Year 2: Susquehanna Freshwater Mussel Surveys

Award Number 47260

Submitted to:
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Editor’s note: At the request of the funding agency, this redacted version does not include information identifying location related to its findings. For a complete version of the report, contact either Ms. Adriance or Mr. Bell as listed above.
Executive Summary

In this project we focused on providing population estimates for four pearly mussel species of greatest conservation need (SGCN): *Alasmidonta varicosa* (brook floater), *A. marginata* (elktoe), *Lasmigona subviridis* (green floater) and *Lampsilis cariosa* (yellow lampmussel) in four New York Susquehanna River Watershed rivers. In 2009, we completed mapping of assigned river shorelines and bottoms and searched for the SGCN with a combination of SCUBA and snorkel dives and walking searches. We focused specifically on waste water treatment plant (WWTP) impacts on the pearly mussel SGCN. We found evidence of the four SGCN in each of the rivers studied, although only recently spent shells and no live brook floaters were found in the Tioughnioga River. Negative impacts on pearly mussel SGCN were not associated with WWTPs. Changes in water conditions and search methods provide contrasting results on pearly mussel surveys of the same river sections. Pearly mussel SGCN were found in areas below extended riffles (apparently thriving in the oxygenated waters) and in areas with minimally mobile substrates (presumably avoiding pulverization).

Recommendations:

- Additional research into the causes of, and mitigation for, mobile substrates in rivers.
- Additional research into native pearly mussel susceptibility to death from fouling by zebra mussels (*Dreissena polymorpha*).
- A more thorough search for pearly mussel SGCN replacing the quantitative surveys scheduled for year 3 of this project.

Rationale:

- Mobile substrates appear to be associated with stormwater inputs and may be the most limiting factor for pearly mussel SGCN in the Susquehanna River Watershed.
- Zebra mussels, moving downstream from headwater areas on the Susquehanna, the Chenango, and the West Branch of the Tioughnioga Rivers, are fouling native pearly mussels causing the death of the pearly mussels.
- Quantitative surveys were intended to associate pearly mussel SGCN with river bottom and river shoreline character. The difference between minimally mobile substrates and mobile substrates appears to be the most significant river bottom characteristic associated with pearly mussels. The lack of data on hand addressing this characteristic limits accurate quantification. Resources are available to identify pearly mussel SGCN in a variety of Susquehanna River Watershed rivers and streams. We should be better able to characterize SGCN population stability status with more qualitative surveys.
Background

Although long impacted by anthropogenic activities, the New York Susquehanna drainage basin provides habitat for about a dozen species of unionids (Clark & Berg, 1959; Harman, 1970; Strayer & Fetterman, 1999) including four “Species of Greatest Conservation Need” (SGCN) as determined by the New York State Department of Environmental Conservation (NYSDEC, 2008). These four species are *Alasmidonta varicosa* (brook floater), *A. marginata* (elktoe), *Lasmigona subviridis* (green floater) and *Lampsilis cariosa* (yellow lampmussel).

Our project tasks for February 2009 through January 2010 were to:
- Conduct field sampling and population estimates for the four SGCN in suitable mapped habitat.
- Analyze data and produce presence/absence maps.
- Produce and submit an annual report.

Methods Used in 2009

Methods described in our “Year 1” report were used to complete mapping of assigned river areas. Subsequent to mapping, we supplemented GPS data with notebook data and created ESRI ArcGIS® Desktop (ArcMap™ Version 9.2 or later plus extensions) files for river bottom and shoreline characterizations.

Concurrent with the final mapping effort, we began diving, using SCUBA and snorkel, to find locations with pearly mussel SGCN. Initially, we used clear bottom buckets in these efforts, but stopped when it became clear that the green floater (*L. subviridis*) was frequently missed using this technology. We used SCUBA in water as shallow as 0.3 m to ensure eyes were within 20 cm of our search area. Snorkel searches, which were more easily executed and which covered more river bottom area, were used in shallow water, particularly in clear water. Searches were completed with no serious effort to complete cross river transects, rather divers would swim cross river, but would end up swimming diagonally to the current as the current moved them downstream. In some wider reaches (lengths of river), divers would split the river returning to the shoreline from which they started from the middle of the river (as estimated by their tenders). In other locations, divers would persist in their “cross-river” swim until reaching the opposite shoreline. Once there, they would endeavor to return to their initial shoreline. Consequently, the result was a series of “zig-zags” moving downstream with large areas of the river reach “surveyed” which were never actually viewed.

