

A Reexamination of the Mussel Fauna (Bivalvia: Unionidae) of the Olentangy River: Thirty Years
After Hoggarth (1990) and sixty years after Stein (1963)

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Introduction

Stein (1963) completed the first systematic survey of the mussels of the Olentangy River. She recorded the presence of 29 species for the river, three of which were not found alive or as freshly dead shells. Much of her data was based on museum specimens at The Ohio State University Museum of Biological Diversity, and so a species being classified as extirpated in 1963 means that it was only ever collected as a subfossil or weathered shell. The three extirpated species were *Elliptio crassidens* (elephant ear), *Ortmanniana ligamentina* (mucket), and *Epioblasma rangiana* (northern riffleshell). Hoggarth (1990) reported finding one very old dead specimen of *Ligumia recta* (black sandshell), which also would have been extirpated prior to 1963.

Hoggarth (1990) completed the second systematic study of the mussels of the river nearly 30 years later. He noted then, that of the 31 species of mussels reported for the river (he added one living species not found by Stein or extirpated as noted above), one third were extirpated, and an additional third were in peril of being lost. The six species that were extirpated during the 30-year period from 1963 and 1990 were *Alasmidonta viridis* (slippershell), *Simpsonaias ambigua* (salamander mussel), *Theliderma cylindrica* (rabbitsfoot), *Pleurobema clava* (clubshell), *Uniomerous tetralasmus* (pondhorn), and *Obovaria subrotunda* (round hickorynut). The current survey was designed to determine how the mussel fauna has fared over the last 30+ years.

There have been a few, more limited studies, associated with dam removal (Fleece *et al.*, 2013), bridge/pipeline construction (Hoggarth, 1997, 2000, 2002, 2004, 2007, 2009, 2010ab, 2013, 2014, 2015ab; STONE, 2019; EMHT, 2020b, 2021), and one faunal survey that discovered a species thought to be lost from the river (Bolton, 2008), but nothing systematic that examined the mussel fauna from headwaters to mouth. Still, these smaller studies demonstrate that the river remains an important habitat for mussels in central Ohio. This report is a third systematic survey of the mussels of

the Olentangy River employing comparable methods to Hoggarth (1990) and more recent surveys of the Little Miami River (Hoggarth and Goodman, 2007; Hoggarth, 2020). This survey resampled all the sites sampled by Hoggarth (1990) and many of the sites reported on by Stein (1963). Two upstream sites not sampled by Stein (1963) or Hoggarth (1990) also were sampled.

Materials and Methods

A total of 40 sites were sampled from the headwaters to the mouth of the river. Two sites not sampled in 1990 were added upstream of the most upstream site sampled in 1989, and eight sites (sites 31-38) were sampled downstream of the most downstream site sampled in 1989. Sites were surveyed in a linear fashion from headwaters to mouth with no more than two or three sites sampled per day. Each site was sampled by three people for a minimum of two hours (unless no mussels were found). Line transects and quadrat sampling was performed at each site where living or freshly dead shells were found (extant populations of mussels). Where extant mussels were found, a twenty-meter line transect was positioned parallel to the bank with two rows of $\frac{1}{4}$ square meter quadrats sampled in a linear fashion from downstream to upstream along each transect (a total of 10 quadrats were sampled on each side of the line). Mussels collected from each quadrat were identified, counted, recorded, and returned to the river (live mussels) or collected to voucher the species at that location. Specimens of the Asiatic clam (*Corbicula fluminea*) and zebra mussels (*Dreissena polymorpha*) were enumerated along with the mussels. Prior to quadrat sampling, general collecting was performed. During this portion of the study, an area of stream was searched by three collectors for no less than 1 $\frac{1}{2}$ hours and no more than 2 hours (where extant mussels were found). All live mussels found were treated identically to those found in the quadrats. Dead shells were retained as vouchers or identified and returned to the stream.

Prior to conducting the mussel survey, water chemistry data were collected. Turbidity was measured with a HACH Turbidity Meter (NTU), and conductivity was measured using a HACH Sension5 Conductivity Meter (uS/cm). Iron, total Phosphate, Nitrate, and Sulfate concentrations were found using a HACH Field Spectrophotometer (mg/l). The conductivity meter became unreliable at Site 19 and was not used after that.

Results

A total of 32 species of mussels have been recorded for the Olentangy River (Table 1). Twenty-nine species were originally identified for the river by Stein (1963). She found 26 of these species extant with three species already extirpated from the river by the time of her study. Those species were *E. crassidens* (elephant ear), *O. ligamentina* (mucket), and *E. rangiana* (northern riffleshell). Hoggarth (1990) added one species not found by Stein (1963) and collected 20 additional species alive or as freshly dead shells for a total of 21 species extant in the river. He found one very old dead shell of *L. recta* (black sandshell), which he thought was extirpated from the river prior to 1963. Added during that survey was *Lasmigona complanata* (white heelsplitter) and found to be extirpated were *A. viridis* (slippershell), *S. ambigua* (salamander mussel), *T. cylindrica* (rabbitsfoot), *P. clava* (clubshell), *U. tetralasmus* (pondhorn), and *O. subrotunda* (round hickorynut). None of the previous four extirpated species of mussels (including *L. recta*, black sandshell) were found other than as very old dead shells, and so their status did not change in the river. By 1990 there were 10 extirpated species from the river. Note too that Hoggarth (1990) did not find *Cyclonaias tuberculata* (hence only finding 21 extant species with the addition of *L. complanata*), but that species was found alive in the river after he completed his study (Bolton, 2008) and so that species is not treated here as an extirpated species.

During the current study no additional species were determined to be extirpated from the river and one species (*Quadrula quadrula*, mapleleaf) was added to the fauna. This gives a total of 32 species for the river with 22 of these currently represented by viable populations (Table 1). Table 2 (summary reach data) and Table 3 (all data) shows the distribution and abundance of mussels within the river for both the 1990 and 2022 surveys. The distribution areas are 1) headwaters, 2) upper midsection, upstream of Delaware Lake, 3) lower midsection, upstream of Delaware Lake, 4) immediately downstream of Delaware Lake (Scenic River section), and 5) upstream of the mouth of the river with the Scioto River. Area 1 comprised sites 00-9; Area 2 comprised sites 10-13; Area 3 comprised sites 14-19; Area 4 comprised sites 20-30, and Area 5 comprised sites 31-38. Areas 2 and 3 were originally combined (midsection) but were divided due to significant water quality and habitat quality differences between the upper and lower portions of this reach, which resulted in significantly different mussel communities in each reach. Area 4 was divided from Area 5 as it delineates the Scenic River portion of the river and represents the downstream end of the collections made in 1990. Area 5 was not sampled in 1989 (Hoggarth, 1990) but there have been many site-specific mussel surveys (and relocations) in this reach of the river all of which is reviewed here.

Area 1 (Headwaters; from sites 00-9) has suffered the most significant mussel losses in the river (Table 2, Figures 1 & 2). This reach went from a ratio of extant individual mussels to extirpated mussels of 6.6:1 in 1990 to 0.4:1 in 2022. This means that for every old dead shell found in 1990 almost seven living and freshly dead specimens were found while in 2022 old dead shells were almost three times more abundant than extant individuals. This trend continues downstream into Area 2 (upper midsection from sites 10-13) where the ratio of extant to extirpated in 1990 was 4.6:1 and in 2022 1:1. The mussel community improved greatly in Area 3 (lower midsection from sites 14-19) where the ratio was 4.2:1 in 1990 and 5.5:1 in 2022. This trend was continued downstream of

Delaware Lake within the Scenic River section of the river (a ratio of 4.4:1 in 1990 and 5.5:1 in 2022) where the mussel community was more or less stable. No comparison can be made downstream toward the mouth as no mussels were sampled from this reach in 1990, but this study, as well as other studies designed as mitigation for dam removal and bridge construction, show a widely expanded mussel community within this reach. Figure 1 (individuals) and Figure 2 (species) shows that the headwaters and upper midsection of the river have lost diversity while the lower midsection of the river, the Scenic River section of the river, and the reach from the designated reach to the mouth have retained their mussel diversity (upper midsection and scenic river section) or greatly increased mussel diversity (downstream reach). Although not completely responsible, turbidity of the water in the headwaters and immediately below (Figure 3) was shown not to be associated with flow while downstream of Buckeye Lake, turbidity and flow were related as they should be.

Mussels rely on their gills for three major functions during their life cycle: 1) breathing, 2) feeding, and 3) for females, breeding. Water that enters a mussel's shell through their incurrent siphon passes through water tubes that separate the outside from the inside surface of each gill. As the water passes through these tubes, food and particulate material is strained out (filter feeding). Silt (high turbidity) interferes with both processes by clogging the tubes (the flow is required for respiration) and decreasing feeding efficiency by overusing the silt channels on the gills that separate food particles from non-food particles. In addition, many mussels rely on visual methods to attract a fish host and complete their life cycle. Turbidity makes sight-feeding (and as many glochidial packages look like food items for fish) impossible and therefore the transition of glochidia from female mussels to their hosts, improbable. Finally, excess siltation (sedimentation) is known to bury thick-shelled mussel species, and the combination of these has certainly influenced the mussels of the upper Olentangy River. Note from Figure 3 (top graph) that there was no correlation between flow and turbidity: this

means that turbidity is always high and that the impacts associated with turbidity in this reach is always apparent. The same is not true below Delaware Lake where turbidity fluctuates with flow: certainly, turbidity and sedimentation are problems downstream as well, but not to the extent that they are upstream.

Species Accounts

Subfamily Anododontinae

Utterbackia imbecillis (paper pondshell) – Stein (1963) noted that this species was common downstream of Dodridge and present but less common upstream. That is essentially the same as was found in 1990 and again this year. The species was very abundant in the impoundment behind the 5th Avenue Dam but has retained its presence in both the headwaters and downstream reaches of the river. This is a pond or slack-water species that lives in mud. Howard (1914, 1915) reported finding juvenile specimens in the gills (marsupia) of a female paper pondshell, and so it is possible that this species could be more abundant upstream than was found if it does not require a fish host for completion of its life cycle. However, Tucker (1927, 1928) was able to show transformation of glochidia into juvenile mussels on bluegill sunfish (*Lepomis macrochirus*). In any event, this species seems to be holding its own in the Olentangy River.

Pyganodon grandis (common floater) – The common floater is one of the two most abundant, and widely distributed, species of mussel in Ohio. It is usually found in slow-moving and even still water but also can be found in faster flowing water in streams. It employs a wide variety of fish hosts. Stein (1963) identified it as the most widely distributed and most abundant mussel in the river. It was widely distributed and abundant in 1990 and during this survey. It was found from site #0 in Galion to the mouth of the river (site #38). Both this species and *U. imbecillis* are probably abundant in

Delaware Lake as both species can become abundant in impoundments. This species and *Lampsilis siliquoidea* (fatmucket) described below demonstrate the current distribution of mussels in the system well: they were more abundant in the headwaters in 1990 than 2022, are now found more often as weathered and subfossil shells upstream of site #14 and are doing well downstream of Delaware Lake.

Anodontoidea ferussacianus (cylindrical papershell) is a headwaters species that was not found downstream of site #6 in 1990 or 2022 (other than one living specimen found in the receding waters of the 5th Avenue impoundment). It is one of the species that has lost distribution and abundance as the headwaters of the river have suffered from excessive sedimentation and agricultural development. Stein (1963) noted that this species was limited to the headwaters of the river and as such it is in danger of being lost.

Strophitus undulatus (creeper) was historically common and widespread in the river (Stein, 1963) being reported from 30 of her 45 sites. Today, it still would be described as widespread but not abundant. It was collected alive from each section of the river, except the upper midsection and it is one of the headwaters species that has survived, although in fewer numbers. It is a species that can inhabit a wide range of habitats and substrate types. It is as often found in run habitats and among the rhizomes of water willow (*Justicia americana*) as other, more sensitive species, however, it can be found in slow and slack-water habitats as well. As was true for *P. grandis* (common floater), it uses many fish species as host for their larvae, which may account for the range of habitat available to this species.

Alasmidonta viridis (slippershell) is another headwaters species that has suffered due to environmental degradation of the upper Olentangy River. According to Stein (1963) this little mussels is most often found in coarse gravel in strong current: that type of habitat is very rare today in the headwaters of the river. Almost all the gravel substrate is either buried or filled with fine sediment

making it unavailable for this mussel. This species was only collected as weathered or subfossil shells in 1990 and only one subfossil specimen of this species was found during the current survey. The species is extirpated from the river today.

Alasmidonta marginata (elktoe), the large-stream equivalent of *A. viridis* (slipershell), has not suffered the same fate as its smaller cousin. This is undoubtedly because the coarse gravel substrates in fast water within the lower sections of the river remain. Stein (1963) noted that she only found three specimens upstream of Delaware Lake, however in 1990, the species was encountered in large numbers as far upstream as site #10. No freshly dead or living specimens of this species were collected upstream of the impoundment during the current survey. The species is doing well downstream of Delaware Lake and demonstrates one of the themes of this study: the impact of Delaware Lake on the mussel fauna of the Olentangy River. Very few mussels were found alive or as freshly dead shells at the two sites immediately upstream or downstream of the impoundment in 2022 suggesting the impoundment separates and isolates the two mussel communities and serves as a barrier to repopulation, especially of the headwaters. However, it also functions as a base level for the river where the sedimentation issues associated with the upstream portion of the river are mitigated by the slack-water lake. Figure 3 clearly shows that turbidity upstream of the impoundment was not related to flow (as it should be) while it shows the expected outcome below the impoundment: that is that as river levels climb due to a rain event, turbidity increases as well. The opposite also is true, as stream level recedes, turbidity decreases.

Lasmigona costata (fluted-shell) was, and remains, one of the most common species of mussel in the Olentangy River. It is found throughout the lower portion of the river and in the favorable areas upstream of Delaware Lake. During this survey it was found to be extant from site #6 to site #37. This species demonstrates a similar pattern to *A. marginata* (elktoe), the only difference being that the

species is still extant upstream of the impoundment and doing well within the lower midsection of the river.

Lasmigona compressa (creek heelsplitter) is another headwaters species (although not strictly so as are *A. viridis* (slippershell) and *A. ferussacianus* (cylindrical papershell)) that has suffered a complete loss in the headwaters of the river. It was widely distributed but rare during Stein's (1963) study, was narrowly distributed (sites #10-#12) and rare in 1990 and absent from the river other than one live specimen collected at Highbanks Metropark during the current survey. It should be noted that this species always seems to be rare wherever it is found and so finding just a few specimens is not unusual. EMHT (2020a) reported finding three living specimens of this species near the OSU Hospitals off ramp from USR 23, but the photograph of the specimen in that document is of *L. costata* (fluted-shell) and so the data in their report were not included in this report.

Lasmigona complanata (white heelsplitter) was not reported for the river by Stein (1963). However, given the large size of this mussel and the facts that it has been increasing in distribution across the state due to its preference for soft substrate (which has become more abundant across the state), and its tendency to live near the margins of streams where it is highly visible, suggests that Stein (1963) did not miss the species, but that the species was not present in the system in 1963. It was narrowly introduced prior to 1990 (one live specimen was found at site #26) but is more broadly distributed today (from site #22 to site #38) and is the most abundant mussel in the Olentangy River today. Dodridge Dam (at site #34) has not blocked the distribution of this mussel and as noted the first introduction of this mussel was upstream of this dam. This species is abundant in the Scioto River, which accounts for its distribution from the mouth of the Olentangy to Dodridge Dam and since fish are not blocked from upstream (they can go over the dam during high water events), it is probable that the

species gained access to the river via a bait-bucket introduction (as glochidia on one or more fish hosts) and have found suitable habitat in the river ever since.

Simposonaias ambigua (salamander mussel) was rare in the Olentangy River in 1963 (Stein, 1963) and was not collected in 1990 or during the current survey. Stein's records are based on two freshly dead specimens collected by David Stansbery in 1960 and 1962. The species no longer occurs in the Olentangy River and it is unknown if the mudpuppy (*Necturus maculosus*) still exists in the river. Unlike other species of mussels, who use fish as host, the salamander mussel uses the mudpuppy and so the absence of the mussel may foretell the absence of its host. However, since the species uses the mudpuppy and the mudpuppy spends most of its time under large flat rocks or submerged logs, it might still be present in the river, but mostly hidden.

Subfamily Ambleminae

Amblema plicata (threeridge) was distributed throughout the mainstem of the Olentangy River except at the two most headwater sites (Stein, 1963). It was still present in both headwaters and downstream in 1990 and has been eliminated from the headwaters today. It is still a member of the mussel community upstream of Delaware Lake (in the lower midsection of the river) and is doing very well, especially from the Dodridge Dam downstream, in the Scenic and lower portion of the river.

Quadrula quadrula (mapleleaf) is a relatively new arrival to the Olentangy River. It was not collected by Stein and was not represented by specimens collected from the river at The Ohio State University Museum of Biological Diversity (Stein, 1963). It was not found during the survey in 1989 (Hoggarth, 1990). However, this species is very common today in the Scioto River in Columbus (STONE & TRC, 2019a, b). In this case, one freshly dead shell of this species was found at the Sharron Township Nature Preserve (Site 32) while all other specimens were found downstream of Dodridge Dam. It is apparent that the dam has blocked migration of this species upstream. Generally,

it uses catfish as host and it seems likely that someone fishing at the dam released one or more catfish into the dam pool behind the dam.

Theliderma cylindrica (rabbitsfoot) was last found alive in the Olentangy River in 1961 by Mr. Boker between Graceland Shopping Center and the Henderson Road Bridge (my sites #32 and #33) (Stein, 1963). Since then, the species has been reported only as weathered and subfossil shells (OSUM database, 2022). Ten weathered/subfossil shells were found in 1990 and five were found during the current survey. The species once ranged from upstream of Delaware Lake to the vicinity of Henderson Road but is now extirpated from the river. It is listed as a federally threatened and Ohio endangered species.

Cyclonaias tuberculata (purple pimpleback) is most abundant today in the vicinity of the Panhandle Road Bridge in Delaware, Ohio. In 1963 only five specimens were known from the river (Stein, 1963). Hoggarth (1990) was unable to find the species alive during that survey, but Bolton (2008) found 14 specimens (including 11 living specimens) from the Panhandle Road Bridge area and Hoggarth (2015a) found six living and one freshly dead specimen from the same area. One freshly dead specimen was found during the current survey at this site. This species has maintained a viable population at this location.

