

Impact of the Round Goby (*Neogobius melanostomus*) on Tributary Streams of Lake Erie

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Budget: \$5,000

Introduction:

The round goby (*Neogobius melanostomus*) is an invasive exotic fish species introduced to the Great Lakes in the early 1990s in ballast from European ships. The spread of the round goby has generally followed the spread of the zebra mussel, which is one of its primary food sources. In 1994, the round goby was discovered in the Flint River in Michigan, which does not contain zebra mussels. If a similar invasion occurs in Lake Erie tributary streams it could negatively impact native fish species such as sculpins, logperch, and many native darter species.

A preliminary survey conducted this summer showed that gobies are present in significant numbers in both Elk and Walnut Creeks. The primary focus of the proposed research project will be to determine if round gobies have colonized other tributaries of Lake Erie, and if so, the precise extent of colonization in each stream. This will be accomplished by sampling upstream from the mouth of each tributary until gobies are no longer encountered. The position of goby advancement will be recorded using GPS. From these data, future goby advancements can be monitored. Also, analyses of possible interactions between gobies and native species will be conducted. The microhabitat preference of round gobies will be analyzed (i.e. is there a preference for bedrock, gravel, small cobble, large cobble habitats). Food habits of gobies will be compared with other benthic species (e.g. sculpins, logperch, darters, and madtoms) to determine if there is a potential for feeding competition among gobies and native species. The third component of the study will be to collect age and growth data to determine the age structure of gobies in streams.

Methods:

Gobies will be collected by electrofishing using a backpack electroshocker and by seining. Preliminary investigation showed that both methods produce optimal results in different habitat types. The primary streams that will be sampled will be Conneaut Creek (Pennsylvania portion), Elk Creek, Walnut Creek, Four Mile Creek, Six Mile Creek, Eight Mile Creek, Twelve Mile Creek, and Sixteen Mile Creek. Gobies will be identified in the field during collection so that the precise upstream position of gobies can be recorded using a GPS unit. After collection, all fish will be preserved in formalin (with the exception of gamefish, such as trout, which will be counted and released) and returned to the laboratory. Fish will then be identified to species, and the relative abundance of gobies will be determined. Goby abundance also will be estimated using the catch per unit effort (CPUE) method. After species identification, goby stomachs (and those of other benthic fish species) will be dissected out and the contents removed. Food items contained in the stomachs will be identified to the lowest taxonomic level possible. Food habits will then be analyzed according to the type of food present, relative abundance of food in the diet, and volume of each food item in the diet. Age and growth of gobies will be analyzed by weighing and measuring each goby and determining its age by a combination of the size frequency method and scale age determination.

Results:

Round gobies were collected from four of the six streams sampled. Round gobies had their greatest density in Elk Creek where 137.1 gobies were collected per hour of electrofishing. Where present, gobies made up 17.1 percent of the fish present in Elk Creek. Gobies were collected as far as 1.4 miles from the mouth of Elk Creek, and the GPS coordinates for their furthest upstream progress are N42°01.229' and W080°21.683'.

Round gobies had their second greatest density in Twenty Mile Creek, where 103.8 round gobies were collected per hour of electrofishing. In Twenty Mile Creek round gobies made up 30.4 percent of fish collected. Round gobies occurred 0.4 miles upstream from the mouth of Twenty Mile Creek, where a falls probably blocked further movement. The GPS coordinates for upstream progress in Twenty Mile Creek are: N42°15.571' and W079°46.635'.

The third greatest density of round gobies was found in Walnut Creek where 42.6 round gobies were collected per hour of electrofishing. Round gobies made up 12.7 percent of fish collected. Round gobies were collected as far as 0.3 miles upstream from the mouth of Walnut Creek, and the GPS coordinates for this point are N42°04.421' and W080°14.075'.

