Method for the Manual Removal of the Asian Clam (Corbicula fluminea) as an Invasive Species in the Mukwonago River – Summer 2014

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Introduction:

Figure 1: Asian clams of varying sizes taken from Lulu Lake with a penny for size.

In 2008, the invasive Asian clam (*Corbicula fluminea*) was found in the Mukwonago River unit of Southern Kettle Moraine Forest, the former Rainbow Springs golf course. This was one of the first instances of this invasive being found in inland waters. In 2013, Tina Wolbers of the Wisconsin Department of Natural Resources and Jerry Ziegler of The Nature Conservancy found the Asian clam in Lulu Lake, an area upriver of the golf course. This has proven to be rather concerning, as a species moving upriver is indicative of spread due to human activities. It is for this reason that the Friends of the Mukwonago River wrote and were awarded a grant that aims to explore, educate, and control the spread of the Asian clam as well as other invasive species within the Mukwonago River watershed and beyond.

It has been my job to kick-start a removal effort for the Asian clam. With the help of many individuals and multiple organizations, I believe we were able to develop an easily executed and scientifically sound method for testing the effectiveness of manual removal as a means of control for the Asian clam. At the request of Lisie Kitchel of the Wisconsin Department of Natural Resources, I've also been removing the invasive zebra mussel and acquiring meristic data on native mussels and Sphaeriidae while going about the Asian clam removal.

Materials:

4 x pieces of ¼ inch PVC pipe, each cut to a length of one meter with holes drilled into them (so it won't float)

4 x ¼ inch PVC elbow joints

1 x metal kitchen colander (per worker)

1 x mesh bag w/ carabiner to attach to belt/waders (per worker)

1 x GPS unit, to mark coordinates of plot

Ziploc bags, for storing samples

Chest waders (optional) – most of the sites surveyed were easily accessible with hip waders, but using a standard bathing/wet suit was also found to be practical or even preferred on weather-permitting days

Waterproof notebook w/pencil (optional)

For Disinfection:

Buckets of bleach-water mix and tap water for disinfection of equipment

Spray bottle (optional) for spraying down equipment or waders with bleach-water mix

Boot Brush w/pick (optional) for removal of stubborn sediment from footwear used during sampling

Figure 2: Example setup for disinfection equipment.

Method:

PVC pipes and elbow joints were used to create a 1 meter x 1 meter square, this was used to designate the sample plot. For the first plot, the square was thrown blindly over my shoulder and where it landed was the semi-randomized sample area. Subsequent plots in the sequence were designated by bordering the square as it lay in the initial plot, creating a ladder design.

Figure 3: Author demonstrating removal procedure.

Before beginning the actual removal, the GPS unit was used to acquire the GPS coordinates of each plot. Then, the colander was used to scoop into the substrate (1-2 inches into it), the submerged colander was then shaken to filter out sand and soil. Next, I began picking through what remained in the colander to search for both living and dead Asian clams (*C. fluminea*), zebra mussels (*D. polymorpha*), native Sphaeriidae species (also known as Fingernail clams), and native mussels species. All non-living bivalve shells (Asian clam, zebra mussel, and native bivalves) were collected and placed in the mesh collection bag for later sorting and counting. All living Asian clams and zebra mussels were also placed into the mesh collection bag. Live native mussels or Sphaeriidae were not removed from the plot due to Wisconsin state law prohibiting their removal. Any live native species were counted before they were returned to their original location. It was found that it took approximately 25-30 scoops with the colander to cover the whole of one plot (5x5 rows within the square). Between each plot all samples taken were placed in Ziploc bags. Each bag was labeled with the date, name of the site, and appropriate plot sequence number (first plot = "Plot #1", second plot = "Plot #2", etc.). The type of substrate within each plot was also noted (more gravel than sand, more sand than gravel, high vegetation, etc.).