Fusconaia flava (Wabash pigtoe) had a similar distribution to *A. plicata* (threeridge) according to Stein (1963). Both species extended farther into the headwaters than any other species and extended downstream of Delaware Lake, although *F. flava* (Wabash pigtoe) stopped near the Henderson Road Bridge while *A. plicata* (threeridge) continued downstream. This species appears to be holding its own in the lower midsection of the river and is now more abundant downstream than in previous surveys of the mussel fauna of the river. In the Olentangy River specimens of the Wabash pigtoe (*F. flava*) and the round pigtoe (*Pleurobema sintoxia*) are exceedingly difficult to distinguish.

Pleurobema clava (clubshell) is a federally and Ohio endangered species. Two freshly dead specimens were found in 1960 in Worthington (Stein, 1963) but all other material in the Museum of Biological Diversity at OSU is weathered or subfossil shells. It has not been collected alive from the river and it thought to be extirpated today.

Pleurobema sintoxia (round pigtoe) ranged from middle Marion County to the 5th Avenue Bridge. One freshly dead specimen was found at the Route 529 Bridge (site #14) in 1990 and other extant specimens were collected from the river in the vicinity of the 5th Avenue Bridge during the current survey. As noted above, this species is sometimes very difficult to distinguish from *F. flava* (Wabash pigtoe) and, both species are in decline in the river, but holding on in the lower portion of the Olentangy.

Euryntia dilatata (spike) is one of the most resilient mussels in Ohio. It was widely distributed, but only locally abundant in the upper and lower midsections of the river (above Delaware Lake) in 1990 and has remained abundant in the lower midsection of the river (immediately upstream of Delaware Lake). Stein (1963) noted that it was most abundant in the lower portion of the river (that was not the case in 1990 or in the current survey) but that the species did venture upstream as well. Siltation and sedimentation impacts appear to have been too much for the species in the upper midsection of the river but it still very abundant downstream of Clarion where conservation efforts have maintained a more stream-like river (composed of riffle, run, and pool habitats with fairly clear water and gravel and sand substrates).

Elliptio crassidens (elephant ear) was believed to be extirpated from the river by Stein (1963) and there has been no evidence to the contrary since then. One subfossil specimen of this species was collected by David Stansbery from downstream of Dodridge Dam in 1959. That remains the only specimen of this species reported for the river.

Unio merous tetralasmus (pondhorn) is a western prairie species that is periodically reported in Ohio. Stein (1963) noted that it was relatively abundant between the 5th and 3rd avenue bridges, and she reported finding it both alive and as freshly dead shells. It has only been taken as weathered dead shells since. This species is extirpated from the Olentangy River today.

Subfamily Lampsilinae

Ptychobranthus fasciolaris (kidneyshell) was distributed from site #21 to the mouth of the Olentangy River in 1990 and from site #22 to the mouth of the river this year. It has not been a dominant member of the community, but its distribution and abundance appear to be stable. Stein (1963) came to the same conclusion: the species was relatively widespread in the lower portion of the river but not abundant wherever found. As much as any other species, the kidneyshell speaks to the continued, and even improving, water and habitat quality of the lower Olentangy River downstream of Delaware Dam. It is a species that generally buries into the substrate and indicates fairly good water quality. Both adults and juveniles were found during the current survey.

Ortmanniana ligamentina (mucket) has never been collected alive or as a freshly dead shell from the Olentangy River. Four subfossil specimens collected in the 1950s and 1960s represent all the specimens of this species collected from the river. This species was extirpated from the river prior to Stein (1963) and has not had access since and is not a part of the river's unionid fauna today. It is also not part of the Scioto River's mussel fauna upstream of Greenlawn Dam and so will probably not be present in the Olentangy River for many, if any, years.

Toxolasma parvum (Lilliput) is a slack-water species that lives in the fine silt at the surface of the substrate. It is often found at the end of long trails in this fine sediment as it seems to be constantly on the move. Stein (1963) suggests that this species is like *A. viridis* (slippershell) in that it was widely distributed, but not abundant, in the headwaters of the river but then it reappeared downstream of the

5th Avenue Dam (perhaps as specimens from a source population in the impoundment upstream of this dam). In 1990 (Hoggarth, 1990) a few scattered specimens were found in the headwaters of the river, however by 2022 those specimens were lost but there were specimens found in the lower portion of the river downstream of Dodridge Dam. The species appears to be holding on in the lower portion of the river but has been lost, with other losses, from the headwaters.

Obovaria subrotunda (round hickorynut) was not collected from the river in 1990 (Hoggarth, 1990) but was reported as a weathered or subfossil specimen during the current survey. Stein (1963) was unable to find the species alive during her survey but did note that she did find a few freshly dead shells. These shells were found between Delaware Lake and Dodridge Dam. The species is now extirpated from the river.

Ligumia recta (black sandshell) was not collected from the river by Stein (1963) or reported from the collections of The Ohio State University Museum of Biological Diversity. It was not collected during the current survey. A single weathered specimen was collected from site # 21 (downstream of Delaware Lake) in 1989 (Hoggarth, 1990), and this species is believed to be extirpated from the river today.

Paetulunio fabalis (rayed bean) is a federally endangered species that was first reported for the Olentangy River by Stein (1963). She collected living and freshly dead specimens from the river near the Route 23 Bridge and identified this reach as the center of the population of this species in the river. The species still exists upstream of Delaware Lake (site #14) but was not found alive or as a freshly dead shell downstream of the lake in the vicinity of the Route 23 Bridge during the current survey or during the earlier one (Hoggarth, 1990).

Cambarunio iris (rainbow) was more abundant and more widespread than its former congener (both *fabalis* and *iris* were in the genus *Villosa*). It still is. Stein (1963) found it to be widespread but

uncommon throughout the system and Hoggarth (1990) found it mostly from sites #11 to #14 (midsection of the river). During the current survey, the rainbow was found in good numbers in the lower midsection of the river (from sites #14 and #16). It was one of the more common members of the community at both sites.

Lampsilis siliquoidea (fatmucket) was the most common mussel found in the current survey. It was found alive from the furthest upstream site (site #00) to the mouth of the river. It was often the only living, or freshly dead, mussel found at a site, and it clearly demonstrated the minimum of environmental quality necessary in the river to support mussels. It was found in the headwaters where mussels could be found. It was found in the lower midsection of the river, and it was found to be widely distributed in the Scenic River section of the river and downstream within Columbus. Stein (1963) and Hoggarth (1990) found it to be similarly distributed and abundant.

Lampsilis cardium (plain pocketbook) had a similar distribution as *L. costata* (fluted-shell) and *A. plicata* (threeridge) (Stein, 1963). It has maintained that distribution to the 1990s and today. It is not as abundant as *L. siliquoidea* (fatmucket) but seems to be doing well in the lower midsection, Scenic River section, and lower portion of the river. Some female specimens were observed with mantle flaps extended, an indication that the species is reproducing in the river. Stein (1963) found this species in the lower headwaters of the river but it has been eliminated from that section today. This species is mostly found in run habitats where females attract their fish host by employing minnow-like mantle flaps. The excessive siltation (and constant turbidity) within the headwaters and upper midsection of the river have eliminated this species from these areas.

Lampsilis fasciola (fine-rayed lampmussel) is a riffle species of *Lampsilis*. It is generally more uncommon than *L. cardium* (plain pocketbook) but usually as widely distributed in medium sized rivers (not a headwaters species). All extant specimens of this species were found in the lower portion

of the river in 1990 (Hoggarth, 1990) and most living and freshly dead specimens encountered during this survey were found there as well. *Lampsilis fasciola* (fine-rayed lampmussel) females also employ a colored mantle flap during reproduction and require clear water to attract their sight-feeding hosts.

Epioblasma rangiana (northern riffleshell) is a federally listed endangered species that was eliminated from the Olentangy River prior to 1963 (Stein, 1963). Four old dead shells of this species were represented by specimens in The Ohio State University Museum of Biological Diversity prior to 1963 and only one subfossil specimen has been collected from the river since (site #36). This species was extirpated from the river prior to 1963 and still is absent.

Epioblasma triquetra (snuffbox) is a federally listed endangered species that has remained in the Olentangy River. A new population of this species (represented by two freshly dead shells and one live animal) was found in Marion County at site #14. That site also yielded one freshly dead specimen of *P. fabalis* (bean shell). Stein (1963) noted that this species was relatively common in the Olentangy River and had a similar distribution as *L. fasciola* (fine-rayed lampmussel). Both are riffle dwelling species, employ sight methods to attract a fish host, and are triply impacted by excessive siltation: 1) clog their gills, interfering with feeding and gas exchange, 2) reduce light penetration, interfering with reproduction, and 3) overworking feeding channels on the gills with sediment, interfering with feeding and causing excessive use of energy while feeding.

Discussion

Higgins (1858) was an avid collector of mussels and the first person to collect them from the Scioto River and its tributaries in central Ohio and move shells to a museum collection. Today, these shells are in the collection of The Ohio State University Museum of Biological Diversity. Higgins (1858) collected some of these shells from the Olentangy River and commented, in some cases, on the

abundance and distribution of species in the river. Stansbery (mid to late 1950s-1960s) provided the next snapshot of the mussels of the river, all of which was summarized by Stein (1963). Stein reported 29 species of mussels for the river. She noted that three of these species had already been lost: *E. crassidens* (elephant ear), *O. ligamentina* (mucket), and *E. rangiana* (northern riffleshell). Hoggarth (1990) provided the next snapshot. He collected 24 species, including one not previously found in the river (see above) (*L. complanata*, white heelsplitter) and others believed to be extirpated from the river today (*A. viridis*, slippershell; *S. ambigua*, salamander mussel; *T. cylindrica*, rabbitsfoot; *P. clava*, clubshell; *U. tetralasmus*, pondhorn; *O. subrotunda*, round hickorynut; and *L. recta*, black sandshell). The purple pimpleback (*C. tuberculata*) was not collected by Hoggarth (1990) but was re-discovered during the current survey and found by Bolton (2008) at one site on the river. During the current survey no new species were found to be extirpated from the river and one species was found for the first time. That species, *Q. quadrula* (mapleleaf) is very abundant downstream within the Scioto River (STONE & TRC, 2019ab) and has moved upstream from the mouth of the river to Dodridge Dam.

The current condition of the mussel community of the Olentangy River is divided by section. The upper section (headwaters) has suffered an almost complete loss of mussels, and the upper midsection of the river has followed the headwaters. Immediately downstream, the lower midsection of the river has retained mussel species diversity and abundance. Delaware Lake has served as a barrier and isolator of mussels and negatively influenced the community immediately upstream (two upstream sites) and immediately downstream (two downstream sites). Downstream of Delaware Lake, the Scenic River section of the river has retained its diversity and abundance, and the lower section of the river has increased its diversity of mussels. Certainly, agricultural development has impacted the upper river, while conservation efforts have preserved the mussels of the upper midsection and Scenic River section. Improved water and habitat quality downstream of the Scenic River section has

increased the diversity and abundance of mussels in this section. Communities, like mussel communities are resilient and it is possible if conditions improve, that the mussel communities in the headwaters can be restored. Perhaps, some of the tributaries have retained some of the headwaters' species that could ultimately repopulate these sections of the river once it has been restored. Improved water quality (especially reduced siltation) is necessary to restore the mussel community.

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Table 1. History of the study of the mussels of the Olentangy River: Stein (1963), Hoggarth (1990), and the current survey (2022).

			1963	1990	2022
1	<i>Utterbackia imbecillis</i>	paper pondshell	Yes	Yes	Yes
2	<i>Pyganodon grandis</i>	common floater	Yes	Yes	Yes
3	<i>Anodontoides ferussacianus</i>	cylindrical papershell	Yes	Yes	Yes
4	<i>Strophitus undulatus</i>	creeper	Yes	Yes	Yes
5	<i>Alasmidonta viridis</i>	slippershell	Yes	No	No
6	<i>Alasmidonta marginata</i>	elktoe	Yes	Yes	Yes
7	<i>Lasmigona costata</i>	fluted-shell	Yes	Yes	Yes
8	<i>Lasmigona compressa</i>	creek heelsplitter	Yes	Yes	Yes
9	<i>Lasmigona complanata</i>	white heelsplitter	NA	Yes	Yes
10	<i>Simpsonaias ambigua</i>	salamander mussel	Yes	NA	NA
11	<i>Amblema plicata</i>	threeridge	Yes	Yes	Yes
12	<i>Quadrula quadrula</i>	mapleleaf	NA	NA	Yes
13	<i>Theliderma cylindrica</i>	rabbitsfoot	Yes	No	No
14	<i>Cyclonaias tuberculata</i>	purple pimpleback	Yes	NA	Yes
15	<i>Fusconaia flava</i>	Wabash pigtoe	Yes	Yes	Yes
16	<i>Pleurobema clava</i>	clubshell	Yes	No	No
17	<i>Pleurobema sintoxia</i>	round pigtoe	Yes	Yes	Yes
18	<i>Eurynia dilatata</i>	spike	Yes	Yes	Yes
19	<i>Elliptio crassidens</i>	elephant ear	No	NA	NA
20	<i>Unio merous tetralasmus</i>	pondhorn	Yes	NA	No
21	<i>Ptychobranhus fasciolaris</i>	kidneyshell	Yes	Yes	Yes
22	<i>Ortmanniana ligamentina</i>	mucket	No	NA	NA
23	<i>Toxolasma parvum</i>	Lilliput	Yes	Yes	Yes
24	<i>Obovaria subrotunda</i>	round hickorynut	Yes	NA	NA
25	<i>Ligumia recta</i>	black sandshell	NA	No	NA
26	<i>Paetulunio fabalis</i>	rayed bean	Yes	Yes	Yes
27	<i>Cambarunio iris</i>	rainbow	Yes	Yes	Yes
30	<i>Lampsilis siliquoidea</i>	fat mucket	Yes	Yes	Yes
28	<i>Lampsilis cardium</i>	plain pocketbook	Yes	Yes	Yes
29	<i>Lampsilis fasciola</i>	fine-rayed lampmussel	Yes	Yes	Yes
31	<i>Epioblasma rangiana</i>	northern riffleshell	No	NA	NA
32	<i>Epioblasma triquetra</i>	snuffbox	Yes	Yes	Yes
	Total extant species		26	20	22
	Total extirpated species		4	10	10

Yes – collected alive or freshly dead (extant species), No – collected as a weathered or subfossil shell only (extirpated species), NA – Not Applicable (was not collected during this survey)

Table 2. Distribution of extant and extirpated mussels from the Olentangy River.

	1963			1990				2022											
		1-E	1-X	2-E	2-X	3-E	3-X	4-E	4-X	1-E	1-X	2-E	2-X	3-E	3-X	4-E	4-X	5-E	5-X
<i>U. imbecillis</i>	+	1	0	1	0	1	1	1	1	0	1	1	0	1	0	20	2	762	1
<i>P. grandis</i>	+	43	0	33	1	29	1	14	1	1	9			2	1	21	5	894	0
<i>A. ferussacianus</i>	+	20	1							2	2							1	0
<i>S. undulatus</i>	+	7	0	53	0	13	0	5	2	3	3	0	1	10	7	7	4	50	0
<i>A. viridis</i>	+	0	5	0	2									0	1				
<i>A. marginata</i>	+			20	0	12	0	28	0					1	1	26	9	45	10
<i>L. costata</i>	+	0	11	15	0	5	1	0	12	1	1	0	2	16	7	18	4	160	6
<i>L. compressa</i>	+			4	0											1	0		
<i>L. complanata</i>	-							1	0							99	6	2787	4
<i>S. ambigua</i>	+																		
<i>A. plicata</i>	+	24	1	3	28	2	2	10	2	0	0	1	11	6	51	7	1291	1	
<i>Q. quadrula</i>	-																	83	0
<i>T. cylindrica</i>	+			0	1	0	1	0	8				0	1	0	4			
<i>C. tuberculata</i>	+																		
<i>F. flava</i>	+	0	5	1	6	0	2	0	2	0	0	1	1	1	4	3	68	3	
<i>P. clava</i>	+					0	1											0	1
<i>P. sintoxia</i>	+	0	2	0	2	1	1	0	1					1	2	1	5	9	3
<i>E. dilatata</i>	+	0	1	135	27	11	2	68	13			11	4	139	1	38	9	4	6
<i>E. crassidens</i>	-																		
<i>U. tetralasmus</i>	+																	0	1
<i>P. fasciolaris</i>	+							35	3			0	1	1	3	27	11	6	2
<i>O. ligamentina</i>	-																		
<i>T. parvum</i>	+	1	0	1	1	1	1											9	0
<i>O. subrotunda</i>	+																	0	1
<i>L. recta</i>	-							1											
<i>P. fabalis</i>	+			3	3	0	4	2	7					1	5				

Table 2. Distribution of extant and extirpated mussels from the Olentangy River. – continued -

	1963		1990					2022													
			1-E	1-X	2-E	2-X	3-E	3-X	4-E	4-X	1-E	1-X	2-E	2-X	3-E	3-X	4-E	4-X	5-E	5-X	
<i>C. iris</i>	+				18	14	3	2	0	2					31	1	0	2	0	1	
<i>L. siliquoides</i>	+		102	4	139	1	38	3	54	3		7	17	4	4	53	6	54	15	1766	5
<i>L. cardium</i>	+				1	2	2	1	38	6				0	1	20	1	123	10	270	3
<i>L. fasciola</i>	+				0	1	0	1	44	2				0	1	0	1	52	4	85	2
<i>E. rangiana</i>	-																			0	1
<i>E. triquetra</i>	+				2	4	0	4	1	2					4	8	0	1	0	3	
Total			198	30	429	93	118	28	301	68	14	33	16	16	292	53	564	102	8290	57	

1963 (Stein, 1963), 1990 (Hoggarth, 1990), 2022 (current study)

1-E – Area 1, extant; 1-X – area 1, extirpated. Ratio of extant to extirpated specimens is 198/30 = 6.6:1 (1990) and 14/33 = 0.4:1 (2022)
 2-E – Area 2, extant; 2-X – area 2, extirpated. Ratio of extant to extirpated specimens is 429/93 = 4.6:1 (1990) and 16/16 = 1:1 (2022)
 3-E – Area 3, extant; 3-X – area 3, extirpated. Ratio of extant to extirpated specimens is 118/28 = 4.2:1 (1990) and 292/53 = 5.5:1 (2022)
 4-E – Area 4, extant; 4-X – area 4, extirpated. Ratio of extant to extirpated specimens is 301/68 = 4.4:1 (1990) and 564/102 = 5.5:1 (2022)
 5-E – Area 5, extant; 5-X – area 5, extirpated.