We started our surveys closest to Cooperstown and, as our technique became more refined over time, those initial surveys (particularly on the main stem of the Susquehanna River upstream of Sidney) were not as focused on specific river character aspects as were subsequent surveys. The number of divers working concurrently varied from one to three. A dive tender, working from a kayak or standing in the river using the kayak as a work platform, recorded all data from one or two divers. The tender recorded waypoints, species information, and pertinent notes for all living SGCN unless the density was great enough that such recordings slowed the
survey. In those cases, start and stop waypoints were used to mark a river reach, and total numbers of pearly mussels, by species, were recorded, or density per unit area were noted.

We surveyed several river reaches including waste water treatment plant (WWTP) outputs. These surveys started upstream and extended downstream of the WWTPs for XXXXXX, XXXXXX, and XXXXXXX. Additionally, we surveyed the headwaters of the Chemung River at XXXXXX Xxxx with two WWTPs, one on either side of this river.

We resurveyed the area just upstream of where the XXXXXXXXXXX Xxxx joins the Chenango River (Nxx xx.xxx Wxx xx.xxx; UTM xxT xxxxxxxE, xxxxxxx) on 9 July 2009 as a follow-up to our survey of this area on 11 July 2008.

Zebra mussels (*Dreissena polymorpha*) were first recorded in the NY Susquehanna River Watershed in Eatonbrook Reservoir (Madison County, NY). We observed a population of Eastern lampmussels (*Lampsilis radiata*) in Eatonbrook Reservoir for several years after zebra mussels invaded that water body. The Eastern lampmussels burrowed through the sediments, but not under them. Zebra mussels fouled the posterior ends of the lampmussels which contain the lampmussel siphons. In 2000, 2002, 2004, and 2006, we cleaned the zebra mussels from these lampmussels. All, except seven in 2000, were fouled with zebra mussels. The lampmussel population lost few members during that period. No cleaning was done in 2007 and 2008. We returned to this location (Nxx xx.xxx Wxx xx.xxx; UTM xxT xxxxxxxE, xxxxxxx) on 15 May 2009 to ascertain the status of these mussels.

**Results**

We mapped all assigned river reaches not mapped in 2008. We also mapped the results of our searches for pearly mussels. Accompanying this report are ArcGIS shapefiles depicting rivers mappings and pearly mussel search results. These files should replace all “draft” files provided with the “Year 1” report because pearly mussel tentative identifications have been resolved and river character files have been corrected.

This season, we sampled 29 different extended reaches with a total of 48 SCUBA dives, 11 snorkel dives, and eight walked searches. We found one or more species of the SGCN alive in 23 of the 29 extended reaches. Table 1 is a summary of freshwater pearly mussel SGCN identified live and dead in surveyed rivers in 2008 and 2009. We did not find any live or dead Eastern pearlshell (*Margaritifera margaritifera*) in our surveys subsequent to our 2008 informal survey of the East Fork of the Otselic Creek where it crosses XXXXXX Xxxx just east of New York Route 26 (Nxx xx.xxx Wxx xx.xxx; UTM xxT xxxxxxxE, xxxxxxx).

WWTP river reach survey results are summarized in Table 2. Not included in Table 2 are results for the survey between the two WWTPs on the Chemung River at XXXXXX Xxxx. They were not included in Table 2 because we did not survey a comparable distance upstream of the WWTPs, however, SGCN were found in the Chemung proximate to the effluent of both of these WWTPs.
Table 1. NYSDEC freshwater pearly mussel “species of greatest conservation need” (SGCN) observed in the Upper Susquehanna Watershed while mapping and searching rivers in the summers of 2008 and 2009. Brook Floater = *Alasmidonta varicosa*; elktoe = *Alasmidonta marginata*; green floater = *Lasmigona subviridis*; yellow lampmussel = *Lampsilis cariosa*; L = live specimens observed; D = dead specimens observed; SGCN spp. = number of SGCN species found in each listed river and for the entire watershed (Total).

