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# THE SPREAD OF INVASIVE ASIAN CLAMS (*CORBICULA FLUMINEA*) IN THE RAYSTOWN BRANCH OF THE JUNIATA RIVER AND OTHER STREAMS IN THE HUNTINGDON AREA

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## ABSTRACT

Our study focused on the spread of the invasive Asian Clam (*Corbicula fluminea*) along 10 sites in the Raystown Branch of the Juniata River, Lake Raystown, and its tributaries. Based on our results, we determined that the invasive Asian clam was more prevalent in the sites that had a higher conductivity. This is because organisms that have a hard outer shell or exoskeleton need higher calcium levels to maintain them. Other factors that impacted the presence of freshwater clams were water velocity and depth. In many cases, if the location we were surveying had high water velocity there were very few or no clams found. The implication of this is that clams like to remain stationary, as it allows them to filter their nutrients out of the water more efficiently, fast moving water disrupts this because the nutrients pass by too quickly, without giving the clams a chance to filter it out. This would result in many of the clams dying off because of insufficient nutrients. One final factor that we concluded impacted the spread of Asian Clams at our different locations was pH. Areas with lower pHs would make it more difficult for these locations to harbor clams. Lower pH or higher acidity dissolves and weakens the clams' outer shells which would make them more vulnerable to predators like raccoons or aquatic birds. Ultimately no native clams were found over the course of this study. All live clams and clam shells found in sampling areas were from the invasive Asian Clam.

*Keywords:* *Corbicula fluminea* distribution, freshwater mussel, invasive species, water chemistry

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## INTRODUCTION

We examined the spread of invasive Asian Clams (*Corbicula fluminea*), in the Raystown Branch of the Juniata River and other streams in the Huntingdon Area. If there are streams with conditions conducive for thriving clam populations- high pH, high conductivity as a proxy for calcium availability, and adequate substrate- then we will find more Asian Clams than in streams that lack these features. This study is crucial for understanding the conditions of the spread of the invasive Asian Clam, because it will indicate the environments in which these clams thrive. Once we know these conditions, it will become easier to predict the spread, as well as locate already spreading populations of the clams. This can help environmentalists understand the difference in conditions that invasive and native clams thrive in, allowing us to support or find populations of native

clams along the Juniata River and its tributaries that have long been driven out. Asian Clams damage and destroy industrial water systems, clog up intake pipes, compete for resources against other species, and ultimately alter the habitat and the native mussels and clams (Asiatic clam 2008).

The Asian Clam is a species of bivalve mussel that originates from Asia, Africa, and Australia. It was first discovered in the U.S. in the 1920s on the North Pacific coast (Sousa et al. 2008). Their rapid growth, early sexual maturity, high fecundity, and resistance to pollution makes them able to out-compete native species very efficiently (Sousa et al., 2008). They are found in freshwater bodies all over the U.S. and do well in estuarine habitats (NCR, 2008). Populations of native freshwater mussels have been declining across the U.S. A study done in 2020 suggests that a cause for this could potentially be the

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Asian Clam even though it is much overlooked (Haag et al. 2020).

## METHODS AND FIELD SITES

Ten sites along the Raystown Branch of the Juniata River, Lake Raystown, and its tributaries were chosen for sampling; these locations are shown below in Figure 1. These sites include all public locations (minus one



Figure 1. Map of the field sites that have been and will be sampled for freshwater clams. Purple points are sites in Raystown lake, teal points are those along the Juniata River, and yellow points are contributing streams.

but access has been granted by the property owner). Four sites are along the river, one site being above the lake and dam (Red Cut Lane) which has confirmed sightings of freshwater clams, the next site downstream is near Portstown Park in downtown Huntingdon, here we can check the presence of clams with the addition of human activity. The last two sites on the Juniata River are on either side of the Warrior Ridge Dam. These sites allowed us to look at clam distribution along the same stretch of river with no additional tributaries meeting the river in between the two sites, so the only difference is the dam for each of these sites. In the lake itself, we chose four sites

roughly equally spaced along the shore. These sites include the riffle below the Raystown Dam which contains a lot of sediment and could make a good environment for clams, the next site is the Seven Points Campground which has a peninsula and bay in the lake, the third lake site is near Upper Corners Road along the lakeshore, which appears to be an undisturbed patch of Forest and shoreline, this will help give us an idea of clam distribution in an area with little human contact, the last lake site we intend to visit is Raystown Field Station due to its restricted access and large area. Finally, we visited four of the Juniata Rivers tributary streams to see what the freshwater clam populations are like in these streams. Streams that we visited included Muddy Run, Standing Stone Creek, Crooked Creek, and Shaver's Creek. At each site we