For each subsequent visit to a sample site, two individual plots were removed from. The first plot was the exact location removed from during the previous visit. The second plot's location was directly adjacent to the location of the previous plot. Upon completion of each plot, stones or sticks were placed at the four corners of the sample square and pictures were taken to aid in identification during subsequent visits, as the sample square was not left at the site.

Between each site, gear was disinfected with a bleach water mixture by either submerging it in the solution or spraying it with a spray bottle. In addition to following proper disinfection protocol, I tried to go from “least invaded” to “most invaded” sites to prevent further spread of the invasive species.

Figure 4: Sample analysis- unsorted sample in the center being sorted into appropriate piles around edge of tray.

Sample bags were sorted and counted off-site in a timely manner to prevent decay of live specimen. The mixed samples were separated by species (note: native mussels shells and shell fragments did not need to be identified further than “Native Mussel”) and status (either “live”, “paired shell (dead)”, or “shell half/fragment”). *See Figure 4.* Once the sample was sorted, each category was counted and the data was entered into a spread sheet along with the appropriate coordinates, substrate notes, plot sequence number, and date. Live Asian clam specimen were placed back into the bag and put into the freezer for the DNR while all other sample material was disposed of.

Notes:

- It was best to have two people work on a single plot, each worker started at one corner of the square and eventually met somewhere in the middle. Having more than two workers in a single plot was found to be disruptive.
- The invasive Asian clam and zebra mussel were both relatively easily distinguishable from native bivalves. There was some initial confusion between some of the smallest Asian clams and native Sphaeriidae, but the main differences were found to be the well-defined ridges on the Asian clam (far less defined on Sphaeriidae), the easily crushed shell of native Sphaeriidae (significantly harder shells on the Asian clam), and the dark purple-colored area found towards the umbo of the Asian clam (not present in Sphaeriidae). *See Figure 5*.

Figure 5: Juvenile Asian clam (right) showing the well-defined ridges and dark purple mark towards umbo. Native Sphaeriidae on the left lacks these features.

- The focus of the project was the Asian clam, so if it was noticed that there was an abundance of another species (Sphaeriidae for instance), an estimation was sometimes made. This was done by determining approximately how many of a certain species/category (ex. “Fingernail clam/half shell”) were in an average pan at a given plot, and then multiplying that number by 25 to account for the full square. This estimation saved time and energy so that the focus could remain on the Asian clam. This method was not used to make estimations for the Asian clam, as data integrity was most important for this species. Anytime an estimation was made it was denoted when entering the number into the datasheet.

Data:

					Corbicula			Zebra Mussels			Misc. Native Mussels			Fingernail Clams		
Date	**Site**	**Plot Coordinates**	**Ladder Phase**	**Substrate**	**Live Corbicula**	**Paired Shells Corbicula**	**Half Shells Corbicula**	**Live Zebra**	**Paired Shells Zebra**	**Half Shells Zebra**	**Live Mussels**	**Paired Shells Mussels**	**Half Shells Mussels**	**Live Fingernail**	**Paired Shells Fingernail**	**Half Shells Fingernail**
7/1/2014	Rainbow Springs Bridge	N 42.85559, W 88.41814	N/A	Gravel-sand mix	12	35	625	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
7/11/2014	Rainbow Springs Bridge	N 42.85552, W 88.41793	1st	Mostly sand, some gravel	126	234	521	2	0	16	4	4	40	2	0	48
7/15/2014	Cty Road I Bridge	N 42.86073, W 88.36567	1st	Muck and stones	0	0	0	0	0	0	0	0	0	0	0	0
7/15/2014	Beulah Road Bridge	N 42.85454, W 88.39531	1st	Mostly sand, some gravel	19	99	70	1	2	33	2	1	21	100	18	555
7/15/2014	Beulah Road Bridge	N 42.85456, W 88.39477	1st	Gravel-sand mix	7	15	13	0	0	3	0	0	16	0	0	186
7/21/2014	Hwy 83 Bridge	N 42.85709, W 88.32713	1st	Mostly gravel, some stones	0	0	0	1	0	1	77	2	29	525*	263*	275*
7/21/2014	Rainbow Springs Bridge	N 42.85552, W 88.41793	1st	Mostly sand, some gravel	110	133	538	0	1	21	8	5	15	1	0	131
7/21/2014	Rainbow Springs Bridge	N 42.85551, W 88.41791	2nd	Mostly sand, some gravel	128	177	711	0	0	23	8	2	17	1	0	68
8/1/2014	Mukwonago River @ Cty. Rd. E	N 42.85431, W 88.43320	1st	Mostly sand, some gravel	174	103	417	58	50	409	0	0	7	0	0	167
8/13/2014	Eagle Springs South Discharge	N 42.85340, W 88.43412	1st	Gravel-sand mix	0	0	0	31	5	288	0	0	1	0	0	4
8/30/2014	Beulah Road Bridge	N 42.85454, W 88.39531	1st	Mostly sand, some gravel	34	52	68	0	2	29	1	1	12	113	50	375
8/30/2014	Beulah Road Bridge	Need Coordinates	2nd	Mostly sand, some gravel	50	26	53	0	1	20	1	2	15	125	75	725