<table>
<thead>
<tr>
<th>River Mapped</th>
<th>Brook Floater</th>
<th>Elktoe</th>
<th>Green Floater</th>
<th>Yellow Lamp Mussel</th>
<th>SGCN Spp.</th>
<th>SGCN Spp. Alive</th>
</tr>
</thead>
<tbody>
<tr>
<td>Susquehanna River, Main Stem</td>
<td>L, D</td>
<td>L, D</td>
<td>L, D</td>
<td>L, D</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>Chenango River</td>
<td>L, D</td>
<td>L, D</td>
<td>L, D</td>
<td>L, D</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>Chemung River</td>
<td>L, D</td>
<td>L, D</td>
<td>L, D</td>
<td>L, D</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>Tioughnioga River, East Branch &amp; Downstream</td>
<td>D</td>
<td>L, D</td>
<td>L, D</td>
<td>L, D</td>
<td>4</td>
<td>3</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td>3L; 4D</td>
<td>4L; 4D</td>
<td>4L; 4D</td>
<td>4L; 4D</td>
<td>4</td>
<td>4</td>
</tr>
</tbody>
</table>

Table 2. NYSDEC freshwater pearly mussel “species of greatest conservation need” (SGCN) observed in the vicinity of waste water treatment plants (WWTPs) in the Upper Susquehanna Watershed in the summer of 2009 with distances searched upstream and downstream noted in meters. L = live specimens observed; D = dead specimens observed; SGCN spp. = number of SGCN species found in river reach searched and in the three upstream and downstream reaches (Total) searched.

| Table redacted. |

Our 2009 survey of the area where the Xxxxxxxxxxxx Xxxxx joins the Chenango River revealed an attention gaining number of recently dead pearly mussels (84 mussels including a total of 17 dead from four target SGCN) along the south side of the Xxxxxxxxxxxx Xxxxx. This contrasted with the relatively few and more or less north-to-south evenly distributed old and recently dead pearly mussels noted in the same area the year before (37 including a total of 11 dead from two of the four target SGCN all of which were removed in 2008). NYS DOT supervised bridge repair work on NYS Route 12B where it crosses the Xxxxxxxxxxxx Xxxxx occurred from before the 2008 visit until the 2009 survey. Construction vehicles and equipment were parked and stored along the south side of the Xxxxxxxxxxxx Xxxxx at the NYSDEC access point. Silt fences were observed to be in poor condition and did not appear to be stopping the movement of construction debris into the river.

Our 2009 survey of Eastern lampmussels (*Lampsilis radiata*) in Eatonbrook revealed that 118 lampmussels of 121 were dead. All 121 were fouled with zebra mussels (*D. polymorpha*).
Discussion

While river velocity is largely dependent on slope, the secondary characteristic determining water velocities is river height (water depth). Summer rains raised river heights far above normal (70th - 90th percentile) bringing sight-depriving silt and injury-threatening velocities to the Susquehanna River system in New York. We did not dive for several weeks at a time this summer. These periods are normally the time of the year when we would find low velocity, clearer water in the rivers. Because of the weather challenge, we did not dive many of the locations of historical SGCN provided by the NY Natural Heritage Program to ascertain SGCN population trends.

Data provided by the NY Natural Heritage Program would indicate that a sizeable mixed population of pearly mussels was extirpated in the vicinity of the Xxxxxx Xxxxx Xxxxxxx I-88 bridge (xxT xxxxxx E xxxxxxx; Nxx xx.xxx Wxx xx.xxx). The most recent survey results provided us (Aug 1996) found no adults in contrast to earlier surveys. Our June 2009 survey found a healthy bed of pearly mussels with two SGCN: yellow lampmussel (L. cariosa) and elktoe (A. marginata) and a number of other species: Eastern elliptio (Elliptio complanata), Eastern lampmussel (L. radiata) and squawfoot (Strophitus undulatus). It might appear to be an issue of searcher technique or expertise, but consider the following two search sequences.

On 25 July on the Chenango River, Lord spotted a live yellow lampmussel (L. cariosa), in a riffle, near the Otsiningo Park x x x x x (xxT xxxxxx E xxxxxxx; Nxx xx.xxx Wxx xx.xxx) north of Binghamton while mapping shorelines, and initiated a 20 minute walking search. Pokorny assisted for approximately 10 minutes (30 minute total search time). They found 11 more live yellow lampmussels, as well as a brook floater (A. varicosa), an Eastern lampmussel (L. radiata), and a triangle floater (A. undulata). On 18 August, we initiated a follow-up to the wading survey in the same area. Lord again waded, but this time his effort was aided by two experienced divers, Barber and Vogler. This approximately 30 minute (90 minute total) search revealed only two live yellow lampmussels (L. cariosa) in the area. On the date of the later survey, the Chenango River was up 350%+ over median for the date because of intense rain nine days earlier. Water was higher, moving faster, and more brown-green in color.