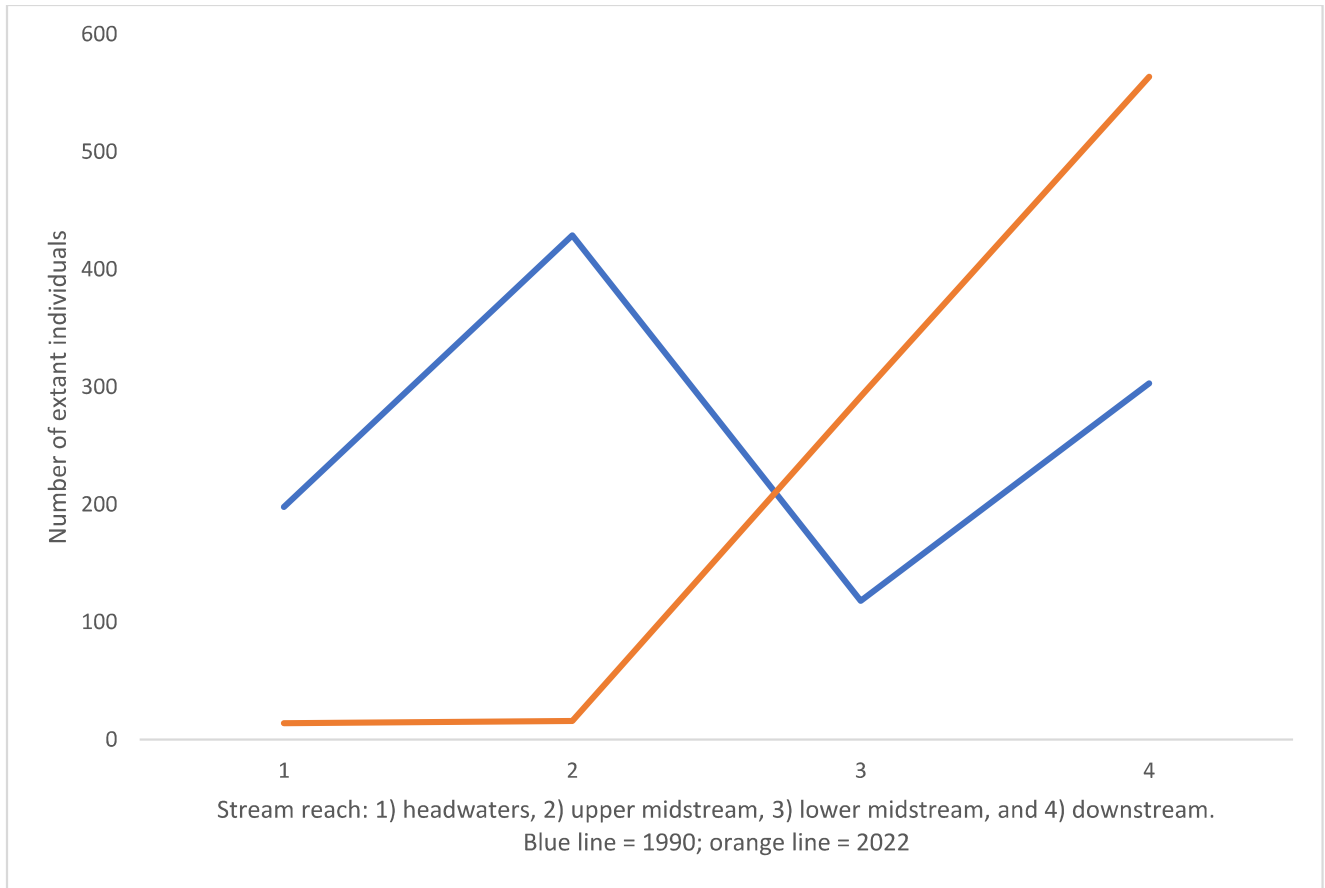


Figure 1. Number of living or freshly dead (extant) individual mussels collected from the Olentangy River in 1990 (blue line) and 2022 (orange line).

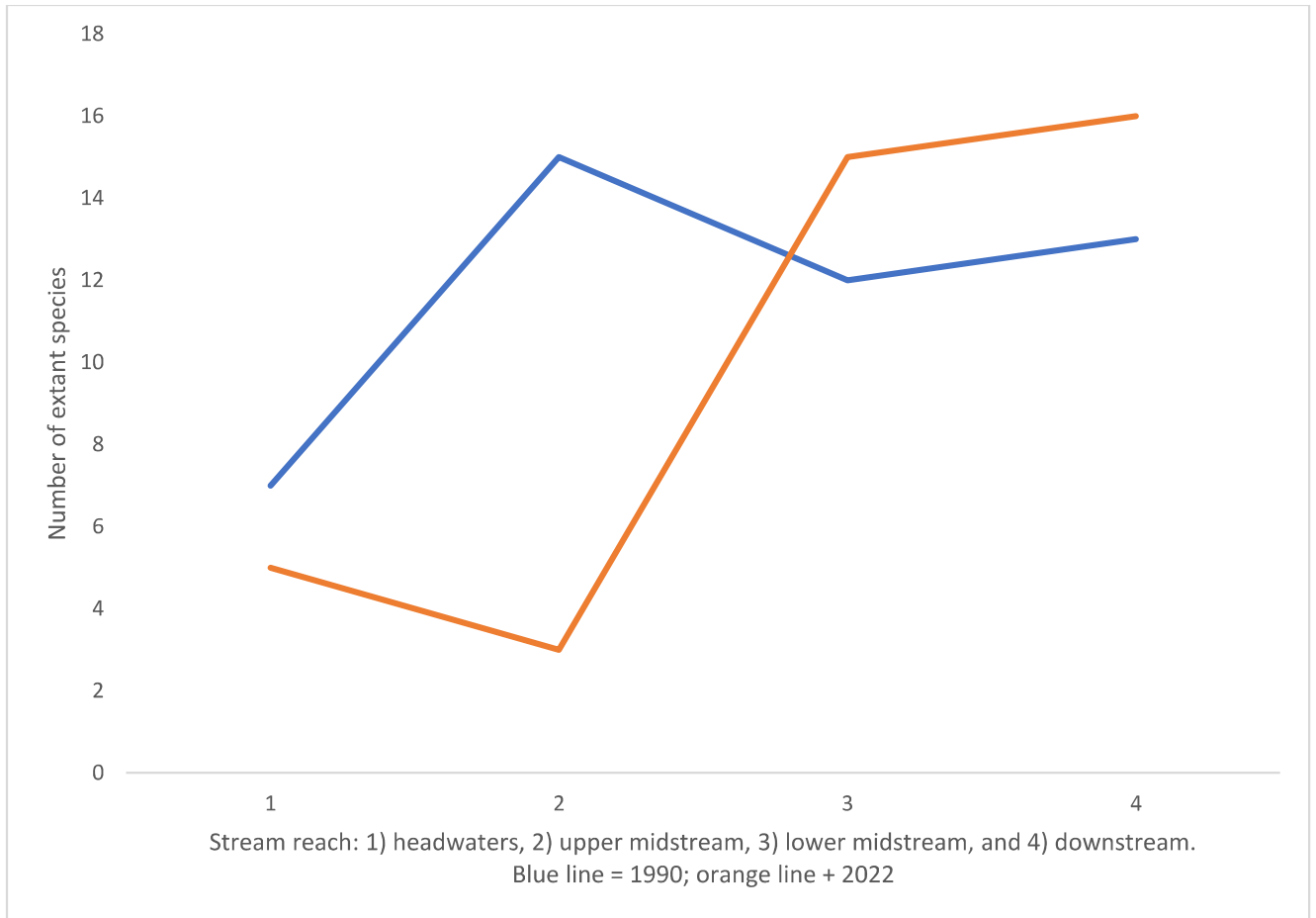


Figure 2. Number of species represented by living or freshly dead (extant) individual mussels collected from the Olentangy River in 1990 (blue line) and 2022 (orange line).

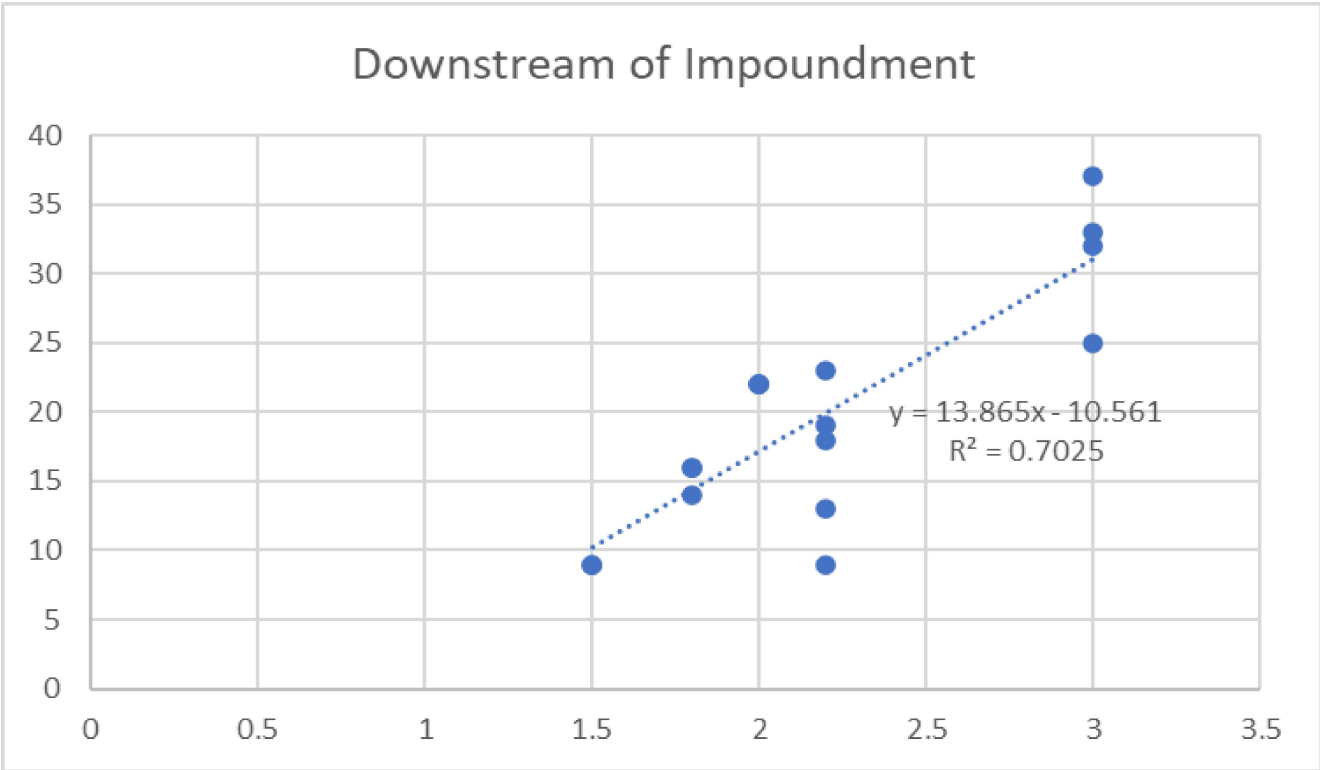
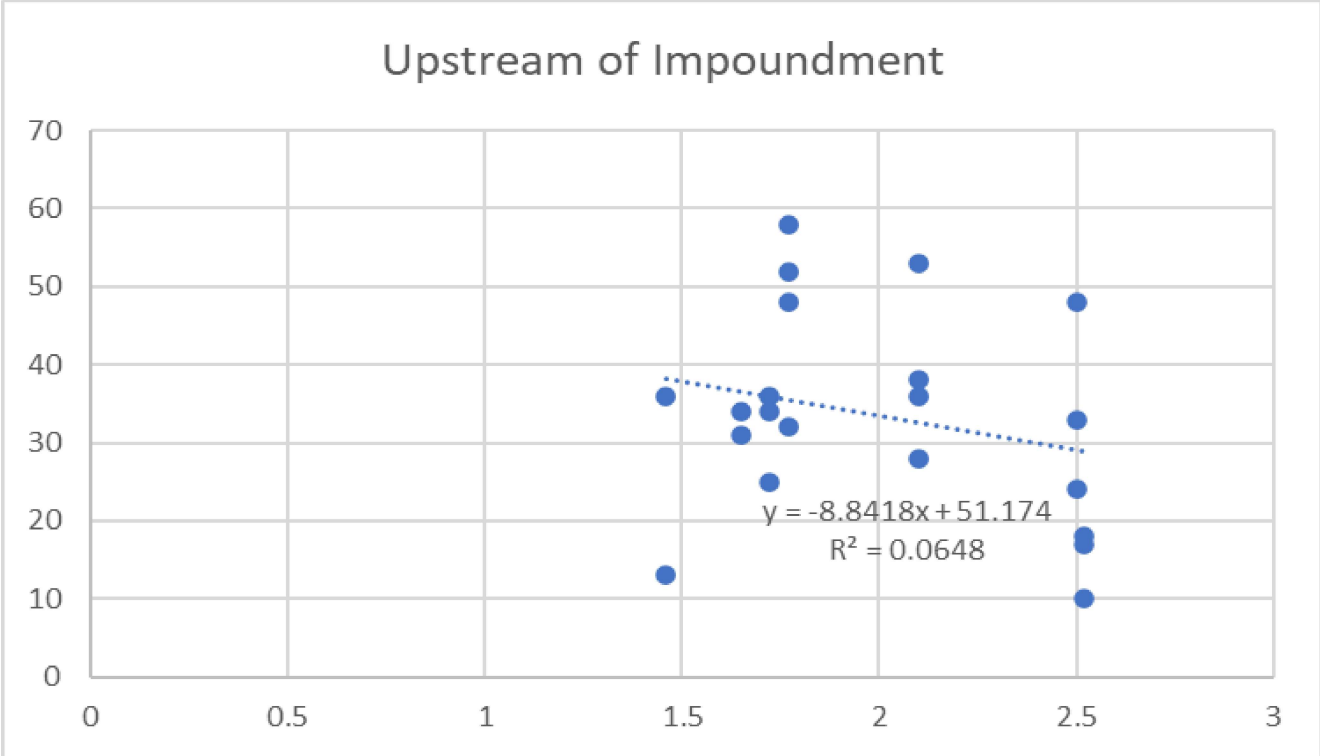


Figure 3. Relationship between turbidity (y-axis) and flow in stream gage height (x-axis) upstream of Delaware Lake (upper graph) and downstream of Delaware Lake (lower graph).

Appendix 1: The Mussel Data

Site 00. Olentangy River at Cobey Park in Galion, Crawford County, Ohio. 40.736752°
-82.775572°.

	Not sampled in 1989					25 May 2022				
	Live	FD	WD	Sub	Total	Live	FD	WD	Sub	Total
1. <i>Lampsilis siliquoidea</i>	--	--	--	--	--	2	0	0	1	3
Total	--	--	--	--	--	2	0	0	1	3
Total Extant Species	--					1				
Total Extirpated Species	--					0				
Total Extant Individuals	--					2				
Total Extirpated Individuals	--					1				
<i>Corbicula fluminea</i>	--					0	3	0	0	3
Mussel density – 0 mussels/5m ² (0/m ²)										<i>Corbicula</i> density – 0 <i>Corbicula</i> /5m ² (0/m ²)

Site 0. Olentangy River at Heise Park in Galion, Crawford County, Ohio. 40.737109°
-82.798023°.

	Not sampled in 1989					25 May 2022				
	Live	FD	WD	Sub	Total	Live	FD	WD	Sub	Total
1. <i>Utterbackia imbecillis</i>	--	--	--	--	--	0	0	1	0	1
2. <i>Pyganodon grandis</i>	--	--	--	--	--	0	0	0	1	1
3. <i>Lampsilis siliquoidea</i>	--	--	--	--	--	0	0	0	1	1
Total	--	--	--	--	--	0	0	1	2	3
Total Extant Species	--					0				
Total Extirpated Species	--					3				
Total Extant Individuals	--					0				
Total Extirpated Individuals	--					3				
<i>Corbicula fluminea</i>	--					0	0	0	0	0
Mussel density – 0 mussels/5m ² (0/m ²)										<i>Corbicula</i> density – 0 <i>Corbicula</i> /5m ² (0/m ²)

Site 1. Olentangy River at TR 93 (Taylor Road) Bridge, Polk Township, Crawford County, Ohio.
40.723580° -82.834741°.

	16 September 1989					25 May 2022				
	Live	FD	WD	Sub	Total	Live	FD	WD	Sub	Total
1. <i>Pyganodon grandis</i>	0	0	0	0	0	0	0	1	0	1
2. <i>Anodontoides ferussacianus</i>	0	0	0	0	0	0	1	0	0	1
3. <i>Strophitus undulatus</i>	0	0	0	0	0	0	1	0	0	1
4. <i>Lampsilis siliquoidea</i>	0	0	0	0	0	1	0	0	0	1
Total	0	0	0	0	0	1	2	1	0	4
Total Extant Species	0					3				
Total Extirpated Species	0					1				
Total Extant Individuals	0					3				
Total Extirpated Individuals	0					1				
<i>Corbicula fluminea</i>	0	0	0	0	0	3	0	0	0	3
Mussel density – 0 mussels/5m ² (0/m ²)										<i>Corbicula</i> density – 3 <i>Corbicula</i> /5m ² (0.6/m ²)

Site 2. Olentangy River at TR 87 (Shearer Road) Bridge, Whetstone Township, Crawford County, Ohio. 40.747766° -82.871180°.

	16 September 1989					26 May 2022				
	Live	FD	WD	Sub	Total	Live	FD	WD	Sub	Total
1. <i>Pyganodon grandis</i>	0	5	0	0	5	0	0	1	0	1
2. <i>Anodontoides ferussacianus</i>	1	1	0	0	2	0	0	0	0	0
3. <i>Strophitus undulatus</i>	0	1	0	0	1	0	0	2	0	2
4. <i>Alasmidonta viridis</i>	0	0	2	0	2	0	0	0	0	0
5. <i>Lasmigona costata</i>	0	0	1	0	1	0	0	0	0	0
6. <i>Amblema plicata</i>	0	0	1	0	1	0	0	0	0	0
7. <i>Fusconaia flava</i>	0	0	2	0	2	0	0	0	0	0
8. <i>Eurynia dilatata</i>	0	0	1	0	1	0	0	0	0	0
9. <i>Lampsilis siliquoidea</i>	1	0	1	0	2	1	0	4	0	5
Total	2	7	8	0	17	1	0	7	0	8
Total Extant Species						1				
Total Extirpated Species						2				
Total Extant Individuals						1				
Total Extirpated Individuals						7				
<i>Corbicula fluminea</i>	0	0	0	0	0	38	0	0	0	38
Mussel density – 0 mussels/5m ² (0/m ²)						Corbicula density – 35 Corbicula/5m ² (7/m ²)				

Site 3. Olentangy River at TR 154 (Snyder Road) Bridge, Whetstone Township, Crawford County, Ohio. 40.754844° -82.897020°.