Sample Sites:

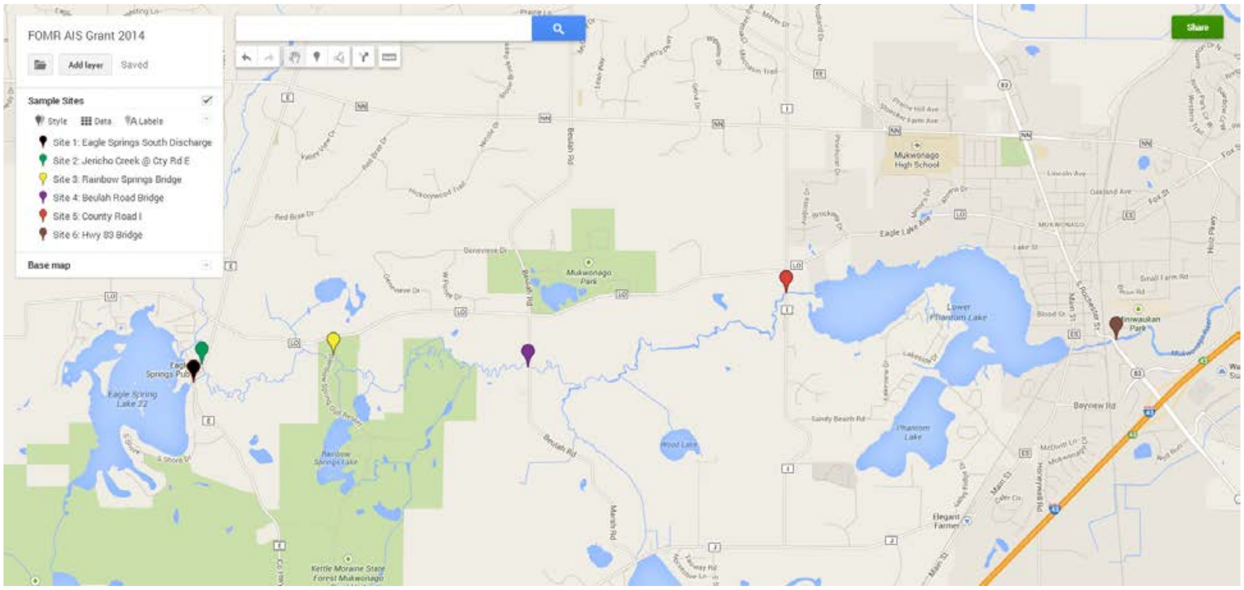

Figure 6: Map of the sample sites visited. Original available at: [https://mapsengine.google.com/map/edit?mid=zGgvXv0VBn5Y.kXDvmFwTH02A]

Site 1: Eagle Springs South Discharge: This small stream of water comes from the bottom of Eagle Springs Lake, so the water temperature is noticeably lower than the other dam just north of this one. *C. fluminea* were not found at this site.