On 14 July, our search team (3 divers and one tender who searched by walking) spent approximately 45 minutes (135 minutes total) in a riffle-run area just upstream of Xxxxx Xxxx (xxT xxxxxx E xxxxxxx; Nxx xx.xxx Wxx xx.xxx) near Cortland, NY. They found eight green floaters (L. subviridis), one yellow lampmussel (L. cariosa), 50+ Eastern elliptio (Elliptio complanata), eight triangle floaters (A. undulata), and one Eastern lampmussel (L. radiata). On 7 October, Lord returned to search the specific area where five of the eight green floaters were located. He spent approximately 45 minutes in the water and found only one live pearly mussel, an Eastern elliptio (Elliptio complanata). River height (water depth) at the time of the October survey was up (445% of the median for the date as measured in Cortland) and water temperature was seasonably cooler than it had been in July.

Searcher experience, searcher visual acuity, search method, water height, water velocity, water transparency, water temperature, and leaf litter all can vary from one site visit to the next impairing the validity of any findings about pearly mussel SGCN.
Our observations in both Eatonbrook Reservoir and in the rivers provide cause for concern about a currently widespread and abundant pearly mussel species: the Eastern lampmussel (*L. radiata*). When pearly mussels burrow under sediments, zebra mussels adhering to them are often scraped off or smothered. Many pearly mussels do, in times of high moving water or during the winter, burrow until buried. We found no Eastern lampmussel burrowing under the sediments until buried which would make this species more susceptible to death by fouling.

We identified a pattern that nearly always provides pearly mussel SGCN in the surveyed rivers. We identify an area downstream of an extended riffle or series of riffles (which presumably oxygenates the water and is often associated with a chain of islands in the river) and look for bottom substrates that are minimally mobile (which apparently provides refuge from molar action [grinding substrates]). All four of our target SGCN are found in such locations.

While a focus on the pattern described regularly found each of the SGCN, we found few brook floaters (*A. varicosa*). Perhaps this is not surprising since Strayer and Jirka (1997) describes the brook floater as “a running water species…said to favor gravelly riffles,” however, they also describe the yellow lampmussel (*L. cariosa*) as living “in riffles,” and we found them commonly in depths of 2m while the green floater is described as “found most frequently in the quiet parts of large creeks and small rivers” and we frequently found them among yellow lampmussels and elktoes (*A. marginata*). Trusting our successes, we focused on a pattern producing the greatest number of pearly mussel SGCN. Now, having reviewed our data and our relative lack of success in finding brook floaters, we will, at least part of the time, focus on “strong current and gravelly bottoms, thus…in and near riffles” (Ortman, 1919) to see if brook floaters are as uncommon as it appears from our research to date.

Our observations at the confluence of the Xxxxxx Xxxxx with the Chenango River recommend review of NYSDOT practices in work areas along rivers containing SGCN, but there is no proof that DOT is responsible for the dead mussels. We do note, however, that one bridge worker volunteered that he observed the mussels burrowing when debris would fall into the river.

Our review of the literature of moving waters and sediments reveals no insights into the causes of mobile sediments or minimally mobile sediments. We know that recognition of the difference is widespread among those who have ventured into streams while wearing waders. Those so experienced will recall moving across fast moving waters where the substrate provided a walkway not unlike pavement while recalling much slower moving waters with unstable sediments which threatened to twist an ankle with each step. The former are what we are calling minimally mobile substrates and the latter are mobile substrates. We suspect the difference is associated with stormwater surge. To reduce flooding, urban and suburban drainage systems are typically designed to move storm run-off as quickly as possible. Artificial drainage systems tend to be straight, smooth and semi-circular in shape, giving the drains high throughput and low friction values. Drainpipes are typically joined to streams and rivers at right angles to the flow of the stream or river. When they deliver stormwater to a river or stream, they deliver it with energy sufficient to reshape the bottom. This is exemplified best (not exclusively) by our experience on the Chemung River by Xxxxxx Xxxx (xxT xxxxxxxE xxxxxxx; Nxx xx.xxx Wxx
where we found at least seven pearly mussel species alive (L. cariosa, A. marginata, A. varicosa, L. subviridis, L. radiata, A. undulata, and one tentatively identified P. cataracta) in an approximately 700 m reach from the Chemung’s origin to a sizeable culvert emptying stormwater from the town of Xxxxxxx Xxxx. In the approximately 840 m reach surveyed downstream of the culvert, we found one live yellow lampmussel (L. cariosa), the species best able to tolerate molar action. As soon as our three divers encountered the mobile substrates at the culvert, they each surfaced to gain insight as to what had changed.