	16 September 1989					26 May 2022				
	Live	FD	WD	Sub	Total	Live	FD	WD	Sub	Total
1. <i>Pyganodon grandis</i>	1	14	0	0	15	0	1	3	0	4
2. <i>Anodontoides ferussacianus</i>	1	14	0	0	15	0	1	1	0	2
3. <i>Strophitus undulatus</i>	0	1	0	0	1	0	1	0	0	1
4. <i>Alasmidonta viridis</i>	0	0	1	0	1	0	0	0	0	0
5. <i>Lampsilis siliquoidea</i>	1	3	0	0	4	0	3	3	0	6
Total	3	32	1	0	36	0	6	7	0	13
Total Extant Species						4				
Total Extirpated Species						1				
Total Extant Individuals						6				
Total Extirpated Individuals						7				
<i>Corbicula fluminea</i>	0	0	0	0	0	120	0	0	0	120
Mussel density – 0 mussels/5m ² (0/m ²)						Corbicula density – 120 Corbicula/5m ² (24/m ²)				

Site 4. Olentangy River at TR 158 (New Winchester Center Road) Bridge, Whetstone Township, Crawford County, Ohio. 40.726106° -82.918384°.

	16 September 1989					26 May 2022				
	Live	FD	WD	Sub	Total	Live	FD	WD	Sub	Total
1. <i>Pyganodon grandis</i>	0	6	0	0	6	0	0	1	0	1
2. <i>Alasmidonta viridis</i>	0	0	1	0	1	0	0	0	0	0
3. <i>Lampsilis siliquoidea</i>	0	2	0	0	2	0	0	0	0	0
Total	0	8	1	0	9	0	0	1	0	1

Total Extant Species	2	0
Total Extirpated Species	1	1
Total Extant Individuals	8	0
Total Extirpated Individuals	1	1
<i>Corbicula fluminea</i>	0	0 0 0 0 0 200 0 0 0 0 200
Mussel density – 0 mussels/5m ² (0/m ²)		<i>Corbicula</i> density – 200 <i>Corbicula</i> /5m ² (40/m ²)

Site 5. Olentangy River at CR 19 (Monnette-New Winchester Road) Bridge, Whetstone Township, Crawford County, Ohio. 40.718956° -82.936534°.

	16 September 1989					3 June 2022				
	Live	FD	WD	Sub	Total	Live	FD	WD	Sub	Total
1. <i>Pyganodon grandis</i>	3	0	0	0	3	0	0	0	0	0
2. <i>Anodontooides ferussacianus</i>	0	0	1	0	1	0	0	0	0	0
3. <i>Lasmigona costata</i>	0	0	1	0	1	0	0	0	0	0
4. <i>Amblema plicata</i>	1	4	0	0	5	0	0	0	0	0
5. <i>Lampsilis siliquoidea</i>	1	1	0	0	2	0	0	0	0	0
Total	5	5	2	0	12	0	0	0	0	0
Total Extant Species	3					0				
Total Extirpated Species	2					0				
Total Extant Individuals	10					0				
Total Extirpated Individuals	2					0				
<i>Corbicula fluminea</i>	0	0	0	0	0	112	0	0	0	112
Mussel density – 0 mussels/5m ² (0/m ²)						<i>Corbicula</i> density – 100 <i>Corbicula</i> /5m ² (20/m ²)				

Site 6. Olentangy River at TR 68 (Wyandot-Marion Road) Bridge, Tully Township, Marion County, Ohio. 40.7049099° -82.942018°.

	12 August 1989					3 June 2022				
	Live	FD	WD	Sub	Total	Live	FD	WD	Sub	Total
1. <i>Pyganodon grandis</i>	1	3	0	0	4	0	0	2	0	2
2. <i>Anodontooides ferussacianus</i>	0	3	0	0	3	0	0	1	0	1
3. <i>Strophitus undulatus</i>	0	1	0	0	1	0	1	1	0	2
4. <i>Lasmigona costata</i>	0	0	2	0	2	0	1	1	0	2
5. <i>Amblema plicata</i>	0	4	0	0	4	0	0	0	0	0
6. <i>Pleurobema sintoxia</i>	0	0	0	1	1	0	0	0	0	0
7. <i>Toxolasma parvum</i>	0	1	0	0	1	0	0	0	0	0
8. <i>Lampsilis siliquoidea</i>	38	7	0	0	45	0	0	8	0	8
Total	39	19	2	1	61	0	2	13	0	15
Total Extant Species	5					2				
Total Extirpated Species	3					6				
Total Extant Individuals	58					2				
Total Extirpated Individuals	3					13				
<i>Corbicula fluminea</i>	0	0	0	0	0	90	2	0	0	92
Mussel density – 0 mussels/5m ² (0/m ²)						<i>Corbicula</i> density – 90 <i>Corbicula</i> /5m ² (18/m ²)				

Site 7. Olentangy River at CR 67 (Moral-Kirkpatrick Road) Bridge, Tully Township, Marion County, Ohio. 40.689358° -82.945314°.

	12 August 1989					3 June 2022				
	Live	FD	WD	Sub	Total	Live	FD	WD	Sub	Total
1. <i>Pyganodon grandis</i>	0	1	0	0	1	0	0	0	0	0
2. <i>Strophitus undulatus</i>	0	1	0	0	1	0	0	0	0	0
3. <i>Lasmigona costata</i>	0	0	2	0	2	0	0	0	0	0
4. <i>Amblema plicata</i>	3	3	0	0	6	0	0	0	0	0
5. <i>Fusconaia flava</i>	0	0	1	0	1	0	0	0	0	0
6. <i>Lampsilis siliquoidea</i>	38	7	0	0	45	0	0	0	0	0
Total	41	12	3	0	56	0	0	0	0	0
Total Extant Species	4					0				
Total Extirpated Species	2					0				
Total Extant Individuals	53					0				
Total Extirpated Individuals	3					0				
<i>Corbicula fluminea</i>	0	0	0	0	0	0	0	0	0	0
Mussel density – 0 mussels/5m ² (0/m ²)										<i>Corbicula</i> density – 0 <i>Corbicula</i> /5m ² (0/m ²)

Site 8. Olentangy River at TR 196 (Lyons Road) Bridge, Tully Township, Marion County, Ohio. 40.659526° -82.948413°.

	13 August 1989					3 June 2022				
	Live	FD	WD	Sub	Total	Live	FD	WD	Sub	Total
1. <i>Pyganodon grandis</i>	0	3	0	0	3	0	0	0	0	0
2. <i>Strophitus undulatus</i>	1	1	0	0	2	0	0	0	0	0
3. <i>Alasmidonta viridis</i>	0	0	1	0	1	0	0	0	0	0
4. <i>Lasmigona costata</i>	0	0	4	0	4	0	0	0	0	0
5. <i>Amblema plicata</i>	1	4	0	0	5	0	0	0	0	0
6. <i>Fusconaia flava</i>	0	0	2	0	2	0	0	0	0	0
7. <i>Pleurobema sintoxia</i>	0	0	1	0	1	0	0	0	0	0
8. <i>Lampsilis siliquoidea</i>	0	0	2	0	2	0	0	0	0	0
Total	2	8	10	0	20	0	0	0	0	0
Total Extant Species	3					0				
Total Extirpated Species	5					0				
Total Extant Individuals	10					0				
Total Extirpated Individuals	10					0				
<i>Corbicula fluminea</i>	0	0	0	0	0	0	0	0	0	0
Mussel density – 0 mussels/5m ² (0/m ²)										<i>Corbicula</i> density – 0 <i>Corbicula</i> /5m ² (0/m ²)

Site 9. Olentangy River at TR 195 (Wyandot-Marion Road) Bridge, Scott Township, Marion County, Ohio. 40.652552° -82.961578°.

	12 August 1989					22 June 2022				
	Live	FD	WD	Sub	Total	Live	FD	WD	Sub	Total
1. <i>Utterbackia imbecillis</i>	0	1	0	0	1	0	0	0	0	0
2. <i>Pyganodon grandis</i>	0	6	0	0	6	0	0	0	0	0
3. <i>Strophitus undulatus</i>	0	1	0	0	1	0	0	0	0	0
4. <i>Lasmigona costata</i>	0	0	1	0	1	0	0	0	0	0
5. <i>Amblema plicata</i>	0	4	0	0	4	0	0	0	0	0
6. <i>Lampsilis siliquoidea</i>	0	3	0	0	3	0	0	0	0	0

Total	0	15	1	0	16	0	0	0	0	0
Total Extant Species	5					0				
Total Extirpated Species	1					0				
Total Extant Individuals	15					0				
Total Extirpated Individuals	1					0				
<i>Corbicula fluminea</i>	0	0	0	0	0	0	0	0	0	0
Mussel density – 0 mussels/5m ² (0/m ²)										<i>Corbicula</i> density – 0 <i>Corbicula</i> /5m ² (0/m ²)

Site 10. Olentangy River at SR 746 (North Caledona-Ashley Road) Bridge, Claridon Township, Marion County, Ohio. 40.621531° -82.962625°.

	12 August 1989					22 June 2022				
	Live	FD	WD	Sub	Total	Live	FD	WD	Sub	Total
1. <i>Utterbackia imbecillis</i>	0	1	0	0	1	0	0	0	0	0
2. <i>Pyganodon grandis</i>	3	7	0	0	10	0	0	0	0	0
3. <i>Strophitus undulatus</i>	4	7	0	0	11	0	0	0	0	0
4. <i>Alasmidonta viridis</i>	0	0	2	0	2	0	0	0	0	0
5. <i>Alasmidonta marginata</i>	1	0	0	0	1	0	0	0	0	0
6. <i>Lasmigona costata</i>	2	5	0	0	7	0	0	0	0	0
7. <i>Lasmigona compressa</i>	0	1	0	0	1	0	0	0	0	0
8. <i>Amblema plicata</i>	3	0	1	0	4	0	0	0	0	0
9. <i>Theliderma cylindrica</i>	0	0	0	1	1	0	0	0	0	0
10. <i>Fusconaia flava</i>	0	0	2	1	3	0	0	0	0	0
11. <i>Eurynia dilatata</i>	50	29	0	0	79	0	0	0	0	0
12. <i>Toxolasma parvum</i>	0	0	1	0	1	0	0	0	0	0
13. <i>Paetulunio fabalis</i>	0	0	1	0	1	0	0	0	0	0
14. <i>Cambarunio iris</i>	1	8	0	0	9	0	0	0	0	0
15. <i>Lampsilis siliquoidea</i>	53	22	0	0	75	0	0	0	0	0
16. <i>Lampsilis cardium</i>	0	0	1	0	1	0	0	0	0	0
17. <i>Epioblasma triquetra</i>	0	0	2	0	2	0	0	0	0	0
Total	117	80	10	2	209	0	0	0	0	0
Total Extant Species	10					0				
Total Extirpated Species	7					0				
Total Extant Individuals	197					0				
Total Extirpated Individuals	12					0				
<i>Corbicula fluminea</i>	0	0	0	0	0	0	0	0	0	0
Mussel density – 0 mussels/5m ² (0/m ²)										<i>Corbicula</i> density – 0 <i>Corbicula</i> /5m ² (0/m ²)

Site 11. Olentangy River at TR 166 (Roberts Road) Bridge, Claridon Township, Marion County, Ohio. 40.601850° -82.972837°.

	13 August 1989					22 June 2022				
	Live	FD	WD	Sub	Total	Live	FD	WD	Sub	Total
1. <i>Pyganodon grandis</i>	0	5	0	0	5	0	0	0	0	0
2. <i>Strophitus undulatus</i>	1	1	0	0	2	0	0	0	0	0
3. <i>Alasmidonta marginata</i>	0	4	0	0	4	0	0	0	0	0
4. <i>Lasmigona costata</i>	3	2	0	0	5	0	0	0	0	0
5. <i>Lasmigona compressa</i>	1	0	0	0	1	0	0	0	0	0

Site 13. Olentangy River at TR 169 (Marion-Edison Road) Bridge, Claridon Township, Marion County, Ohio. 40.559728° -82.995721°.

	13 August 1989					23 June 2022				
	Live	FD	WD	Sub	Total	Live	FD	WD	Sub	Total
1. <i>Utterbackia imbecillis</i>	0	0	0	0	0	0	1	0	0	1
2. <i>Pyganodon grandis</i>	0	4	1	0	5	0	0	0	0	0
3. <i>Strophitus undulatus</i>	0	2	0	0	2	0	0	0	0	0
4. <i>Lasmigona costata</i>	0	0	0	0	0	0	0	0	1	1
5. <i>Amblema plicata</i>	0	0	1	0	1	0	0	0	0	0
6. <i>Fusconaia flava</i>	0	0	1	0	1	0	0	1	0	1
7. <i>Eurynia dilatata</i>	0	1	0	0	1	2	5	1	0	8
8. <i>Ptychobranchus fasciolaris</i>	0	0	0	0	0	0	0	1	0	1
9. <i>Lampsilis siliquoidea</i>	6	1	1	0	8	0	4	0	0	4
10. <i>Lampsilis cardium</i>	0	0	0	0	0	0	0	1	0	1
Total	6	8	4	0	18	2	10	4	1	17
Total Extant Species	4					3				
Total Extirpated Species	2					4				
Total Extant Individuals	14					12				
Total Extirpated Individuals	4					5				
<i>Corbicula fluminea</i>	0	0	0	0	0	24	3	0	0	27
Mussel density – 0 mussels/5m ² (0/m ²)										<i>Corbicula</i> density – 20 <i>Corbicula</i> /5m ² (4/m ²)

Site 14. Olentangy River at SR 529 (Marion-Mt. Gilead Road) Bridge, Richland Township, Marion County, Ohio. 40.544134° -83.018919°.

	19 August 1989					23 June & 15 Sept. 2022				
	Live	FD	WD	Sub	Total	Live	FD	WD	Sub	Total
1. <i>Utterbackia imbecillis</i>	0	1	0	0	1	0	0	0	0	0
2. <i>Pyganodon grandis</i>	2	8	0	0	10	0	0	0	0	0
3. <i>Strophitus undulatus</i>	0	10	0	0	10	1	3	1	0	5
4. <i>Alasmidonta marginata</i>	0	10	0	0	10	0	0	0	0	0
5. <i>Lasmigona costata</i>	0	4	0	0	4	0	12	1	0	13
6. <i>Amblema plicata</i>	0	2	0	0	2	3	6	2	0	11
7. <i>Theliderma cylindrica</i>	0	0	1	0	1	0	0	0	0	0
8. <i>Fusconaia flava</i>	0	0	1	0	1	0	0	1	0	1
9. <i>Pleurobema clava</i>	0	0	0	1	1	0	0	0	0	0
10. <i>Pleurobema sintoxia</i>	0	1	0	0	1	0	0	2	0	2
11. <i>Eurynia dilatata</i>	4	5	0	0	9	14	55	0	0	69
12. <i>Toxolasma parvum</i>	0	1	0	0	1	0	0	0	0	0
13. <i>Paetulunio fabalis</i>	0	0	1	1	2	0	1	2	3	6
14. <i>Cambarunio iris</i>	0	3	1	0	4	0	14	0	0	14
15. <i>Lampsilis siliquoidea</i>	12	15	0	0	27	2	33	0	0	35
16. <i>Lampsilis cardium</i>	0	2	0	0	2	0	12	0	0	12
17. <i>Epioblasma triquetra</i>	0	0	2	0	2	1	3	3	2	9
Total	18	62	6	2	88	21	139	12	5	177
Total Extant Species	12					9				
Total Extirpated Species	5					2				

Total Extant Individuals	80					160				
Total Extirpated Individuals	8					17				
<i>Corbicula fluminea</i>	0	0	0	0	0	7	2	0	0	9
Mussel density – 4 mussels/5m ² (0.8/m ²)						Corbicula density – 7 <i>Corbicula</i> /5m ² (1.4/m ²)				

Site 15. Olentangy River at CR 148 (Firstenberger Road) Bridge, Richland Township, Marion County, Ohio. 40.527985° -83.013277°.

	19 August 1989					23 June 2022				
	Live	FD	WD	Sub	Total	Live	FD	WD	Sub	Total
1. <i>Pyganodon grandis</i>	8	0	0	0	8	0	0	0	0	0
2. <i>Strophitus undulatus</i>	0	0	0	0	0	0	0	1	0	1
3. <i>Lasmigona costata</i>	0	0	0	0	0	0	0	1	0	1
4. <i>Alasmidonta marginata</i>	1	0	0	0	1	0	0	0	0	0
5. <i>Amblema plicata</i>	0	0	0	0	0	0	0	1	0	1
6. <i>Eurynia dilatata</i>	1	0	0	0	1	0	2	0	0	2
7. <i>Lampsilis siliquoidea</i>	2	0	0	0	2	0	0	0	0	0
Total	12	0	0	0	12	0	2	3	0	5
Total Extant Species	4					1				
Total Extirpated Species	0					3				
Total Extant Individuals	12					2				
Total Extirpated Individuals	0					3				
<i>Corbicula fluminea</i>	0	0	0	0	0	5	0	0	0	5
Mussel density – 0 mussels/5m ² (0/m ²)						Corbicula density – 5 <i>Corbicula</i> /5m ² (1/m ²)				

Site 16. Olentangy River at TR 154 (Cardington Road) Bridge, Richland Township, Marion County, Ohio. 40.513055° -83.033226°.