Site 2: Mukwonago River at Cty. Rd. E: The area south of the Eagle Springs dam is known as the Mukwonago River. Jericho Creek feeds into the Mukwonago River shortly thereafter. This site is just south of County Road E and is known as the Mukwonago River. *C. fluminea* were found at this site.

Site 3: Rainbow Springs Bridge: This site is the former Rainbow Springs Golf Course, today it is known as the Kettle Moraine State Forest: Mukwonago River Unit and is owned by the Wisconsin DNR. This is the site that the Asian clam was first found within the watershed in 2008. *C. fluminea* were found at this location.

Site 4: Beulah Road Bridge: There is a small patch of gravel just south of the bridge on the east side of the road where 1-2 cars can be parked- presumably canoe or kayak put-in areas. Either side of the bridge has water of a suitable depth for sampling. *C. fluminea* were found at this site.

Site 5: County Road I: This wetland surrounded area has a small canoe/kayak put-in area with parking for several cars. The bottom of the river is quite muddy, however, which makes sampling difficult. The plot sampled here was very close to the shore, as the depth towards the middle of the river was found to be too difficult to sample from. *C. fluminea* were not found at this site.

Site 6: Hwy 83 Bridge: The stretch of river east of the Phantom Lakes dam is considered to be one of the final breeding grounds in the state of Wisconsin for the state-endangered Rainbow Shell mussel. This area was found to have an abundance of various species of native mussels. *C. fluminea* were not found here.

Analysis:

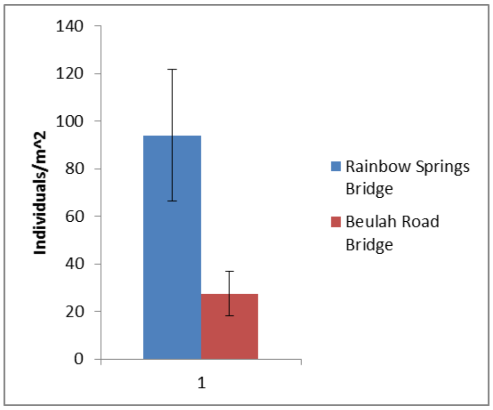

Figure 7: Mean Asian clam density per meter squared.

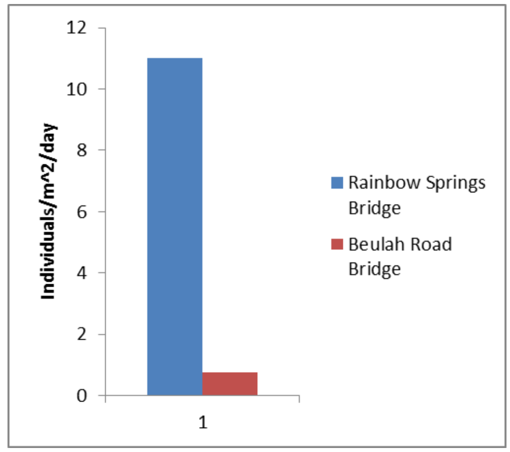

Figure 8: Number of individuals recolonized the revisited plots per day.

The data from the sites that were able to be revisited was analyzed to determine the recolonization trends of the Asian clam. First, a mean density was found for the live Asian clams found at each of the two sites (*see Figure 7*). Next, the number of live individuals found on the second visits was divided by the number of days since the last visit. This gave us an idea of how many Asian clams were recolonizing the cleared plot per day (*See Figure 8*). Next, the percent change in number of live individuals found during the second visit to each site was graphed (*See Figure 9*). This data is particularly interesting for the Rainbow Springs Bridge site, as it took a mere 10 days for the Asian clams to nearly replace themselves. Finally, the average number of individuals found per square meter in each substrate was graphed (*See Figure 10*). This data suggests that the Asian clam tends to prefer sandy substrates and perhaps find substrates of mucky or gravely composition to be unfavorable.