The sheer size of the culvert described speaks to the challenge we have in limiting impervious surfaces and in reducing stormwater surge. Our focus on WWTPs (Table 2; Figure 1) provided no evidence that WWTPs are directly responsible for reduced pearly mussel SGCN. Some WWTPs likely reduced river oxygen levels which appear to be limiting to pearly mussel SGCN, but many more well-oxygenated river reaches are unsupportive of pearly mussel SGCN because of the molar actions of their sediments. We recommend follow-up studies of sediment mobility causes and amelioration.

We recommend additional research into native pearly mussel susceptibility to death by zebra mussels (D. polymorpha) fouling to determine if currently plentiful species are more threatened by this invasive species.

We recommend a fourth year be inserted into our three year project schedule. This should be completed before the final year of quantitative sampling. The reason for this recommendation is to ensure we use the material and personnel resources accumulated and developed in 2008 and 2009 before quantitative sampling begins because quantitative sampling will use a somewhat different mix of resources. Approval of this recommendation will facilitate more sampling because training and equipment are in place and immediately available. We recommend 2010 sampling for SGCN in the following New York Susquehanna watershed streams and rivers for the reasons noted:

- **West Branch of the Tioughnioga River**: unintentionally omitted from the original contract. The West Branch parallels Interstate-81 and is subject to DOT maintenance and construction activities. We propose that this river be mapped and surveyed for pearly mussel SGCN.

- **Otselic River**: the fifth pearly mussel SGCN found in our survey, a single Eastern pearlshell (Margaritifera margaritifera), was found in the headwaters of this river during a cursory 2008 survey. Consequently, we should survey this river in some detail for pearly mussel SGCN. River character mapping is not recommended at this time.

- **Xxxxxxxx Xxxxx**: provided, proximate to its confluence with the Chenango River, the densest bed of mussels found in our surveys. This river may be valuable as a refuge should we need to temporarily move pearly mussel SGCN from other Susquehanna watershed areas. Furthermore, it may serve as a source for pearly mussel SGCN if other Susquehanna watershed rivers and streams would benefit from transplanted SGCN. River character mapping is not recommended at this time.
Figure 1. Chemung River origin at Xxxxxxx Xxxx showing pearly mussel species of greatest conservation need (SGCN) found, on 27 July 2009, upstream and downstream of large stormwater culvert (Xxxxxx Xxxxx) associated with change in river bottom from minimally mobile substrates (upstream) and mobile substrates (downstream). WWTP = waste water treatment plant. SGCN: *L. cariosa* = yellow lampmussel; *A. marginata* = elktoe; *A. varicosa* = brook floater; *L. subviridis* = green floater.
• **Unadilla River**: historically held pearly mussel beds. River character mapping is not recommended at this time.

• **Otego Creek**: historically held pearly mussel beds. River character mapping is not recommended at this time.

• **Oaks Creek**: historically held pearly mussel beds. River character mapping is not recommended at this time.

If funding for the requested fourth year cannot be identified, we recommend you substitute the above task list for existing third year tasks. This recommendation is not made lightly, but is important after consideration of our association of pearly mussel SGCN with areas downstream of extended riffles with minimally mobile substrates. Our mapped data includes riffles, but does not differentiate between mobile substrates and minimally mobile substrates. Therefore, we are less optimistic regarding the insights produced by the quantitative sampling specified in the contract for year three.

Nevertheless, in the absence of an authorization to vary from our existing contract, we will survey quantitatively per Strayer & Smith (2003) in the summer of 2010. For the major bottom types (riffle, pool, & run), we will randomly choose locations for shore-to-shore transects which we will dive (if the dives can be safely executed). On each of these shore-to-shore transects, a diver or divers will survey the transect at a width of 1 m. Three 1 m quadrats will be randomly located along the transect, and the bottom sediments excavated to a depth of 20 cm (if the bottom is loose enough for excavation) and removed. Excavated materials will be sifted through increasingly finer mesh sieves, and immature and small pearly mussels will be identified and counted. Data collected will be used with accumulated mapping data to create estimates (with calculated variances) for the pearly mussel SGCN.
References