	19 August 1989					24 June 2022				
	Live	FD	WD	Sub	Total	Live	FD	WD	Sub	Total
1. <i>Pyganodon grandis</i>	2	2	0	0	4	0	1	0	0	1
2. <i>Strophitus undulatus</i>	1	0	0	0	1	0	3	2	0	5
3. <i>Alasmidonta marginata</i>	0	1	0	0	1	0	0	1	0	1
4. <i>Lasmigona costata</i>	0	1	0	0	1	0	0	3	0	3
5. <i>Pleurobema sintoxia</i>	0	0	1	0	1	0	0	0	0	0
6. <i>Eurynia dilatata</i>	1	0	0	0	1	31	29	0	0	60
7. <i>Toxolasma parvum</i>	0	0	1	0	1	0	0	0	0	0
8. <i>Paetulunio fabalis</i>	0	0	1	0	1	0	0	0	0	0
9. <i>Cambarunio iris</i>	0	0	0	0	0	1	16	0	0	17
10. <i>Lampsilis siliquoidea</i>	5	1	0	0	6	3	11	0	0	14
11. <i>Lampsilis cardium</i>	0	0	0	0	0	0	3	0	0	3
12. <i>Epioblasma triquetra</i>	0	0	1	0	1	0	0	2	0	2
Total	9	5	4	0	18	35	63	8	0	106
Total Extant Species	6					6				
Total Extirpated Species	4					3				
Total Extant Individuals	14					98				
Total Extirpated Individuals	4					8				
<i>Corbicula fluminea</i>	0	3	0	0	3	35	0	0	0	35

Mussel density – 27 mussels/5m² (5.4/m²)

Corbicula density – 35 *Corbicula*/5m² (7/m²)

Site 17. Olentangy River at TR 141 (South James Road) Bridge (King’s Mill Covered Bridge), Richland Township, Marion County, Ohio. 40.512412° -83.053328°.

	19 August 1989					24 June 2022				
	Live	FD	WD	Sub	Total	Live	FD	WD	Sub	Total
1. <i>Utterbackia imbecillis</i>	0	0	0	0	0	0	1	0	0	1
2. <i>Pyganodon grandis</i>	1	6	0	0	7	0	0	0	0	0
3. <i>Strophitus undulatus</i>	0	1	0	0	1	0	1	2	0	3
4. <i>Lasmigona costata</i>	0	0	0	0	0	0	1	1	0	2
5. <i>Amblema plicata</i>	0	0	0	0	0	0	0	2	0	2
6. <i>Eurynia dilatata</i>	0	0	0	0	0	4	2	0	0	6
7. <i>Cambarunio iris</i>	0	0	0	0	0	0	0	1	0	1
8. <i>Lampsilis siliquoidea</i>	1	2	0	0	3	1	1	5	0	7
9. <i>Lampsilis cardium</i>	0	0	0	0	0	0	1	0	0	1
Total	2	9	0	0	11	5	7	11	0	23
Total Extant Species	3					6				
Total Extirpated Species	0					2				
Total Extant Individuals	11					12				
Total Extirpated Individuals	0					11				
<i>Corbicula fluminea</i>	0	0	0	0	0	32	0	0	0	32
Mussel density – 3 mussels/5m ² (0.6/m ²)										
<i>Corbicula</i> density – 32 <i>Corbicula</i> /5m ² (6.4/m ²)										

Site 18. Olentangy River at TR 140 (Waldo-Fulton Road) Bridge, Waldo Township, Marion County, Ohio. 40.459727° -83.071464°.

	20 August 1989					30 June 2022				
	Live	FD	WD	Sub	Total	Live	FD	WD	Sub	Total
1. <i>Utterbackia imbecillis</i>	0	0	1	0	1	0	0	0	0	0
2. <i>Pyganodon grandis</i>	0	0	1	0	1	0	0	1	0	1
3. <i>Strophitus undulatus</i>	0	1	0	0	1	0	0	0	0	0
4. <i>Lasmigona costata</i>	0	0	1	0	1	0	0	0	1	1
5. <i>Amblema plicata</i>	0	0	2	0	2	0	0	0	1	1
6. <i>Theliderma cylindrica</i>	0	0	0	0	0	0	0	0	1	1
7. <i>Fusconaia flava</i>	0	0	1	0	1	0	0	0	0	0
8. <i>Eurynia dilatata</i>	0	0	2	0	2	0	0	1	0	1
9. <i>Ptychobranhus fasciolaris</i>	0	0	0	0	0	0	0	1	0	1
10. <i>Paetulunio fabalis</i>	0	0	1	0	1	0	0	0	0	0
11. <i>Cambarunio iris</i>	0	0	1	0	1	0	0	0	0	0
12. <i>Lampsilis siliquoidea</i>	0	0	3	0	3	0	0	1	0	1
13. <i>Lampsilis cardium</i>	0	0	1	0	1	0	0	0	1	1
14. <i>Lampsilis fasciola</i>	0	0	1	0	1	0	0	0	0	0
15. <i>Epioblasma triquetra</i>	0	0	1	0	1	0	0	0	1	1
Total	0	1	16	0	17	0	0	4	5	9
Total Extant Species	1					0				
Total Extirpated Species	12					9				
Total Extant Individuals	1					0				

Total Extirpated Individuals	16					9				
<i>Corbicula fluminea</i>	0	2	0	0	2	0	0	0	0	0
Mussel density – 0 mussels/5m ² (0/m ²)										<i>Corbicula</i> density – 0 <i>Corbicula</i> /5m ² (0/m ²)

Site 18. Olentangy River at TR 140 (Waldo-Fulton Road) Bridge, Waldo Township, Marion County, Ohio. 40.459727° -83.071464°. [Hoggarth, 2005]

16 August 2005

	Live	FD	WD	Sub	Total
1. <i>Pyganodon grandis</i>	0	1	0	0	1
2. <i>Strophitus undulatus</i>	0	2	1	0	3
3. <i>Alasmidonta viridis</i>	0	0	1	0	1
4. <i>Alasmidonta marginata</i>	1	0	0	0	1
5. <i>Lasmigona costata</i>	2	1	0	0	3
6. <i>Amblema plicata</i>	0	2	0	0	2
7. <i>Fusconaia flava</i>	0	1	0	0	1
8. <i>Pleurobema sintoxia</i>	1	0	0	0	1
9. <i>Eurynia dilatata</i>	2	0	0	0	2
10. <i>Ptychobranhus fasciolaris</i>	0	1	2	0	3
11. <i>Lampsilis siliquoidea</i>	2	0	0	0	2
12. <i>Lampsilis cardium</i>	3	1	0	0	4
13. <i>Lampsilis fasciola</i>	0	0	1	0	1
Total	11	9	5	0	25
Total Extant Species	11				
Total Extirpated Species	2				
Total Extant Individuals	20				
Total Extirpated Individuals	5				

Site 19. Olentangy River at SR 229 (Norton Road) Bridge, Waldo Township, Marion County, Ohio. 40.434901° -83.059229°.

20 August 1989

30 June 2022

	Live	FD	WD	Sub	Total	Live	FD	WD	Sub	Total
No mussels found										
Total	0	0	0	0	0	0	0	0	0	0
Total Extant Species	0					0				
Total Extirpated Species	0					0				
Total Extant Individuals	0					0				
Total Extirpated Individuals	0					0				
<i>Corbicula fluminea</i>	0	0	0	0	0	0	0	0	0	0
Mussel density – 0 mussels/5m ² (0/m ²)										<i>Corbicula</i> density – 0 <i>Corbicula</i> /5m ² (0/m ²)

Site 20. Olentangy River at TR 213 (Main Road) Bridge, Troy Township, Delaware County, Ohio. 40.354017° -83.068105°.

20 August 1989

1 July 2022

	Live	FD	WD	Sub	Total	Live	FD	WD	Sub	Total
1. <i>Utterbackia imbecillis</i>	0	0	0	0	0	1	0	0	0	1
2. <i>Amblema plicata</i>	0	0	1	0	1	0	0	0	0	0

3. <i>Strophitus undulatus</i>	0	0	1	0	1	0	0	0	0	0
4. <i>Lasmigona costata</i>	0	0	1	0	1	0	0	1	0	1
5. <i>Lasmigona complanata</i>	0	0	0	0	0	0	1	0	0	1
6. <i>Theliderma cylindrica</i>	0	0	0	2	2	0	0	0	0	0
7. <i>Cyclonaias tuberculata</i>	0	0	0	0	0	0	1	0	0	1
8. <i>Fusconaia flava</i>	0	0	0	1	1	0	0	0	0	0
9. <i>Eurynia dilatata</i>	0	2	0	0	2	0	1	1	0	2
10. <i>Ptychobranhus fasciolaris</i>	0	0	0	0	0	0	0	1	0	1
11. <i>Lampsilis siliquoidea</i>	0	0	1	0	1	0	0	2	0	2
12. <i>Lampsilis cardium</i>	0	0	2	0	2	0	1	0	0	1
13. <i>Lampsilis fasciola</i>	0	1	0	0	1	0	0	0	0	0
Total	0	4	6	3	13	2	17	7	0	26
Total Extant Species	3					6				
Total Extirpated Species	7					3				
Total Extant Individuals	4					19				
Total Extirpated Individuals	9					7				
<i>Corbicula fluminea</i>	0	6	0	0	6	5	5	0	0	10
Mussel density – 0 mussels/5m ² (0/m ²)										
										<i>Corbicula</i> density – 5 <i>Corbicula</i> /5m ² (1.0/m ²)

Site 22. Olentangy River at TR 215/216 (Hudson/Panhandle Road) Bridge, Delaware Township, Delaware County, Ohio. 40.324882° -83.070872°. [Bolton (2008): Hoggarth (2015a, b)]

	15 June 2007					24 September 2015				
	Live	FD	WD	Sub	Total	Live	FD	WD	Sub	Total
1. <i>Utterbackia imbecillis</i>	0	0	1	0	1	6	2	0	0	8
2. <i>Pyganodon grandis</i>	0	0	1	0	1	6	0	0	0	6
3. <i>Alasmidonta marginata</i>	0	0	0	1	1	0	0	0	0	0
4. <i>Lasmigona costata</i>	2	0	1	0	3	0	0	0	0	0
5. <i>Lasmigona complanata</i>	0	0	0	0	0	1	0	0	0	1
6. <i>Amblema plicata</i>	3	0	1	1	5	0	0	0	0	0
7. <i>Cyclonaias tuberculata</i>	11	2	1	0	14	6	1	0	0	7
8. <i>Pleurobema sintoxia</i>	1	0	1	0	2	0	0	0	0	0
9. <i>Eurynia dilatata</i>	16	4	1	0	21	15	0	0	0	15
10. <i>Ptychobranhus fasciolaris</i>	2	2	0	0	4	0	0	0	0	0
11. <i>Lampsilis siliquoidea</i>	0	0	1	0	1	4	0	0	0	4
12. <i>Lampsilis cardium</i>	4	1	1	0	6	1	0	0	0	1
13. <i>Lampsilis fasciola</i>	1	0	0	0	1	0	0	0	0	0
Total	40	9	9	2	60	39	3	0	0	42
Total Extant Species	8				7					
Total Extirpated Species	4				0					
Total Extant Individuals	49				42					
Total Extirpated Individuals	11				0					

Corbicula fluminea and *Driessena polymorpha* were observed in small numbers

Site 23. Olentangy River at USR 23 Bridge, Delaware Township, Delaware County, Ohio. 40.255325° -83.062585°.

12 June 1988

15 July 2022

	Live	FD	WD	Sub	Total	Live	FD	WD	Sub	Total
1. <i>Pyganodon grandis</i>	0	0	0	0	0	0	1	0	0	1
2. <i>Strophitus undulatus</i>	0	0	0	0	0	0	0	0	0	0
3. <i>Alasmidonta marginata</i>	0	0	0	0	0	0	0	1	0	1
4. <i>Lasmigona costata</i>	0	0	0	0	0	0	1	0	0	1
5. <i>Lasmigona complanata</i>	0	0	0	0	0	0	2	0	0	2
6. <i>Theliderma cylindrica</i>	0	0	0	0	0	0	0	0	0	0
7. <i>Fusconaia flava</i>	0	0	0	0	0	0	0	0	0	0
8. <i>Eurynia dilatata</i>	0	0	0	0	0	0	0	0	0	0
9. <i>Lampsilis siliquoidea</i>	0	0	0	0	0	0	1	0	0	1
10. <i>Lampsilis cardium</i>	0	0	0	0	0	0	0	0	1	1
11. <i>Lampsilis fasciola</i>	0	0	0	0	0	0	1	0	0	1
Total	0	0	0	0	0	0	6	1	1	8
Total Extant Species	0					5				
Total Extirpated Species	0					2				
Total Extant Individuals	0					6				
Total Extirpated Individuals	0					2				
<i>Corbicula fluminea</i>	0	0	0	0	0	0	7	100	0	107
Mussel density – 0 mussels/5m ² (0/m ²)							Corbicula density – 0 Corbicula/5m ² (0/m ²)			

Site 23. Olentangy River at USR 23 Bridge, Delaware Township, Delaware County, Ohio. 40.255325° -83.062585°. [Hoggarth, 2014]

	15 September 2014				
	Live	FD	WD	Sub	Total
1. <i>Utterbackia imbecillis</i>	3	0	0	0	3
2. <i>Pyganodon grandis</i>	5	0	0	0	5
3. <i>Alasmidonta marginata</i>	2	0	0	0	2
4. <i>Lasmigona costata</i>	2	0	0	0	2
5. <i>Lasmigona complanata</i>	25	0	0	0	25
6. <i>Cyclonaias tuberculata</i>	1	0	0	0	1
7. <i>Lampsilis siliquoidea</i>	1	0	0	0	1
8. <i>Lampsilis cardium</i>	1	0	0	0	1
Total	40	0	0	0	40
Total Extant Species	8				
Total Extirpated Species	0				
Total Extant Individuals	40				
Total Extirpated Individuals	0				

Site 24. Olentangy River at old mill dam, 1.0 miles S of Stratford, Liberty Township, Delaware County, Ohio. 40.255325° -83.062585°.

	30 September 1989					15 July 2022				
	Live	FD	WD	Sub	Total	Live	FD	WD	Sub	Total
No mussels found										
Total	0	0	0	0	0	0	0	0	0	0
Total Extant Species	0					0				
Total Extirpated Species	0					0				

Total Extant Individuals	0	0
Total Extirpated Individuals	0	0
<i>Corbicula fluminea</i>	0	0
Mussel density – 0 mussels/5m ² (0/m ²)		<i>Corbicula</i> density – 0 <i>Corbicula</i> /5m ² (0/m ²)

Site 25. Olentangy River at CR 123 (Hyatts Road) Bridge, Liberty Township, Delaware County, Ohio.
40.214939° -83.060325°.

	30 September 1989					21 July 2022				
	Live	FD	WD	Sub	Total	Live	FD	WD	Sub	Total
1. <i>Utterbackia imbecillis</i>	1	0	0	0	1	0	0	0	0	0
2. <i>Pyganodon grandis</i>	5	1	0	0	6	0	0	0	0	0
3. <i>Strophitus undulatus</i>	0	0	0	0	0	0	0	1	0	1
4. <i>Alasmidonta marginata</i>	3	1	0	0	4	0	0	0	1	1
5. <i>Lasmigona complanata</i>	0	0	0	0	0	0	1	0	0	1
6. <i>Ptychobranchnus fasciolaris</i>	0	0	0	0	0	0	0	0	1	1
7. <i>Lampsilis siliquoidea</i>	2	0	0	0	2	0	0	0	0	0
8. <i>Lampsilis cardium</i>	1	0	0	0	1	0	0	0	0	0
9. <i>Lampsilis fasciola</i>	0	1	0	0	1	0	0	0	0	0
Total	12	3	0	0	15	0	1	1	2	4
Total Extant Species	6					1				
Total Extirpated Species	0					3				
Total Extant Individuals	15					1				
Total Extirpated Individuals	0					3				
<i>Corbicula fluminea</i>	0	0	0	0	0	0	4	0	0	4
Mussel density – 0 mussels/5m ² (0/m ²)										<i>Corbicula</i> density – 0 <i>Corbicula</i> /5m ² (0/m ²)

Site 26. Olentangy River at CR 124 (Home Road) Bridge, Liberty Township, Delaware County, Ohio.
40.194098° -83.052063°.

	30 September 1989					21 July 2022				
	Live	FD	WD	Sub	Total	Live	FD	WD	Sub	Total
1. <i>Pyganodon grandis</i>	0	0	0	0	0	0	1	0	0	1
2. <i>Strophitus undulatus</i>	1	1	0	0	2	0	0	0	0	0
3. <i>Alasmidonta marginata</i>	5	1	0	0	6	0	1	0	0	1
4. <i>Lasmigona complanata</i>	1	0	0	0	1	0	1	0	0	1
5. <i>Ptychobranchnus fasciolaris</i>	1	0	0	0	1	0	0	0	1	1
6. <i>Lampsilis siliquoidea</i>	9	2	0	0	11	0	0	0	0	0
7. <i>Lampsilis cardium</i>	1	1	0	0	2	0	1	1	0	2
8. <i>Lampsilis fasciola</i>	1	0	0	0	1	0	0	0	0	0
Total	19	5	0	0	24	0	4	1	1	6
Total Extant Species	7					4				
Total Extirpated Species	0					1				
Total Extant Individuals	24					4				
Total Extirpated Individuals	0					2				
<i>Corbicula fluminea</i>	100	3	0	0	103	0	10	0	0	10
Mussel density – 0 mussels/5m ² (0/m ²)										<i>Corbicula</i> density – 0 <i>Corbicula</i> /5m ² (0/m ²)

Site 26. Olentangy River at CR 124 (Home Road) Bridge, Liberty Township, Delaware County, Ohio. 40.194098° -83.052063°. [Hoggarth, 2007]

14 August 2007

	Live	FD	WD	Sub	Total
1. <i>Strophitus undulatus</i>	2	0	0	0	2
2. <i>Alasmidonta marginata</i>	18	0	0	0	18
3. <i>Lasmigona costata</i>	1	0	0	0	1
4. <i>Lasmigona complanata</i>	5	0	0	0	5
5. <i>Ptychobranchnus fasciolaris</i>	4	0	0	0	4
6. <i>Lampsilis siliquoidea</i>	9	0	0	0	9
7. <i>Lampsilis cardium</i>	28	0	0	0	28
8. <i>Lampsilis fasciola</i>	30	0	0	0	30
Total	97	0	0	0	97
Total Extant Species	8				
Total Extirpated Species	0				
Total Extant Individuals	97				
Total Extirpated Individuals	0				

Site 27. Olentangy River at CR 114 (Orange Road) Bridge, Liberty Township, Delaware County, Ohio. 40.175795° -83.045581°.