Figure 2. Images taken of the four tributary sites in order left to right, Muddy Run, Standing Stone, Shaver's Creek, Crooked Creek. Images taken by Lauren Mahkovic.



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Figure 3. Images of the two sites at Lake Raystown, right to left as site one, then two. Images taken by Lauren Mahkovic.



Figure 4. Images of the four sites taken along the Juniata River, left to right as site one, two, three, four. Images taken by Lauren Mahkovic.

utilizes meters to measure pH, salinity, dissolved oxygen, temperature, and levels of conductivity as a proxy for calcium carbonate. At all the field sites, waders are needed to enter the streams. We did not use any tools to collect clams, just pick them up similarly to any other macroinvertebrate collection. Looking for opened shells is a good indicator for locating live clams, as they indicate the stream is or recently was suitable for sustaining clams. After securing a clam, a photo was taken so that it can be identified later once the proper resources are present.

## MATERIALS AND EQUIPMENT

We tested the water chemistry at our locations to determine if there were any conditions that affected mussel abundance and/or diversity. The measurements we took were conductivity, pH, oxygen levels, temperature, and salinity. For this we needed water conductivity, pH and dissolved oxygen meters, waders, collection containers, and scale bar. The waders were needed so that we could wade as far into the water as possible to ensure that we covered sufficient sample locations. The collection containers were to take any samples back in case we needed to identify them later.

## RESULTS

Our results are given in Tables 1 and 2 and Figures 5 and 6.

Table 1. The water chemistry of all 10 field sites, rows shaded in yellow had live clams and those shaded in green did not have live clams but where clam shells were found.

Field Site	Ph	Conductivity (US)	Dissolved O2 (mg/L)	Salinity (PPT)	Temperature (celcius)
Raystown Lake	6.58	184.7	10.91	0.1	14.2

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#1					
Raystown Lake #2	6.5	191.2	10.64	0.1	15.4
Juniata River #1	8.14	259.6	12.08	0.2	14.9
Juniata River #2	N/A	166.8	9.68	0.1	11.9
Juniata River #3	N/A	195.1	8.6	0.1	12.3
Juniata River #4	7.09	216.6	8.5	0.1	16.8
Muddy Run	7.03	603	11.04	0.3	11.6
Standing Stone	7.15	141.5	9.85	0.1	14.2
Shaver's Creek	N/A	198.1	5.80	0.1	13.0
Crooked Creek	7.57	350.8	10.38	0.2	13.6

Table 2. The number of *Corbicula fluminea* found at each field site and whether or not Asian Clam shells were found.

Field Site	Number of Asian Clams Found	Clam Shells Present?
Muddy Run	0	No
Standing Stone	0	Yes
Shaver's Creek	0	No
Crooked Creek	11	Yes
Lake Raystown Site 1	0	Yes
Lake Raystown Site 2	0	Yes
Juniata River Site 1	13	Yes
Juniata River Site 2	0	No
Juniata River Site 3	0	Yes
Juniata River Site 4	0	Yes

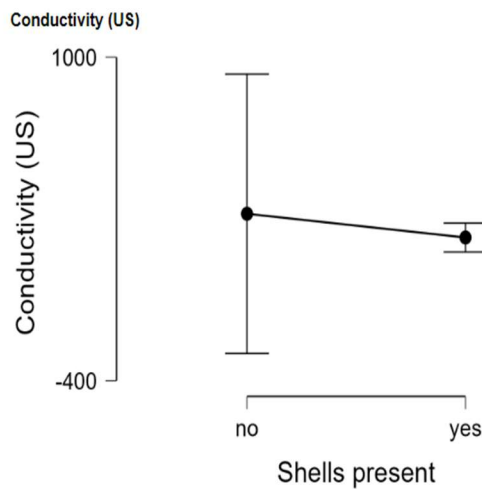


Figure 5. Shows the conductivity levels when shells are and are not present.

