round Goby and Mottled Sculpin Spawning Interactions

Final Report

Major Objectives and Goals

To determine whether round gobies interfere with mottled sculpin spawning. To compare spawning shelter requirements of the two species in a effort to find methods of minimizing round goby spawning success while maximizing mottled sculpin spawning success.

Summary of Progress

The purpose of our study is to determine whether the local extinction of mottled sculpin could be caused by round gobies interfering with spawning and determine whether habitat modification could minimize round goby reproduction while maximizing mottled sculpin reproduction. The mottled sculpin is an important food item for yellow perch in the Great Lakes. We were able to establish that round gobies can interfere with mottled sculpin reproduction when male round gobies seize the spawning shelter and eat the eggs. We were also able to show that round gobies use larger spawning shelters than mottled sculpins use. Hence, covering areas of intense round goby spawning with rock too small for their nesting may be a useful method for controlling round goby numbers and minimizing their impact on native species.

Accomplishments

(1) Demonstration of spawning interference by round gobies on mottled sculpins, (2) demonstration of differences in nest site selection and requirements in round gobies and mottled sculpins.

Narrative Report

Since its establishment in southwestern Lake Michigan in the early 1990's, the round goby has caused the local extinction of the mottled sculpin in areas where the round goby has become abundant. The mottled sculpin is particularly vulnerable because both mottled sculpins and round gobies prefer similar rocky habitat, have similar diets, and both species nest in rock cavities. Mottled sculpin are an important component in the diet of yellow perch in rocky areas of Lake Michigan and their loss may have a negative impact on yellow perch. Our work prior to this study suggested that the cause of mottled sculpin extinctions was due to nesting interference. In the field we could find male and female mottled sculpins in reproductive condition and post-reproductive condition, but could find neither nests nor juveniles. This project has as its main objectives the determination of whether round gobies interfere with mottled sculpin nesting and the determination of whether there are differences in the spawning requirements for round gobies and mottled sculpins.

To establish whether round gobies interfered with mottled sculpin nesting, we established 12 pairs of mottled sculpins in sections of an artificial stream. In ten of the pairs there was successful nesting; two pairs had one individual die before spawning. In five of the successful nest site sections a large male round goby was added and within a few days the mottled sculpin eggs mass had been eaten by the round goby. In each case the male round goby changed to its spawning coloration and began to defend the nest site.

Our measurements of natural spawning shelters of round gobies and mottled sculpins showed that round gobies used larger rocks and required a larger surface area for egg deposition. Nests were sampled from Lake Michigan (mottled sculpins and round gobies) and Lake Erie, and the Flint and Shiawassee Rivers, Michigan (round gobies). The volumes of individual eggs of round gobies and mottled sculpins are nearly identical, but round gobies lay their eggs in a single layer while mottled sculpins lay their eggs in a multilayered mass. Hence an equivalent weight, volume, or number of mottled sculpin eggs requires a

smaller surface area, cavity, and rock. Importantly, there was virtually no overlap in egg mass surface areas and very little overlap in rock size with round gobies using larger rocks than mottled sculpin use. This suggests that habitats might be modified to discourage round goby spawning while enhancing mottled sculpin spawning.

Field experiments with artificial shelters also indicate that it may be feasible to either modify habitat to discourage round goby spawning and enhance mottled sculpin spawning. Round gobies deposited eggs in tile lean-to shelters that were 30 cm square, but usually not in smaller shelters. Mottled sculpins deposited eggs in shelters that were either 30 cm square or 15 cm square with about equal percentages of each type being used. Hence smaller shelters could potentially be provided for mottled sculpins to spawn in and these shelters would not be particularly attractive to round gobies.

Another factor that might be useful in designing mottled sculpin specific shelters is where eggs are placed. In lean-to shelters the mottled sculpins always laid their eggs in corners between the roof and a supporting wall. Round gobies avoided these locations and deposited their eggs only on flat surfaces. This difference may be due to a difference in female position during egg-laying. Female mottled sculpins lie on their backs while spawning and it may be that having an adjacent wall helps maintain the posture. Mottled sculpins never lay their eggs on a ceiling higher than a bit more than their body depth. Round gobies frequently deposit eggs on ceilings higher than their body depth. We suspect that female round gobies use their fused "suction-cup" pelvic fins to attach to vertical walls and high ceilings during egg deposition. Because it is difficult to attach to corners it is difficult to lay eggs there. An artificial mottled sculpin spawning shelter would probably be too small for round gobies to use and the internal architecture could include corners that would discourage use by round gobies while encouraging mottled sculpin spawning.

At this point in the project we think it is feasible to enhance mottled sculpin spawning while inhibiting round goby spawning by (1) habitat modification to cover round goby spawning areas with rocks too small for spawning and (2) adding artificial spawning shelters to such sites for mottled sculpin spawning.

We also began work in two ancillary areas. During the project we found one site with extremely dense round goby spawning. We mapped the site and its nests to determine whether the round gobies tended to aggregate. We have also been videotaping activity around the nests to increase our knowledge of round goby spawning behavior. This will be part of a Master’s thesis by Kirby Wolfe.

We also have been working on designing round goby spawning shelters that could act as male and egg traps. In some locales it may be difficult to modify the habitat, but it might be feasible to attract spawning fish away from the natural substrates and into shelters that can be collected at appropriate time intervals during the spawning season. We had some success with plastic drink containers which could be cheaply modified into traps. This was the project of a summer intern, Grace Kilbane.

Brief Summary

Our project has demonstrated that mottled sculpins are severely impacted by round gobies and the mechanism is likely to be nesting interference. Male round gobies may evict defending mottled sculpins to take over a spawning shelter. The round gobies also consume the mottled sculpin eggs. It may be feasible to anticipate where round gobies are most likely to nest and so become a nuisance. It may also be possible to alter habitat to minimize round goby nesting or design artificial shelters for mottled sculpins that round gobies are unlikely to utilize. Is some places it may be feasible to design "hyper-attractive" round goby nests that can be harvested for egg destruction.

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