30 September 1989

22 July 2022

	Live	FD	WD	Sub	Total	Live	FD	WD	Sub	Total
1. <i>Pyganodon grandis</i>	0	1	0	0	1	0	0	0	0	0
2. <i>Strophitus undulatus</i>	0	0	0	0	0	0	1	1	0	2
3. <i>Alasmidonta marginata</i>	7	2	0	0	9	0	0	0	0	0
4. <i>Lasmigona costata</i>	0	0	0	0	0	0	0	1	0	1
5. <i>Lasmigona complanata</i>	0	0	0	0	0	1	0	1	0	2
6. <i>Amblema plicata</i>	2	0	1	0	3	0	0	0	0	0
7. <i>Eurynia dilatata</i>	1	0	0	0	1	0	0	2	0	2
8. <i>Pleurobema sintoxia</i>	0	0	0	0	0	0	0	0	1	1
9. <i>Ptychobranchnus fasciolaris</i>	10	4	0	0	14	0	0	3	0	3
10. <i>Cambarunio iris</i>	0	0	0	0	0	0	0	1	0	1
11. <i>Lampsilis siliquoidea</i>	10	0	0	0	10	0	0	2	0	2
12. <i>Lampsilis cardium</i>	7	0	1	0	8	0	4	2	0	6
13. <i>Lampsilis fasciola</i>	6	2	0	0	8	0	4	0	0	4
Total	43	9	2	0	54	1	9	13	1	24
Total Extant Species	8					4				
Total Extirpated Species	0					6				
Total Extant Individuals	52					10				
Total Extirpated Individuals	2					14				
<i>Corbicula fluminea</i>	0	0	0	0	0	30	0	0	0	30
Mussel density – 0 mussels/5m ² (0/m ²)										<i>Corbicula</i> density – 30 <i>Corbicula</i> /5m ² (6.0/m ²)

Site 28. Olentangy River at SR 750 (Powel Road) Bridge, Liberty Township, Delaware County, Ohio. 40.156869° -83.045256°.

1 October 1989

22 July 2022

	Live	FD	WD	Sub	Total	Live	FD	WD	Sub	Total
1. <i>Pyganodon grandis</i>	0	1	0	0	1	0	0	0	0	0
2. <i>Strophitus undulatus</i>	0	1	0	0	1	1	0	0	0	1
3. <i>Alasmidonta marginata</i>	7	0	0	0	7	0	0	0	0	0
4. <i>Lasmigona costata</i>	0	0	0	10	10	3	4	0	0	7
5. <i>Lasmigona complanata</i>	0	0	0	0	0	0	1	1	0	2
6. <i>Amblema plicata</i>	2	0	0	0	2	3	2	0	0	5
7. <i>Theliderma cylindrica</i>	0	0	0	2	2	0	0	0	0	0
8. <i>Euryntia dilatata</i>	0	0	0	10	10	0	2	2	0	4
9. <i>Pleurobema sintoxia</i>	0	0	0	0	0	0	0	0	1	1
10. <i>Ptychobranhus fasciolaris</i>	2	0	0	0	2	0	0	0	0	0
11. <i>Lampsilis siliquoidea</i>	10	1	0	0	11	1	5	0	0	6
12. <i>Lampsilis cardium</i>	14	1	0	0	15	7	2	0	0	9
13. <i>Lampsilis fasciola</i>	25	2	0	0	27	0	2	1	0	3
14. <i>Epioblasma triquetra</i>	0	0	0	1	1	0	0	0	0	0
Total	60	6	0	23	89	15	18	4	1	38
Total Extant Species	8					8				
Total Extirpated Species	4					1				
Total Extant Individuals	66					33				
Total Extirpated Individuals	23					5				
<i>Corbicula fluminea</i>	0	0	0	0	0	32	2	0	0	34
Mussel density – 4 mussels/5m ² (0.8/m ²)										<i>Corbicula</i> density – 32 <i>Corbicula</i> /5m ² (6.1/m ²)

Site 28. Olentangy River at SR 750 (Powel Road) Bridge, Liberty Township, Delaware County, Ohio. 40.156869° -83.045256°. [Hoggarth 2009]

8 October 2009

	Live	FD	WD	Sub	Total
1. <i>Strophitus undulatus</i>	0	1	0	1	2
2. <i>Alasmidonta marginata</i>	0	3	0	1	4
3. <i>Lasmigona costata</i>	1	0	0	0	1
4. <i>Lasmigona complanata</i>	12	1	0	0	13
5. <i>Amblema plicata</i>	3	0	0	1	4
6. <i>Theliderma cylindrica</i>	0	0	0	1	1
7. <i>Fusconaia flava</i>	0	0	0	2	2
8. <i>Pleurobema sintoxia</i>	0	0	0	1	1
9. <i>Ptychobranhus fasciolaris</i>	12	3	0	4	19
10. <i>Lampsilis siliquoidea</i>	10	3	0	5	18
11. <i>Lampsilis cardium</i>	19	1	0	2	22
12. <i>Lampsilis fasciola</i>	4	1	0	0	5
Total	61	13	0	18	92
Total Extant Species	9				
Total Extirpated Species	3				
Total Extant Individuals	74				
Total Extirpated Individuals	18				

Site 29. Olentangy River downstream of SR 750 (Powel Road) Bridge, Highbanks MetroPark, Liberty Township, Delaware County, Ohio. 40.156869° -83.045256°.

	23 July 1989					22 July 2022				
	Live	FD	WD	Sub	Total	Live	FD	WD	Sub	Total
1. <i>Strophitus undulatus</i>	2	0	0	0	2	1	0	0	0	1
2. <i>Alasmidonta marginata</i>	1	0	0	0	1	0	0	2	0	2
3. <i>Lasmigona costata</i>	0	0	0	0	0	2	0	1	0	3
4. <i>Lasmigona complanata</i>	0	0	0	0	0	45	0	2	0	47
5. <i>Lasmigona compressa</i>	0	0	0	0	0	1	0	0	0	1
6. <i>Amblema plicata</i>	3	0	0	0	3	30	1	3	0	34
7. <i>Theliderma cylindrica</i>	0	0	0	0	0	0	0	0	3	3
8. <i>Pleurobema sintoxia</i>	0	0	0	0	0	0	0	1	0	1
9. <i>Eurynia dilatata</i>	0	0	0	0	0	0	0	1	0	1
10. <i>Ptychobranhus fasciolaris</i>	7	0	0	0	7	0	0	1	0	1
11. <i>Lampsilis siliquoidea</i>	6	0	0	0	6	15	1	1	0	17
12. <i>Lampsilis cardium</i>	1	0	0	0	1	45	1	1	0	47
13. <i>Lampsilis fasciola</i>	3	0	0	0	3	3	0	0	0	3
14. <i>Epioblasma triquetra</i>	1	0	0	0	1	0	0	0	1	1
Total	24	0	0	0	24	142	3	13	4	162
Total Extant Species	8					8				
Total Extirpated Species	0					5				
Total Extant Individuals	24					145				
Total Extirpated Individuals	0					17				
<i>Corbicula fluminea</i>	0	0	0	0	0	150	0	0	0	150
Mussel density – 5 mussels/5m ² (1.0/m ²)										Corbicula density – 150 <i>Corbicula</i> /5m ² (30/m ²)

Site 30. Olentangy River at USR 270 Bridge, Sharon Township, Franklin County, Ohio. 40.112325° -83.023325°.

	1 October 1989					11 August 2022				
	Live	FD	WD	Sub	Total	Live	FD	WD	Sub	Total
1. <i>Pyganodon grandis</i>	0	1	0	0	1	0	1	1	0	2
2. <i>Strophitus undulatus</i>	0	0	0	0	0	0	1	1	0	2
3. <i>Alasmidonta marginata</i>	1	0	0	0	1	2	0	3	0	5
4. <i>Lasmigona costata</i>	0	0	0	0	0	0	2	0	0	2
5. <i>Lasmigona complanata</i>	0	0	0	0	0	2	1	2	0	5
6. <i>Amblema plicata</i>	2	0	0	0	2	6	3	0	0	9
7. <i>Fusconaia flava</i>	0	0	0	0	0	2	2	1	0	5
8. <i>Eurynia dilatata</i>	0	1	0	0	1	0	0	2	0	2
9. <i>Ptychobranhus fasciolaris</i>	2	2	0	0	4	1	3	0	0	4
10. <i>Cambarunio iris</i>	0	0	0	0	0	0	0	0	1	1
11. <i>Lampsilis siliquoidea</i>	1	1	0	0	2	0	4	3	0	7
12. <i>Lampsilis cardium</i>	10	2	0	0	12	0	7	2	0	9
13. <i>Lampsilis fasciola</i>	2	1	0	0	3	2	4	3	0	9
Total	18	8	0	0	26	15	28	18	1	62
Total Extant Species	8					11				
Total Extirpated Species	0					2				

Total Extant Individuals	26	43
Total Extirpated Individuals	0	19
<i>Corbicula fluminea</i>	0 0 0 0 0	10 5 0 0 15
Mussel density – 3 mussels/5m ² (0.6/m ²)		<i>Corbicula</i> density – 10 <i>Corbicula</i> /5m ² (2.0/m ²)

Site 31. Olentangy River at Antrim Park, Sharon Township, Franklin County, Ohio. 40.081622°
-83.029926°.

	Not sampled in 1989					11 August 2022				
	Live	FD	WD	Sub	Total	Live	FD	WD	Sub	Total
1. <i>Strophitus undulatus</i>						0	2	0	0	2
2. <i>Alasmidonta marginata</i>						0	0	2	1	3
3. <i>Lasmigona costata</i>						0	0	3	0	3
4. <i>Lasmigona complanata</i>						0	0	2	0	2
5. <i>Amblema plicata</i>						1	1	0	0	2
6. <i>Cyclonaias tuberculata</i>						0	0	3	0	3
7. <i>Fusconaia flava</i>						1	0	2	0	3
8. <i>Pleurobema sintoxia</i>						0	0	1	0	1
9. <i>Pleurobema clava</i>						0	0	0	1	1
10. <i>Eurynia dilatata</i>						0	1	2	0	3
11. <i>Ptychobranhus fasciolaris</i>						1	2	1	0	4
12. <i>Lampsilis siliquoidea</i>						1	1	1	0	3
13. <i>Lampsilis cardium</i>						0	4	1	0	5
14. <i>Lampsilis fasciola</i>						1	2	0	0	3
Total	--	--	--	--	--	5	13	18	2	38
Total Extant Species	--					8				
Total Extirpated Species	--					6				
Total Extant Individuals	--					18				
Total Extirpated Individuals	--					20				
<i>Corbicula fluminea</i>	--	--	--	--	--	0	2	0	0	2
Mussel density – 0 mussels/5m ² (0/m ²)										<i>Corbicula</i> density – 0 <i>Corbicula</i> /5m ² (0/m ²)

Site 32 – Sharon Township Nature Preserve, Sharon Township, Franklin County, Ohio. 40.069895°
-83.033176°.

	Not sampled in 1989					12 August 2022				
	Live	FD	WD	Sub	Total	Live	FD	WD	Sub	Total
1. <i>Strophitus undulatus</i>						0	1	0	0	1
2. <i>Alasmidonta marginata</i>						0	0	3	0	3
3. <i>Lasmigona costata</i>						0	3	0	0	3
4. <i>Lasmigona complanata</i>						0	0	1	0	1
5. <i>Amblema plicata</i>						2	4	0	0	6
6. <i>Quadrula quadrula</i>						0	1	0	0	1
7. <i>Fusconaia flava</i>						1	0	0	0	1
8. <i>Pleurobema sintoxia</i>						1	2	0	0	3
9. <i>Ptychobranhus fasciolaris</i>						0	1	0	0	1
10. <i>Cambarunio iris</i>						0	0	0	1	1
11. <i>Lampsilis siliquoidea</i>						0	3	1	0	4

12. <i>Lampsilis cardium</i>						0	1	0	0	1
13. <i>Lampsilis fasciola</i>						1	1	0	0	2
Total	--	--	--	--	--	5	17	5	1	28
Total Extant Species	--					10				
Total Extirpated Species	--					3				
Total Extant Individuals	--					22				
Total Extirpated Individuals	--					6				
<i>Corbicula fluminea</i>	--	--	--	--	--	16	2	0	0	18
Mussel density – 0 mussels/5m ² (0/m ²)							Corbicula density – 16 <i>Corbicula</i> /5m ² (3.2/m ²)			

Site 33 – Henderson Road access/Park of Roses, Clinton Township, Franklin County, Ohio.

40.046658° -83.032192°.

	Not sampled in 1989					12 August 2022				
	Live	FD	WD	Sub	Total	Live	FD	WD	Sub	Total
1. <i>Strophitus undulatus</i>						0	2	0	0	2
2. <i>Alasmidonta marginata</i>						0	2	1	0	3
3. <i>Lasmigona costata</i>						0	2	1	0	3
4. <i>Lasmigona complanata</i>						0	1	0	0	1
5. <i>Amblema plicata</i>						0	2	0	0	2
6. <i>Fusconaia flava</i>						2	6	0	0	8
7. <i>Pleurobema sintoxia</i>						0	2	0	0	2
8. <i>Eurynia dilatata</i>						0	1	0	0	1
9. <i>Lampsilis siliquoidea</i>						0	1	1	0	2
10. <i>Lampsilis cardium</i>						0	3	0	0	3
11. <i>Lampsilis fasciola</i>						2	5	0	0	7
Total	--	--	--	--	--	4	27	3	0	34
Total Extant Species	--					11				
Total Extirpated Species	--					0				
Total Extant Individuals	--					31				
Total Extirpated Individuals	--					3				
<i>Corbicula fluminea</i>	--	--	--	--	--	194	0	0	0	2
Mussel density – 1 mussels/5m ² (0.2/m ²)							Corbicula density – 150 <i>Corbicula</i> /5m ² (30/m ²)			

Site 34 – Dodridge Road access to Tuttle Park Community Center. Clinton Township, Franklin

County, Ohio. 40.016955° -83.016210°. [EMHT 2020b]

	15 September 2022					21 September 2020				
	Live	FD	WD	Sub	Total	Live	FD	WD	Sub	Total
1. <i>Strophitus undulatus</i>	0	0	0	0	0	6	0	0	0	6
2. <i>Lasmigona costata</i>	0	0	0	0	0	28	0	0	0	28
3. <i>Lasmigona complanata</i>	0	1	0	0	1	128	0	0	0	128
4. <i>Quadrula quadrula</i>	0	0	0	0	0	62	0	0	0	62
5. <i>Amblema plicata</i>	0	0	0	0	0	180	0	0	0	180
6. <i>Fusconaia flava</i>	0	0	0	0	0	1	0	0	0	1
7. <i>Ptychobranchus fasciolaris</i>	0	0	0	0	0	2	0	0	0	2
8. <i>Lampsilis siliquoidea</i>	0	1	0	0	1	77	0	0	0	77
9. <i>Lampsilis cardium</i>	0	1	0	0	1	22	0	0	0	22

10. <i>Lampsilis fasciola</i>	0	1	0	0	1	3	0	0	0	3
Total	0	4	0	0	4	509	0	0	0	509
Total Extant Species	4					10				
Total Extirpated Species	0					0				
Total Extant Individuals	4					509				
Total Extirpated Individuals	0					0				
<i>Corbicula fluminea</i>	--	--	--	--	--	--	--	--	--	--
Mussel density – 1 mussels/5m ² (0.2/m ²)										<i>Corbicula</i> density – 150 <i>Corbicula</i> /5m ² (30/m ²)

Site 34 – Dodridge Road access to Tuttle Park Community Center. Clinton Township, Franklin County, Ohio. 40.016955° -83.016210°. [Hoggarth 2010b]

	19 September 2010				
	Live	FD	WD	Sub	Total
1. <i>Pyganodon grandis</i>	12	0	0	0	12
2. <i>Strophitus undulatus</i>	1	0	0	0	1
3. <i>Alasmidonta marginata</i>	1	0	0	0	1
4. <i>Lasmigona complanata</i>	6	0	0	0	6
5. <i>Lampsilis siliquoidea</i>	14	0	0	0	14
6. <i>Lampsilis cardium</i>	1	0	0	0	1
Total	35	0	0	0	35
Total Extant Species	6				
Total Extirpated Species	0				
Total Extant Individuals	35				
Total Extirpated Individuals	0				

Site 35 – OSU campus (salvaged mussel location), Clinton Township, Franklin County, Ohio. 40.003330° -83.022394°. [EMHT 2021]

	6 October 2022					20 September 2021				
	Live	FD	WD	Sub	Total	Live	FD	WD	Sub	Total
1. <i>Strophitus undulatus</i>	0	1	0	0	1	1	0	0	0	1
2. <i>Lasmigona costata</i>	0	1	0	0	1	0	0	0	0	0
3. <i>Lasmigona complanata</i>	1	0	0	0	1	0	0	0	0	0
4. <i>Quadrula quadrula</i>	0	2	0	0	2	3	0	0	0	3
5. <i>Amblema plicata</i>	2	2	0	0	4	4	0	0	0	4
6. <i>Lampsilis siliquoidea</i>	2	1	0	0	3	3	0	0	0	3
7. <i>Lampsilis cardium</i>	2	3	0	0	5	0	0	0	0	0
8. <i>Lampsilis fasciola</i>	0	1	0	0	1	6	0	0	0	6
Total	7	11	0	0	18	17	0	0	0	17
Total Extant Species	8					5				
Total Extirpated Species	0					0				
Total Extant Individuals	18					17				
Total Extirpated Individuals	0					0				
<i>Corbicula fluminea</i>	--	--	--	--	--	--	--	--	--	--
Mussel density – 5 mussels/5m ² (1.0/m ²)										<i>Corbicula</i> density – 100 <i>Corbicula</i> /5m ² (20/m ²)

Site 35 – OSU campus (salvaged mussel location), Clinton Township, Franklin County, Ohio.
40.003330° -83.022394°. [Fleece et al. 2013]

1 July 2013

	Live	FD	WD	Sub	Total
1. <i>Utterbackia imbecillis</i>	719	0	0	0	719
2. <i>Pyganodon grandis</i>	690	0	0	0	690
3. <i>Anodontoides ferussacianus</i>	1	0	0	0	1
4. <i>Strophitus undulatus</i>	12	0	0	0	12
5. <i>Alasmidonta marginata</i>	2	0	0	0	2
6. <i>Lasmigona costata</i>	74	0	0	0	74
7. <i>Lasmigona complanata</i>	1899	0	0	0	1899
8. <i>Amblema plicata</i>	574	0	0	0	574
9. <i>Quadrula quadrula</i>	487	0	0	0	487
10. <i>Fusconaia flava</i>	53	0	0	0	53
11. <i>Pleurobema sintoxia</i>	3	0	0	0	3
12. <i>Uniomerous tetralasma</i>	0	0	1	0	1
13. <i>Toxolasma parvum</i>	8	0	0	0	8
14. <i>Lampsilis siliquoidea</i>	1513	0	0	0	1513
15. <i>Lampsilis cardium</i>	98	0	0	0	98
16. <i>Lampsilis fasciola</i>	31	0	0	0	31
Total	6164	0	1	0	6165
Total Extant Species	15				
Total Extirpated Species	1				
Total Extant Individuals	6164				
Total Extirpated Individuals	1				