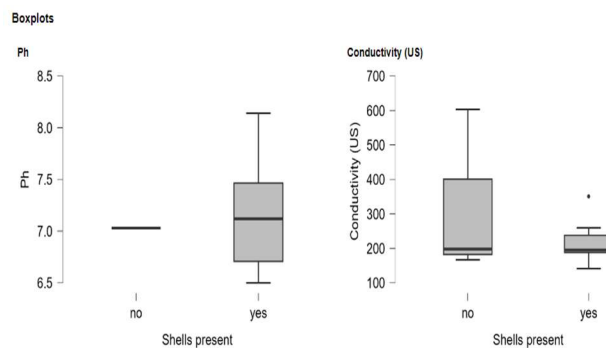


Figure 6. Shows the pH levels where shells are and are not present (left). Shows the conductivity range where shells are not present and when they are (right).

## DISCUSSION

We visited twelve field sites allowing several conclusions about clam distribution to be made. No native clams were found, there were several sites that had no clams found but had evidence of a clam population in the form of shells. All clams found have been the invasive Asian Clam (*Corbicula Fluminea*) and they ranged in size from app. 1 cm to 3 cm along the opening axis of the shell. The streams that clams were found in had several things in common, a lack of silty sediment in favor of larger gravel and cobbles, shallower slower moving water along stream edges, and rocky riffles in the water. We believe this is because clams prefer the calmer, less silty streams to

live in because they are filter feeders, so it makes sense to find neither clams or their shells in streams that are fast and filled with fine sediment. Contributing factors to the abundance of Asian Clams and a lack of native clams in areas where they could seemingly thrive could possibly be the Asian Clams out competing and out reproducing the native clams or even the presence of pollutants native clams may be much more sensitive to than their invasive counterpart.

Muddy Run was the first of the tributary streams we sampled for clams. The stream lives up to its name in the way the substrate is extremely silty with very little riffles or cobbles of rock. Anytime we stepped in the water, large plumes of sediment would be kicked up and spread downstream. Muddy Run had the highest dissolved O<sub>2</sub> of any tributary (11.04) and the highest salinity as well (0.3). It is believed due to the high conductivity of muddy run (603) and the presence of other shelled macroinvertebrates like crayfish that are known to inhabit the stream, that the water chemistry could support clams but the substrate is the main limiting factor for why we do not find clams or clam shells at this site.

Standing Stone was one of the next several tributary streams sampled. This stream was deep and very fast moving but did have a rocky substrate we believed would be perfect for clams. However, we did not find any clams at this site but did find opened clam shells indicating they can live in the stream and generally water chemistry and substrate aren't pressing issues here. There were Asian Clam Shells present at this site however towards the shallower bank where the water was slightly calmer. Overall, we concluded that the water was too deep and fast for a community of filter feeding clams to be present.

The third tributary sampled was Shaver's Creek in Petersburg, PA. This stream was sampled in a park near downtown and generally was lifeless. The stream was deeper than any of the other tributaries and had an extremely silty sediment. While the water chemistry is mostly unremarkable, this stream had the lowest dissolved oxygen by far with 5.8 milligrams per liter. This may be attributed to the general lack of plant life in the stream but could also be due to other factors we could not test for such as pollutants or heavy metals. Additionally, no signs of life were found other than a single decomposed fish, and no clams shells of any variety were found.

The last tributary used for this study was sampled in Riverside Park of downtown Huntingdon. Crooked Creek was the only Juniata River tributary that had live Asian Clams, a total of 11 live clams and a countless number of shells were found. Crooked Creek had the perfect clam environment, shallow medium pace water, and a substrate of pea gravel sized sediment that didn't overwhelm the clams in silt like

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the other sites. Chemically the water is also very favorable for clam survival. Out of all the tributaries sampled it has the highest (most basic) pH, and the second highest dissolved oxygen, conductivity, and salinity. These factors combined make it easier for clams, native and invasive, to feed, consolidate calcium carbonate in their shells, and avoid predators.