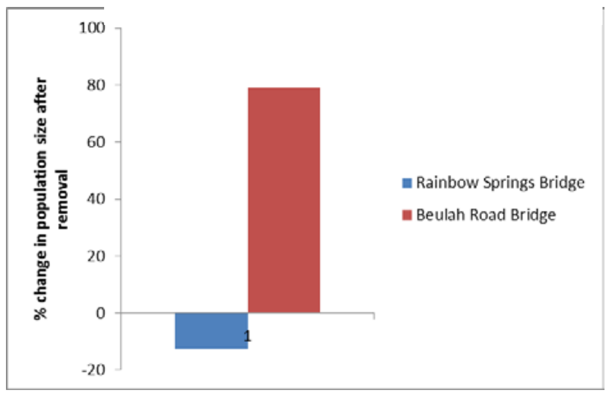

Figure 9: Percent change in number of individuals from first visit to second.

The main goal of project was to maximize removal efforts, while also collecting data on the effectiveness of removal methods employed. The advantage of using the “ladder” sampling method is that it removes twice per visit (following the initial visit) while also collecting data on the recolonization of the previously sampled plot.

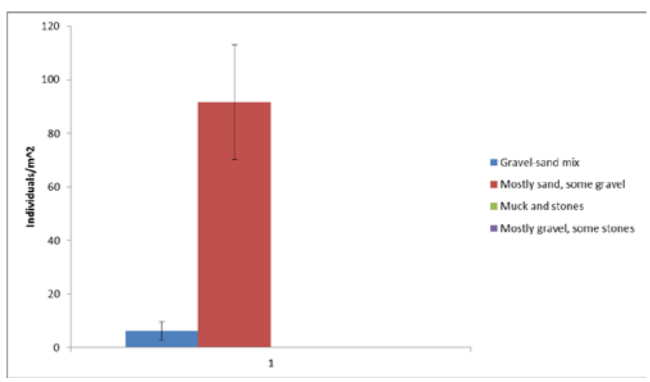

Figure 10: Average number of individuals found per square meter in the various substrate types encountered.

There were few issues that arose throughout the course of the experiment. When it came to choosing the locations of sample sites, it was found that the best places were those that were most accessible. This meant that areas of high human activity, road crossings and bridges for example, were chosen. Certain stretches of river were left unchecked due to their inaccessibility. Another issue that I ran into was the sheer amount of time it took to do the sampling. The Mukwonago River was an hour long drive from my house and the actual process of picking through the pans proved to be a rather laborious and tiring process for me, initially, but also for the various volunteers I'd taken along. However, making estimations where appropriate (especially for the Fingernail clams) and having a dedicated assistant should make the process run much faster. Having three people working a single plot seems to be less efficient than having two working a plot. Thus, I recommend that once trained, a group would be best suited to split into groups of two to work each site.

Additionally, I believe that this study would have greatly benefitted from the addition of a control plot at each site in which the *Corbicula* removed would be counted and returned to the exact location they were removed from. This would provide greater validity to the conclusions drawn from the manipulated plots as many external factors could be skewing the data from the removal plots. If time and manpower permit, it would be a great addition to the procedure at each site.

With what little data I've acquired over the summer, it seems that the Asian clam can be found with highest abundance in primarily sandy substrates. They appeared to not be established in the stretch of river that runs beneath County Highway I. This may be due to unfavorable substrate composition, as the river bottom is quite "mucky" there. It was also not found to be established in the waters downriver of the Phantom Lake dam. My findings thus far lead me to believe that this may be due to the again unfavorable, gravel-dominant substrate. The area east of the dam also has an abundance of native mussels which may be outcompeting the Asian clam from being able to establish itself here.

More data will be necessary to draw further conclusions about the Mukwonago River watershed's Asian clam population. However, now that a standardized procedure exists for sample collection, additional data can be collected with greater ease.

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