Site 36 – Former 5th Ave dam site & downstream, Clinton Township, Franklin County, Ohio.
40.011831° -83.017271°. [Hoggarth 2010a]

24 September 2010

6 October 2022

	Live	FD	WD	Sub	Total	Live	FD	WD	Sub	Total
1. <i>Utterbackia imbecillis</i>	4	2	1	0	7	0	0	0	0	0
2. <i>Pyganodon grandis</i>	33	3	0	0	36	0	0	0	0	0
3. <i>Strophitus undulatus</i>	2	0	0	0	2	1	2	0	0	3
4. <i>Alasmidonta marginata</i>	7	0	1	0	8	0	0	0	0	0
5. <i>Lasmigona costata</i>	16	0	1	0	17	1	1	1	0	3
6. <i>Lasmigona complanata</i>	188	0	0	0	188	2	3	0	0	5
7. <i>Amblema plicata</i>	57	0	1	0	58	3	2	0	0	5
8. <i>Quadrula quadrula</i>	38	2	0	0	40	4	4	2	0	10
9. <i>Fusconaia flava</i>	0	1	0	0	1	1	0	1	0	2
10. <i>Pleurobema sintoxia</i>	0	1	1	1	3	0	0	0	0	0
11. <i>Eurynia dilatata</i>	0	0	1	1	2	0	0	0	0	0
12. <i>Ptychobranhus fasciolaris</i>	0	0	1	0	1	0	0	0	0	0
13. <i>Obovaria subrotunda</i>	0	0	0	1	1	0	0	0	0	0
14. <i>Lampsilis siliquoidea</i>	26	0	1	0	27	7	1	1	0	9
15. <i>Lampsilis cardium</i>	26	3	0	0	29	4	3	0	0	7
16. <i>Lampsilis fasciola</i>	17	0	0	0	17	1	2	2	0	5

17. <i>Epioblasma triquetra</i>	0	0	0	1	1	0	0	0	0	0
18. <i>Epioblasma rangiana</i>	0	0	0	1	1	0	0	0	0	0
Total	414	12	8	5	439	24	18	7	0	49
Total Extant Species	13					9				
Total Extirpated Species	5					0				
Total Extant Individuals	426					42				
Total Extirpated Individuals	13					7				
<i>Corbicula fluminea</i>	--	--	--	--	--	50	0	0	0	50
Mussel density – 4 mussels/5m ² (0.8/m ²)										<i>Corbicula</i> density –50 <i>Corbicula</i> /5m ² (10/m ²)

Site 36 – Former 5th Ave dam site & downstream, Clinton Township, Franklin County, Ohio.
39.987445° -83.024416°. [Fleece et al. 2013]

	1 July 2013				
	Live	FD	WD	Sub	Total
1. <i>Utterbackia imbecillis</i>	20	0	0	0	20
2. <i>Pyganodon grandis</i>	129	0	0	0	129
3. <i>Strophitus undulatus</i>	9	0	0	0	9
4. <i>Alasmidonta marginata</i>	24	0	0	0	24
5. <i>Lasmigona costata</i>	25	0	0	0	25
6. <i>Lasmigona complanata</i>	495	0	0	0	495
7. <i>Amblema plicata</i>	395	0	0	0	395
8. <i>Quadrula quadrula</i>	78	0	0	0	78
9. <i>Lampsilis siliquoidea</i>	86	0	0	0	86
10. <i>Lampsilis cardium</i>	77	0	0	0	77
11. <i>Lampsilis fasciola</i>	1	0	0	0	1
Total	1339	0	0	0	1339
Total Extant Species	11				
Total Extirpated Species	0				
Total Extant Individuals	1339				
Total Extirpated Individuals	0				

Site 37 – Goodale Road Bridge, Clinton Township, Franklin County, Ohio. 39.974281° -83.020128°.
[Hoggarth 2013]

	2 August 2013					25 August 2022				
	Live	FD	WD	Sub	Total	Live	FD	WD	Sub	Total
1. <i>Utterbackia imbecillis</i>	0	13	0	0	13	1	3	0	0	4
2. <i>Pyganodon grandis</i>	4	18	0	0	22	3	1	0	0	4
3. <i>Strophitus undulatus</i>	2	7	0	0	9	1	0	0	0	1
4. <i>Alasmidonta marginata</i>	1	8	0	0	9	0	0	2	0	2
5. <i>Lasmigona costata</i>	3	4	0	0	7	1	1	0	0	2
6. <i>Lasmigona complanata</i>	39	21	0	0	60	2	0	1	0	3
7. <i>Amblema plicata</i>	39	12	0	0	51	5	3	0	0	8
8. <i>Quadrula quadrula</i>	62	21	0	0	83	23	2	2	0	27
9. <i>Fusconaia flava</i>	0	0	0	0	0	0	1	0	0	1
10. <i>Eurynia dilatata</i>	0	0	0	0	0	1	1	1	0	3
11. <i>Toxolasma parvum</i>	1	0	0	0	1	0	0	0	0	0

12. <i>Lampsilis siliquoidea</i>	10	10	0	0	28	5	1	0	0	6
13. <i>Lampsilis cardium</i>	5	5	0	0	10	10	2	1	0	13
14. <i>Lampsilis fasciola</i>	0	5	0	0	5	2	1	0	0	3
15. <i>Epioblasma triquetra</i>	0	0	0	0	0	0	0	0	1	1
Total	174	124	0	0	298	54	16	7	1	78
Total Extant Species	12					12				
Total Extirpated Species	0					2				
Total Extant Individuals	298					70				
Total Extirpated Individuals	0					8				
<i>Corbicula fluminea</i>	--	--	--	--	--	2	1	0	0	3
Mussel density – 5 mussels/5m ² (1.0/m ²)										<i>Corbicula</i> density – 12 <i>Corbicula</i> /5m ² (2.4/m ²)

Site 38 – Confluence with the Scioto River, Clinton Township, Franklin County, Ohio. 39.964758°
-83.017114°.

	Not sampled in 1989					25 August 2022				
	Live	FD	WD	Sub	Total	Live	FD	WD	Sub	Total
1. <i>Pyganodon grandis</i>						0	1	0	0	1
2. <i>Lasmigona complanata</i>						0	1	0	0	1
3. <i>Amblema plicata</i>						0	3	0	0	3
4. <i>Fusconaia flava</i>						0	1	0	0	1
5. <i>Eurynia dilatata</i>						0	0	1	0	1
6. <i>Lampsilis siliquoidea</i>						2	1	0	0	3
7. <i>Lampsilis cardium</i>						0	0	1	0	1
8. <i>Lampsilis fasciola</i>						1	1	0	0	2
9. <i>Epioblasma triquetra</i>						0	0	0	1	1
Total	--	--	--	--	--	3	8	2	1	14
Total Extant Species	--					6				
Total Extirpated Species	--					3				
Total Extant Individuals	--					11				
Total Extirpated Individuals	--					3				
<i>Corbicula fluminea</i>	--	--	--	--	--	2	1	0	0	3
Mussel density – 0 mussels/5m ² (0/m ²)										<i>Corbicula</i> density – 2 <i>Corbicula</i> /5m ² (0.4/m ²)

Appendix 2. The Water Data

Site #	Turbidity NTU	Iron mg/l	Sulfate mg/l	Nitrate mg/l	Phosphorous mg/l	Conductivity uS/cm	Date
00	18	0.27	42.0	3.8	4.1	529	25 May 2022
0	10	0.68	86.0	3.0	0.1	592	25 May 2022
1	17	0.34	132.0	8.8	4.9	681	25 May 2022
2	24	2.30	52.0	6.8	3.4	669	26 May 2022
3	33	1.51	43.0	5.2	11.9	648	26 May 2022
4	48	0.82	47.0	1.4	5.2	618	26 May 2022
4	23	0.58	42.0	3.2	3.8	659	3 June 2022
5	36	0.31	53.0	3.2	14.0	650	3 June 2022
6	28	0.35	54.0	2.2	2.0	230*	3 June 2022
7	38	2.14*	51.0	7.2	6.4	649	3 June 2022
8	53	0.38	51.0	7.9	11.8	660	3 June 2022
8	34	0.29	51.0	6.5	4.6	525*	22 June 2022
9	52	0.32	70.0	3.9	5.8	273*	22 June 2022
10	32	0.34	57.0	4.5	3.1	325*	22 June 2022
11	48	0.24	53.0	9.6	9.3	347*	22 June 2022
12	58	0.21	47.0	2.6	46.8*	640	22 June 2022
13	36	0.34	63.0	0.4	16.1	557	23 June 2022
14	25	2.46*	55.0	5.1	5.9	551	23 June 2022
15	34	0.20	54.0	4.5	16.9	551	23 June 2022
16	34	0.22	59.0	4.8	7.6	662	24 June 2022
17	31	0.29	62.0	2.1	13.1	260*	24 June 2022
17	16	0.10	56.0	2.6	0.0	-----	30 June 2022
18	13	0.15	60.0	6.1	3.0	-----	30 June 2022
19	36	0.23	35.0	4.2	6.2	-----	30 June 2022
20	46	0.70	30.0	9.0	16.3	-----	1 July 2022
21	46	0.45	27.0	1.8	2.3	-----	1 July 2022
22	37	0.19	23.0	3.7	2.5	-----	15 July 2022
23	22	0.35	49.0	10.9	7.5	-----	15 July 2022
24	32	0.24	34.0	1.5	8.7	-----	15 July 2022
25	33	0.21	37.0	3.1	14.1	-----	21 July 2022
26	25	0.16	45.0	4.6	17.3	-----	21 July 2022
27	23	0.22	45.0	1.9	18.8	-----	22 July 2022
28	13	0.14	46.0	7.2	2.8	-----	22 July 2022
29	9	0.18	42.0	3.7	14.3	-----	22 July 2022
29	16	0.08	48.0	3.2	2.9	-----	11 August 2022
30	16	0.34	47.0	3.1	1.5	-----	11 August 2022
31	14	0.22	45.0	6.0	6.9	-----	11 August 2022
32	19	0.30	57.0	3.8	12.8	-----	12 August 2022
33	18	0.14	63.0	4.3	19.3	-----	12 August 2022
34	18	0.16	61.0	3.3	2.1	-----	12 August 2022
35	9	0.10	60.0	2.1	0.3	-----	6 October 2022

36	9	0.11	60.0	2.0	0.2	-----	6 October 2022
37	22	0.21	56.0	1.8	1.1	-----	25 August 2022
38	22	0.20	58.0	2.0	1.2	-----	25 August 2022

* out of range for the study – faulty reading

----- Conductivity meter malfunctioned, discontinued use

Phosphorous – total phosphorous

Appendix 3. Google Earth image showing the locations of sites 00 – 38

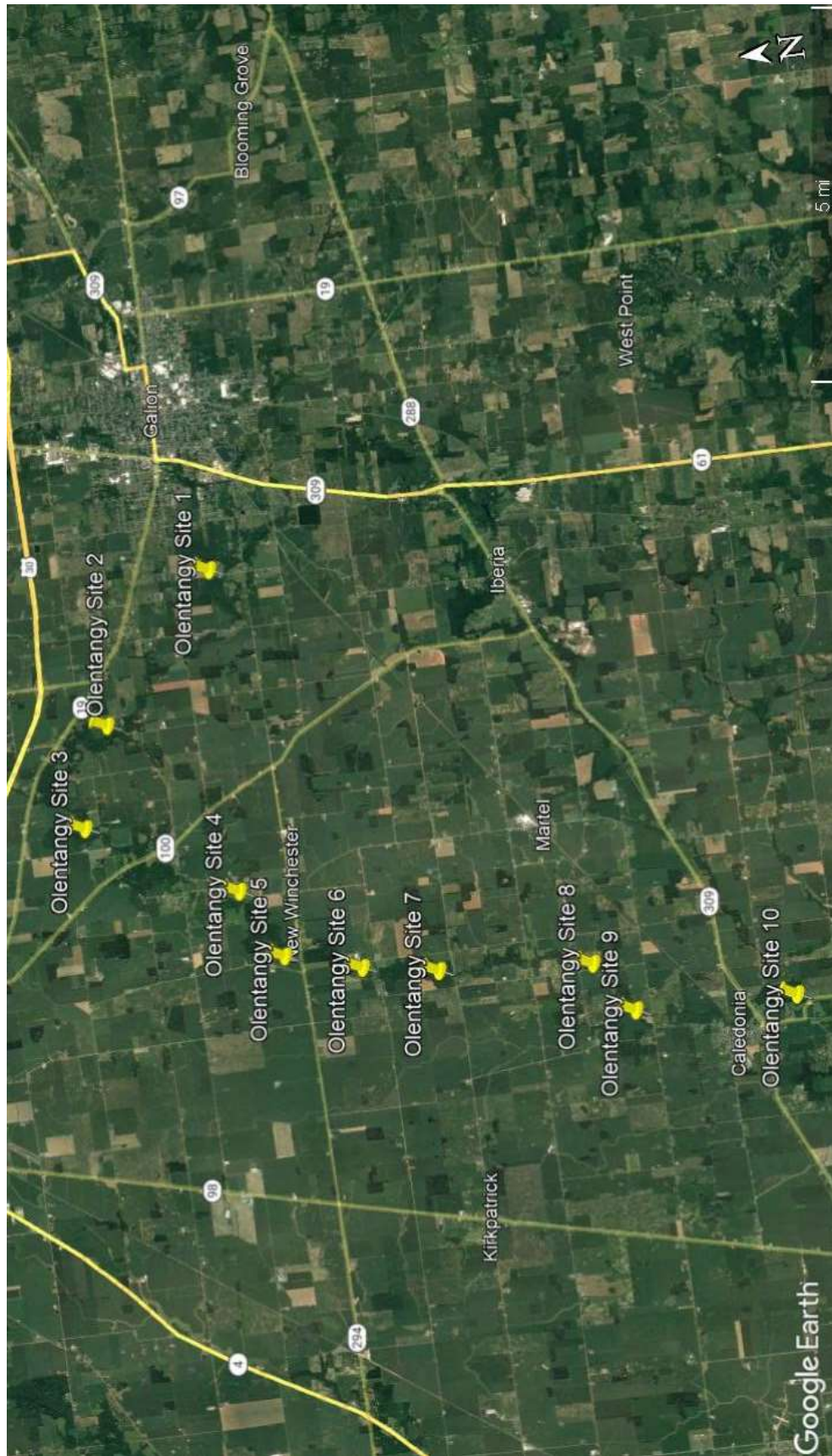


Figure 1. Olenfanty Sites 1-10 (headwaters)

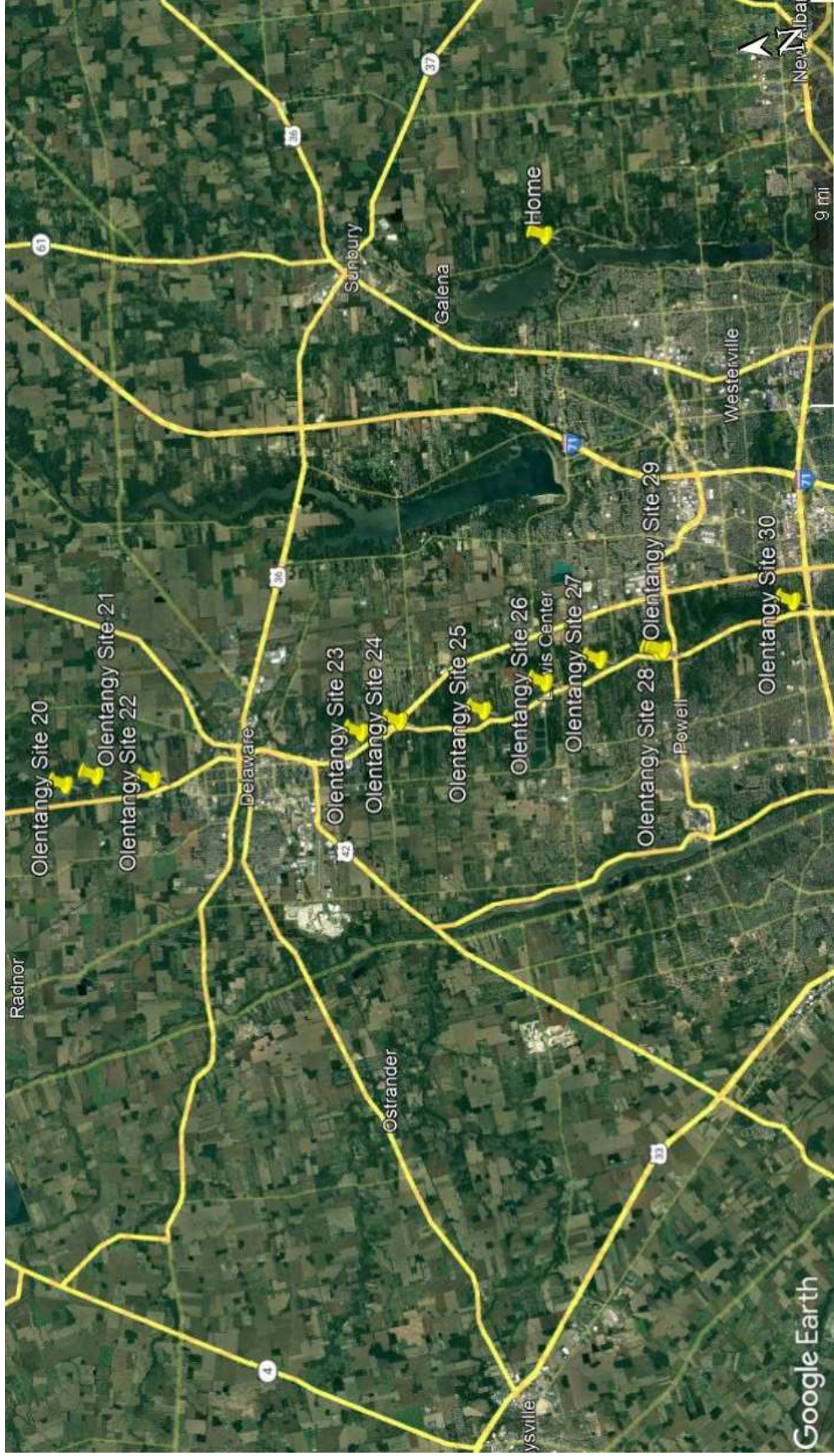


Figure 3. Olentangy Sites 20-30 (between Delaware Lake and Columbus)