Figure 7. Images of the Asian Clams found at Crooked Creek by Lauren Mahkovic.

We chose to sample two sites at lake Raystown which gave us a lot of insight into the spread of the Asian Clam in Pennsylvania. Sites sampled include Seven Points Recreation Area and the picnic area beneath Seven Points Boat Launch. At the recreation area there were a substantial amount of large clam shells, indicating a massive population at some point in the lake's history if not right now. This area had a substrate of small rocks to sand size particles that would make a suitable habitat for clams. At this site temperature, dissolved oxygen, and salinity are all very similar to the other sites and conducive to clam survival, however, the conductivity and Ph were both lower than initially thought. This may be a deterrent to thriving clam populations and we believe this is due to the activity of motorized boats on the lake adding CO<sub>2</sub> to the water making it slightly more acidic. The second site had a rockier substrate made up of more gravel and cobbles but had nearly identical water chemistry. There were no live clams found at this site but many clam shells were found.

Four sites were chosen for sampling along the Juniata River in a variety of different areas due to the variability in environment. The Juniata River that runs through the Huntingdon Area generally is considered a small river often called the Little Juniata, it is home

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to a wide variety of different environments that can suit different communities. Generally, the Juniata River has a rocky substrate of boulders, cobbles, and gravel, with some more sandy and silty sections of shoreline. The furthest upstream sampling site at Red Cut Lane, has been known to have live Asian Clams in the past but at the time of sampling only shells were found and there was evidence of a flood going through the area. The water chemistry is in line with what we would expect to see at a clam bearing site. Additionally, there was a mixed substrate at this site. One portion was an organic silty bar and the other is a shoreline with pebbles and cobbles where more of the clam shells were found. Moving downstream, the next sampled site of the Juniata River is site one, sampled from Portstown Park in Huntingdon. 13 live Asian Clams have been found at this site, most of the sampled sites thus far. This could be due to the site's unique water chemistry as compared to the downstream sites. This site has the highest recorded Ph, allowing for more calcium carbonate to be available, the highest conductivity of the river sites which indicates a large amount of calcium carbonate available, as well as the highest salinity and dissolved oxygen. These factors allow for the more salt tolerant Asian Clam to flourish in these conditions more so than the native clams, none of which were found. Sites two and three were sampled further downstream on either side of Warriors Ridge Dam. Between these two sites, there are no notable differences in water chemistry, substrate, and water depth or speed. No live clams were here at either site but clam shells were found below the dam along the spillway shore. The lack of clams above the dam could potentially be due to the higher water and water level fluctuation caused by the dam making it inhospitable. Below the dam the lack of live clams but the presence of shells could potentially be due to predators such as raccoons coming when the water level is low and the live clams being flushed downstream when the floodgates are opened.

Regarding statistical analysis, our data was far too limited to garner any significant p-values. However, we were able to produce several relevant graphs. As seen by Figures 5 and 6, we determined that the most relevant water chemistry data was pH and conductivity. From Figure 6 we can determine that the pH range of sites where shells were found is significantly greater than the conductivity range of sites where shells were found, which was much narrower. This would imply that the clams are much more sensitive to conductivity than pH. This is also evidenced by the fact that while most of our clam shells were found at sites with a near basic pH, that is also the pH level of the sites in which we did not find any evidence of clams. Whereas the sites where we

found evidence of clams had a conductivity reaching 700, but the highest conductivity of a sites containing clams was around 350. Simply put, clams are more likely to be found at sites with a basic pH and a conductivity of around 150-250.



Figure 8. Images of the Asian Clams found in the Juniata River by Lauren Mahkovic.

Based on our findings we draw several conclusions about the spread of the Asian Clam in central Pennsylvania. It is clear there that the Asian Clam has had a pervasive spread through local waterways and has outcompeted native clam species. From our water chemistry and environmental data, we can predict that Asian Clams can be found at sites with basic pH, high conductivity, and a substrate similar to pea gravel.

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