Round Gobies were also collected from Sixteen Mile Creek at a rate of 13.7 gobies per hour of electrofishing. Round gobies only made up 1.5 percent of fish collected in Sixteen Mile Creek. Round goby density was low because fish were only collected from the pool just above the mouth. Therefore, no GPS coordinates were recorded for round goby movement into Sixteen Mile Creek.

Round gobies were not collected from Twelve Mile Creek or Conneaut Creek. Additionally, no disjunct populations of round gobies were collected in upstream areas of any of the sampled streams, which indicate that thus far there has been no "bait-bucket transfer" of round gobies in the streams sampled.

Thus far round gobies have progressed farthest into Elk Creek. It is possible that further progression would occur into creeks over time, and the current GPS coordinates would allow the monitoring of future round goby movements. One indication that gobies may move farther upstream is that round gobies appear to be spawning in the streams where they were found. Males round gobies with very dark spawning/nest guarding coloration were collected from Elk Creek, Twenty Mile Creek, and Walnut Creek. Spawning in these streams may allow round gobies to colonize more upstream areas over time.

Round goby length in all streams combined ranged from 28 mm to 95 mm (total length). Based on aging fish by counting scale annuli, four age groups were collected: 0+, 1+, 2+ and 3+ (only four were collected). Age groups had considerable length overlap, but the mean length of each group was: 0+: 44.2 mm, 1+: 67.9 mm, 2+: 79.8 mm, and 3+: 88.3 mm. All four age 3+ fish were females. Fish in the other size groups were both males and females combined.

Length-weight regression analysis of ln transformed length and weight showed a very significant length-weight relationship ($r^2 = 0.980$, $P < 0.0001$). The length-weight relationship is described by the equation: $\ln W = -11.632 + 3.095 (\ln L)$.

Round goby food habits were analyzed based on four size classes. In general, fish in the largest size class ate fewer larger food items, rather than higher numbers of small food items, which the smaller size classes fed upon. Fish in the size class from 31-45 mm fed primarily on dipterans in the family Chironomidae, and had a narrow diet breadth with only six different food items found. Their diet consisted of 72.5 percent chironomid larvae, 10.0 percent fish eggs, 7.5 percent chironomid pupae, 5.0 percent *Caenis* mayfly nymphs, and low numbers of caddisfly larvae (family Hydropsychidae) and water mites (Acarina). Gobies in the size class 46-60 mm also fed most heavily on chironomids, and had a narrow diet breadth feeding on only five different food items. Chironomid larvae made up 87.0 percent of the diet, followed by chironomid pupae at 6.9 percent and *Baetis* mayfly nymphs at 4.3 percent. Fish in this size class also fed on *Caenis* mayfly nymphs and hydropsychid caddisfly larvae in low numbers. Gobies in the size class 61-75 mm again had similar food habits, feeding mainly on chironomids, but they had a greater diet breadth than fish in the smaller two size classes, feeding on 13 different food items. Chironomid larvae made up 82.4 percent of the diet of fish 61-75 mm, *Caenis* mayfly nymphs 4.4 percent, beetle

larvae in family Ptilodactylidae made up 3.1 percent, hydroptychid caddisfly larvae 2.2 percent, and water mites, caddisfly larvae in the family Hydroptilidae, and chironomid pupae made up 1.3 percent of the diet. Food items that made up less than 1 percent of the diet were *Stenonema* (family Heptageniidae) mayfly nymphs, caddisfly larvae from the family Polycentropodidae, *Stenelmis* (family Elmidae) beetle larvae and adults, Psephenus (family Psephenidae) beetle larvae, and terrestrial ants (family Formicidae). The fourth size class is comprised of round gobies greater than 75 mm. This size class had a different diet, and the only diet not dominated by chironomids. The most abundant food item of fish in the largest size class were *Caenis* nymphs at 33.3 percent, chironomid larvae 31.1 percent, *Stenonema* nymphs 20.0 percent, caddisfly larvae from the family Limnephilidae 6.7 percent, *Baetis* nymphs 4.4 percent, and fish eggs and stonefly nymphs in the family Perlidae at 2.2 percent.