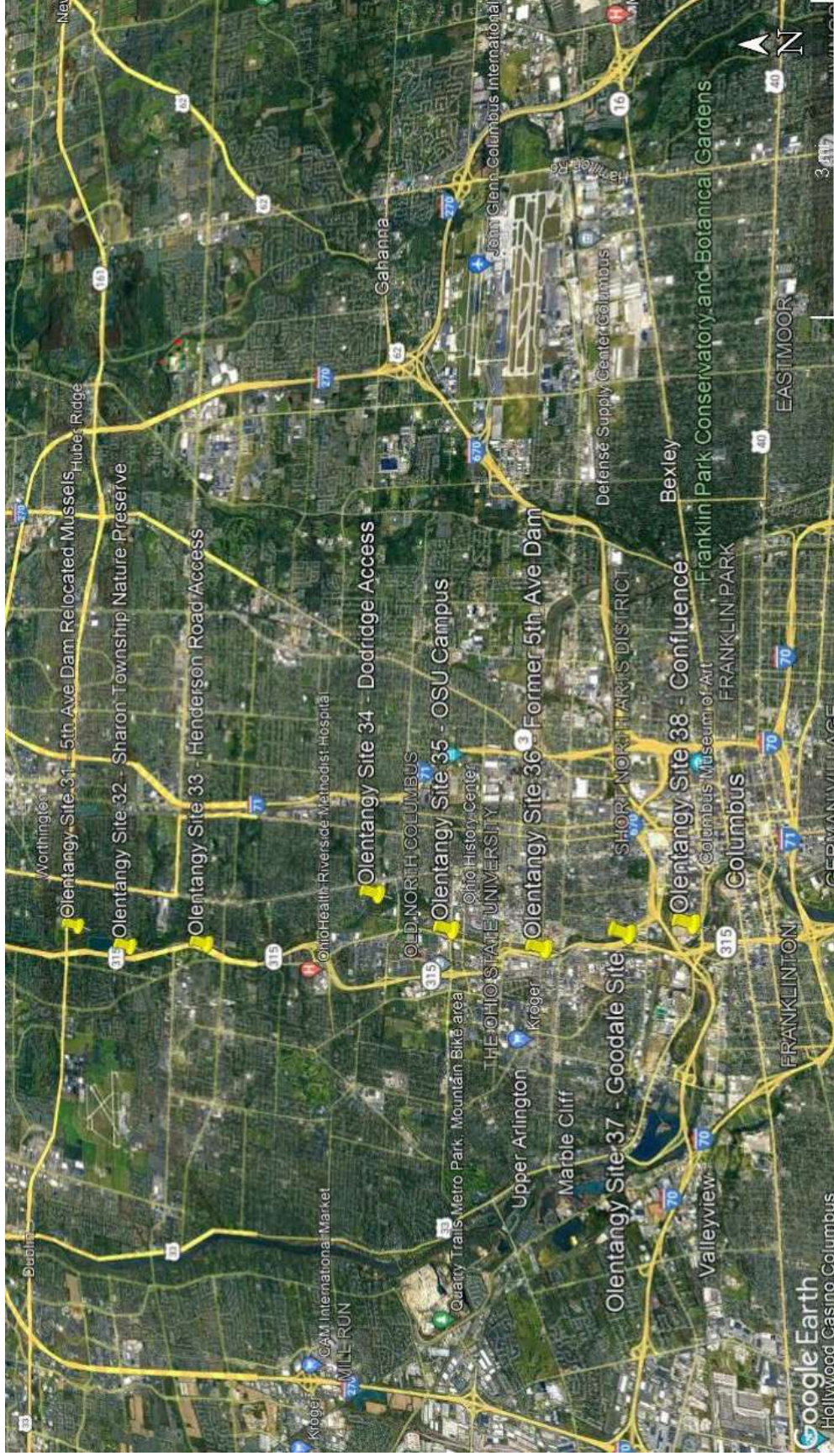
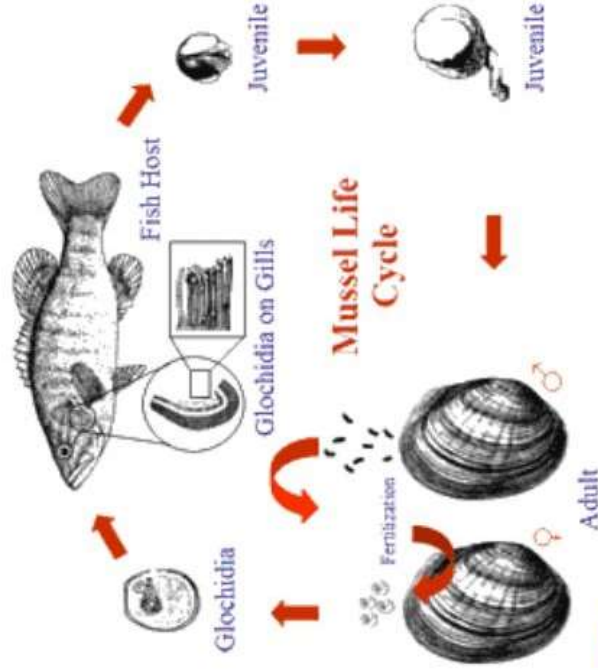


Figure 4 – Olentangy Sites 31-38 (new sites from IR270 to the confluence)

Correlation of Fish and Mussels in the Olentangy River



Introduction



- There have been very few studies on the fish population and distribution in the Olentangy river and most are over five years old. There are regular studies done on freshwater mussel populations in Ohio, so these studies can be used to expand the data on the distribution of fish in these areas. The species diversity, population size, and distribution of freshwater species is important for the fishing industry and serves as an indicator for water pollution.
- Part of the freshwater mussel life cycle includes living in the gills of fish (Modesto et al., 2017). These mussels have known fish that are more likely to act as hosts and the presence of certain mussels could correlate with the presence of certain fish.
- Goal: To investigate this possible correlation between the mussels in the Olentangy River and the known fish populations.

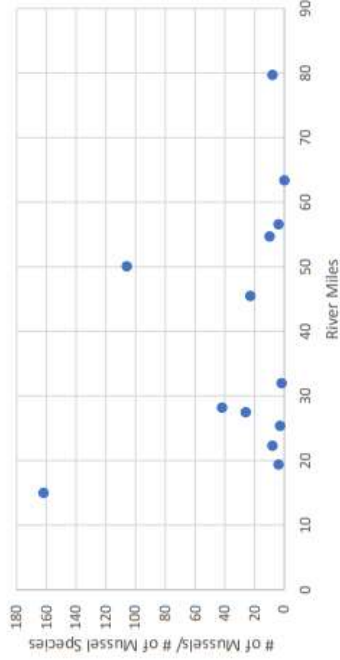
Methods

- A total of 40 sites were sampled between May and September 2022.
- General collecting was performed following transect sampling. During this portion of the study, an area of stream was searched by three collectors for no less than 1 ½ hours and no more than 2 hours. All live mussels found were returned to the river. Dead shells were retained as vouchers or identified and returned to the stream.
- Data from the EPA, Freshwater Mussel Society, and OSUM was used to get numbers for the populations of fish in the river.

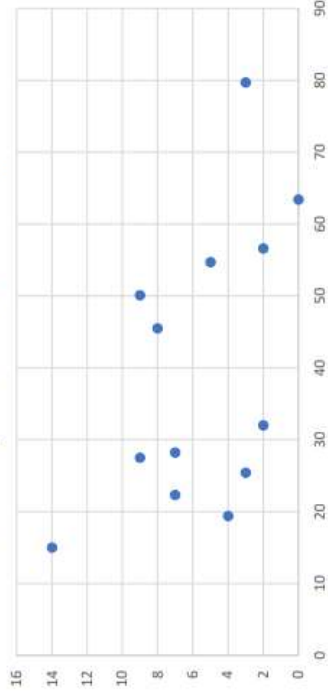


Data

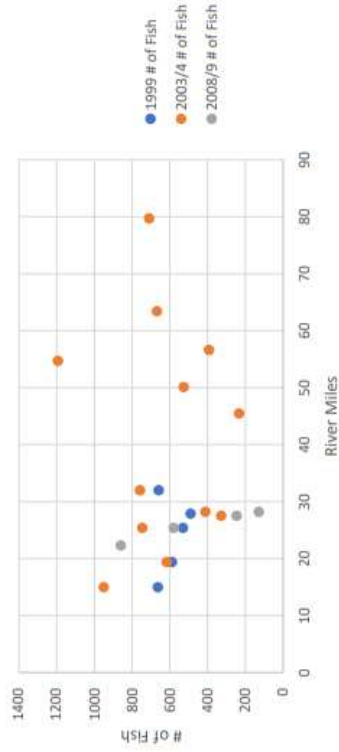
of Mussels at Different River Miles 2022



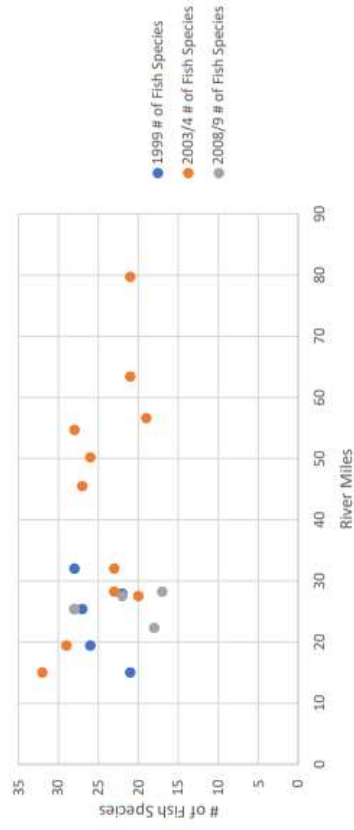
of Mussel Species at Different River Miles 2022



of Fish at Different River Miles Over Time



of Fish Species at Different River Miles Over Time





Results

- There does appear to be more mussels where more fish are present and there is an increase in mussels and fish from upstream (high river miles) to downstream.
- The white heelsplitter (*Lasmigona complanata*) was only found at site # 26 in 1989 (1 live specimen), upstream of Dodridge Dam, but was found more widely this past year almost up to the Delaware Dam.
- One *Quadrula quadrula* was found upstream of the Dodridge Dam but was abundant downstream of that dam.



Conclusions

- Here we have an instance of the ability of fish to migrate affecting the ability of mussels to migrate in the Olen tangy River. In particular, this migration ability was impacted by the Dodridge Dam.
- Since *Lasmigona complanata* was introduced upstream of the dam, it was able to migrate downstream using fish that were able to swim over the dam.
- *Quadrula quadrula* is downstream of the dam and is unable to migrate upstream due to the fish not being able to get over the dam.



An Analysis of Water Quality in the Olentangy River

By Megan Caldwell
Advisor: Dr. Hoggarth

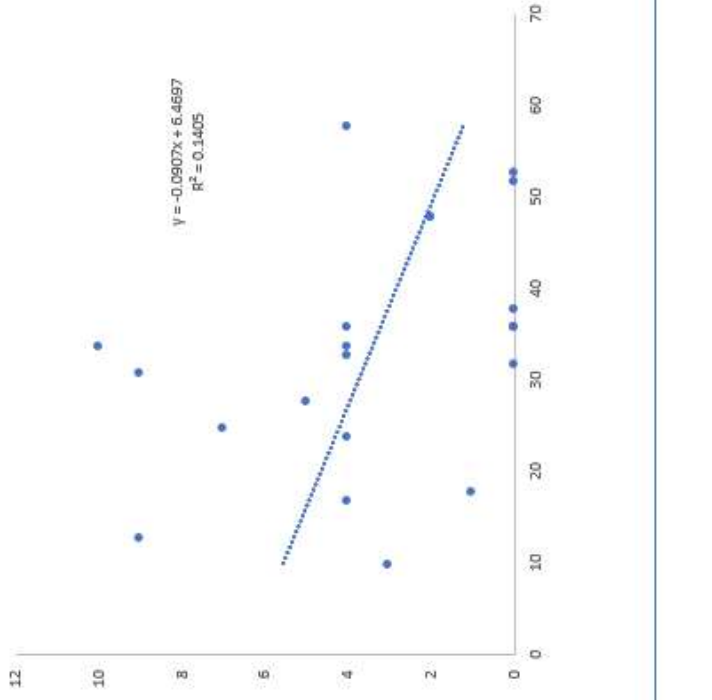
Turbidity and Mussels

- Turbidity is a measure of how clear the water is and how much silt is present.
- Phosphorus increases around agricultural areas which increases runoff and silt in the stream
- Silt can interfere with mussel's respiration and feeding abilities.
 - This is due to silt blocking tubes that allow oxygen to enter
- It was expected that an increase in turbidity would decrease the mussel population

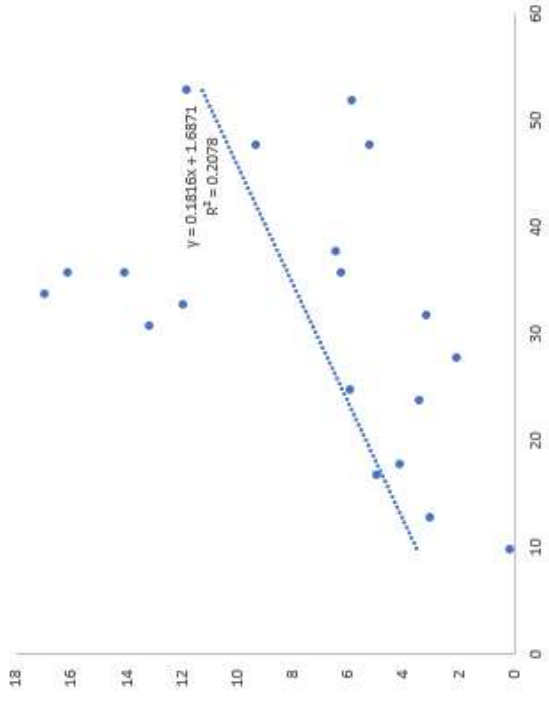
Methods

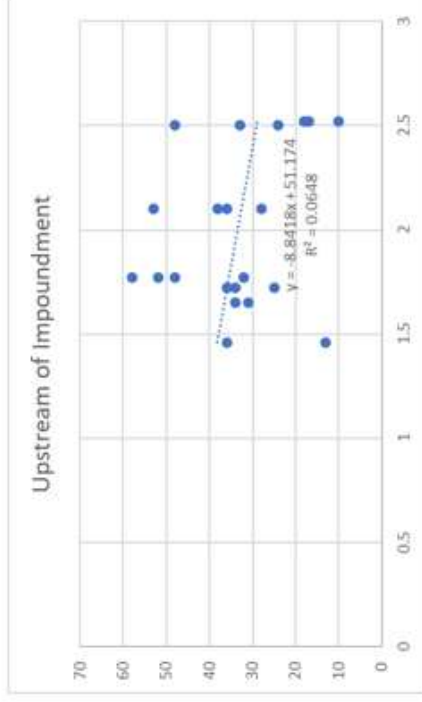
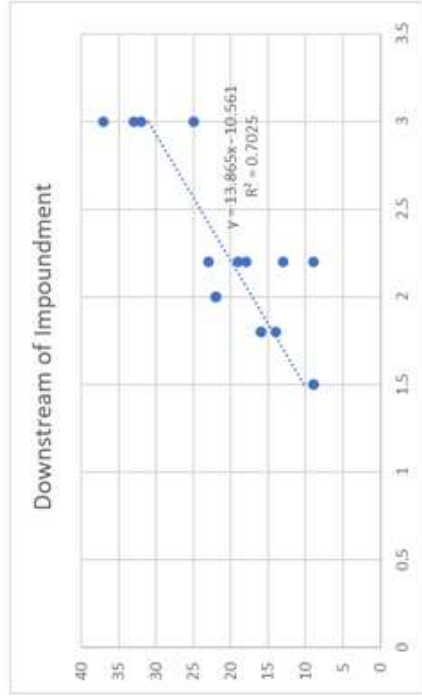
- Water samples were collected using a grab sample technique at each site
- Turbidity was measured using a Hach Turbidity Meter
- Phosphorus levels were measured using a Hach Spectrophotometer

Turbidity vs Species Found



Turbidity vs Phosphorus





Conclusions

- Upstream of the impoundment, turbidity is always high regardless of stream height
- Downstream of the impoundment, turbidity fluctuates more with the stream height
- There were less mussel populations present upstream of the impoundment due to high turbidity

Acknowledgements

- Dr. Hoggarth
- C. Campagne
- Ohio Department of Natural Resources
- Otterbein University Biology Department

Appendix 5. Photographs



Photograph 1. *Utterbackia imbecillis* from site #20.



Photograph 2. Two specimens of *Pyganodon grandis* from the Olentangy River.



Photograph 3. Specimens of *Lasmigona complanata* from the Olentangy River.



Photograph 4. Specimen of *Lasmigona compressa* collected from Highbanks MetroPark.



Photograph 5. *Amblema plicata* collected from the Olentangy River.



Photograph 6. *Ptychobranchus fasciolaris* collected from the Olentangy River.



Photograph 7. Distorted specimen of *Lampsilis siliquoidea* from the Olentangy River.



Photograph 8. Three specimens of *Lamprolaima cardium* from the lower Olentangy River.



Photograph 9. Living female *Lampsilis cardium* with mantle flaps extended from the lower Olentangy River.



Photograph 10. *Cambarunio iris* collected from the lower midsection of the Olentangy River.



Photograph 11. *Cambarunio iris* (upper left) and *Eurynia dilatata* (lower right) from the upper midsection of the Olentangy River.



Photograph 12. Living specimen of *Epioblasma triquetra* from the Olentangy River at site #14.



Photograph 13. Two freshly dead specimens of *Epioblasma triquetra* from the Olentangy River at site #14.



Photograph 14. Freshly dead specimen of *P Paetulonio fabalis* collected from the Olentangy River at site #14.



Photograph 15. Representative photograph of the high turbidity in the headwaters and upper midsection of the river.



Photograph 16. Representative photograph of the lower turbidity in the lower midsection, Scenic River section, and lower portion of the Olentangy R iver.